Strictly Confidential: (For Internal and Restricted use only)
Secondary School Examination
March 2019
Marking Scheme – MATHEMATICS (SUBJECT CODE -041)

PAPER CODE: 30/1/1, 30/1/2, 30/1/3

General Instructions: -

1. You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully. **Evaluation is a 10-12 days mission for all of us. Hence, it is necessary that you put in your best efforts in this process.**
2. Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration. Marking Scheme should be strictly adhered to and religiously followed. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and marks be awarded to them.**
3. The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
4. If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled.
5. If a question does not have any parts, marks must be awarded in the left hand margin and encircled.
6. If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out.
7. No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
8. A full scale of marks 1-80 has to be used. Please do not hesitate to award full marks if the answer deserves it.
9. Every examiner has to necessarily do evaluation work for full working hours i.e. 8 hours every day and evaluate 25 answer books per day.
10. Ensure that you do not make the following common types of errors committed by the Examiner in the past:-
    - Leaving answer or part thereof unassessed in an answer book.
    - Giving more marks for an answer than assigned to it.
    - Wrong transfer of marks from the inside pages of the answer book to the title page.
    - Wrong question wise totaling on the title page.
    - Wrong totaling of marks of the two columns on the title page.
    - Wrong grand total.
    - Marks in words and figures not tallying.
    - Wrong transfer of marks from the answer book to online award list.
    - Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.)
    - Half or a part of answer marked correct and the rest as wrong, but no marks awarded.

11. While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as (X) and awarded zero (0) Marks.

12. Any unassessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.

13. The Examiners should acquaint themselves with the guidelines given in the Guidelines for spot Evaluation before starting the actual evaluation.

14. Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.

15. The Board permits candidates to obtain photocopy of the Answer Book on request in an RTI application and also separately as a part of the re-evaluation process on payment of the processing charges.

QUESTION PAPER CODE 30/1/1

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. Let the point A be (x, y)

$\therefore \quad \frac{1+x}{2} = 2$ and $\frac{4+y}{2} = -3$ $\frac{1}{2}$

$\Rightarrow \quad x = 3$ and $y = -10$

$\therefore$ Point A is $(3, -10)$ $\frac{1}{2}$

2. Since roots of the equation $x^2 + 4x + k = 0$ are real

$\Rightarrow \quad 16 - 4k \geq 0$ $\frac{1}{2}$

$\Rightarrow \quad k \leq 4$ $\frac{1}{2}$

OR

Roots of the equation $3x^2 - 10x + k = 0$ are reciprocal of each other

$\Rightarrow$ Product of roots = 1 $\frac{1}{2}$

$\Rightarrow \quad \frac{k}{3} = 1 \Rightarrow k = 3$ $\frac{1}{2}$

3. $\tan 2A = \cot (90° - 2A)$

$\therefore \quad 90° - 2A = A - 24°$ $\frac{1}{2}$

$\Rightarrow \quad A = 38°$ $\frac{1}{2}$

OR

$\sin 33° = \cos 57°$ $\frac{1}{2}$

$\therefore \quad \sin^2 33° + \sin^2 57° = \cos^2 57° + \sin^2 57° = 1$ $\frac{1}{2}$

4. Numbers are 12, 15, 18, ..., 99 $\frac{1}{2}$

$\therefore \quad 99 = 12 + (n - 1) \times 3$

$\Rightarrow \quad n = 30$ $\frac{1}{2}$

5. AB = 1 + 2 = 3 cm $\frac{1}{2}$

$\Delta ABC \sim \Delta ADE$

$\therefore \quad \frac{ar\,(ABC)}{ar\,(ADE)} = \frac{AB^2}{AD^2} = \frac{9}{1}$ $\frac{1}{2}$

$\therefore \quad ar(\Delta ABC) : ar(\Delta ADE) = 9 : 1$

6. Any one rational number between $\sqrt{2}$ (1.41 approx.) and $\sqrt{3}$ (1.73 approx.) 1

e.g., 1.5, 1.6, 1.63 etc.

SECTION B

7. Using Euclid's Algorithm

$$\left.\begin{aligned} 7344 &= 1260 \times 5 + 1044 \\ 1260 &= 1044 \times 1 + 216 \\ 1044 &= 216 \times 4 + 180 \\ 216 &= 180 \times 1 + 36 \\ 180 &= 36 \times 5 + 0 \end{aligned}\right\}$$ $1\frac{1}{2}$

HCF of 1260 and 7344 is 36. $\frac{1}{2}$

OR

Using Euclid's Algorithm

$a = 4q + r, \ 0 \le r < 4$

$\Rightarrow \quad a = 4q, \ a = 4q + 1, \ a = 4q + 2$ and $a = 4q + 3$. 1

Now $a = 4q$ and $a = 4q + 2$ are even numbers. $\frac{1}{2}$

Therefore when a is odd, it is of the form

$a = 4q + 1$ or $a = 4q + 3$ for some integer q. $\frac{1}{2}$

8. $a_n = a_{21} + 120$

$= (3 + 20 \times 12) + 120$

$= 363$ 1

$\therefore \quad 363 = 3 + (n - 1) \times 12$

$\Rightarrow \quad n = 31$ 1

or 31st term is 120 more than a_{21}.

OR

$a_1 = S_1 = 3 - 4 = -1$ $\frac{1}{2}$

$a_2 = S_2 - S_1 = [3(2)^2 - 4(2)] - (-1) = 5$ $\frac{1}{2}$

$\therefore\ d = a_2 - a_1 = 6$ $\frac{1}{2}$

Hence $a_n = -1 + (n - 1) \times 6 = 6n - 7$ $\frac{1}{2}$

Alternate method:

$S_n = 3n^2 - 4n$

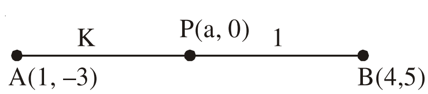
$\therefore \quad S_{n-1} = 3(n - 1)^2 - 4(n - 1) = 3n^2 - 10n + 7$ 1

Hence $a_n = S_n - S_{n-1}$

$= (3n^2 - 4n) - (3n^2 - 10n + 7)$ $\frac{1}{2}$

$= 6n - 7$ $\frac{1}{2}$

9. Let the required point be (a, 0) and required ratio AP : PB = k : 1 $\frac{1}{2}$



$\therefore \quad a = \frac{4k+1}{k+1}$

$0 = \frac{5k-3}{k+1}$

$\Rightarrow \quad k = \frac{3}{5}$ or required ratio is 3 : 5 1

Point P is $\left(\frac{17}{8}, 0\right)$ $\frac{1}{2}$

10. Total number of outcomes = 8 $\frac{1}{2}$

Favourable number of outcomes (HHH, TTT) = 2 $\frac{1}{2}$

Prob. (getting success) = $\frac{2}{8}$ or $\frac{1}{4}$ $\frac{1}{2}$

$\therefore$ Prob. (losing the game) = $1-\frac{1}{4}=\frac{3}{4}$. $\frac{1}{2}$

11. Total number of outcomes = 6.

(i) Prob. (getting a prime number (2, 3, 5)) = $\frac{3}{6}$ or $\frac{1}{2}$ 1

(ii) Prob. (getting a number between 2 and 6 (3, 4, 5)) = $\frac{3}{6}$ or $\frac{1}{2}$. 1

12. System of equations has infinitely many solutions

$\therefore \quad \frac{c}{12} = \frac{3}{c} = \frac{3-c}{-c}$ $\frac{1}{2}$

$\Rightarrow \quad c^2 = 36 \Rightarrow c = 6$ or $c = -6$ ...(1) $\frac{1}{2}$

Also $-3c = 3c - c^2 \Rightarrow c = 6$ or $c = 0$ ...(2) $\frac{1}{2}$

From equations (1) and (2)

$c = 6$. $\frac{1}{2}$

SECTION C

13. Let us assume $\sqrt{2}$ be a rational number and its simplest form be $\frac{a}{b}$, a and b are coprime positive integers and $b \neq 0$.

So $\sqrt{2} = \frac{a}{b}$

$\Rightarrow \quad a^2 = 2b^2$ 1

Thus a^2 is a multiple of 2

$\Rightarrow$ a is a multiple of 2. $\frac{1}{2}$

Let a = 2 m for some integer m

$\therefore \quad b^2 = 2m^2$ $\frac{1}{2}$

Thus b^2 is a multiple of 2

$\Rightarrow$ b is a multiple of 2 $\frac{1}{2}$

Hence 2 is a common factor of a and b.

This contradicts the fact that a and b are coprimes

Hence $\sqrt{2}$ is an irrational number. $\frac{1}{2}$

14. Sum of zeroes = k + 6 1

Product of zeroes = 2(2k – 1) 1

Hence $k + 6 = \frac{1}{2} \times 2(2k - 1)$

$\Rightarrow \quad k = 7$ 1

15. Let sum of the ages of two children be x yrs and father's age be y yrs.

$\therefore \quad y = 3x \qquad ...(1)$ 1

and $\quad y + 5 = 2(x + 10) \qquad ...(2)$ 1

Solving equations (1) and (2)

$x = 15$

and $\quad y = 45$

Father's present age is 45 years. 1

OR

Let the fraction be $\frac{x}{y}$

$\therefore \quad \frac{x - 2}{y} = \frac{1}{3} \qquad ...(1)$ 1

and $\quad \frac{x}{y - 1} = \frac{1}{2} \qquad ...(2)$ 1

Solving (1) and (2) to get x = 7, y = 15.

$\therefore$ Required fraction is $\frac{7}{15}$ 1

16. Let the required point on y-axis be (0, b) $\frac{1}{2}$

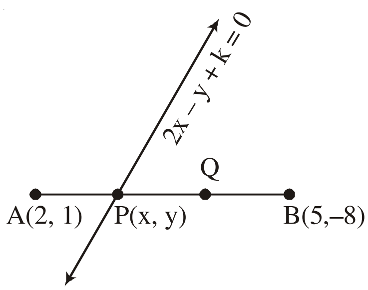
$\therefore \quad (5-0)^2 + (-2-b)^2 = (-3-0)^2 + (2-b)^2$ 1

$\Rightarrow \quad 29 + 4b + b^2 = 13 + b^2 - 4b$

$\Rightarrow \quad b = -2$ 1

$\therefore$ Required point is (0, –2) $\frac{1}{2}$

OR



AP : PB = 1 : 2 $\frac{1}{2}$

$x = \frac{4+5}{3} = 3$ and $y = \frac{2-8}{3} = -2$ $\frac{1}{2} + \frac{1}{2}$

Thus point P is (3, –2). $\frac{1}{2}$

Point (3, –2) lies on $2x - y + k = 0$

$\Rightarrow \quad 6 + 2 + k = 0$

$\Rightarrow \quad k = -8.$ 1

17. LHS $= \sin^2\theta + \text{cosec}^2\theta + 2\sin\theta\,\text{cosec}\,\theta + \cos^2\theta + \sec^2\theta + 2\cos\theta\sec\theta$ 1

$= (\sin^2\theta + \cos^2\theta) + \text{cosec}^2\theta + \sec^2\theta + \frac{2\sin\theta}{\sin\theta} + 2\frac{\cos\theta}{\cos\theta}.$

$= 1 + 1 + \cot^2\theta + 1 + \tan^2\theta + 2 + 2$ $1\frac{1}{2}$

$= 7 + \cot^2\theta + \tan^2\theta = \text{RHS}$ $\frac{1}{2}$

OR

$\text{LHS} = \left(1 + \frac{1}{\tan A} - \text{cosec}\,A\right)(1 + \tan A + \sec A)$

$= \frac{1}{\tan A}(\tan A + 1 - \sec A)\,(1 + \tan A + \sec A)$ 1

$= \frac{1}{\tan A}[(1 + \tan A)^2 - \sec^2 A]$ 1

$= \frac{1}{\tan A}[1 + \tan^2 A + 2\tan A - 1 - \tan^2 A]$

$= 2 = \text{RHS}$ 1

Alternate method

$$\text{LHS} = \left(1+\frac{\cos A}{\sin A}-\frac{1}{\sin A}\right)\left(1+\frac{\sin A}{\cos A}+\frac{1}{\cos A}\right)$$ 1

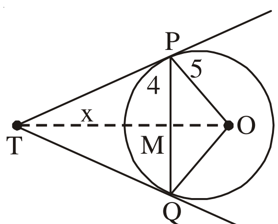
$$= (\sin A + \cos A - 1)(\cos A + \sin A + 1)\cdot\frac{1}{\cos A \sin A}$$

$$= \left[(\sin A + \cos A)^2 - 1\right]\times\frac{1}{\sin A \cos A}$$ 1

$$= (1 + 2\sin A \cos - 1)\times\frac{1}{\sin A \cos A}$$ $\frac{1}{2}$

$$= 2 = \text{RHS}$$ $\frac{1}{2}$

18. Join OT and OQ. $\frac{1}{2}$



TP = TQ

$\therefore$ TM $\perp$ PQ and bisects PQ

Hence PM = 4 cm

Therefore OM = $\sqrt{25-16} = \sqrt{9} = 3$ cm. $\frac{1}{2}$

Let TM = x

From ΔPMT, $PT^2 = x^2 + 16$

From ΔPOT, $PT^2 = (x + 3)^2 - 25$

Hence $x^2 + 16 = x^2 + 9 + 6x - 25$

$\Rightarrow 6x = 32 \Rightarrow x = \frac{16}{3}$ 1

Hence $PT^2 = \frac{256}{9} + 16 = \frac{400}{9}$

$\therefore \quad PT = \frac{20}{3}$ cm. 1

19. $\Delta ACB \sim \Delta ADC$ (AA similarity)

$$\Rightarrow \quad \frac{AC}{BC} = \frac{AD}{CD} \qquad \text{...(1)}$$ 1

Also $\Delta ACB \sim \Delta CDB$ (AA similarity)

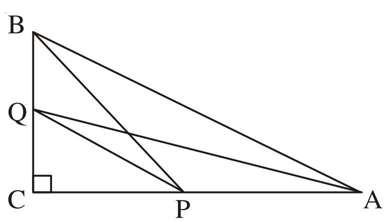
$$\Rightarrow \quad \frac{AC}{BC} = \frac{CD}{BD} \qquad \text{...(2)}$$ 1

Using equations (1) and (2)

$$\frac{AD}{CD} = \frac{CD}{BD}$$

$\Rightarrow \quad CD^2 = AD \times BD$ 1

OR



Correct Figure $\frac{1}{2}$

$AQ^2 = CQ^2 + AC^2$ 1

$BP^2 = CP^2 + BC^2$ $\frac{1}{2}$

$\therefore\ AQ^2 + BP^2 = (CQ^2 + CP^2) + (AC^2 + BC^2)$

$= PQ^2 + AB^2.$ 1

20. $AC = \sqrt{64+36} = 10\,\text{cm}.$

$\therefore$ Radius of the circle (r) = 5 cm. 1

Area of shaded region = Area of circle – Ar(ABCD) $\frac{1}{2}$

$= 3.14 \times 25 - 6 \times 8$ 1

$= 78.5 - 48$

$= 30.5\ \text{cm}^2.$ $\frac{1}{2}$

21. Length of canal covered in 30 min = 5000 m. $\frac{1}{2}$

$\therefore$ Volume of water flown in 30 min = $6 \times 1.5 \times 5000\ \text{m}^3$ 1

If 8 cm standing water is needed

then area irrigated = $\dfrac{6 \times 1.5 \times 5000}{.08} = 562500 \text{ m}^2$. $1+\frac{1}{2}$

22. Modal class is 30-40 $\frac{1}{2}$

$\therefore$ Mode = $l + \left(\dfrac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$

$= 30 + \left(\dfrac{16-10}{32-10-12}\right) \times 10$ 2

= 36. $\frac{1}{2}$

SECTION D

23. Let the smaller tap fills the tank in x hrs

$\therefore$ the larger tap fills the tank in (x – 2) hrs.

Time taken by both the taps together = $\dfrac{15}{8}$ hrs.

Therefore $\dfrac{1}{x} + \dfrac{1}{x-2} = \dfrac{8}{15}$ 2

$\Rightarrow$ $4x^2 - 23x + 15 = 0$ $\frac{1}{2}$

$\Rightarrow$ $(4x - 3)(x - 5) = 0$

$x \neq \dfrac{3}{4}$ $\therefore$ $x = 5$ 1

Smaller and larger taps can fill the tank seperately in 5 hrs and 3 hrs resp. $\frac{1}{2}$

OR

Let the speed of the boat in still water be x km/hr and speed of the stream be y km/hr.

Given $\dfrac{30}{x-y} + \dfrac{44}{x+y} = 10$ ...(i) 1

and $\dfrac{40}{x-y} + \dfrac{55}{x+y} = 13$ ...(ii) 1

Solving (i) and (ii) to get

$x + y = 11$ ..(iii)

and $x - y = 5$ ...(iv)

Solving (iii) and (iv) to get x = 8, y = 3. 1+1

Speed of boat = 8 km/hr & speed of stream = 3 km/hr.

24. $S_4 = 40 \Rightarrow 2(2a + 3d) = 40 \Rightarrow 2a + 3d = 20$ 1

$S_{14} = 280 \Rightarrow 7(2a + 13d) = 280 \Rightarrow 2a + 13d = 40$ 1

Solving to get d = 2 $\frac{1}{2}$

and a = 7 $\frac{1}{2}$

$\therefore \quad Sn = \frac{n}{2}[14 + (n-1) \times 2]$

$= n(n + 6)$ or $(n^2 + 6n)$ 1

25. LHS $= \dfrac{\sin A - \cos A + 1}{\sin A + \cos A - 1}$

Dividing num. & deno. by cos A

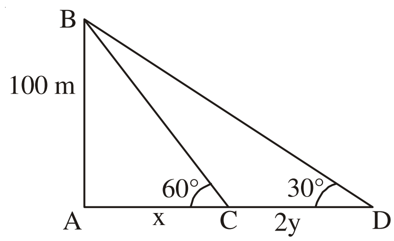
$= \dfrac{\tan A - 1 + \sec A}{\tan A + 1 - \sec A}$ 1

$= \dfrac{\tan A - 1 + \sec A}{(\tan A - \sec A) + (\sec^2 A - \tan^2 A)}$ 1

$= \dfrac{\tan A - 1 + \sec A}{(\tan A - \sec A)(1 - \sec A - \tan A)}$ 1

$= \dfrac{-1}{\tan A - \sec A} = \dfrac{1}{\sec A - \tan A} = \text{RHS}$ 1

26. Correct Figure 1



Let the speed of the boat be y m/min

$\therefore$ CD = 2y

$\tan 60° = \sqrt{3} = \frac{100}{x} \Rightarrow x = \frac{100}{\sqrt{3}}$ 1

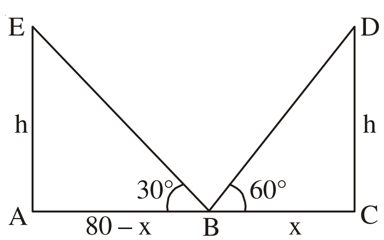
$\tan 30° = \frac{1}{\sqrt{3}} = \frac{100}{x+2y} \Rightarrow x + 2y = 100\sqrt{3}$ 1

$\therefore y = \frac{100\sqrt{3}}{3} = 57.73$ 1

or speed of boat = 57.73 m/min.

OR

Correct Figure 1



Let BC = x so AB = 80 – x

where AC is the road.

$\tan 60° = \sqrt{3} = \frac{h}{x} \Rightarrow h = x\sqrt{3}$ 1

and $\tan 30° = \frac{1}{\sqrt{3}} = \frac{h}{80-x} \Rightarrow h\sqrt{3} = 80 - x$ 1

Solving equation to get

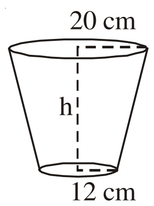
$x = 20,\ h = 20\sqrt{3}$

$\therefore$ AB = 60 m, BC = 20 m and $h = 20\sqrt{3}$ m. 1

27. Correct construction of ΔABC. 2

Correct construction of triangle similar to triangle ABC. 2

28. Volume of the bucket = 12308.8 cm^3



Let $r_1 = 20$ cm, $r_2 = 12$ cm

$\therefore \quad V = \frac{\pi h}{3}(r_1^2 + r_2^2 + r_1 r_2)$

$\therefore \quad 12308.8 = \frac{3.14 \times h}{3}(400 + 144 + 240)$ 1

$\Rightarrow h = \frac{12308.8 \times 3}{3.14 \times 784} = 15$ cm 1

Now $l^2 = h^2 + (r_1 - r_2)^2 = 225 + 64 = 289$

$\Rightarrow \quad l = 17$ cm. 1

Surface area of metal sheet used = $\pi r_2^2 + \pi l\,(r_1 + r_2)$

$= 3.14\,(144 + 17 \times 32)$

$= 2160.32$ cm^2. 1

29. Correct given, to prove, figure and construction $\frac{1}{2} \times 4 = 2$

Correct proof. 2

30.

Class	Frequency	Cumulative freq.
0-10	f_1	f_1
10-20	5	$5 + f_1$
20-30	9	$14 + f_1$
30-40	12	$26 + f_1$
40-50	f_2	$26 + f_1 + f_2$
50-60	3	$29 + f_1 + f_2$
60-70	2	$31 + f_1 + f_2$
	40	

Correct Table 1

Median = 32.5 $\Rightarrow$ median class is 30-40. $\frac{1}{2}$

Now $32.5 = 30 + \frac{10}{12}(20 - 14 - f_1)$ 1

$\Rightarrow f_1 = 3$ 1

Also $31 + f_1 + f_2 = 40$

$\Rightarrow f_2 = 6$ $\frac{1}{2}$

OR

Less than type distribution is as follows

Marks	No. of students		
Less than 5	2		
Less than 10	7		
Less than 15	13		
Less than 20	21		
Less than 25	31		
Less than 30	56		
Less than 35	76		
Less than 40	94		
Less than 45	98		
Less than 50	100	Correct Table	$1\frac{1}{2}$

Plotting of points (5, 2), (10, 7) (15, 13), (20, 21), (25, 31), (30, 56),

(35, 76), (40, 94), (45, 98), (50, 100) $1\frac{1}{2}$

Joining to get the curve $\frac{1}{2}$

Getting median from graph (approx. 29) $\frac{1}{2}$

QUESTION PAPER CODE 30/1/2

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. Let the point A be (x, y)

$\therefore \quad \frac{x+3}{2} = -2$ and $\frac{y+4}{2} = 2$ $\quad \frac{1}{2}$

$\Rightarrow \quad x = -7$ and $y = 0$

Point is (–7, 0) $\quad \frac{1}{2}$

2. Any one rational number between $\sqrt{2}$ (1.41 approx.) and $\sqrt{3}$ (1.73 approx.) $\quad 1$

e.g., 1.5, 1.6, 1.63 etc.

3. Numbers are 12, 15, 18, ..., 99 $\quad \frac{1}{2}$

$\therefore \quad 99 = 12 + (n - 1) \times 3$

$\Rightarrow \quad n = 30$ $\quad \frac{1}{2}$

4. tan 2 A = cot (90° – 2A)

$\therefore \quad 90° - 2A = A - 24°$ $\quad \frac{1}{2}$

$\Rightarrow \quad A = 38°$ $\quad \frac{1}{2}$

OR

$\sin 33° = \cos 57°$ $\quad \frac{1}{2}$

$\therefore \quad \sin^2 33° + \sin^2 57° = \cos^2 57° + \sin^2 57° = 1$ $\quad \frac{1}{2}$

5. Since roots of the equation $x^2 + 4x + k = 0$ are real

$\Rightarrow \quad 16 - 4k \geq 0$ $\quad \frac{1}{2}$

$\Rightarrow \quad k \leq 4$ $\quad \frac{1}{2}$

OR

Roots of the equation $3x^2 - 10x + k = 0$ are reciprocal of each other

$\Rightarrow$ Product of roots = 1 $\frac{1}{2}$

$\Rightarrow \frac{k}{3} = 1 \Rightarrow k = 3$ $\frac{1}{2}$

6. AB = 1 + 2 = 3 cm $\frac{1}{2}$

$\Delta ABC \sim \Delta ADE$

$\therefore \frac{ar(ABC)}{ar(ADE)} = \frac{AB^2}{AD^2} = \frac{9}{1}$ $\frac{1}{2}$

$\therefore ar(\Delta ABC) : ar(\Delta ADE) = 9 : 1$

SECTION B

7. System of equations has infinitely many solutions.

$\therefore \frac{2}{k+1} = \frac{3}{2k-1} = \frac{7}{4k+1}$ $\frac{1}{2}$

$\Rightarrow 4k - 2 = 3k + 3$ $\frac{1}{2}$

$\Rightarrow k = 5$

Also $12k + 3 = 14k - 7$ $\frac{1}{2}$

$\Rightarrow k = 5$

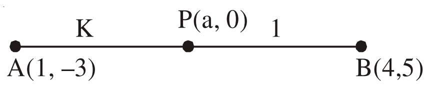
Hence k = 5. $\frac{1}{2}$

8. Total number of outcomes = 6.

(i) Prob. (getting a prime number (2, 3, 5)) = $\frac{3}{6}$ or $\frac{1}{2}$ 1

(ii) Prob. (getting a number between 2 and 6 (3, 4, 5)) = $\frac{3}{6}$ or $\frac{1}{2}$. 1

9. Let the required point be (a, 0) and required ratio AP : PB = k : 1 $\frac{1}{2}$



$$\therefore \quad a = \frac{4k+1}{k+1}$$

$$0 = \frac{5k-3}{k+1}$$

$\Rightarrow \quad k = \frac{3}{5}$ or required ratio is 3 : 5 $\quad 1$

Point P is $\left(\frac{17}{8}, 0\right)$ $\quad \frac{1}{2}$

10. Total number of outcomes = 8 $\quad \frac{1}{2}$

Favourable number of outcomes (HHH, TTT) = 2 $\quad \frac{1}{2}$

Prob. (getting success) = $\frac{2}{8}$ or $\frac{1}{4}$ $\quad \frac{1}{2}$

$\therefore$ Prob. (losing the game) = $1-\frac{1}{4}=\frac{3}{4}$. $\quad \frac{1}{2}$

11. $a_n = a_{21} + 120$

$= (3 + 20 \times 12) + 120$

$= 363$ $\quad 1$

$\therefore \quad 363 = 3 + (n - 1) \times 12$

$\Rightarrow \quad n = 31$ $\quad 1$

or 31st term is 120 more than a_{21}.

OR

$a_1 = S_1 = 3 - 4 = -1$ $\quad \frac{1}{2}$

$a_2 = S_2 - S_1 = [3(2)^2 - 4(2)] - (-1) = 5$ $\quad \frac{1}{2}$

$\therefore\ d = a_2 - a_1 = 6$ $\quad \frac{1}{2}$

Hence $a_n = -1 + (n - 1) \times 6 = 6n - 7$ $\quad \frac{1}{2}$

Alternate method:

$S_n = 3n^2 - 4n$

$\therefore \quad S_{n-1} = 3(n-1)^2 - 4(n-1) = 3n^2 - 10n + 7$ 1

Hence $a_n = S_n - S_{n-1}$

$= (3n^2 - 4n) - (3n^2 - 10n + 7)$ $\frac{1}{2}$

$= 6n - 7$ $\frac{1}{2}$

12. Using Euclid's Algorithm

$$\left.\begin{array}{l} 7344 = 1260 \times 5 + 1044 \\ 1260 = 1044 \times 1 + 216 \\ 1044 = 216 \times 4 + 180 \\ 216 = 180 \times 1 + 36 \\ 180 = 36 \times 5 + 0 \end{array}\right\}$$ $1\frac{1}{2}$

HCF of 1260 and 7344 is 36. $\frac{1}{2}$

OR

Using Euclid's Algorithm

$a = 4q + r, \ 0 \le r < 4$

$\Rightarrow \quad a = 4q, \ a = 4q + 1, \ a = 4q + 2$ and $a = 4q + 3$. 1

Now $a = 4q$ and $a = 4q + 2$ are even numbers. $\frac{1}{2}$

Therefore when a is odd, it is of the form

$a = 4q + 1$ or $a = 4q + 3$ for some integer q. $\frac{1}{2}$

SECTION C

13.

Class	**x**	**Freq (f)**	$u = \frac{x-50}{20}$	**fu**
0-20	10	12	–2	–24
20-40	30	15	–1	–15
40-60	50	32	0	0
60-80	70	k	1	k
80-100	90	13	2	26
		72 + k		–13 + k

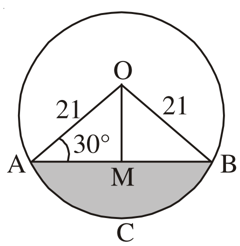
Correct Table 2

$$\bar{x} = 53 = 50 + 20 \times \frac{-13+k}{72+k}$$

$\Rightarrow$ 3k + 216 = 20k – 260

$\Rightarrow$ k = 28 1

14. Draw OM $\perp$ AB



$\angle OAB = \angle OBA = 30°$ $\frac{1}{2}$

$\sin 30° = \frac{1}{2} = \frac{OM}{21} \Rightarrow OM = \frac{21}{2}$

$\cos 30° = \frac{\sqrt{3}}{2} = \frac{AM}{21} \Rightarrow AM = \frac{21}{2}\sqrt{3}$

Area of $\Delta OAB = \frac{1}{2} \times AB \times OM = \frac{1}{2} \times 21\sqrt{3} \times \frac{21}{2}$

$= \frac{441}{4}\sqrt{3}\text{ cm}^2.$ 1

$\therefore$ Area of shaded region = Area (sector OACB) – Area (ΔOAB)

$= \frac{22}{7} \times 21 \times 21 \times \frac{120}{360} - \frac{441}{4}\sqrt{3}$ 1

$= \left(462 - 441\frac{\sqrt{3}}{4}\right)\text{cm}^2$ or 271.3 cm^2 (approx.) $\frac{1}{2}$

15. $\Delta ACB \sim \Delta ADC$ (AA similarity)

$\Rightarrow \quad \frac{AC}{BC} = \frac{AD}{CD}$ ...(1) 1

Also $\Delta ACB \sim \Delta CDB$ (AA similarity)

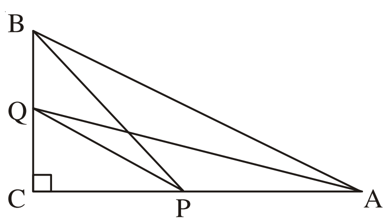
$\Rightarrow \quad \frac{AC}{BC} = \frac{CD}{BD}$ ...(2) 1

Using equations (1) and (2)

$$\frac{AD}{CD} = \frac{CD}{BD}$$

$\Rightarrow \quad CD^2 = AD \times BD$ 1

OR



Correct Figure $\frac{1}{2}$

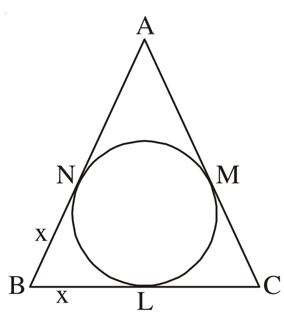
$AQ^2 = CQ^2 + AC^2$ 1

$BP^2 = CP^2 + BC^2$ $\frac{1}{2}$

$\therefore\ AQ^2 + BP^2 = (CQ^2 + CP^2) + (AC^2 + BC^2)$

$= PQ^2 + AB^2.$ 1

16.



Let BL = x = BN

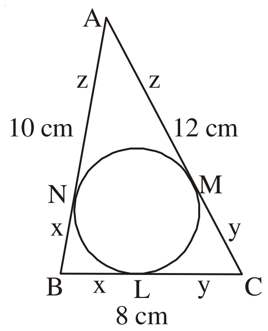
$\left.\begin{array}{l}\therefore\ CL = 8 - x = CM \\ \because\ AC = 12 \Rightarrow AM = 4 + x = AN\end{array}\right\}$ 1

Now AB = AN + NB = 10 $\Rightarrow$ x + 4 + x = 10

$\Rightarrow$ x = 3 1

$\therefore$ BL = 3 cm, CM = 5 cm and AN = 7 cm 1

Alternate method



Let BL = BN = x (tangents from external points are equal) $\frac{1}{2}$

CL = CM = y

AN = AM = z

$\therefore$ AB + BC + AC = 2x + 2y + 2z = 30

$\Rightarrow$ x + y + z = 15 ...(i) 1

Also x + z = 10, x + y = 8 and y + z = 12

Subtracting from equation (i)

y = 5, z = 7 and x = 3 $\frac{1}{2}+\frac{1}{2}+\frac{1}{2}$

$\therefore$ BL = 3 cm, CM = 5 cm and AN = 7 cm.

17. Length of canal covered in 30 min = 5000 m. $\frac{1}{2}$

$\therefore$ Volume of water flown in 30 min = 6 × 1.5 × 5000 m^3 1

If 8 cm standing water is needed

then area irrigated = $\frac{6\times1.5\times5000}{.08} = 562500\ m^2$. $1+\frac{1}{2}$

18. Let us assume $\sqrt{2}$ be a rational number and its simplest form be $\frac{a}{b}$, a and b are coprime positive integers and b ≠ 0.

So $\sqrt{2} = \frac{a}{b}$

$\Rightarrow$ $a^2 = 2b^2$ 1

Thus a^2 is a multiple of 2

$\Rightarrow$ a is a multiple of 2. $\frac{1}{2}$

Let a = 2 m for some integer m

$\therefore$ $b^2 = 2m^2$ $\frac{1}{2}$

Thus b^2 is a multiple of 2

$\Rightarrow$ b is a multiple of 2 $\frac{1}{2}$

Hence 2 is a common factor of a and b.

This contradicts the fact that a and b are coprimes

Hence $\sqrt{2}$ is an irrational number. $\frac{1}{2}$

19. Sum of zeroes = k + 6 1

Product of zeroes = 2(2k – 1) 1

Hence $k + 6 = \frac{1}{2} \times 2(2k - 1)$

$\Rightarrow \quad k = 7$ 1

20. Let the required point on y-axis be (0, b) $\frac{1}{2}$

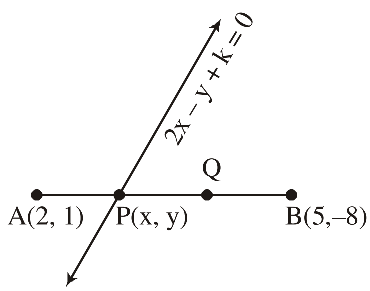
$\therefore \quad (5 - 0)^2 + (-2 - b)^2 = (-3 - 0)^2 + (2 - b)^2$ 1

$\Rightarrow \quad 29 + 4b + b^2 = 13 + b^2 - 4b$

$\Rightarrow \quad b = -2$ 1

$\therefore$ Required point is (0, –2) $\frac{1}{2}$

OR



AP : PB = 1 : 2 $\frac{1}{2}$

$x = \frac{4+5}{3} = 3$ and $y = \frac{2-8}{3} = -2$ $\frac{1}{2} + \frac{1}{2}$

Thus point P is (3, –2). $\frac{1}{2}$

Point (3, –2) lies on 2x – y + k = 0

$\Rightarrow \quad 6 + 2 + k = 0$

$\Rightarrow \quad k = -8.$ 1

21. Let sum of the ages of two children be x yrs and father's age be y yrs.

$\therefore \quad y = 3x \qquad ...(1)$ 1

and $\quad y + 5 = 2(x + 10) \qquad ...(2)$ 1

Solving equations (1) and (2)

$x = 15$

and $y = 45$

Father's present age is 45 years. 1

OR

Let the fraction be $\frac{x}{y}$

$\therefore \quad \frac{x-2}{y} = \frac{1}{3}$ ...(1) 1

and $\frac{x}{y-1} = \frac{1}{2}$ ...(2) 1

Solving (1) and (2) to get $x = 7$, $y = 15$.

$\therefore$ Required fraction is $\frac{7}{15}$ 1

22. LHS $= \sin^2\theta + \text{cosec}^2\theta + 2\sin\theta\,\text{cosec}\,\theta + \cos^2\theta + \sec^2\theta + 2\cos\theta\sec\theta$ 1

$= (\sin^2\theta + \cos^2\theta) + \text{cosec}^2\theta + \sec^2\theta + \frac{2\sin\theta}{\sin\theta} + 2\frac{\cos\theta}{\cos\theta}.$

$= 1 + 1 + \cot^2\theta + 1 + \tan^2\theta + 2 + 2$ $1\frac{1}{2}$

$= 7 + \cot^2\theta + \tan^2\theta = \text{RHS}$ $\frac{1}{2}$

OR

LHS $= \left(1 + \frac{1}{\tan A} - \text{cosec}\,A\right)(1 + \tan A + \sec A)$

$= \frac{1}{\tan A}(\tan A + 1 - \sec A)\,(1 + \tan A + \sec A)$ 1

$= \frac{1}{\tan A}[(1 + \tan A)^2 - \sec^2 A]$ 1

$= \frac{1}{\tan A}[1 + \tan^2 A + 2\tan A - 1 - \tan^2 A]$

$= 2 = \text{RHS}$ 1

Alternate method

$$\text{LHS} = \left(1+\frac{\cos A}{\sin A}-\frac{1}{\sin A}\right)\left(1+\frac{\sin A}{\cos A}+\frac{1}{\cos A}\right) \qquad 1$$

$$= (\sin A+\cos A-1)(\cos A+\sin A+1)\cdot\frac{1}{\cos A\sin A}$$

$$= \left[(\sin A+\cos A)^2-1\right]\times\frac{1}{\sin A\cos A} \qquad 1$$

$$= (1+2\sin A\cos-1)\times\frac{1}{\sin A\cos A} \qquad \frac{1}{2}$$

$$= 2 = \text{RHS} \qquad \frac{1}{2}$$

SECTION D

23. $$\text{LHS} = \frac{\sin^2 A/\cos^2 A}{\dfrac{\sin^2 A}{\cos^2 A}-1}+\frac{1/\sin^2 A}{\dfrac{1}{\cos^2 A}-\dfrac{1}{\sin^2 A}} \qquad 1$$

$$= \frac{\sin^2 A}{\sin^2 A-\cos^2 A}+\frac{\cos^2 A}{\sin^2 A-\cos^2 A} \qquad 1$$

$$= \frac{1}{\sin^2 A-\cos^2 A} \qquad 1$$

$$= \frac{1}{1-2\cos^2 A} \qquad 1$$

24. Here $a = 3$, $a_n = 83$ and $S_n = 903$

Therefore $83 = 3 + (n-1)d$

$\Rightarrow \quad (n-1)d = 80$ ...(i) 1

Also $903 = \dfrac{n}{2}[2a+(n-1)d] = \dfrac{n}{2}(6+80) = 43n$ (using (i)) $1+\frac{1}{2}$

$$\left.\begin{aligned}&\Rightarrow \quad n = 21\\ &\text{and} \quad d = 4\end{aligned}\right\} \qquad 1\frac{1}{2}$$

25. Correct construction of ΔABC 2

Correct construction of triangle similar to ΔABC. 2

26.

Class	**Frequency**	**Cumulative freq.**
0-10	f_1	f_1
10-20	5	$5 + f_1$
20-30	9	$14 + f_1$
30-40	12	$26 + f_1$
40-50	f_2	$26 + f_1 + f_2$
50-60	3	$29 + f_1 + f_2$
60-70	2	$31 + f_1 + f_2$
	40	

Correct Table 1

Median = 32.5 $\Rightarrow$ median class is 30-40. $\frac{1}{2}$

Now $32.5 = 30 + \frac{10}{12}(20 - 14 - f_1)$ 1

$\Rightarrow f_1 = 3$ 1

Also $31 + f_1 + f_2 = 40$

$\Rightarrow f_2 = 6$ $\frac{1}{2}$

OR

Less than type distribution is as follows

Marks	No. of students
Less than 5	2
Less than 10	7
Less than 15	13
Less than 20	21
Less than 25	31
Less than 30	56
Less than 35	76
Less than 40	94
Less than 45	98
Less than 50	100

Correct Table $1\frac{1}{2}$

Plotting of points (5, 2), (10, 7) (15, 13), (20, 21), (25, 31), (30, 56),

(35, 76), (40, 94), (45, 98), (50, 100) $1\frac{1}{2}$

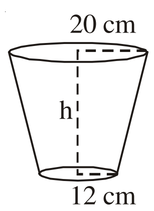
Joining to get the curve $\frac{1}{2}$

Getting median from graph (approx. 29) $\frac{1}{2}$

27. Correct given, to prove, figure and construction $\frac{1}{2} \times 4 = 2$

Correct proof. 2

28. Volume of the bucket = 12308.8 cm^3



Let r_1 = 20 cm, r_2 = 12 cm

$\therefore \quad V = \frac{\pi h}{3}(r_1^2 + r_2^2 + r_1 r_2)$

$\therefore \quad 12308.8 = \frac{3.14 \times h}{3}(400 + 144 + 240)$ 1

$\Rightarrow \ h = \frac{12308.8 \times 3}{3.14 \times 784} = 15 \text{ cm}$ 1

Now $l^2 = h^2 + (r_1 - r_2)^2 = 225 + 64 = 289$

$\Rightarrow \quad l = 17$ cm. 1

Surface area of metal sheet used $= \pi r_2^2 + \pi l\,(r_1 + r_2)$

$= 3.14\ (144 + 17 \times 32)$

$= 2160.32\ cm^2$. 1

29. Let the smaller tap fills the tank in x hrs

$\therefore$ the larger tap fills the tank in (x – 2) hrs.

Time taken by both the taps together = $\frac{15}{8}$ hrs.

Therefore $\frac{1}{x} + \frac{1}{x-2} = \frac{8}{15}$ 2

$\Rightarrow \quad 4x^2 - 23x + 15 = 0$ $\frac{1}{2}$

$\Rightarrow \quad (4x - 3)\ (x - 5) = 0$

$x \neq \frac{3}{4} \quad \therefore\ x = 5$ 1

Smaller and larger taps can fill the tank seperately in 5 hrs and 3 hrs resp. $\frac{1}{2}$

OR

Let the speed of the boat in still water be x km/hr and speed of the stream be y km/hr.

Given $\frac{30}{x-y} + \frac{44}{x+y} = 10$ ...(i) 1

and $\frac{40}{x-y} + \frac{55}{x+y} = 13$ ...(ii) 1

Solving (i) and (ii) to get

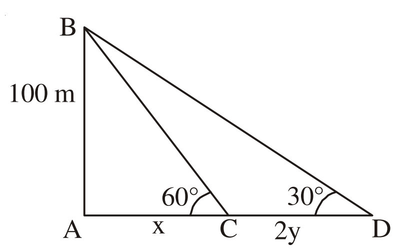
$x + y = 11$ ..(iii)

and $x - y = 5$ ...(iv)

Solving (iii) and (iv) to get x = 8, y = 3. 1+1

Speed of boat = 8 km/hr & speed of stream = 3 km/hr.

30. Correct Figure 1



Let the speed of the boat be y m/min

$\therefore\ CD = 2y$

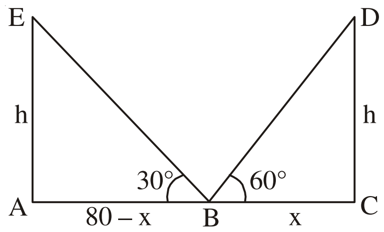
$\tan 60° = \sqrt{3} = \frac{100}{x} \Rightarrow x = \frac{100}{\sqrt{3}}$ 1

$\tan 30° = \frac{1}{\sqrt{3}} = \frac{100}{x+2y} \Rightarrow x + 2y = 100\sqrt{3}$ 1

$\therefore\ y = \frac{100\sqrt{3}}{3} = 57.73$ 1

or speed of boat = 57.73 m/min.

OR



Correct Figure 1

Let BC = x so AB = 80 – x

where AC is the road.

$\tan 60° = \sqrt{3} = \frac{h}{x} \Rightarrow h = x\sqrt{3}$ 1

and $\tan 30° = \frac{1}{\sqrt{3}} = \frac{h}{80 - x} \Rightarrow h\sqrt{3} = 80 - x$ 1

Solving equation to get

$x = 20,\ h = 20\sqrt{3}$

$\therefore$ AB = 60 m, BC = 20 m and h = $20\sqrt{3}$ m. 1

QUESTION PAPER CODE 30/1/3

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. LCM $(x^3y^2, xy^3) = x^3y^3$. 1

2. Numbers are 12, 15, 18, ..., 99 $\frac{1}{2}$

$\therefore \quad 99 = 12 + (n - 1) \times 3$

$\Rightarrow \quad n = 30$ $\frac{1}{2}$

3. AB = 1 + 2 = 3 cm $\frac{1}{2}$

$\Delta ABC \sim \Delta ADE$

$\therefore \quad \frac{ar\,(ABC)}{ar\,(ADE)} = \frac{AB^2}{AD^2} = \frac{9}{1}$ $\frac{1}{2}$

$\therefore \quad ar(\Delta ABC) : ar(\Delta ADE) = 9 : 1$

4. Let the point A be (x, y)

$\therefore \quad \frac{1+x}{2} = 2$ and $\frac{4+y}{2} = -3$ $\frac{1}{2}$

$\Rightarrow \quad x = 3$ and $y = -10$

$\therefore \quad$ Point A is (3, –10) $\frac{1}{2}$

5. Since roots of the equation $x^2 + 4x + k = 0$ are real

$\Rightarrow \quad 16 - 4k \geq 0$ $\frac{1}{2}$

$\Rightarrow \quad k \leq 4$ $\frac{1}{2}$

OR

Roots of the equation $3x^2 - 10x + k = 0$ are reciprocal of each other

$\Rightarrow \quad$ Product of roots = 1 $\frac{1}{2}$

$\Rightarrow \quad \frac{k}{3} = 1 \Rightarrow k = 3$ $\frac{1}{2}$

6. $\tan 2A = \cot (90° - 2A)$

$\therefore \quad 90° - 2A = A - 24°$ $\frac{1}{2}$

$\Rightarrow \quad A = 38°$ $\frac{1}{2}$

OR

$\sin 33° = \cos 57°$ $\frac{1}{2}$

$\therefore \quad \sin^2 33° + \sin^2 57° = \cos^2 57° + \sin^2 57° = 1$ $\frac{1}{2}$

SECTION B

7. Required numbers are

14, 21, 28, 35, ..., 98. 1

$98 = 14 + (n - 1) \times 7$ $\frac{1}{2}$

$\Rightarrow \quad n = 13$ $\frac{1}{2}$

OR

Given $S_n = n^2$

$S_1 = a_1 = 1$ $\frac{1}{2}$

$S_2 = a_1 + a_2 = 4$

$\Rightarrow a_2 = 3$ $\frac{1}{2}$

$\therefore d = a_2 - a_1 = 2$ $\frac{1}{2}$

$a_{10} = 1 + 18 = 19$ $\frac{1}{2}$

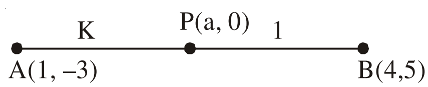
8. Total number of outcomes = 8 $\frac{1}{2}$

Favourable number of outcomes (HHH, TTT) = 2 $\frac{1}{2}$

Prob. (getting success) = $\frac{2}{8}$ or $\frac{1}{4}$ $\frac{1}{2}$

$\therefore$ Prob. (losing the game) $= 1 - \frac{1}{4} = \frac{3}{4}$. $\frac{1}{2}$

9. Let the required point be (a, 0) and required ratio AP : PB = k : 1 $\frac{1}{2}$



$$\therefore \quad a = \frac{4k+1}{k+1}$$

$$0 = \frac{5k-3}{k+1}$$

$\Rightarrow$ $k = \frac{3}{5}$ or required ratio is 3 : 5 1

Point P is $\left(\frac{17}{8}, 0\right)$ $\frac{1}{2}$

10. Total number of outcomes = 6.

(i) Prob. (getting a prime number (2, 3, 5)) $= \frac{3}{6}$ or $\frac{1}{2}$ 1

(ii) Prob. (getting a number between 2 and 6 (3, 4, 5)) $= \frac{3}{6}$ or $\frac{1}{2}$. 1

11. System of equations has infinitely many solutions

$\therefore \quad \frac{c}{12} = \frac{3}{c} = \frac{3-c}{-c}$ $\frac{1}{2}$

$\Rightarrow \quad c^2 = 36 \Rightarrow c = 6$ or $c = -6$ ...(1) $\frac{1}{2}$

Also $-3c = 3c - c^2 \Rightarrow c = 6$ or $c = 0$ ...(2) $\frac{1}{2}$

From equations (1) and (2)

$c = 6.$ $\frac{1}{2}$

12. Using Euclid's Algorithm

$$\left.\begin{aligned} 7344 &= 1260 \times 5 + 1044 \\ 1260 &= 1044 \times 1 + 216 \\ 1044 &= 216 \times 4 + 180 \\ 216 &= 180 \times 1 + 36 \\ 180 &= 36 \times 5 + 0 \end{aligned}\right\}$$ $1\frac{1}{2}$

HCF of 1260 and 7344 is 36. $\frac{1}{2}$

OR

Using Euclid's Algorithm

$a = 4q + r, 0 \le r < 4$

$\Rightarrow \quad a = 4q,\ a = 4q + 1,\ a = 4q + 2$ and $a = 4q + 3.$ 1

Now $a = 4q$ and $a = 4q + 2$ are even numbers. $\frac{1}{2}$

Therefore when a is odd, it is of the form

$a = 4q + 1$ or $a = 4q + 3$ for some integer q. $\frac{1}{2}$

SECTION C

13. Let $p(x) = 3x^3 + 10x^2 - 9x - 4$.

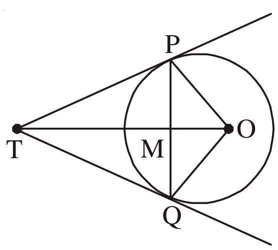
One of the zeroes is 1, therefore dividing p(x) by (x – 1)

$p(x) = (x - 1)(3x^2 + 13x + 4)$ $1\frac{1}{2}$

$= (x - 1)(x + 4)(3x + 1)$ 1

All zeroes are $x = 1,\ x = -4$ and $x = -\frac{1}{3}$. $\frac{1}{2}$

14.



Join OQ, TP = TQ $\therefore$ TM $\perp$ PQ and bisects PQ

Hence PM = 4 cm.

$\therefore\ OM = \sqrt{25-16} = \sqrt{9} = 3\,\text{cm}$ 1

Let TM = x $\therefore\ PT^2 = x^2 + 16$ (ΔPMT)

$PT^2 = (x + 3)^2 - 25$ (ΔPOT)

Hence $x^2 + 16 = (x + 3)^2 - 25 = x^2 + 9 + 6x - 25$ 1

$\Rightarrow 6x = 32 \Rightarrow x = \frac{16}{3}$

Hence $PT^2 = \frac{256}{9} + 16 = \frac{400}{9}$

$\Rightarrow\ PT = \frac{20}{3}\,\text{cm}$ 1

15. Let us assume $\dfrac{2+\sqrt{3}}{5}$ be a rational number.

Let $\dfrac{2+\sqrt{3}}{5} = \dfrac{a}{b}$ (b ≠ 0, a and b are integers)

$\Rightarrow \quad \sqrt{3} = \dfrac{5a-2b}{b}$ 1

$\because$ a, b are integers

$\therefore \quad \dfrac{5a-2b}{b}$ is a rational number 1

i.e. $\sqrt{3}$ is a rational number

which contradicts the fact that $\sqrt{3}$ is irrational

Therefore is $\dfrac{2+\sqrt{3}}{5}$ is an irrational number. 1

16. LHS $= \sin^2\theta + \text{cosec}^2\theta + 2\sin\theta\,\text{cosec}\,\theta + \cos^2\theta + \sec^2\theta + 2\cos\theta\sec\theta$ 1

$= (\sin^2\theta + \cos^2\theta) + \text{cosec}^2\theta + \sec^2\theta + \dfrac{2\sin\theta}{\sin\theta} + 2\dfrac{\cos\theta}{\cos\theta}.$

$= 1 + 1 + \cot^2\theta + 1 + \tan^2\theta + 2 + 2$ $1\frac{1}{2}$

$= 7 + \cot^2\theta + \tan^2\theta = \text{RHS}$ $\frac{1}{2}$

OR

LHS $= \left(1 + \dfrac{1}{\tan A} - \text{cosec } A\right)(1 + \tan A + \sec A)$

$= \dfrac{1}{\tan A}(\tan A + 1 - \sec A)\,(1 + \tan A + \sec A)$ 1

$= \dfrac{1}{\tan A}[(1+\tan A)^2 - \sec^2 A]$ 1

$= \dfrac{1}{\tan A}[1 + \tan^2 A + 2\tan A - 1 - \tan^2 A]$

$= 2 = \text{RHS}$ 1

Alternate method

$$\text{LHS} = \left(1 + \frac{\cos A}{\sin A} - \frac{1}{\sin A}\right)\left(1 + \frac{\sin A}{\cos A} + \frac{1}{\cos A}\right) \qquad 1$$

$$= (\sin A + \cos A - 1)(\cos A + \sin A + 1) \cdot \frac{1}{\cos A \sin A}$$

$$= \left[(\sin A + \cos A)^2 - 1\right] \times \frac{1}{\sin A \cos A} \qquad 1$$

$$= (1 + 2\sin A \cos - 1) \times \frac{1}{\sin A \cos A} \qquad \frac{1}{2}$$

$$= 2 = \text{RHS} \qquad \frac{1}{2}$$

17. Let sum of the ages of two children be x yrs and father's age be y yrs.

$\therefore$ $y = 3x$ ...(1) 1

and $y + 5 = 2(x + 10)$ ...(2) 1

Solving equations (1) and (2)

$x = 15$

and $y = 45$

Father's present age is 45 years. 1

OR

Let the fraction be $\frac{x}{y}$

$\therefore$ $\frac{x-2}{y} = \frac{1}{3}$ ...(1) 1

and $\frac{x}{y-1} = \frac{1}{2}$ ...(2) 1

Solving (1) and (2) to get $x = 7$, $y = 15$.

$\therefore$ Required fraction is $\frac{7}{15}$ 1

18. Let the required point on y-axis be (0, b) $\frac{1}{2}$

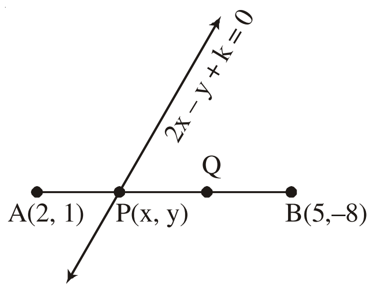
$\therefore$ $(5-0)^2 + (-2-b)^2 = (-3-0)^2 + (2-b)^2$ 1

$\Rightarrow$ $29 + 4b + b^2 = 13 + b^2 - 4b$

$\Rightarrow$ $b = -2$ 1

$\therefore$ Required point is (0, –2) $\frac{1}{2}$

OR



AP : PB = 1 : 2 $\frac{1}{2}$

$x = \frac{4+5}{3} = 3$ and $y = \frac{2-8}{3} = -2$ $\frac{1}{2}+\frac{1}{2}$

Thus point P is (3, –2). $\frac{1}{2}$

Point (3, –2) lies on $2x - y + k = 0$

$\Rightarrow$ $6 + 2 + k = 0$

$\Rightarrow$ $k = -8$. 1

19. Modal class is 30-40 $\frac{1}{2}$

$\therefore$ $\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$

$= 30 + \left(\frac{16-10}{32-10-12}\right) \times 10$ 2

$= 36.$ $\frac{1}{2}$

20. Length of canal covered in 30 min = 5000 m. $\frac{1}{2}$

$\therefore$ Volume of water flown in 30 min = $6 \times 1.5 \times 5000 \text{ m}^3$ 1

If 8 cm standing water is needed

then area irrigated $= \frac{6 \times 1.5 \times 5000}{.08} = 562500 \text{ m}^2$. $1+\frac{1}{2}$

21. $\Delta ACB \sim \Delta ADC$ (AA similarity)

$\Rightarrow \quad \dfrac{AC}{BC} = \dfrac{AD}{CD}$ ...(1) 1

Also $\Delta ACB \sim \Delta CDB$ (AA similarity)

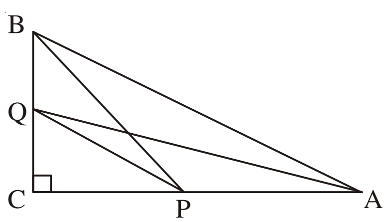
$\Rightarrow \quad \dfrac{AC}{BC} = \dfrac{CD}{BD}$ ...(2) 1

Using equations (1) and (2)

$\dfrac{AD}{CD} = \dfrac{CD}{BD}$

$\Rightarrow \quad CD^2 = AD \times BD$ 1

OR



Correct Figure $\frac{1}{2}$

$AQ^2 = CQ^2 + AC^2$ 1

$BP^2 = CP^2 + BC^2$ $\frac{1}{2}$

$\therefore\ AQ^2 + BP^2 = (CQ^2 + CP^2) + (AC^2 + BC^2)$

$= PQ^2 + AB^2.$ 1

22. $AC = \sqrt{64+36} = 10$ cm.

$\therefore$ Radius of the circle (r) = 5 cm. 1

Area of shaded region = Area of circle – Ar(ABCD) $\frac{1}{2}$

$= 3.14 \times 25 - 6 \times 8$ 1

$= 78.5 - 48$

$= 30.5\ cm^2.$ $\frac{1}{2}$

SECTION D

23. $\sec^2\theta = \left(x + \dfrac{1}{4x}\right)^2 = x^2 + \dfrac{1}{16x^2} + \dfrac{1}{2}$ 1

$\therefore \quad \tan^2\theta = \sec^2\theta - 1 = x^2 + \frac{1}{16x^2} - \frac{1}{2}$ 1

$\Rightarrow \quad \tan^2\theta = \left(x - \frac{1}{4x}\right)^2$

$\Rightarrow \quad \tan\theta = \left(x - \frac{1}{4x}\right)$ or $\left(\frac{1}{4x} - x\right)$ 1

Hence $\sec\theta + \tan\theta = 2x$ or $\frac{1}{2x}$ 1

24. Correct given, to prove, figure, construction $\frac{1}{2}\times 4 = 2$

Correct proof. 2

25. Less than type distribution is as follows

Daily income	**Number of workers**
Less than 220	12
Less than 240	26
Less than 260	34
Less than 280	40
Less than 300	50

Correct Table $1\frac{1}{2}$

Plotting of points (220, 12), (240, 26), (260, 34) (280, 40) and (300, 50) $1\frac{1}{2}$

Joining to get curve 1

OR

Daily expenditure	x_i	No. of households (f_i)	$u_i = \frac{x - 225}{50}$	f_iu_i
100-150	125	4	–2	–8
150-200	175	5	–1	–5
200–250	225	12	0	0
250–300	275	2	1	2
300-350	325	2	2	4
		$\Sigma f_i = 25$		$\Sigma f_iu_i = -7$

Correct Table 2

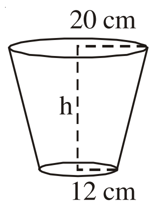
Mean $= 225 + 50 \times \left(\frac{-7}{25}\right) = 211$ 2

Mean expenditure on food is ₹ 211.

26. Correct construction of ΔABC. 2

Correct construction of triangle similar to triangle ABC. 2

27.



Volume of the bucket = 12308.8 cm^3

Let $r_1 = 20$ cm, $r_2 = 12$ cm

$\therefore \quad V = \frac{\pi h}{3}(r_1^2 + r_2^2 + r_1 r_2)$

$\therefore \quad 12308.8 = \frac{3.14 \times h}{3}(400 + 144 + 240)$ 1

$\Rightarrow \ h = \frac{12308.8 \times 3}{3.14 \times 784} = 15$ cm 1

Now $l^2 = h^2 + (r_1 - r_2)^2 = 225 + 64 = 289$

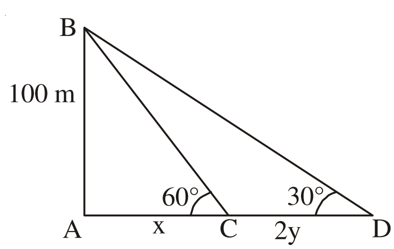
$\Rightarrow \quad l = 17$ cm. 1

Surface area of metal sheet used $= \pi r_2^2 + \pi l\,(r_1 + r_2)$

$= 3.14\ (144 + 17 \times 32)$

$= 2160.32\ cm^2$. 1

28. Correct Figure 1



Let the speed of the boat be y m/min

$\therefore$ CD = 2y

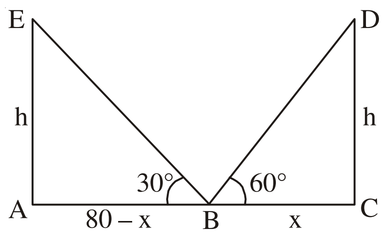
$\tan 60° = \sqrt{3} = \frac{100}{x} \Rightarrow x = \frac{100}{\sqrt{3}}$ 1

$\tan 30° = \frac{1}{\sqrt{3}} = \frac{100}{x + 2y} \Rightarrow x + 2y = 100\sqrt{3}$ 1

$\therefore \ y = \frac{100\sqrt{3}}{3} = 57.73$ 1

or speed of boat = 57.73 m/min.

OR



Correct Figure 1

Let BC = x so AB = 80 – x

where AC is the road.

$\tan 60° = \sqrt{3} = \frac{h}{x} \Rightarrow h = x\sqrt{3}$ 1

and $\tan 30° = \frac{1}{\sqrt{3}} = \frac{h}{80 - x} \Rightarrow h\sqrt{3} = 80 - x$ 1

Solving equation to get

$x = 20,\ h = 20\sqrt{3}$

$\therefore$ AB = 60 m, BC = 20 m and h = $20\sqrt{3}$ m. 1

29. Let the smaller tap fills the tank in x hrs

$\therefore$ the larger tap fills the tank in (x – 2) hrs.

Time taken by both the taps together = $\frac{15}{8}$ hrs.

Therefore $\frac{1}{x} + \frac{1}{x-2} = \frac{8}{15}$ 2

$\Rightarrow \quad 4x^2 - 23x + 15 = 0$ $\frac{1}{2}$

$\Rightarrow \quad (4x - 3)(x - 5) = 0$

$x \neq \frac{3}{4} \quad \therefore x = 5$ 1

Smaller and larger taps can fill the tank seperately in 5 hrs and 3 hrs resp. $\frac{1}{2}$

OR

Let the speed of the boat in still water be x km/hr and speed of the stream be y km/hr.

Given $\frac{30}{x-y} + \frac{44}{x+y} = 10$ ...(i) 1

and $\frac{40}{x-y} + \frac{55}{x+y} = 13$ ...(ii) 1

Solving (i) and (ii) to get

$x + y = 11$ ..(iii)

and $x - y = 5$ ...(iv)

Solving (iii) and (iv) to get $x = 8$, $y = 3$. 1+1

Speed of boat = 8 km/hr & speed of stream = 3 km/hr.

30. $S_4 = 40 \Rightarrow 2(2a + 3d) = 40 \Rightarrow 2a + 3d = 20$ 1

$S_{14} = 280 \Rightarrow 7(2a + 13d) = 280 \Rightarrow 2a + 13d = 40$ 1

Solving to get $d = 2$ $\frac{1}{2}$

and $a = 7$ $\frac{1}{2}$

$\therefore \quad Sn = \frac{n}{2}[14 + (n-1) \times 2]$

$= n(n + 6)$ or $(n^2 + 6n)$ 1

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Secondary School Certificate Examination

March 2019

Marking Scheme — Mathematics 30/2/1, 30/2/2, 30/2/3

General Instructions:

1. The Marking Scheme provides general guidelines to reduce subjectivity in the marking. The answers given in the Marking Scheme are suggested answers. The content is thus indicative. If a student has given any other answer which is different from the one given in the Marking Scheme, but conveys the meaning, such answers should be given full weightage

2. Evaluation is to be done as per instructions provided in the marking scheme. It should not be done according to one's own interpretation or any other consideration — Marking Scheme should be strictly adhered to and religiously followed.

3. Alternative methods are accepted. Proportional marks are to be awarded.

4. If a candidate has attempted an extra question, marks obtained in the question attempted first should be retained and the other answer should be scored out.

5. A full scale of marks - 0 to 80 has to be used. Please do not hesitate to award full marks if the answer deserves it.

6. Separate Marking Scheme for all the three sets has been given.

7. As per orders of the Hon'ble Supreme Court. The candidates would now be permitted to obtain photocopy of the Answer book on request on payment of the prescribed fee. All examiners/Head Examiners are once again reminded that they must ensure that evaluation is carried out strictly as per value points for each answer as given in the Marking Scheme.

QUESTION PAPER CODE 30/2/1

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. LCM (336, 54) = $\frac{336 \times 54}{6}$ $\frac{1}{2}$

$= 336 \times 9 = 3024$ $\frac{1}{2}$

2. $\frac{3-a}{3a} - \frac{1}{a} = \frac{3-a-3}{3a} = -\frac{1}{3}$ 1

3. $2x^2 - 4x + 3 = 0 \Rightarrow D = 16 - 24 = -8$ $\frac{1}{2}$

$\therefore$ Equation has NO real roots $\frac{1}{2}$

4. $\sin^2 60° + 2 \tan 45° - \cos^2 30 = \left(\frac{\sqrt{3}}{2}\right)^2 + 2(1) - \left(\frac{\sqrt{3}}{2}\right)^2$ [For any two correct values] $\frac{1}{2}$

$= 2$ $\frac{1}{2}$

OR

$\sin A = \frac{3}{4} \Rightarrow \cos A = \sqrt{1 - \frac{9}{16}} = \frac{\sqrt{7}}{4}$ $\frac{1}{2}$

$\sec A = \frac{4}{\sqrt{7}}$ $\frac{1}{2}$

5. Point on x-axis is (2, 0) 1

6. ΔABC: Isosceles $\Delta \Rightarrow AC = BC = 4$ cm. $\frac{1}{2}$

$AB = \sqrt{4^2 + 4^2} = 4\sqrt{2}$ cm $\frac{1}{2}$

OR

$\frac{AD}{BD} = \frac{AE}{CE} \Rightarrow \frac{AD}{7.2} = \frac{1.8}{5.4}$ $\frac{1}{2}$

$\therefore$ $AD = \frac{7.2 \times 1.8}{5.4} = 2.4$ cm. $\frac{1}{2}$

SECTION B

7. Smallest number divisible by 306 and 657 = LCM (306, 657) 1

LCM (306, 657) = 22338 1

8. A, B, C are collinear $\Rightarrow$ ar. (ΔABC) = 0 $\frac{1}{2}$

$\therefore \quad \frac{1}{2}[x(6-3)-4(3-y)-2(y-6)] = 0$ 1

$\Rightarrow \quad 3x + 2y = 0$ $\frac{1}{2}$

OR

Area of triangle = $\frac{1}{2}[1(6+5)-4(-5+1)-3(-1-6)]$ 1

$= \frac{1}{2}[11+16+21] = \frac{48}{2} = 24$ sq. units. 1

9. P(blue marble) = $\frac{1}{5}$, P(black marble) = $\frac{1}{4}$

$\therefore \quad$ P(green marble) = $1-\left(\frac{1}{5}+\frac{1}{4}\right)=\frac{11}{20}$ 1

Let total number of marbles be x

then $\frac{11}{20}\times x = 11 \Rightarrow x = 20$ 1

10. For unique solution $\frac{1}{3} \neq \frac{2}{k}$ 1

$\Rightarrow \quad k \neq 6$ 1

11. Let larger angle be x°

$\therefore \quad$ Smaller angle = 180° – x° $\frac{1}{2}$

$\therefore \quad (x) - (180 - x) = 18$ $\frac{1}{2}$

$2x = 180 + 18 = 198 \Rightarrow x = 99$ $\frac{1}{2}$

$\therefore \quad$ The two angles are 99°, 81° $\frac{1}{2}$

OR

Let Son's present age be x years

Then Sumit's present age = 3x years. $\frac{1}{2}$

$\therefore$ 5 Years later, we have, $3x + 5 = \frac{5}{2}(x+5)$ $\frac{1}{2}$

$6x + 10 = 5x + 25 \Rightarrow x = 15$ $\frac{1}{2}$

$\therefore$ Sumit's present age = 45 years $\frac{1}{2}$

12. Maximum frequency = 50, class (modal) = 35 – 40. $\frac{1}{2}$

$$\text{Mode} = L + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$$

$$= 35 + \frac{50-34}{100-34-42} \times 5$$ 1

$$= 35 + \frac{16}{24} \times 5 = 38.33$$ $\frac{1}{2}$

SECTION C

13. Let $2 + 5\sqrt{3} = a$, where 'a' is a rational number. $\frac{1}{2}$

than $\sqrt{3} = \frac{a-2}{5}$ 1

Which is a contradiction as LHS is irrational and RHS is rational 1

$\therefore$ $2 + 5\sqrt{3}$ can not be rational $\frac{1}{2}$

Hence $2 + 5\sqrt{3}$ is irrational.

Alternate method:

Let $2 + 5\sqrt{3}$ be rational $\frac{1}{2}$

$\therefore$ $2 + 5\sqrt{3} = \frac{p}{q}$, p, q are integers, $q \neq 0$

$\Rightarrow \sqrt{3} = \left(\frac{p}{q} - 2\right) \div 5 = \frac{p - 2q}{5q}$ 1

LHS is irrational and RHS is rational

which is a contradiction. 1

$\therefore\ 2 + 5\sqrt{3}$ is irrational. $\frac{1}{2}$

OR

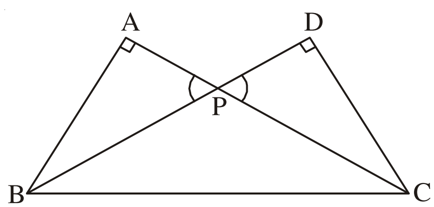
2048 = 960 × 2 + 128

960 = 128 × 7 + 64 2

128 = 64 × 2 + 0

$\therefore$ HCF (2048, 960) = 64 1

14. Correct Figure $\frac{1}{2}$



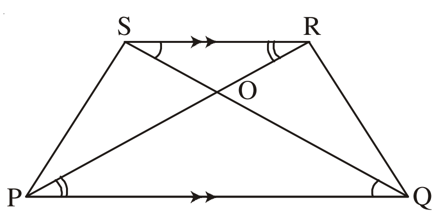
$\Delta APB \sim \Delta DPC$ [AA similarity] 1

$\frac{AP}{DP} = \frac{BP}{PC}$ 1

$\Rightarrow$ AP × PC = BP × DP $\frac{1}{2}$

OR

Correct Figure $\frac{1}{2}$



In ΔPOQ and ΔROS

$\left.\begin{array}{l}\angle P = \angle R \\ \angle Q = \angle S\end{array}\right\}$ alt. $\angle$s

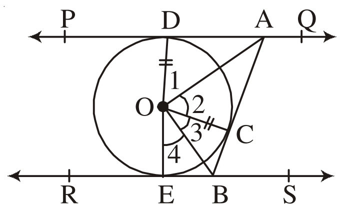
$\therefore\ \Delta POQ \sim \Delta ROS$ [AA similarity] 1

$\therefore\ \frac{ar(\Delta POQ)}{ar(\Delta ROS)} = \left(\frac{PQ}{RS}\right)^2$ 1

$= \left(\frac{3}{1}\right)^2 = \frac{9}{1}$ $\frac{1}{2}$

$\therefore$ ar(ΔPOQ) : ar(ΔROS) = 9 : 1

15.



Correct Figure $\frac{1}{2}$

$\Delta AOD \cong AOC$ [SAS] 1

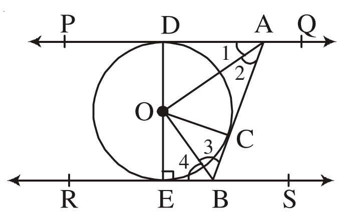
$\Rightarrow \angle 1 = \angle 2$ $\frac{1}{2}$

Similarly $\angle 4 = \angle 3$ $\frac{1}{2}$

$\Rightarrow \angle 1 + \angle 4 = \angle 2 + \angle 3 = \frac{1}{2}(180°)$

$\Rightarrow \angle 2 + \angle 3 = 90°$ or $\angle AOB = 90°$ $\frac{1}{2}$

Alternate method:



Correct Figure $\frac{1}{2}$

$\Delta OAD \cong \Delta AOC$ [SAS]

$\Rightarrow \angle 1 = \angle 2$ 1

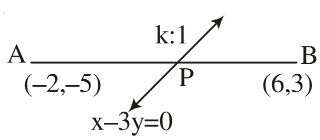
Similarly $\angle 4 = \angle 3$ $\frac{1}{2}$

But $\angle 1 + \angle 2 + \angle 3 + \angle 4 = 180°$ [$\because$ PQ $\parallel$ RS]

$\Rightarrow \angle 2 + \angle 3 = \angle 1 + \angle 4 = \frac{1}{2}(180°) = 90°$ $\frac{1}{2}$

$\therefore$ In ΔAOB, $\angle AOB = 180° - (\angle 2 + \angle 3) = 90°$ $\frac{1}{2}$

16.



Let the line $x - 3y = 0$ intersect the segment

joining A(–2, –5) and B(6, 3) in the ratio k : 1 $\frac{1}{2}$

$\therefore$ Coordinates of P are $\left(\frac{6k-2}{k+1}, \frac{3k-5}{k+1}\right)$ 1

P lies on $x - 3y = 0 \Rightarrow \frac{6k-2}{k+1} = 3\left(\frac{3k-5}{k+1}\right) \Rightarrow k = \frac{13}{3}$

$\therefore$ Ratio is 13 : 3 1

$\Rightarrow$ Coordinates of P are $\left(\frac{9}{2}, \frac{3}{2}\right)$ $\frac{1}{2}$

17. $\left(\frac{3\sin 43°}{\cos 47°}\right)^2 - \frac{\cos 37° \operatorname{cosec} 53°}{\tan 5° \tan 25° \tan 45° \tan 65° \tan 85°}$

$= \left(\frac{3\sin 43°}{\cos(90° - 43°)}\right)^2 - \frac{\cos 37° . \operatorname{cosec}(90° - 37°)}{\tan 5° \tan 25°(1) \tan(90° - 25°) \tan(90° - 5°)}$ 1

$= \left(\frac{3\sin 43°}{\sin 43°}\right)^2 - \frac{\cos 37° . \sec 37°}{\tan 5° . \tan 25°(1) \cot 25° \cot 5°}$ 1

$= 9 - \frac{1}{1} = 8$ 1

18. Radius of quadrant $= OB = \sqrt{15^2 + 15^2} = 15\sqrt{2}$ cm. 1

Shaded area = Area of quadrant – Area of square $\frac{1}{2}$

$= \frac{1}{4}(3.14)[(15\sqrt{2})^2 - (15)^2]$ 1

$= (15)^2 (1.57 - 1) = 128.25 \text{ cm}^2$ $\frac{1}{2}$

OR

$BD = \sqrt{(2\sqrt{2})^2 + (2\sqrt{2})^2} = \sqrt{16} = 4$ cm 1

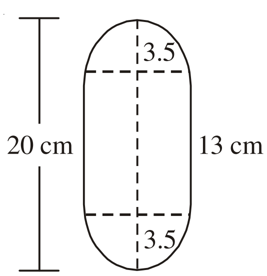
$\therefore$ Radius of circle = 2 cm $\frac{1}{2}$

$\therefore$ Shaded area = Area of circle – Area of square $\frac{1}{2}$

$= 3.14 \times 2^2 - (2\sqrt{2})^2$

$= 12.56 - 8 = 4.56 \text{ cm}^2$ 1

19.



Height of cylinder = 20 – 7 = 13 cm. 1

Total volume $= \pi\left(\frac{7}{2}\right)^2 \cdot 13 + \frac{4}{3}\pi\left(\frac{7}{2}\right)^3 \text{ cm}^3$ 1

$= \frac{22}{7} \times \frac{49}{4}\left(13 + \frac{4}{3} \cdot \frac{7}{2}\right) \text{cm}^3$

$= \frac{77 \times 53}{6} = 680.17 \text{ cm}^3$ 1

20.

x_i :	32.5	37.5	42.5	47.5	52.5	57.5	62.5		$\frac{1}{2}$
f_i :	14	16	28	23	18	8	3	$\Sigma f_i = 110$	$\frac{1}{2}$
u_i :	–3	–2	–1	0	1	2	3		
f_iu_i :	–42	–32	–28	0	18	16	9,	$\Sigma f_iu_i = -59$	1

Mean $= 47.5 - \frac{59 \times 5}{110} = 47.5 - 2.68 = 44.82$ 1

Note: If N is taken as 100, Ans. 44.55 Accept.

If some one write, data is wrong, give full 3 marks.

21.

$$3x^2 - 5 \overline{)\,3x^4 - 9x^3 + x^2 + 15x + k\,}\left(x^2 - 3x + 2\right.$$

$$\begin{array}{l} 3x^4 \qquad\quad - 5x^2 \\ - \qquad\qquad\; + \\ \hline -9x^3 + 6x^2 + 15x + k \\ -9x^3 \qquad\quad + 15x \\ + \qquad\qquad\quad - \\ \hline 6x^2 + k \\ 6x^2 - 10 \\ - \qquad + \\ \hline k + 10 \\ \hline \end{array}$$

2

$\therefore$ $k + 10 = 0 \Rightarrow k = -10$ 1

OR

$$p(y) = 7y^2 - \frac{11}{3}y - \frac{2}{3} = \frac{1}{3}(21y^2 - 11y - 2)$$

$$= \frac{1}{3}[(7y + 1)(3y - 2)]$$ 1

$\therefore$ Zeroes are 2/3, –1/7 $\frac{1}{2}$

Sum of zeroes $= \frac{2}{3} - \frac{1}{7} = \frac{11}{21}$

$\frac{-b}{a} = \frac{11}{21}$ $\therefore$ sum of zeroes $= \frac{-b}{a}$ 1

Product of zeroes $= \left(\frac{2}{3}\right)\left(-\frac{1}{7}\right) = -\frac{2}{21}$

$\frac{c}{a} = -\frac{2}{3}\left(\frac{1}{7}\right) = -\frac{2}{21} \quad \therefore \text{ Product } = \frac{c}{a}$ $\frac{1}{2}$

22. $x^2 + px + 16 = 0$ have equal roots if $D = p^2 - 4(16)(1) = 0$ 1

$p^2 = 64 \Rightarrow p = \pm 8$ $\frac{1}{2}$

$\therefore \quad x^2 \pm 8x + 16 = 0 \Rightarrow (x \pm 4)^2 = 0$ 1

$x \pm 4 = 0$

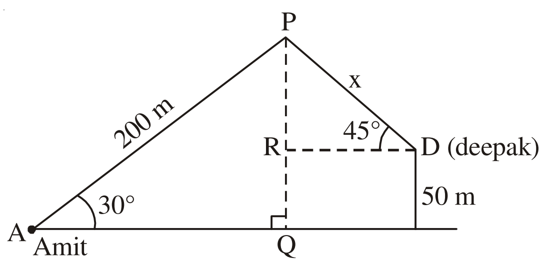
$\therefore$ Roots are $x = -4$ and $x = 4$ $\frac{1}{2}$

SECTION D

23. For correct, given, to prove, construction and figure $\frac{1}{2}\times 4 = 2$

For correct proof. 2

24.



Correct Figure 1

In ΔAPQ

$\frac{PQ}{AP} = \sin 30° = \frac{1}{2}$ $\frac{1}{2}$

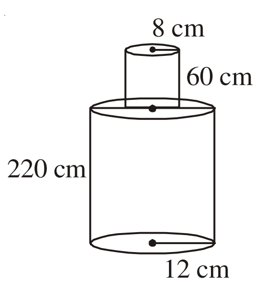
$PQ = (200)\left(\frac{1}{2}\right) = 100 \text{ m}$ 1

$PR = 100 - 50 = 50 \text{ m}$ $\frac{1}{2}$

In ΔPRD, $\frac{PR}{PD} = \sin 45° = \frac{1}{\sqrt{2}}$

$PD = (PR)(\sqrt{2}) = 50\sqrt{2} \text{ m}$ 1

25.



Total volume $= 3.14\,(12)^2\,(220) + 3.14(8)^2(60)\text{ cm}^3$ 1

$= 99475.2 + 12057.6 = 111532.8 \text{ cm}^3$ 1

Mass $= \frac{111532.8 \times 8}{1000}$ kg 1

$= 892.262$ kg 1

26. Constructing an equilateral triangle of side 5 cm 1

Constructing another similar Δ with scale factor $\frac{2}{3}$ 3

OR

Constructing two concentric circle of radii 2 cm and 5 cm 1

Drawing two tangents PA and PB 2

PA = 4.5 cm (approx) 1

27.

	Less than 40	less than 50	less than 60	less than 70	less than 80	less than 90	less than 100	$\frac{1}{2}$
cf.	7	12	20	30	36	42	50	1

Plotting of points (40, 7), (50, 12), (60, 20), (70, 30), (80, 36), (90, 42) and (100, 50) $1\frac{1}{2}$

Joining the points to get the curve 1

28. LHS $= \dfrac{\tan\theta}{1-\dfrac{1}{\tan\theta}} + \dfrac{\dfrac{1}{\tan\theta}}{1-\tan\theta} = \dfrac{\tan^2\theta}{\tan\theta-1} - \dfrac{1}{\tan\theta\,(\tan\theta-1)}$ 1

$= \dfrac{\tan^3\theta-1}{\tan\theta(\tan\theta-1)} = \dfrac{(\tan\theta-1)(\tan^2\theta+\tan\theta+1)}{\tan\theta\,(\tan\theta-1)}$ 1

$= \tan\theta+1+\cot\theta = 1+\dfrac{\sin\theta}{\cos\theta}+\dfrac{\cos\theta}{\sin\theta} = 1+\dfrac{\sin^2\theta+\cos^2\theta}{\sin\theta\cos\theta}$ 1

$= 1+\dfrac{1}{\sin\theta\cos\theta} = 1+\operatorname{cosec}\theta\sec\theta = \text{RHS}$ 1

OR

Consider

$\dfrac{\sin\theta}{\operatorname{cosec}\theta+\cot\theta} - \dfrac{\sin\theta}{\cot\theta-\operatorname{cosec}\theta} = \dfrac{\sin\theta}{\operatorname{cosec}\theta+\cot\theta} + \dfrac{\sin\theta}{\operatorname{cosec}\theta-\cot\theta}$ 1+1

$= \dfrac{\sin\theta[\operatorname{cosec}\theta-\cot\theta+\operatorname{cosec}\theta+\cot\theta]}{\operatorname{cosec}^2\theta-\cot^2\theta} = \dfrac{\sin\theta(2\operatorname{cosec}\theta)}{1} = 2$ $1\frac{1}{2}$

Hence $\dfrac{\sin\theta}{\operatorname{cosec}\theta+\cot\theta} = 2+\dfrac{\sin\theta}{\cot\theta-\operatorname{cosec}\theta}$ $\frac{1}{2}$

29. Let $-82 = a_n$ $\therefore$ $-82 = -7 + (n-1)(-5)$ 1

$\Rightarrow$ $15 = n - 1$ or $n = 16$ 1

Again $-100 = a_m = -7 + (m - 1)(-5)$ 1

$\Rightarrow \quad (m - 1)(-5) = -93$

$m - 1 = \frac{93}{5}$ or $m = \frac{93}{5} + 1 \notin N$ 1

$\therefore \quad -100$ is not a term of the AP.

OR

$S_n = 180 = \frac{n}{2} \cdot [90 + (n-1)(-6)]$ 1

$360 = 90n - 6n^2 + 6n \Rightarrow 6n^2 - 96n + 360 = 0$ 1

$\Rightarrow \quad 6[(n - 6)(n - 10)] = 0 \Rightarrow n = 6, n = 10$ 1

Sum of $a_7, a_8, a_9, a_{10} = 0 \therefore n = 6$ or $n = 10$ 1

30. Let marks in Hindi be x

Then marks in Eng = 30 – x $\frac{1}{2}$

$\therefore \quad (x + 2)(30 - x - 3) = 210$ 1

$\Rightarrow \quad x^2 - 25x + 156 = 0$ or $(x - 13)(x - 12) = 0$ 1

$\Rightarrow \quad x = 13$ or $x = 12$

$\therefore \quad 30 - 13 = 17$ or $30 - 12 = 18$ 1

$\therefore$ Marks in Hindi & English are

(13, 17) or (12, 18) $\frac{1}{2}$

QUESTION PAPER CODE 30/2/2

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. Point on x-axis is (2, 0) 1

2. $\sin^2 60° + 2\tan 45° - \cos^2 30 = \left(\frac{\sqrt{3}}{2}\right)^2 + 2(1) - \left(\frac{\sqrt{3}}{2}\right)^2$ [For any two correct values] $\frac{1}{2}$

$= 2$ $\frac{1}{2}$

OR

$\sin A = \frac{3}{4} \Rightarrow \cos A = \sqrt{1-\frac{9}{16}} = \frac{\sqrt{7}}{4}$ $\frac{1}{2}$

$\sec A = \frac{4}{\sqrt{7}}$ $\frac{1}{2}$

3. ΔABC: Isosceles $\Delta \Rightarrow AC = BC = 4$ cm. $\frac{1}{2}$

$AB = \sqrt{4^2+4^2} = 4\sqrt{2}$ cm $\frac{1}{2}$

OR

$\frac{AD}{BD} = \frac{AE}{CE} \Rightarrow \frac{AD}{7.2} = \frac{1.8}{5.4}$ $\frac{1}{2}$

$\therefore$ $AD = \frac{7.2 \times 1.8}{5.4} = 2.4$ cm. $\frac{1}{2}$

4. $\frac{3-a}{3a} - \frac{1}{a} = \frac{3-a-3}{3a} = -\frac{1}{3}$ 1

5. LCM (336, 54) = $\frac{336 \times 54}{6}$ $\frac{1}{2}$

$= 336 \times 9 = 3024$ $\frac{1}{2}$

6. $a = -4\frac{1}{2},\ d = 1\frac{1}{2},\ \therefore\ a_{21} = -\frac{9}{2} + 20\left(\frac{3}{2}\right)$ $\frac{1}{2}$

$= \frac{51}{2}$ $\frac{1}{2}$

SECTION B

7. For infinitely many solutions,

$$\frac{2}{k+2} = \frac{3}{-3(1-k)} = \frac{7}{5k+1}$$ 1

$\Rightarrow$ 2k – 2 = k + 2 or 5k + 1 = 7k – 7

$\Rightarrow$ k = 4 $\Rightarrow$ 2k = 8 $\Rightarrow$ k = 4

Hence k = 4. 1

8. Maximum frequency = 50, class (modal) = 35 – 40. $\frac{1}{2}$

$$\text{Mode} = L + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$$

$$= 35 + \frac{50-34}{100-34-42} \times 5$$ 1

$$= 35 + \frac{16}{24} \times 5 = 38.33$$ $\frac{1}{2}$

9. Let larger angle be x°

$\therefore$ Smaller angle = 180° – x° $\frac{1}{2}$

$\therefore$ (x) – (180 – x) = 18 $\frac{1}{2}$

2x = 180 + 18 = 198 $\Rightarrow$ x = 99 $\frac{1}{2}$

$\therefore$ The two angles are 99°, 81° $\frac{1}{2}$

OR

Let Son's present age be x years

Then Sumit's present age = 3x years. $\frac{1}{2}$

$\therefore$ 5 Years later, we have, 3x + 5 = $\frac{5}{2}(x+5)$ $\frac{1}{2}$

6x + 10 = 5x + 25 $\Rightarrow$ x = 15 $\frac{1}{2}$

$\therefore$ Sumit's present age = 45 years $\frac{1}{2}$

10. P(blue marble) = $\frac{1}{5}$, P(black marble) $= \frac{1}{4}$

$\therefore$ P(green marble) $= 1 - \left(\frac{1}{5} + \frac{1}{4}\right) = \frac{11}{20}$ 1

Let total number of marbles be x

then $\frac{11}{20} \times x = 11 \Rightarrow x = 20$ 1

11. A, B, C are collinear $\Rightarrow$ ar. (ΔABC) = 0 $\frac{1}{2}$

$\therefore$ $\frac{1}{2}[x(6-3) - 4(3-y) - 2(y-6)] = 0$ 1

$\Rightarrow$ $3x + 2y = 0$ $\frac{1}{2}$

OR

Area of triangle $= \frac{1}{2}[1(6+5) - 4(-5+1) - 3(-1-6)]$ 1

$= \frac{1}{2}[11+16+21] = \frac{48}{2} = 24$ sq. units. 1

12. Smallest number divisible by 306 and 657 = LCM (306, 657) 1

LCM (306, 657) = 22338 1

SECTION C

13. $\frac{XA}{XY} = \frac{2}{5} \Rightarrow \frac{XA}{AY} = \frac{2}{3}$ 1

$\therefore$ Coords. of A are $\left(\frac{-8+18}{5}, \frac{-2-18}{5}\right)$ i.e. $(2, -4)$ 1

A lies on $3x + k(y + 1) = 0$

$\Rightarrow$ $6 + k(-3) = \Rightarrow k = 2$. 1

14. $x^2 + 5x - (a + 3)(a - 2) = 0$

$x^2 + (a + 3)x - (a - 2)x - (a + 3)(a - 2) = 0$ $1\frac{1}{2}$

$[x + (a + 3)][x - (a - 2)] = 0$

$\Rightarrow$ $x = (a - 2)$ or $x = -(a + 3)$ $1\frac{1}{2}$

Alternate method:

$x^2 + 5x - (a^2 + a - 6) = 0$

$$x = \frac{-5 \pm \sqrt{25 + 4(a^2 + a - 6)}}{2}$$ 1

$$= \frac{-5 \pm (2a+1)}{2}$$ 1

$x = (a - 2), -(a + 3)$ 1

15. $A + 2B = 60°$ and $A + 4B = 90°$ 1+1

Solving to get $B = 15°$ and $A = 30°$ 1

16. Let $2 + 5\sqrt{3} = a$, where 'a' is a rational number. $\frac{1}{2}$

than $\sqrt{3} = \frac{a-2}{5}$ 1

Which is a contradiction as LHS is irrational and RHS is rational 1

$\therefore$ $2 + 5\sqrt{3}$ can not be rational $\frac{1}{2}$

Hence $2 + 5\sqrt{3}$ is irrational.

Alternate method:

Let $2 + 5\sqrt{3}$ be rational $\frac{1}{2}$

$\therefore$ $2 + 5\sqrt{3} = \frac{p}{q}$, p, q are integers, $q \neq 0$

$\Rightarrow \sqrt{3} = \left(\frac{p}{q} - 2\right) \div 5 = \frac{p-2q}{5q}$ 1

LHS is irrational and RHS is rational

which is a contradiction 1

$\therefore$ $2 + 5\sqrt{3}$ is irrational. $\frac{1}{2}$

OR

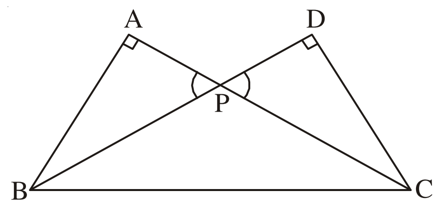
$2048 = 960 \times 2 + 128$

$960 = 128 \times 7 + 64$ 2

$128 = 64 \times 2 + 0$

$\therefore$ HCF (2048, 960) = 64 1

17.



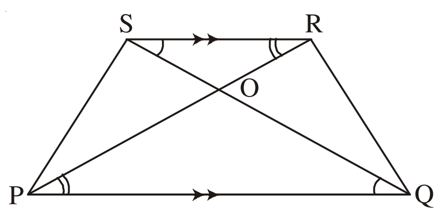
Correct Figure $\frac{1}{2}$

$\Delta APB \sim \Delta DPC$ [AA similarity] 1

$\frac{AP}{DP} = \frac{BP}{PC}$ 1

$\Rightarrow AP \times PC = BP \times DP$ $\frac{1}{2}$

OR



Correct Figure $\frac{1}{2}$

In ΔPOQ and ΔROS

$\left.\begin{matrix}\angle P = \angle R \\ \angle Q = \angle S\end{matrix}\right\}$ alt. $\angle$s

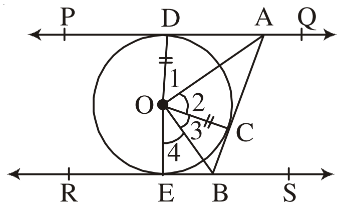
$\therefore$ $\Delta POQ \sim \Delta ROS$ [AA similarity] 1

$\therefore$ $\frac{ar(\Delta POQ)}{ar(\Delta ROS)} = \left(\frac{PQ}{RS}\right)^2$ 1

$= \left(\frac{3}{1}\right)^2 = \frac{9}{1}$ $\frac{1}{2}$

$\therefore$ ar(ΔPOQ) : ar(ΔROS) = 9 : 1

18.



Correct Figure $\frac{1}{2}$

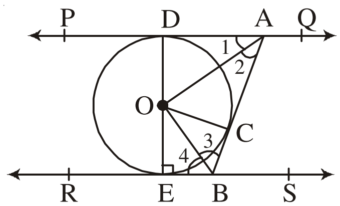
$\Delta AOD \cong AOC$ [SAS] 1

$\Rightarrow \angle 1 = \angle 2$ $\frac{1}{2}$

Similarly $\angle 4 = \angle 3$ $\frac{1}{2}$

$\Rightarrow \angle 1 + \angle 4 = \angle 2 + \angle 3 = \frac{1}{2}(180°)$

$\Rightarrow \angle 2 + \angle 3 = 90°$ or $\angle AOB = 90°$ $\frac{1}{2}$



Alternate method:

Correct Figure $\frac{1}{2}$

$\Delta OAD \cong \Delta AOC$ [SAS]

$\Rightarrow \angle 1 = \angle 2$ 1

Similarly $\angle 4 = \angle 3$ $\frac{1}{2}$

But $\angle 1 + \angle 2 + \angle 3 + \angle 4 = 180°$ [$\because$ PQ || RS]

$\Rightarrow \angle 2 + \angle 3 = \angle 1 + \angle 4 = \frac{1}{2}(180°) = 90°$ $\frac{1}{2}$

$\therefore$ In ΔAOB, $\angle AOB = 180° - (\angle 2 + \angle 3) = 90°$ $\frac{1}{2}$

19. Radius of quadrant = $OB = \sqrt{15^2 + 15^2} = 15\sqrt{2}$ cm. 1

Shaded area = Area of quadrant – Area of square $\frac{1}{2}$

$= \frac{1}{4}(3.14)[(15\sqrt{2})^2 - (15)^2]$ 1

$= (15)^2 (1.57 - 1) = 128.25 \text{ cm}^2$ $\frac{1}{2}$

OR

$BD = \sqrt{(2\sqrt{2})^2 + (2\sqrt{2})^2} = \sqrt{16} = 4 \text{ cm}$ 1

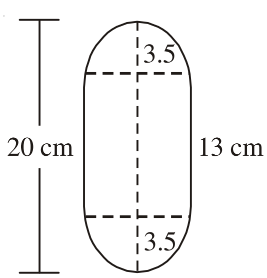
$\therefore$ Radius of circle = 2 cm $\frac{1}{2}$

$\therefore$ Shaded area = Area of circle – Area of square $\frac{1}{2}$

$= 3.14 \times 2^2 - (2\sqrt{2})^2$

$= 12.56 - 8 = 4.56 \text{ cm}^2$ 1

20.



Height of cylinder = 20 – 7 = 13 cm. 1

Total volume $= \pi\left(\frac{7}{2}\right)^2 \cdot 13 + \frac{4}{3}\pi\left(\frac{7}{2}\right)^2 \text{ cm}^3$ 1

$= \frac{22}{7} \times \frac{49}{4}\left(13 + \frac{4}{3}\cdot\frac{7}{2}\right)\text{cm}^3$

$= \frac{77 \times 53}{6} = 680.17 \text{ cm}^3$ 1

21.

x_i :	32.5	37.5	42.5	47.5	52.5	57.5	62.5		$\frac{1}{2}$
f_i :	14	16	28	23	18	8	3	$\Sigma f_i = 110$	$\frac{1}{2}$
u_i :	–3	–2	–1	0	1	2	3		
f_iu_i :	–42	–32	–28	0	18	16	9,	$\Sigma f_iu_i = -59$	1

Mean $= 47.5 - \frac{59 \times 5}{110} = 47.5 - 2.68 = 44.82$ 1

Note: If N is taken as 100, Ans. 44.55 Accept.

If some one write, data is wrong, give full 3 marks.

22. $3x^2 - 5 \overline{\smash{)}\, 3x^4 - 9x^3 + x^2 + 15x + k} \left(x^2 - 3x + 2 \right.$

$$\begin{array}{l} 3x^4 \qquad -5x^2 \\ \underline{- \qquad\quad +} \\ -9x^3 + 6x^2 + 15x + k \\ -9x^3 \qquad + 15x \\ \underline{+ \qquad\qquad -} \\ \qquad 6x^2 + k \\ \qquad 6x^2 - 10 \\ \qquad \underline{- \qquad +} \\ \qquad \underline{k + 10} \end{array}$$ 2

$\therefore$ $k + 10 = 0 \Rightarrow k = -10$ 1

OR

$$p(y) = 7y^2 - \frac{11}{3}y - \frac{2}{3} = \frac{1}{3}(21y^2 - 11y - 2)$$

$= \frac{1}{3}[(7y + 1)(3y - 2)]$ 1

$\therefore$ Zeroes are 2/3, –1/7 $\frac{1}{2}$

Sum of zeroes $= \frac{2}{3} - \frac{1}{7} = \frac{11}{21}$

$\frac{-b}{a} = \frac{11}{21}$ $\therefore$ sum of zeroes $= \frac{-b}{a}$ 1

Product of zeroes $= \left(\frac{2}{3}\right)\left(-\frac{1}{7}\right) = -\frac{2}{21}$

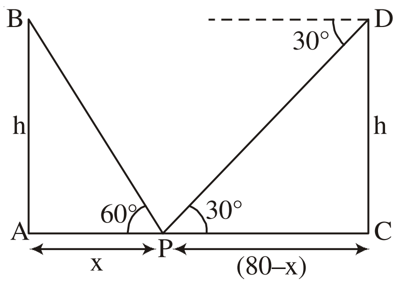
$\frac{c}{a} = -\frac{2}{3}\left(\frac{1}{7}\right) = -\frac{2}{21} \quad \therefore \text{ Product } = \frac{c}{a}$ $\frac{1}{2}$

SECTION D

23. For correct given, to prove, construction and figure $4\times\frac{1}{2}=2$

For correct proof. 2

24. Correct Figure 1



In ΔABP, $\frac{h}{x} = \tan 60° = \sqrt{3}$ ...(i) $\frac{1}{2}$

In ΔCDP, $\frac{h}{80-x} = \tan 30° = \frac{1}{\sqrt{3}}$ ...(ii) $\frac{1}{2}$

dividing (i) by (ii) we get $\frac{80-x}{x} = \frac{3}{1}$

$\Rightarrow$ $3x = 80 - x$ or $4x = 80 \Rightarrow x = 20$ m. 1

and $h = 20\sqrt{3}$ m. $\frac{1}{2}$

$\therefore$ Height of poles is $20\sqrt{3}$ m

and P is at distances 20 m and 60 m from poles $\frac{1}{2}$

25. Let total length of cloth = l m.

$\therefore$ Rate per metre = ₹ $\frac{200}{l}$ $\frac{1}{2}$

$\Rightarrow$ $(l+5)\left(\frac{200}{l} - 2\right) = 200$ 1

$\Rightarrow$ $(l + 5)(200 - 2l) = 200l \Rightarrow l^2 + 5l - 500 = 0$ 1

$\Rightarrow$ $(l + 25)(l - 20) = \Rightarrow l = 20$ m. 1

$\therefore$ Rate per metre = ₹ $\frac{200}{20}$ = ₹10 per metre $\frac{1}{2}$

26. Let $-82 = a_n \therefore -82 = -7 + (n-1)(-5)$ 1

$\Rightarrow \quad 15 = n - 1$ or $n = 16$ 1

Again $-100 = a_m = -7 + (m-1)(-5)$ 1

$\Rightarrow \quad (m-1)(-5) = -93$

$m - 1 = \frac{93}{5}$ or $m = \frac{93}{5} + 1 \notin N$ 1

$\therefore \quad -100$ is not a term of the AP.

OR

$S_n = 180 = \frac{n}{2} \cdot [90 + (n-1)(-6)]$ 1

$360 = 90n - 6n^2 + 6n \Rightarrow 6n^2 - 96n + 360 = 0$ 1

$\Rightarrow \quad 6[(n-6)(n-10)] = 0 \Rightarrow n = 6, n = 10$ 1

Sum of $a_7, a_8, a_9, a_{10} = 0 \therefore n = 6$ or $n = 10$ 1

27. LHS $= \dfrac{\tan\theta}{1 - \dfrac{1}{\tan\theta}} + \dfrac{\dfrac{1}{\tan\theta}}{1 - \tan\theta} = \dfrac{\tan^2\theta}{\tan\theta - 1} - \dfrac{1}{\tan\theta(\tan\theta - 1)}$ 1

$= \dfrac{\tan^3\theta - 1}{\tan\theta(\tan\theta - 1)} = \dfrac{(\tan\theta - 1)(\tan^2\theta + \tan\theta + 1)}{\tan\theta(\tan\theta - 1)}$ 1

$= \tan\theta + 1 + \cot\theta = 1 + \dfrac{\sin\theta}{\cos\theta} + \dfrac{\cos\theta}{\sin\theta} = 1 + \dfrac{\sin^2\theta + \cos^2\theta}{\sin\theta\cos\theta}$ 1

$= 1 + \dfrac{1}{\sin\theta\cos\theta} = 1 + \operatorname{cosec}\theta\sec\theta = \text{RHS}$ 1

OR

Consider

$\dfrac{\sin\theta}{\operatorname{cosec}\theta + \cot\theta} - \dfrac{\sin\theta}{\cot\theta - \operatorname{cosec}\theta} = \dfrac{\sin\theta}{\operatorname{cosec}\theta + \cot\theta} + \dfrac{\sin\theta}{\operatorname{cosec}\theta - \cot\theta}$ 1+1

$= \dfrac{\sin\theta[\operatorname{cosec}\theta - \cot\theta + \operatorname{cosec}\theta + \cot\theta]}{\operatorname{cosec}^2\theta - \cot^2\theta} = \dfrac{\sin\theta(2\operatorname{cosec}\theta)}{1} = 2$ $1\frac{1}{2}$

Hence $\dfrac{\sin\theta}{\operatorname{cosec}\theta + \cot\theta} = 2 + \dfrac{\sin\theta}{\cot\theta - \operatorname{cosec}\theta}$ $\frac{1}{2}$

28.	Less than 40	less than 50	less than 60	less than 70	less than 80	less than 90	less than 100	$\frac{1}{2}$
cf.	7	12	20	30	36	42	50	1

Plotting of points (40, 7), (50, 12), (60, 20), (70, 30), (80, 36), (90, 42) and (100, 50) $1\frac{1}{2}$

Joining the points to get the curve 1

29. Constructing an equilateral triangle of side 5 cm 1

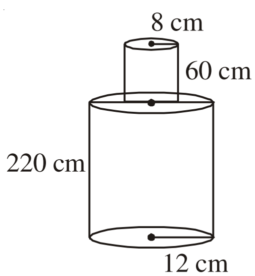
Constructing another similar Δ with scale factor $\frac{2}{3}$ 3

OR

Constructing two concentric circle of radii 2 cm and 5 cm 1

Drawing two tangents PA and PB 2

PA = 4.5 cm (approx) 1

30. 

Total volume = $3.14\,(12)^2\,(220) + 3.14(8)^2(60)$ cm^3 1

$= 99475.2 + 12057.6 = 111532.8$ cm^3 1

Mass = $\frac{111532.8 \times 8}{1000}$ kg 1

= 892.262 kg 1

QUESTION PAPER CODE 30/2/3

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. D = $(4\sqrt{3})^2 - 4(4)(3) = 0$ $\frac{1}{2}$

$\therefore$ Roots are real and equal. $\frac{1}{2}$

2. $\sin^2 60° + 2\tan 45° - \cos^2 30 = \left(\frac{\sqrt{3}}{2}\right)^2 + 2(1) - \left(\frac{\sqrt{3}}{2}\right)^2$ [For any two correct values] $\frac{1}{2}$

$= 2$ $\frac{1}{2}$

OR

$\sin A = \frac{3}{4} \Rightarrow \cos A = \sqrt{1 - \frac{9}{16}} = \frac{\sqrt{7}}{4}$ $\frac{1}{2}$

$\sec A = \frac{4}{\sqrt{7}}$ $\frac{1}{2}$

3. Point on x-axis is (2, 0) 1

4. ΔABC: Isosceles $\Delta \Rightarrow AC = BC = 4$ cm. $\frac{1}{2}$

$AB = \sqrt{4^2 + 4^2} = 4\sqrt{2}$ cm $\frac{1}{2}$

OR

$\frac{AD}{BD} = \frac{AE}{CE} \Rightarrow \frac{AD}{7.2} = \frac{1.8}{5.4}$ $\frac{1}{2}$

$\therefore$ $AD = \frac{7.2 \times 1.8}{5.4} = 2.4$ cm. $\frac{1}{2}$

5. $2x^2 - 4x + 3 = 0 \Rightarrow D = 16 - 24 = -8$ $\frac{1}{2}$

$\therefore$ Equation has NO real roots $\frac{1}{2}$

6. LCM (336, 54) = $\frac{336 \times 54}{6}$ $\frac{1}{2}$

$= 336 \times 9 = 3024$ $\frac{1}{2}$

SECTION B

7. E_1 : {(1, 5), (2, 5), (3, 5), (4, 5), (5, 5), (6, 5), (5, 1), (5, 2), (5, 3), (5, 4), (5, 6)}

$\therefore$ P(5 will come at least once) = $P(E_1) = \frac{11}{36}$ 1

P(5 will not come either time) = $1 - \frac{11}{36} = \frac{25}{36}$ 1

8. Maximum frequency = 50, class (modal) = 35 – 40. $\frac{1}{2}$

$$\text{Mode} = L + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$$

$= 35 + \frac{50 - 34}{100 - 34 - 42} \times 5$ 1

$= 35 + \frac{16}{24} \times 5 = 38.33$ $\frac{1}{2}$

9. Let larger angle be x°

$\therefore$ Smaller angle = 180° – x° $\frac{1}{2}$

$\therefore$ (x) – (180 – x) = 18 $\frac{1}{2}$

2x = 180 + 18 = 198 $\Rightarrow$ x = 99 $\frac{1}{2}$

$\therefore$ The two angles are 99°, 81° $\frac{1}{2}$

OR

Let Son's present age be x years

Then Sumit's present age = 3x years. $\frac{1}{2}$

$\therefore$ 5 Years later, we have, 3x + 5 = $\frac{5}{2}(x + 5)$ $\frac{1}{2}$

6x + 10 = 5x + 25 $\Rightarrow$ x = 15 $\frac{1}{2}$

$\therefore$ Sumit's present age = 45 years $\frac{1}{2}$

10. A, B, C are collinear $\Rightarrow$ ar. $(\Delta ABC) = 0$ $\frac{1}{2}$

$\therefore \quad \frac{1}{2}[x(6-3)-4(3-y)-2(y-6)] = 0$ 1

$\Rightarrow \quad 3x + 2y = 0$ $\frac{1}{2}$

OR

Area of triangle $= \frac{1}{2}[1(6+5)-4(-5+1)-3(-1-6)]$ 1

$= \frac{1}{2}[11+16+21] = \frac{48}{2} = 24$ sq. units. 1

11. For unique solution $\frac{1}{3} \neq \frac{2}{k}$ 1

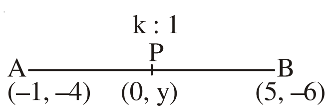
$\Rightarrow \quad k \neq 6$ 1

12. Smallest number divisible by 306 and 657 = LCM (306, 657) 1

LCM (306, 657) = 22338 1

SECTION C

13.



Any point on y-axis is P(0, y) 1

Let P divides AB in k : 1

$\Rightarrow 0 = \frac{5k-1}{k+1} \Rightarrow k = \frac{1}{5}$ i.e. 1:5 1

$\Rightarrow \quad y = \frac{-6k-4}{k+1} = \frac{-\frac{6}{5}-4}{\frac{1}{5}+1} = \frac{-26}{6} = \frac{-13}{3}$ 1

$\Rightarrow \quad$ P is $\left(0, \frac{-13}{3}\right)$

14. Given expression $= \left(\frac{3\tan 41^\circ}{\tan 41^\circ}\right)^2 - \left(\frac{\sin 35^\circ \operatorname{cosec} 35^\circ}{\tan 10^\circ \tan 20^\circ (\sqrt{3}) \cot 20^\circ \cot 10^\circ}\right)^2$ $1\frac{1}{2}$

$= 9 - \frac{1}{3} = \frac{26}{3}$ $1\frac{1}{2}$

15. Radius of first sphere = 3 cm $\quad \therefore \; \frac{4}{3}\pi(3)^3 d = 1 \;\; \{d = \text{density}\}$ $\frac{1}{2}$

let radius of 2nd sphere be r cm $\quad \therefore \; \frac{4}{3}\pi(r)^3.d = 7 \Rightarrow r^3 = 7(3)^3$ $\frac{1}{2}$

$\Rightarrow \quad \frac{4}{3}\pi(3)^3 + \frac{4}{3}\pi\cdot(3)^3\cdot 7 = \frac{4}{3}\pi R^3$ 1

$\Rightarrow \quad R^3 = (3)^3 \; (1 + 7) \Rightarrow R = 3(2) = 6$ $\frac{1}{2}$

$\therefore$ Diameter = 12 cm. $\frac{1}{2}$

16. Let $2 + 5\sqrt{3} = a$, where 'a' is a rational number. $\frac{1}{2}$

then $\sqrt{3} = \frac{a-2}{5}$ 1

Which is a contradiction as LHS is irrational and RHS is rational 1

$\therefore \quad 2 + 5\sqrt{3}$ can not be rational $\frac{1}{2}$

Hence $2 + 5\sqrt{3}$ is irrational.

Alternate method:

Let $2 + 5\sqrt{3}$ be rational $\frac{1}{2}$

$\therefore \; 2 + 5\sqrt{3} = \frac{p}{q}$, p, q are integers, $q \neq 0$

$\Rightarrow \; \sqrt{3} = \left(\frac{p}{q} - 2\right) \div 5 = \frac{p-2q}{5q}$ 1

LHS is irrational and RHS is rational

which is a contradiction 1

$\therefore \; 2 + 5\sqrt{3}$ is irrational. $\frac{1}{2}$

OR

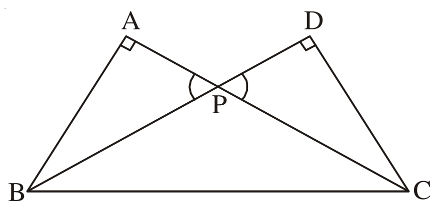
$2048 = 960 \times 2 + 128$

$960 = 128 \times 7 + 64$ 2

$128 = 64 \times 2 + 0$

$\therefore$ HCF $(2048, 960) = 64$ 1

17. Correct Figure $\frac{1}{2}$



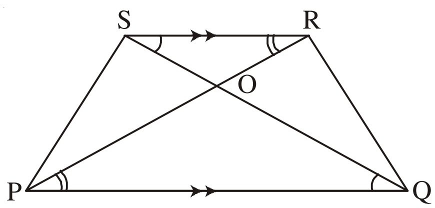
$\Delta APB \sim \Delta DPC$ [AA similarity] 1

$$\frac{AP}{DP} = \frac{BP}{PC}$$ 1

$\Rightarrow AP \times PC = BP \times DP$ $\frac{1}{2}$

OR

Correct Figure $\frac{1}{2}$



In ΔPOQ and ΔROS

$$\left.\begin{array}{l}\angle P = \angle R \\ \angle Q = \angle S\end{array}\right\} \text{alt. } \angle s$$

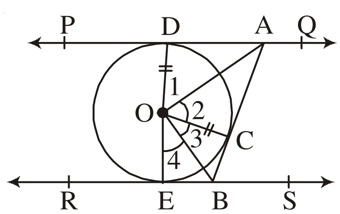
$\therefore$ $\Delta POQ \sim \Delta ROS$ [AA similarity] 1

$$\therefore \quad \frac{ar(\Delta POQ)}{ar(\Delta ROS)} = \left(\frac{PQ}{RS}\right)^2$$ 1

$$= \left(\frac{3}{1}\right)^2 = \frac{9}{1}$$ $\frac{1}{2}$

$\therefore$ $ar(\Delta POQ) : ar(\Delta ROS) = 9 : 1$

18. Correct Figure $\frac{1}{2}$



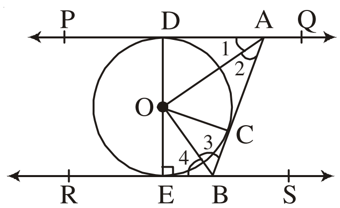
$\Delta AOD \cong AOC$ [SAS] 1

$\Rightarrow \angle 1 = \angle 2$ $\frac{1}{2}$

Similarly $\angle 4 = \angle 3$ $\frac{1}{2}$

$$\Rightarrow \angle 1 + \angle 4 = \angle 2 + \angle 3 = \frac{1}{2}(180°)$$

$\Rightarrow \angle 2 + \angle 3 = 90°$ or $\angle AOB = 90°$ $\frac{1}{2}$



Alternate method:

Correct Figure $\frac{1}{2}$

$\Delta OAD \cong \Delta AOC$ [SAS]

$\Rightarrow \angle 1 = \angle 2$ 1

Similarly $\angle 4 = \angle 3$ $\frac{1}{2}$

But $\angle 1 + \angle 2 + \angle 3 + \angle 4 = 180°$ [$\because$ PQ || RS]

$\Rightarrow \angle 2 + \angle 3 = \angle 1 + \angle 4 = \frac{1}{2}(180°) = 90°$ $\frac{1}{2}$

$\therefore$ In ΔAOB, $\angle AOB = 180° - (\angle 2 + \angle 3) = 90°$ $\frac{1}{2}$

19. Radius of quadrant = $OB = \sqrt{15^2 + 15^2} = 15\sqrt{2}$ cm. 1

Shaded area = Area of quadrant – Area of square $\frac{1}{2}$

$= \frac{1}{4}(3.14)[(15\sqrt{2})^2 - (15)^2]$ 1

$= (15)^2 (1.57 - 1) = 128.25 \text{ cm}^2$ $\frac{1}{2}$

OR

$BD = \sqrt{(2\sqrt{2})^2 + (2\sqrt{2})^2} = \sqrt{16} = 4 \text{ cm}$ 1

$\therefore$ Radius of circle = 2 cm $\frac{1}{2}$

$\therefore$ Shaded area = Area of circle – Area of square $\frac{1}{2}$

$= 3.14 \times 2^2 - (2\sqrt{2})^2$

$= 12.56 - 8 = 4.56 \text{ cm}^2$ 1

20. $x^2 + px + 16 = 0$ have equal roots if $D = p^2 - 4(16)(1) = 0$ 1

$p^2 = 64 \Rightarrow p = \pm 8$ $\frac{1}{2}$

$\therefore$ $x^2 \pm 8x + 16 = 0 \Rightarrow (x \pm 4)^2 = 0$ 1

$x \pm 4 = 0$

$\therefore$ Roots are $x = -4$ and $x = 4$ $\frac{1}{2}$

21. $3x^2 - 5 \overline{)\,3x^4 - 9x^3 + x^2 + 15x + k\,(} \; x^2 - 3x + 2$

$$\begin{array}{l}
3x^4 \qquad\quad - 5x^2 \\
\underline{-\qquad\qquad\;\, +\qquad\qquad\qquad\qquad} \\
\qquad -9x^3 + 6x^2 + 15x + k \\
\qquad -9x^3 \qquad\quad + 15x \\
\underline{\qquad +\qquad\qquad\;\; -\qquad\qquad\quad} \\
\qquad\qquad\quad 6x^2 + k \\
\qquad\qquad\quad 6x^2 - 10 \\
\qquad\qquad\quad \underline{-\qquad +} \\
\qquad\qquad\quad \underline{\;k + 10\;}
\end{array}$$
2

$\therefore \quad k + 10 = 0 \Rightarrow k = -10$ 1

OR

$p(y) = 7y^2 - \frac{11}{3}y - \frac{2}{3} = \frac{1}{3}(21y^2 - 11y - 2)$

$= \frac{1}{3}[(7y+1)(3y-2)]$ 1

$\therefore \quad$ Zeroes are 2/3, –1/7 $\frac{1}{2}$

Sum of zeroes $= \frac{2}{3} - \frac{1}{7} = \frac{11}{21}$

$\frac{-b}{a} = \frac{11}{21} \;\therefore$ sum of zeroes $= \frac{-b}{a}$ 1

Product of zeroes $= \left(\frac{2}{3}\right)\left(-\frac{1}{7}\right) = -\frac{2}{21}$

$\frac{c}{a} = -\frac{2}{3}\left(\frac{1}{7}\right) = -\frac{2}{21} \;\therefore$ Product $= \frac{c}{a}$ $\frac{1}{2}$

22.

x_i :	32.5	37.5	42.5	47.5	52.5	57.5	62.5		$\frac{1}{2}$
f_i :	14	16	28	23	18	8	3	$\Sigma f_i = 110$	$\frac{1}{2}$
u_i :	–3	–2	–1	0	1	2	3		
f_iu_i :	–42	–32	–28	0	18	16	9,	$\Sigma f_iu_i = -59$	1

Mean $= 47.5 - \frac{59 \times 5}{110} = 47.5 - 2.68 = 44.82$ 1

Note: If N is taken as 100, Ans. 44.55 Accept.

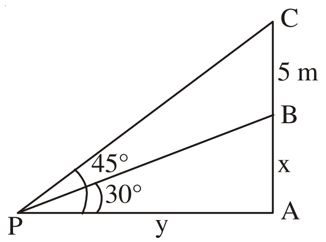
If some one write, data is wrong, give full 3 marks.

SECTION D

23. For correct given, to prove, const. and figure $4\times\frac{1}{2}=2$

For correct proof. 2

24.



In ΔPAC, Correct Figure 1

$$\frac{AC}{AP} = \tan 45° = 1$$ 1

$$\Rightarrow x + 5 = y$$ $\frac{1}{2}$

In ΔPAB, $\frac{x}{y} = \tan 30° = \frac{1}{\sqrt{3}}$

$$\frac{x}{x+5} = \frac{1}{\sqrt{3}} \Rightarrow x = \frac{5}{\sqrt{3}-1} = \frac{5(\sqrt{3}+1)}{3} = 6.83$$ $1\frac{1}{2}$

$\therefore$ Height of tower = 6.83 m

25. Volume of ice-cream in the cylinder $= \pi(6)^2 \cdot 15 \text{ cm}^3$ 1

Volume of ice-cream in one cone $= \frac{1}{3}\pi r^2 \cdot 4r + \frac{2}{3}\pi r^3 \text{ cm}^3$ 1
(Given h = 4r)

$= 2\pi r^3 \text{ cm}^3$ $\frac{1}{2}$

$\Rightarrow \quad 10(2\pi r^3) = \pi(6)^2 \times 15$ 1

$\Rightarrow \quad r^3 = (3)^3 \Rightarrow r = 3$ cm. $\frac{1}{2}$

26. Let marks in Hindi be x

Then marks in Eng = 30 – x $\frac{1}{2}$

$\therefore \quad (x + 2)(30 - x - 3) = 210$ 1

$\Rightarrow \quad x^2 - 25x + 156 = 0$ or $(x - 13)(x - 12) = 0$ 1

$\Rightarrow \quad x = 13$ or $x = 12$

$\therefore$ $30 - 13 = 17$ or $30 - 12 = 18$ 1

$\therefore$ Marks in Hindi & English are

(13, 17) or (12, 18) $\frac{1}{2}$

27. Let $-82 = a_n \therefore -82 = -7 + (n-1)(-5)$ 1

$\Rightarrow$ $15 = n - 1$ or $n = 16$ 1

Again $-100 = a_m = -7 + (m-1)(-5)$ 1

$\Rightarrow$ $(m-1)(-5) = -93$

$m - 1 = \frac{93}{5}$ or $m = \frac{93}{5} + 1 \notin N$ 1

$\therefore$ -100 is not a term of the AP.

OR

$S_n = 180 = \frac{n}{2} \cdot [90 + (n-1)(-6)]$ 1

$360 = 90n - 6n^2 + 6n \Rightarrow 6n^2 - 96n + 360 = 0$ 1

$\Rightarrow$ $6[(n-6)(n-10)] = 0 \Rightarrow n = 6, n = 10$ 1

Sum of $a_7, a_8, a_9, a_{10} = 0 \therefore n = 6$ or $n = 10$ 1

28. LHS $= \dfrac{\tan\theta}{1 - \dfrac{1}{\tan\theta}} + \dfrac{\dfrac{1}{\tan\theta}}{1 - \tan\theta} = \dfrac{\tan^2\theta}{\tan\theta - 1} - \dfrac{1}{\tan\theta(\tan\theta - 1)}$ 1

$= \dfrac{\tan^3\theta - 1}{\tan\theta(\tan\theta - 1)} = \dfrac{(\tan\theta - 1)(\tan^2\theta + \tan\theta + 1)}{\tan\theta(\tan\theta - 1)}$ 1

$= \tan\theta + 1 + \cot\theta = 1 + \dfrac{\sin\theta}{\cos\theta} + \dfrac{\cos\theta}{\sin\theta} = 1 + \dfrac{\sin^2\theta + \cos^2\theta}{\sin\theta\cos\theta}$ 1

$= 1 + \dfrac{1}{\sin\theta\cos\theta} = 1 + \operatorname{cosec}\theta\sec\theta = \text{RHS}$ 1

OR

Consider

$$\frac{\sin\theta}{\operatorname{cosec}\theta+\cot\theta}-\frac{\sin\theta}{\cot\theta-\operatorname{cosec}\theta} = \frac{\sin\theta}{\operatorname{cosec}\theta+\cot\theta}+\frac{\sin\theta}{\operatorname{cosec}\theta-\cot\theta}$$ 1+1

$$= \frac{\sin\theta[\operatorname{cosec}\theta-\cot\theta+\operatorname{cosec}\theta+\cot\theta]}{\operatorname{cosec}^2\theta-\cot^2\theta}=\frac{\sin\theta(2\operatorname{cosec}\theta)}{1}=2$$ $1\frac{1}{2}$

Hence $\dfrac{\sin\theta}{\operatorname{cosec}\theta+\cot\theta} = 2+\dfrac{\sin\theta}{\cot\theta-\operatorname{cosec}\theta}$ $\frac{1}{2}$

29.

	Less than 40	less than 50	less than 60	less than 70	less than 80	less than 90	less than 100	$\frac{1}{2}$
cf.	7	12	20	30	36	42	50	1

Plotting of points (40, 7), (50, 12), (60, 20), (70, 30), (80, 36), (90, 42) and (100, 50) $1\frac{1}{2}$

Joining the points to get the curve 1

30. Constructing an equilateral triangle of side 5 cm 1

Constructing another similar Δ with scale factor $\frac{2}{3}$ 3

OR

Constructing two concentric circle of radii 2 cm and 5 cm 1

Drawing two tangents PA and PB 2

PA = 4.5 cm (approx) 1

Strictly Confidential: (For Internal and Restricted use only)
Secondary School Examination
March 2019
MARKING SCHEME – MATHEMATICS (SUBJECT CODE -041)
PAPER CODE: 30/3/1, 30/3/2, 30/3/3

General Instructions: -

1. You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully. **Evaluation is a 10-12 days mission for all of us. Hence, it is necessary that you put in your best efforts in this process.**
2. Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration. Marking Scheme should be strictly adhered to and religiously followed. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and marks be awarded to them.**
3. The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
4. If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled.
5. If a question does not have any parts, marks must be awarded in the left hand margin and encircled.
6. If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out.
7. No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
8. A full scale of marks 1-80 has to be used. Please do not hesitate to award full marks if the answer deserves it.
9. Every examiner has to necessarily do evaluation work for full working hours i.e. 8 hours every day and evaluate 25 answer books per day.
10. Ensure that you do not make the following common types of errors committed by the Examiner in the past:-
    - Leaving answer or part thereof unassessed in an answer book.
    - Giving more marks for an answer than assigned to it.
    - Wrong transfer of marks from the inside pages of the answer book to the title page.
    - Wrong question wise totaling on the title page.
    - Wrong totaling of marks of the two columns on the title page.
    - Wrong grand total.
    - Marks in words and figures not tallying.
    - Wrong transfer of marks from the answer book to online award list.
    - Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.)
    - Half or a part of answer marked correct and the rest as wrong, but no marks awarded.

11. While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as (X) and awarded zero (0) Marks.

12. Any unassessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.

13. The Examiners should acquaint themselves with the guidelines given in the Guidelines for spot Evaluation before starting the actual evaluation.

14. Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.

15. The Board permits candidates to obtain photocopy of the Answer Book on request in an RTI application and also separately as a part of the re-evaluation process on payment of the processing charges.

QUESTION PAPER CODE 30/3/1

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. $(x + 5)^2 = 2(5x - 3) \Rightarrow x^2 + 31 = 10$ $\frac{1}{2}$

$D = -124$ $\frac{1}{2}$

2. $\dfrac{27}{2^3 \cdot 5^4 \cdot 3^2} = \dfrac{3}{2^3 \cdot 5^4}$ $\frac{1}{2}$

It will terminate after 4 decimal places $\frac{1}{2}$

OR

$429 = 3 \times 11 \times 13$ 1

3. $S_{10} = \dfrac{10}{2}[2 \times 6 + 9 \times 6]$ $\frac{1}{2}$

$= 330$ $\frac{1}{2}$

4. $AB = 5$

$\Rightarrow \sqrt{(x-0)^2 + (-4-0)^2} = 5$ $\frac{1}{2}$

$x^2 + 16 = 25$

$x = \pm 3$ $\frac{1}{2}$

5. Length of chord $= 2\sqrt{a^2 - b^2}$ 1

6. $PQ = 5$ cm $\frac{1}{2}$

$\tan\theta = \dfrac{PQ}{PR} = \dfrac{5}{9}$ $\frac{1}{2}$

OR

$\sec\alpha = \sqrt{1 + \tan^2\alpha}$ $\frac{1}{2}$

$= \sqrt{1 + \dfrac{25}{144}} = \dfrac{13}{12}$ $\frac{1}{2}$

SECTION B

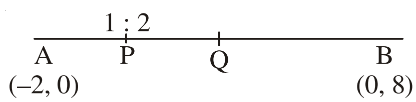
7. Diagonals of parallelogram bisect each other

$$\therefore \quad \left(\frac{3+a}{2}, \frac{1+b}{2}\right) = \left(\frac{5+4}{2}, \frac{1+3}{2}\right)$$ 1

$3 + a = 9, \ 1 + b = 4$

So $a = 6, \ b = 3$ $\frac{1}{2}+\frac{1}{2}$

OR



P divides AB in the ratio 1 : 2

$$\therefore \text{ Coordinates of P are } \left(\frac{0-4}{3}, \frac{8+0}{2}\right) = \left(\frac{-4}{3}, \frac{8}{3}\right)$$ 1

Q divides AB in the ratio 2 : 1

$$\therefore \text{ Coordinates of Q are } \left(\frac{0-2}{3}, \frac{16+0}{3}\right) = \left(\frac{-2}{3}, \frac{16}{3}\right)$$ 1

8. $3x - 5y = 4$ ...(1)

$9x - 2y = 7$

$9x - 15y = 12$

$9x - 2y = 7$

$- \quad + \quad -$

$-13y = 5 \Rightarrow y = -5/13$ 1

From (1), $x = 9/13$ $\therefore$ solution is $\left(\frac{9}{13}, \frac{-5}{13}\right)$ 1

9. HCF (65, 117) = 13 1

$13 = 65n - 117$ $\frac{1}{2}$

Solving, we get, $n = 2$ $\frac{1}{2}$

OR

Required minimum distance $= \text{LCM}(30, 36, 40)$ 1

$30 = 2 \times 3 \times 5$ $\quad = 2^3 \times 3^2 \times 5$

$36 = 2^2 \times 3^2$ $\quad = 360$ cm 1

$40 = 2^3 \times 5$

10. Composite numbers on a die are 4 and 6

$\therefore$ P (composite number) $= \frac{2}{6}$ or $\frac{1}{3}$ 1

Prime numbers are 2, 3 and 5

$\therefore$ P(prime number) $= \frac{3}{6}$ or $\frac{1}{2}$ 1

11. $x^2 - 8x + 18 = 0$

$x^2 - 8x + 16 + 2 = 0$ 1

$(x - 4)^2 = -2$ $\frac{1}{2}$

Square of a number can't be negative

$\therefore$ The equation has no solution. $\frac{1}{2}$

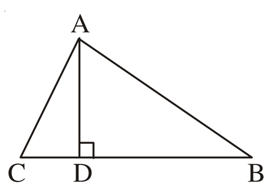
12. Total number of possible outcomes = 34 $\frac{1}{2}$

Favourable number of outcomes is (7, 14, 21, 28 and 35) = 5 1

P(multiple of 7) $= \frac{5}{34}$ $\frac{1}{2}$

SECTION C

13.



$AB^2 = AD^2 + BD^2$ Correct Figure $\frac{1}{2}$

$AC^2 = AD^2 + CD^2$ 1

$AB^2 - AC^2 = BD^2 - CD^2$

$= (3CD)^2 - CD^2$

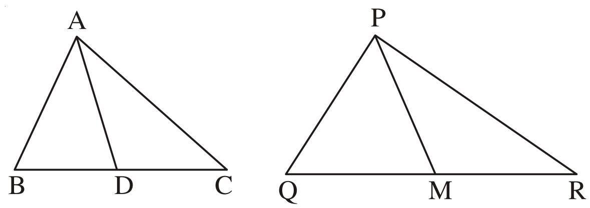
$= 8\ CD^2$ 1

$$= 8 \times \left(\frac{1}{4}BC\right)^2$$

$$\Rightarrow 2AB^2 - 2AC^2 = BC^2$$

$$\text{or } 2AB^2 = 2AC^2 + BC^2 \qquad \frac{1}{2}$$

OR



Correct Figure $\frac{1}{2}$

$\Delta ABC \sim \Delta PQR$

$$\therefore \frac{AB}{PQ} = \frac{BC}{QR} = \frac{AC}{PR} \qquad \frac{1}{2}$$

$$\frac{AB}{PQ} = \frac{2BD}{2QM} \text{ or } \frac{BD}{QM} \qquad 1$$

Also $\angle B = \angle Q$

$$\therefore \Delta ABD \sim \Delta PQM \qquad \frac{1}{2}$$

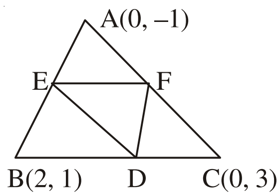
$$\text{So } \frac{AB}{PQ} = \frac{AD}{PM} \qquad \frac{1}{2}$$

14.

$$
\begin{array}{r|l|l}
x^3 - 3x + 1 & \cancel{x^5} - 4x^3 + \cancel{x^2} + 3x + 1 & x^2 - 1 \\
 & \underline{\cancel{x^5} - 3x^3 + \cancel{x^2}} & \\
 & \;\; - \quad + \quad - & \\
 & -\cancel{x^3} + 3\cancel{x} + 1 & \\
 & \underline{-\cancel{x^3} + \cancel{3x} - 1} & \\
 & \;\; + \quad - \quad + & \\
 & 2 &
\end{array}
\qquad 2\frac{1}{2}
$$

Since remainder ≠ 0 ∴ g(x) is not a factor of p(x) $\frac{1}{2}$

15.



Coordinates of mid points are

D(1, 2)

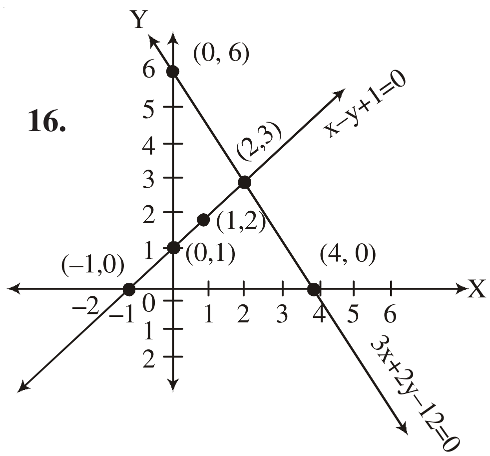
E (1, 0)

F(0 ,1) $1\frac{1}{2}$

Area of ΔDEF = $\frac{1}{2}[1(0-1)+1(1-2)+0]$ 1

$= \frac{1}{2}(-2) = 1\,\text{sq. unit}$ $\frac{1}{2}$

16.



Correct graph 2

Solution is

x = 2, y = 3 $\frac{1}{2}+\frac{1}{2}$

17. Let us assume that $\sqrt{3}$ be a rational number

$\sqrt{3} = \frac{p}{q}$ where p and q are co-primes and q ≠ 0 $\frac{1}{2}$

⇒ $p^2 = 3q^2$ ...(1)

∴ 3 divides p^2

i.e., 3 divides p also ...(2)

Let p = 3m, for some integer m 1

From (1), $9m^2 = 3q^2$

⇒ $q^2 = 3m^2$

∴ 3 divides q^2 i.e., 3 divides q also ...(3) 1

From (2) and (3), we get that 3 divides p and q both which is a contradiction to the fact that p and q are co-primes. $\frac{1}{2}$

Hence our assumption is wrong

$\therefore \sqrt{3}$ is irrational

OR

$1251 - 1 = 1250,\ 9377 - 2 = 9375,\ 15628 - 3 = 15625$ 1

Required largest number = HCF (1250, 9375, 15625)

$$\left.\begin{aligned} 1250 &= 2 \times 5^4 \\ 9375 &= 3 \times 5^4 \\ 6250 &= 2 \times 5^5 \end{aligned}\right\}$$ $1\frac{1}{2}$

$\therefore$ HCF $(1250,\ 9375,\ 15625) = 5^4 = 625$ $\frac{1}{2}$

18. A, B, C are interior angles of ΔABC

$\therefore \quad A + B + C = 180°$ $\frac{1}{2}$

(i) $\sin\left(\frac{B+C}{2}\right) = \sin\left(\frac{180° - A}{2}\right)$

$= \sin\left(90° - \frac{A}{2}\right)$

$= \cos\frac{A}{2}$ $1\frac{1}{2}$

(ii) $\tan\left(\frac{B+C}{2}\right) = \tan\left(\frac{90°}{2}\right)$ $(\because \angle A = 90°)$

$= \tan 45°$ 1

$= 1$

OR

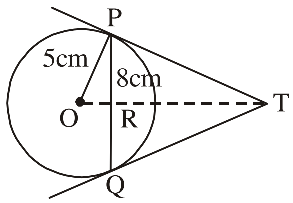
$\tan(A + B) = 1 \ \therefore\ A + B = 45°$ 1

$\tan(A - B) = \frac{1}{\sqrt{3}} \ \therefore\ A - B = 30°$ 1

Solving, we get $\angle A = 37\frac{1°}{2}$ or $37.5°$ $\frac{1}{2}$

$\angle B = 7\frac{1°}{2}$ or $7.5°$ $\frac{1}{2}$

19. Let TR be x cm and TP be y cm



OT is ⊥ bisector of PQ

So PR = 4 cm

In ΔOPR, $OP^2 = PR^2 + OR^2$

$\therefore$ OR = 3 cm 1

In ΔPRT, $y^2 = x^2 + 4^2$ ...(1) $\frac{1}{2}$

In ΔOPT, $(x + 3)^2 = 5^2 + y^2$ $\frac{1}{2}$

$\therefore (x + 3)^2 = 5^2 + x^2 + 16$ [using (1)]

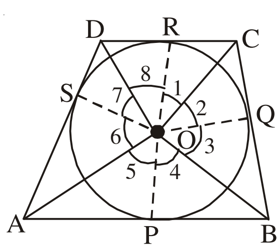
Solving we get $x = \frac{16}{3}$ cm $\frac{1}{2}$

From (1), $y^2 = \frac{256}{9} + 16 = \frac{400}{9}$

So $y = \frac{20}{3}$ cm $\frac{1}{2}$

OR

$\Delta ROC \cong \Delta QOC$ $\frac{1}{2}$



$\therefore \angle 1 = \angle 2$

Similarly $\angle 4 = \angle 3$

$\angle 5 = \angle 6$

$\angle 8 = \angle 7$ 1

$\angle ROQ + \angle QOP + \angle POS + \angle SOR = 360°$ $\frac{1}{2}$

$\therefore 2\angle 1 + 2\angle 4 + 2\angle 5 + 2\angle 8 = 360$

$\Rightarrow \angle 1 + \angle 4 + \angle 5 + \angle 8 = 180°$

So, $\angle DOC + \angle AOB = 180°$

and $\angle AOD + \angle BOC = 180°$. 1

20. Volume of water flowing through canal in 30 minutes

$= 5000 \times 6 \times 1.5 = 45000 \text{ m}^3$ $1\frac{1}{2}$

Area $= 45000 \div \frac{8}{100}$

$= 562500 \text{ m}^2$ $1\frac{1}{2}$

21.

Number of days	**Number of students (fi)**	x_i	$f_i x_i$	
0-6	10	3	30	
6-12	11	9	99	
12-18	7	15	105	
18-24	4	21	84	
24-30	4	27	108	Correct Table 2
30-36	3	33	99	
36-42	1	39	39	
Total	40		564	

$\bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{564}{40}$

$= 14.1$ 1

22. Total area cleaned = 2 × Area of sector

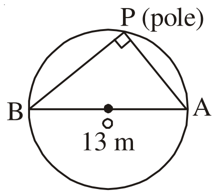
$= 2 \times \frac{\pi r^2 \theta}{260°}$ 1

$= 2 \times \frac{22}{7} \times 21 \times 21 \times \frac{120°}{360°}$ 1

$= 924 \text{ cm}^2$ 1

SECTION D

23.



Correct Figure $\frac{1}{2}$

PB – PA = 7 m

Let AP be x m $\therefore$ PB = (x + 7) m $\frac{1}{2}$

$AB^2 = PB^2 + AB^2$

$\therefore\ 13^2 = (x+7)^2 + x^2$

$x^2 + 7x - 60 = 0$ 1

$= (x + 12)(x - 5) = 0$ 1

$\therefore$ x = 5, –12 Rejected

$\therefore$ Situation is possible $\frac{1}{2}$

$\therefore$ Distance of pole from gate A = 5 m

and distance of pole from gate B = 12 m. $\frac{1}{2}$

24. $ma_m = na_n$

$\Rightarrow\ ma + m(m-1)d = na + n(n-1)d$ 1

$\Rightarrow\ (m-n)a + (m^2 - m - n^2 + n)d = 0$ 1

$(m-n)a + [(m-n)(m+n) - (m-n)d] = 0$ 1

Dividing by (m – n)

So, $a + (m + n - 1)d = 0$

or $a_{m+n} = 0$ 1

OR

Let first three terms be a –d, a and a + d $\frac{1}{2}$

$a - d + a + a + d = 18$

So $a = 6$ $\frac{1}{2}$

$(a - d)(a + d) = 5d$

$\Rightarrow \quad 6^2 - d^2 = 5d$ 1

or $\quad d^2 + 5d - 36 = 0$

$(d + 9)(d - 4) = 0$

so $\quad d = -9$ or 4 1

For d = –9 three numbers are 15, 6 and –3 $\frac{1}{2}$

For d = 4 three numbers are 2, 6 and 10 $\frac{1}{2}$

25. Correct construction of ΔABC 2

Correct construction of triangle similar to ΔABC 2

26. (a) Total surface area of block

= TSA of cube + CSA of hemisphere – Base area of hemisphere 1

$= 6a^2 + 2\pi r^2 - \pi r^2$

$= 6a^2 + \pi r^2$

$= \left(6 \times 6^2 + \frac{22}{7} \times 2.1 \times 2.1\right) cm^2$ $\frac{1}{2}$

$= (216 + 13.86)\ cm^2$

$= 229.86\ cm^2$ $\frac{1}{2}$

(b) Volume of block

$= 6^3 + \frac{2}{3} \times \frac{22}{7} \times (2.1)^3$ 1

$= (216 + 19.40)\ cm^3$

$= 235.40\ cm^3$ 1

OR

Volume of frustum = $12308.8\ cm^3$

$\therefore \quad \frac{1}{3}\pi h(r_1^2 + r_2^2 + r_1 r_2) = 12308.8$

$\Rightarrow \quad \frac{1}{3} \times 3.14 \times h(20^2 + 12^2 + 20 \times 12) = 12308.8$ 1

$h = \frac{12308.8 \times 3}{784 \times 3.14}$

$h = 15$ cm 1

$l = \sqrt{15^2 + (20-12)^2} = 17$ cm. 1

Area of metal sheet used = $\pi l\ (r_1 + r_2) + \pi r_2^2$

$= 3.14[17 \times 32 + 12^2]$

$= 3.14 \times 688\ \text{cm}^2$

$= 2160.32\ \text{cm}^2$ 1

27. Correct figure, given, to prove and construction $\frac{1}{2}\times 4 = 2$

Correct proof. 2

OR

Correct figure, given, to prove and construction $\frac{1}{2}\times 4 = 2$

Correct proof. 2

28. $1 + \sin^2\theta = 3\sin\theta\cos\theta$

Dividing by $\cos^2\theta$

$\sec^2\theta + \tan^2\theta = 3\tan\theta$ 1

$\Rightarrow\quad 1 + \tan^2\theta + \tan^2\theta = 3\tan\theta$

$\Rightarrow\quad 2\tan^2\theta - 3\tan\theta + 1 = 0$ 1

$(\tan\theta - 1)(2\tan\theta - 1) = 0$ 1

So $\tan\theta = 1$ or $\frac{1}{2}$ $\frac{1}{2}+\frac{1}{2}$

Alternate method

$1 + \sin^2\theta = 3\sin\theta\cos\theta$

$\sin^2\theta + \cos^2\theta + \sin^2\theta - 3\sin\theta\cos\theta = 0$ 1

Dividing by $\cos^2\theta$

$\Rightarrow\quad 2\tan^2\theta - 3\tan\theta + 1 = 0$ 1

$\Rightarrow\quad (\tan\theta - 1)(2\tan\theta - 1) = 0$ 1

So $\tan\theta = 1$ or $\frac{1}{2}$ $\frac{1}{2}+\frac{1}{2}$

29.

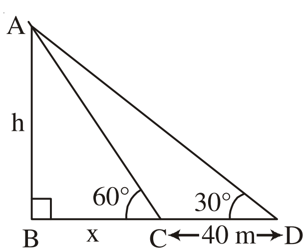
Class interval	**Cumulative Frequency**
More than or equal to 20	100
More than or equal to 30	90
More than or equal to 40	82
More than or equal to 50	70
More than or equal to 60	46
More than or equal to 70	40
More than or equal to 80	15

Correct Table $1\frac{1}{2}$

Plotting of points (20, 100), (30, 90), (40, 82), (50, 70), (60, 46), (70, 40) and (80, 15) $1\frac{1}{2}$

Joining the points to get a curve 1

30. Correct Figure 1



Let AB = h be the height of tower

In ΔABC, $\frac{h}{x} = \tan 60°$

$h = x\sqrt{3}$ 1

In ΔABD, $\frac{h}{x+40} = \tan 30°$

$\Rightarrow h\sqrt{3} = x + 40$ $\frac{1}{2}$

$3x = x + 40$

$\therefore x = 20$ $\frac{1}{2}$

So, height of tower $= h = 20\sqrt{3}$ m $\frac{1}{2}$

$= 20 \times 1.732$ m

$= 34.64$ m $\frac{1}{2}$

QUESTION PAPER CODE 30/3/2

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. Length of chord = $2\sqrt{a^2 - b^2}$ 1

2. PQ = 5 cm $\frac{1}{2}$

tan $\theta = \frac{PQ}{PR} = \frac{5}{9}$ $\frac{1}{2}$

OR

sec $\alpha = \sqrt{1 + \tan^2 \alpha}$ $\frac{1}{2}$

$= \sqrt{1 + \frac{25}{144}} = \frac{13}{12}$ $\frac{1}{2}$

3. $(x + 5)^2 = 2(5x - 3) \Rightarrow x^2 + 31 = 10$ $\frac{1}{2}$

D = –124 $\frac{1}{2}$

4. $\frac{27}{2^3 \cdot 5^4 \cdot 3^2} = \frac{3}{2^3 \cdot 5^4}$ $\frac{1}{2}$

It will terminate after 4 decimal places $\frac{1}{2}$

OR

429 = 3 × 11 × 13 1

5. $S_{10} = \frac{10}{2}[2 \times 6 + 9 \times 6]$ $\frac{1}{2}$

= 330 $\frac{1}{2}$

6. AB = 10

$(13 - 5)^2 + (m + 3)^2 = 10$

$(m + 3)^2 = 100 - 64 = 6^2$ $\frac{1}{2}$

m + 3 = 6

m = 3 $\frac{1}{2}$

SECTION B

7. Composite numbers on a die are 4 and 6

$\therefore$ P (composite number) = $\frac{2}{6}$ or $\frac{1}{3}$ 1

Prime numbers are 2, 3 and 5

$\therefore$ P(prime number) = $\frac{3}{6}$ or $\frac{1}{2}$ 1

8. Total number of possible outcomes = 34 $\frac{1}{2}$

Favourable number of outcomes is (7, 14, 21, 28 and 35) = 5 1

P(multiple of 7) = $\frac{5}{34}$ $\frac{1}{2}$

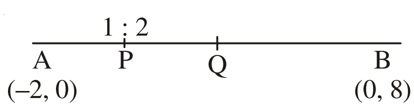
9. Diagonals of parallelogram bisect each other

$\therefore$ $\left(\frac{3+a}{2}, \frac{1+b}{2}\right) = \left(\frac{5+4}{2}, \frac{1+3}{2}\right)$ 1

$3 + a = 9,\ 1 + b = 4$

So $a = 6,\ b = 3$ $\frac{1}{2}+\frac{1}{2}$

OR



P divides AB in the ratio 1 : 2

$\therefore$ Coordinates of P are $\left(\frac{0-4}{3}, \frac{8+0}{2}\right) = \left(\frac{-4}{3}, \frac{8}{3}\right)$ 1

Q divides AB in the ratio 2 : 1

$\therefore$ Coordinates of Q are $\left(\frac{0-2}{3}, \frac{16+0}{3}\right) = \left(\frac{-2}{3}, \frac{16}{3}\right)$ 1

10. $3x - 5y = 4$ ...(1)

$9x - 2y = 7$

$9x - 15y = 12$

$9x - 2y = 7$

$\underline{-\quad +\quad\quad -}$

$-13y = 5 \Rightarrow y = -5/13$ 1

From (1), x = 9/13 $\therefore$ solution is $\left(\frac{9}{13}, \frac{-5}{13}\right)$ 1

11. HCF (65, 117) = 13 1

13 = 65n – 117 $\frac{1}{2}$

Solving, we get, n = 2 $\frac{1}{2}$

OR

Required minimum distance = LCM (30, 36, 40) 1

$30 = 2 \times 3 \times 5$ $\quad = 2^3 \times 3^2 \times 5$

$36 = 2^2 \times 3^2$ $\quad = 360$ cm 1

$40 = 2^3 \times 5$

12. $k^2 - 6x - 1 = 0$

Since the roots are not real $\therefore$ D < 0 1

$(-6)^2 - 4 \times k \times (-1) < 0$

$k < -9$ 1

SECTION C

13. A, B, C are interior angles of ΔABC

$\therefore \quad A + B + C = 180°$ $\frac{1}{2}$

(i) $\sin\left(\frac{B+C}{2}\right) = \sin\left(\frac{180° - A}{2}\right)$

$= \sin\left(90° - \frac{A}{2}\right)$

$= \cos\frac{A}{2}$ $1\frac{1}{2}$

(ii) $\tan\left(\frac{B+C}{2}\right) = \tan\left(\frac{90°}{2}\right)$ $\quad (\because \angle A = 90°)$

$= \tan 45°$ 1

$= 1$

OR

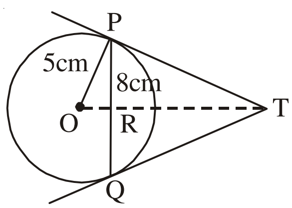
$\tan(A + B) = 1 \therefore A + B = 45°$ 1

$\tan(A - B) = \dfrac{1}{\sqrt{3}} \therefore A - B = 30°$ 1

Solving, we get $\angle A = 37\dfrac{1}{2}°$ or $37.5°$ $\frac{1}{2}$

$\angle B = 7\dfrac{1}{2}°$ or $7.5°$ $\frac{1}{2}$

14. Let TR be x cm and TP be y cm



OT is $\perp$ bisector of PQ

So PR = 4 cm

In ΔOPR, $OP^2 = PR^2 + OR^2$

$\therefore$ OR = 3 cm 1

In ΔPRT, $y^2 = x^2 + 4^2$ ...(1) $\frac{1}{2}$

In ΔOPT, $(x + 3)^2 = 5^2 + y^2$ $\frac{1}{2}$

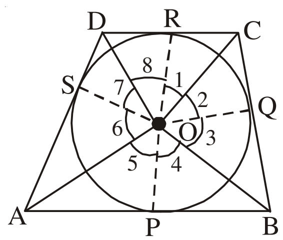
$\therefore (x + 3)^2 = 5^2 + x^2 + 16$ [using (1)]

Solving we get $x = \dfrac{16}{3}$ cm $\frac{1}{2}$

From (1), $y^2 = \dfrac{256}{9} + 16 = \dfrac{400}{9}$

So $y = \dfrac{20}{3}$ cm $\frac{1}{2}$

OR



$\Delta ROC \cong \Delta QOC$ $\frac{1}{2}$

$\therefore \angle 1 = \angle 2$
Similarly $\angle 4 = \angle 3$
$\angle 5 = \angle 6$
$\angle 8 = \angle 7$ 1

$\angle ROQ + \angle QOP + \angle POS + \angle SOR = 360°$ $\frac{1}{2}$

$\therefore 2\angle 1 + 2\angle 4 + 2\angle 5 + 2\angle 8 = 360$

$\Rightarrow \angle 1 + \angle 4 + \angle 5 + \angle 8 = 180°$

So, $\angle DOC + \angle AOB = 180°$

and $\angle AOD + \angle BOC = 180°$. 1

15.

Number of days	**Number of students (fi)**	x_i	$f_i x_i$	
0-6	10	3	30	
6-12	11	9	99	
12-18	7	15	105	
18-24	4	21	84	
24-30	4	27	108	Correct Table 2
30-36	3	33	99	
36-42	1	39	39	
Total	40		564	

$$\overline{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{564}{40}$$

$= 14.1$ 1

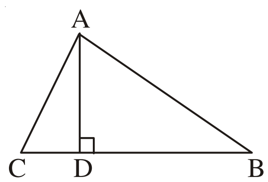
16. Total area cleaned = 2 × Area of sector

$= 2 \times \frac{\pi r^2 \theta}{260°}$ 1

$= 2 \times \frac{22}{7} \times 21 \times 21 \times \frac{120°}{360°}$ 1

$= 924 \text{ cm}^2$ 1

17.



$AB^2 = AD^2 + BD^2$ Correct Figure $\frac{1}{2}$

$AC^2 = AD^2 + CD^2$ 1

$AB^2 - AC^2 = BD^2 - CD^2$

$= (3CD)^2 - CD^2$

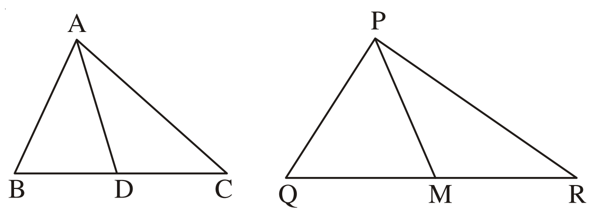
$= 8\ CD^2$ 1

$= 8 \times \left(\frac{1}{4} BC\right)^2$

$\Rightarrow 2AB^2 - 2AC^2 = BC^2$

or $2AB^2 = 2AC^2 + BC^2$ $\frac{1}{2}$

OR



Correct Figure $\frac{1}{2}$

$\Delta ABC \sim \Delta PQR$

$\therefore\ \frac{AB}{PQ} = \frac{BC}{QR} = \frac{AC}{PR}$ $\frac{1}{2}$

$\frac{AB}{PQ} = \frac{2BD}{2QM}$ or $\frac{BD}{QM}$ 1

Also $\angle B = \angle Q$

$\therefore\ \Delta ABD \sim \Delta PQM$ $\frac{1}{2}$

So $\frac{AB}{PQ} = \frac{AD}{PM}$ $\frac{1}{2}$

18.

$$
\begin{array}{r|l|l}
x^3 - 3x + 1 & \cancel{x^5} - 4x^3 + \cancel{x^2} + 3x + 1 & x^2 - 1 \\
 & \cancel{x^5} - 3x^3 + \cancel{x^2} & \\
 & - \quad + \quad - & \\
\hline
 & -\cancel{x^3} + 3\cancel{x} + 1 & \\
 & -\cancel{x^3} + \cancel{3}x - 1 & \\
 & + \quad - \quad + & \\
\hline
 & \qquad\qquad 2 &
\end{array}
$$

$2\frac{1}{2}$

Since remainder $\neq 0$ $\therefore$ g(x) is not a factor of p(x) $\frac{1}{2}$

19. Let us assume that $\sqrt{3}$ be a rational number

$\sqrt{3} = \frac{p}{q}$ where p and q are co-primes and $q \neq 0$ $\frac{1}{2}$

$\Rightarrow \quad p^2 = 3q^2$ ...(1)

$\therefore \quad$ 3 divides p^2

i.e., 3 divides p also ...(2)

Let p = 3m, for some integer m 1

From (1), $9m^2 = 3q^2$

$\Rightarrow \quad q^2 = 3m^2$

$\therefore \quad$ 3 divides q^2 i.e., 3 divides q also ...(3) 1

From (2) and (3), we get that 3 divides p and q both which is a contradiction to the fact that p and q are co-primes. $\frac{1}{2}$

Hence our assumption is wrong $\therefore$ $\sqrt{3}$ is irrational

OR

1251 – 1 = 1250, 9377 – 2 = 9375, 15628 – 3 = 15625 1

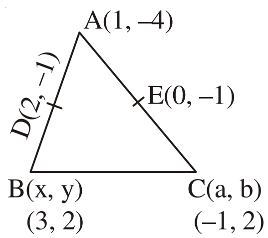
Required largest number = HCF (1250, 9375, 15625)

$$
\left.\begin{array}{l}
1250 = 2 \times 5^4 \\
9375 = 3 \times 5^4 \\
6250 = 2 \times 5^5
\end{array}\right\}
$$

$1\frac{1}{2}$

$\therefore \quad$ HCF (1250, 9375, 15625) = $5^4 = 625$ $\frac{1}{2}$

20.



$$\left(\frac{x+1}{2}, \frac{y-4}{2}\right) = (2, -1)$$

$\therefore\ x = 3,\ y = 2$ 1

$$\left(\frac{1+a}{2}, \frac{-4+b}{2}\right) = (0, -1)$$

$a = -1,\ b = 2$ 1

Area of $\Delta ABC = \frac{1}{2}[1(2-2) + 3(2+4) - 1(-4-2)]$

$= \frac{1}{2} \times 24 = 12$ sq. units 1

21. Let the numbers be 5x and 6x $\frac{1}{2}$

$$\frac{5x-7}{6x-7} = \frac{4}{5}$$ 1

Solving, we get x = 7 $\frac{1}{2}$

$\therefore$ Numbers are 35 and 42 $\frac{1}{2}+\frac{1}{2}$

22. Volume of water flowing through pipe in half an hour

$= \pi r^2 \times 1260\ m^3$ ...(1) $\frac{1}{2}$

Volume of water raised in cylinder

$= \pi \times \frac{40}{100} \times \frac{40}{100} \times \frac{315}{100}\ m^3$ ...(2) 1

$(1) = (2) \Rightarrow r^2 = \frac{4}{10} \times \frac{4}{10} \times \frac{315}{100 \times 2160}$

$= \frac{4}{100 \times 100}\ m^2 = 4\ cm^2$ 1

$\Rightarrow$ r = 2 cm, $\therefore$ diameter = 4 cm $\frac{1}{2}$

SECTION D

23. (a) Total surface area of block

= TSA of cube + CSA of hemisphere – Base area of hemisphere 1

$= 6a^2 + 2\pi r^2 - \pi r^2$

$= 6a^2 + \pi r^2$

$= \left(6 \times 6^2 + \frac{22}{7} \times 2.1 \times 2.1\right) \text{cm}^2$ $\frac{1}{2}$

$= (216 + 13.86)\ \text{cm}^2$

$= 229.86\ \text{cm}^2$ $\frac{1}{2}$

(b) Volume of block

$= 6^3 + \frac{2}{3} \times \frac{22}{7} \times (2.1)^3$ 1

$= (216 + 19.40)\ \text{cm}^3$

$= 235.40\ \text{cm}^3$ 1

OR

Volume of frustum = $12308.8\ \text{cm}^3$

$\therefore \quad \frac{1}{3}\pi h(r_1^2 + r_2^2 + r_1 r_2) = 12308.8$

$\Rightarrow \quad \frac{1}{3} \times 3.14 \times h(20^2 + 12^2 + 20 \times 12) = 12308.8$ 1

$h = \frac{12308.8 \times 3}{784 \times 3.14}$

$h = 15$ cm 1

$l = \sqrt{15^2 + (20 - 12)^2} = 17$ cm. 1

Area of metal sheet used $= \pi l\ (r_1 + r_2) + \pi r_2^2$

$= 3.14[17 \times 32 + 12^2]$

$= 3.14 \times 688\ \text{cm}^2$

$= 2160.32\ \text{cm}^2$ 1

24. Correct figure, given, to prove and construction $\frac{1}{2}\times 4=2$

Correct proof. 2

OR

Correct figure, given, to prove and construction $\frac{1}{2}\times 4=2$

Correct proof. 2

25.

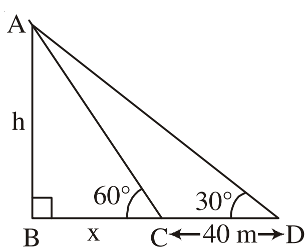
Class interval	**Cumulative Frequency**
More than or equal to 20	100
More than or equal to 30	90
More than or equal to 40	82
More than or equal to 50	70
More than or equal to 60	46
More than or equal to 70	40
More than or equal to 80	15

Correct Table $1\frac{1}{2}$

Plotting of points (20, 100), (30, 90), (40, 82), (50, 70), (60, 46), (70, 40) and (80, 15) $1\frac{1}{2}$

Joining the points to get a curve 1

26. Correct Figure 1



Let AB = h be the height of tower

In ΔABC, $\frac{h}{x} = \tan 60°$

$h = x\sqrt{3}$ 1

In ΔABD, $\frac{h}{x+40} = \tan 30°$

$\Rightarrow h\sqrt{3} = x + 40$ $\frac{1}{2}$

$3x = x + 40$

$\therefore x = 20$ $\frac{1}{2}$

So, height of tower $= h = 20\sqrt{3}$ m $\frac{1}{2}$

$= 20 \times 1.732$ m

$= 34.64$ m $\frac{1}{2}$

27. $ma_m = na_n$

$\Rightarrow$ $ma + m(m-1)d = na + n(n-1)d$ 1

$\Rightarrow$ $(m-n)a + (m^2 - m - n^2 + n)d = 0$ 1

$(m-n)a + [(m-n)(m+n) - (m-n)d] = 0$ 1

Dividing by $(m-n)$

So, $a + (m+n-1)d = 0$

or $a_{m+n} = 0$ 1

OR

Let first three terms be $a - d$, a and $a + d$ $\frac{1}{2}$

$a - d + a + a + d = 18$

So $a = 6$ $\frac{1}{2}$

$(a-d)(a+d) = 5d$

$\Rightarrow$ $6^2 - d^2 = 5d$ 1

or $d^2 + 5d - 36 = 0$

$(d+9)(d-4) = 0$

so $d = -9$ or 4 1

For $d = -9$ three numbers are 15, 6 and -3 $\frac{1}{2}$

For $d = 4$ three numbers are 2, 6 and 10 $\frac{1}{2}$

28. Let the number of books be x

$\frac{80}{x} - \frac{80}{x+4} = 1$ 2

$x^2 + 4x - 320 = 0$ 1

$(x+20)(x-16) = 0$

$x = -20,\ 16$
(rejected)

$\therefore$ Number of books = 16 — 1

29. Correct construction of circle. — 1

Correct construction of tangents. — 3

30. $$\text{LHS} = \frac{1}{1+\sin^2\theta} + \frac{1}{1+\cos^2\theta} + \frac{1}{1+\sec^2\theta} + \frac{1}{1+\operatorname{cosec}^2\theta}$$

$$= \frac{1}{1+\sin^2\theta} + \frac{1}{1+\cos^2\theta} + \frac{1}{1+\dfrac{1}{\cos^2\theta}} + \frac{1}{1+\dfrac{1}{\sin^2\theta}}$$ 1

$$= \frac{1}{1+\sin^2\theta} + \frac{1}{1+\cos^2\theta} + \frac{\cos^2\theta}{\cos^2\theta+1} + \frac{\sin^2\theta}{\sin^2\theta+1}$$ 1

$$= \frac{1+\sin^2\theta}{1+\sin^2\theta} + \frac{1+\cos^2\theta}{1+\cos^2\theta}$$ 1

$= 1 + 1 = 2$

$=$ R.H.S. — 1

QUESTION PAPER CODE 30/3/3

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. PQ = 5 cm $\frac{1}{2}$

$\tan\theta = \frac{PQ}{PR} = \frac{5}{9}$ $\frac{1}{2}$

OR

$\sec\alpha = \sqrt{1+\tan^2\alpha}$ $\frac{1}{2}$

$= \sqrt{1+\frac{25}{144}} = \frac{13}{12}$ $\frac{1}{2}$

2. Length of chord = $2\sqrt{a^2 - b^2}$ 1

3. AB = 5

$\Rightarrow \sqrt{(x-0)^2+(-4-0)^2} = 5$ $\frac{1}{2}$

$x^2 + 16 = 25$

$x = \pm 3$ $\frac{1}{2}$

4. $\frac{27}{2^3 \cdot 5^4 \cdot 3^2} = \frac{3}{2^3 \cdot 5^4}$ $\frac{1}{2}$

It will terminate after 4 decimal places $\frac{1}{2}$

OR

$429 = 3 \times 11 \times 13$ 1

5. $(x + 5)^2 = 2(5x - 3) \Rightarrow x^2 + 31 = 10$ $\frac{1}{2}$

$D = -124$ $\frac{1}{2}$

6. $S_{10} = \frac{10}{2}[2\times 3+9\times 3]$ $\frac{1}{2}$

$= 5 \times 33 = 165$ $\frac{1}{2}$

SECTION B

7. HCF (65, 117) = 13 — 1

13 = 65n − 117 — $\frac{1}{2}$

Solving, we get, n = 2 — $\frac{1}{2}$

OR

Required minimum distance = LCM (30, 36, 40) — 1

$30 = 2 \times 3 \times 5$ $\quad = 2^3 \times 3^2 \times 5$

$36 = 2^2 \times 3^2$ $\quad = 360$ cm — 1

$40 = 2^3 \times 5$

8. Composite numbers on a die are 4 and 6

$\therefore$ P (composite number) = $\frac{2}{6}$ or $\frac{1}{3}$ — 1

Prime numbers are 2, 3 and 5

$\therefore$ P(prime number) = $\frac{3}{6}$ or $\frac{1}{2}$ — 1

9. $x^2 - 8x + 18 = 0$

$x^2 - 8x + 16 + 2 = 0$ — 1

$(x - 4)^2 = -2$ — $\frac{1}{2}$

Square of a number can't be negative

$\therefore$ The equation has no solution. — $\frac{1}{2}$

10. Total number of possible outcomes = 34 — $\frac{1}{2}$

Favourable number of outcomes is (7, 14, 21, 28 and 35) = 5 — 1

P(multiple of 7) = $\frac{5}{34}$ — $\frac{1}{2}$

11. $3x + 4y = 10 \quad \Rightarrow 3x + 4y = 10$

$2x - 2y = 2 \quad \Rightarrow 4x - 4y = 10$

On solving, $7x = 14 \quad \therefore\ x = 2$ 1

So, $y = 1$ 1

Solution is (2, 1)

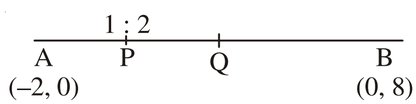
12. Diagonals of parallelogram bisect each other

$$\therefore \quad \left(\frac{3+a}{2}, \frac{1+b}{2}\right) = \left(\frac{5+4}{2}, \frac{1+3}{2}\right)$$ 1

$3 + a = 9,\ 1 + b = 4$

So $a = 6,\ b = 3$ $\frac{1}{2}+\frac{1}{2}$

OR



P divides AB in the ratio 1 : 2

$\therefore$ Coordinates of P are $\left(\frac{0-4}{3}, \frac{8+0}{2}\right) = \left(\frac{-4}{3}, \frac{8}{3}\right)$ 1

Q divides AB in the ratio 2 : 1

$\therefore$ Coordinates of Q are $\left(\frac{0-2}{3}, \frac{16+0}{3}\right) = \left(\frac{-2}{3}, \frac{16}{3}\right)$ 1

SECTION C

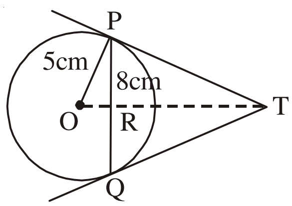
13.

Number of days	Number of students (fi)	x_i	$f_i x_i$	
0-6	10	3	30	
6-12	11	9	99	
12-18	7	15	105	
18-24	4	21	84	
24-30	4	27	108	Correct Table 2
30-36	3	33	99	
36-42	1	39	39	
Total	40		564	

$$\bar{x} = \frac{\Sigma f_i x_i}{\Sigma f_i} = \frac{564}{40}$$

$= 14.1$ 1

14.



Let TR be x cm and TP be y cm

OT is $\perp$ bisector of PQ

So PR = 4 cm

In ΔOPR, $OP^2 = PR^2 + OR^2$

$\therefore$ OR = 3 cm — 1

In ΔPRT, $y^2 = x^2 + 4^2$ ...(1) — $\frac{1}{2}$

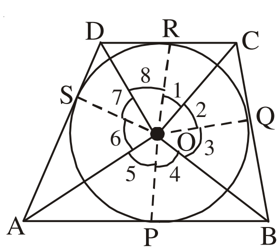
In ΔOPT, $(x + 3)^2 = 5^2 + y^2$ — $\frac{1}{2}$

$\therefore$ $(x + 3)^2 = 5^2 + x^2 + 16$ [using (1)]

Solving we get $x = \frac{16}{3}$ cm — $\frac{1}{2}$

$$\left.\begin{array}{l} \text{From (1), } y^2 = \frac{256}{9} + 16 = \frac{400}{9} \\ \text{So } y = \frac{20}{3} \text{ cm} \end{array}\right\}$$ — $\frac{1}{2}$

OR



$\Delta ROC \cong \Delta QOC$ — $\frac{1}{2}$

$$\left.\begin{array}{l} \therefore \angle 1 = \angle 2 \\ \text{Similarly } \angle 4 = \angle 3 \\ \angle 5 = \angle 6 \\ \angle 8 = \angle 7 \end{array}\right\}$$ — 1

$\angle ROQ + \angle QOP + \angle POS + \angle SOR = 360°$ — $\frac{1}{2}$

$\therefore$ $2\angle 1 + 2\angle 4 + 2\angle 5 + 2\angle 8 = 360$

$\Rightarrow$ $\angle 1 + \angle 4 + \angle 5 + \angle 8 = 180°$

So, $\angle DOC + \angle AOB = 180°$

and $\angle AOD + \angle BOC = 180°$. — 1

15. A, B, C are interior angles of ΔABC

$\therefore \quad A + B + C = 180°$ $\frac{1}{2}$

(i) $\sin\left(\frac{B+C}{2}\right) = \sin\left(\frac{180° - A}{2}\right)$

$= \sin\left(90° - \frac{A}{2}\right)$

$= \cos\frac{A}{2}$ $1\frac{1}{2}$

(ii) $\tan\left(\frac{B+C}{2}\right) = \tan\left(\frac{90°}{2}\right)$ $(\because \angle A = 90°)$

$= \tan 45°$ 1

$= 1$

OR

$\tan (A + B) = 1 \therefore A + B = 45°$ 1

$\tan (A - B) = \frac{1}{\sqrt{3}} \therefore A - B = 30°$ 1

Solving, we get $\angle A = 37\frac{1°}{2}$ or $37.5°$ $\frac{1}{2}$

$\angle B = 7\frac{1°}{2}$ or $7.5°$ $\frac{1}{2}$

16. Let us assume that $\sqrt{3}$ be a rational number

$\sqrt{3} = \frac{p}{q}$ where p and q are co-primes and $q \neq 0$ $\frac{1}{2}$

$\Rightarrow \quad p^2 = 3q^2$ ...(1)

$\therefore \quad$ 3 divides p^2

i.e., 3 divides p also ...(2)

Let $p = 3m$, for some integer m 1

From (1), $9m^2 = 3q^2$

$\Rightarrow \quad q^2 = 3m^2$

$\therefore \quad$ 3 divides q^2 i.e., 3 divides q also ...(3) 1

From (2) and (3), we get that 3 divides p and q both which is a contradiction to the fact that p and q are co-primes. $\frac{1}{2}$

Hence our assumption is wrong $\therefore$ $\sqrt{3}$ is irrational

OR

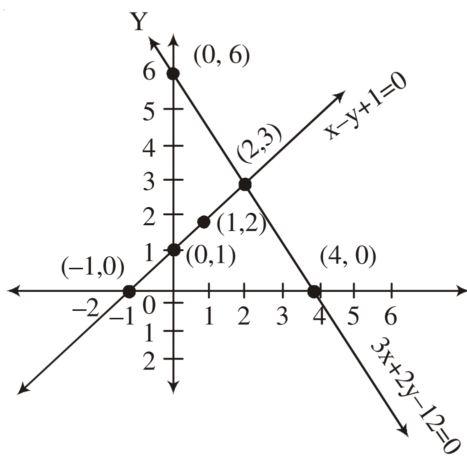
$1251 - 1 = 1250,\ 9377 - 2 = 9375,\ 15628 - 3 = 15625$ 1

Required largest number = HCF (1250, 9375, 15625)

$$\left.\begin{aligned} 1250 &= 2 \times 5^4 \\ 9375 &= 3 \times 5^4 \\ 6250 &= 2 \times 5^5 \end{aligned}\right\}$$ $1\frac{1}{2}$

$\therefore$ HCF (1250, 9375, 15625) = 5^4 = 625 $\frac{1}{2}$

17. Correct graph 2



Solution is

$x = 2,\ y = 3$ $\frac{1}{2}+\frac{1}{2}$

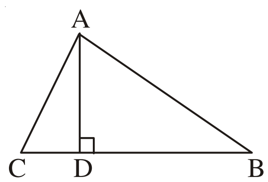
18. Volume of water flowing through canal in 30 minutes

$= 5000 \times 6 \times 1.5 = 45000\ \text{m}^3$ $1\frac{1}{2}$

Area $= 45000 \div \frac{8}{100}$

$= 562500\ \text{m}^2$ $1\frac{1}{2}$

19. $AB^2 = AD^2 + BD^2$ Correct Figure $\frac{1}{2}$



$AC^2 = AD^2 + CD^2$ 1

$AB^2 - AC^2 = BD^2 - CD^2$

$= (3CD)^2 - CD^2$

$= 8\ CD^2$ 1

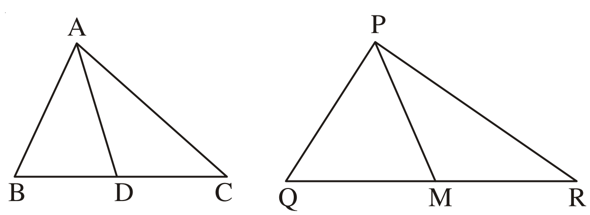
$= 8 \times \left(\frac{1}{4}BC\right)^2$

$\Rightarrow 2AB^2 - 2AC^2 = BC^2$

or $2AB^2 = 2AC^2 + BC^2$ $\frac{1}{2}$

OR

Correct Figure $\frac{1}{2}$



$\Delta ABC \sim \Delta PQR$

$\therefore\ \frac{AB}{PQ} = \frac{BC}{QR} = \frac{AC}{PR}$ $\frac{1}{2}$

$\frac{AB}{PQ} = \frac{2BD}{2QM}$ or $\frac{BD}{QM}$ 1

Also $\angle B = \angle Q$

$\therefore\ \Delta ABD \sim \Delta PQM$ $\frac{1}{2}$

So $\frac{AB}{PQ} = \frac{AD}{PM}$ $\frac{1}{2}$

20. Area of minor segment $= \dfrac{\pi r^2 \theta}{360°} - \dfrac{\sqrt{3}}{4} r^2$ 1

$= 14 \times 14 \left[\dfrac{22}{7} \times \dfrac{60°}{360°} - \dfrac{1.73}{4} \right] \text{cm}^2$ 1

$= \dfrac{14 \times 14}{84} (44 - 36.33)\ \text{cm}^2$

$= 17.90\ \text{cm}^2$ (approx.) 1

21. $\dfrac{1}{2}[(k+1)(-3+k) + 4(-k-1) + 7(1+3)] = 6$ 1

$\dfrac{1}{2}(k^2 - 6k + 21) = 6$ 1

$\Rightarrow \quad k^2 - 6k + 9 = 0$

$(k - 3)^2 = 0$

$\therefore \quad k = 3$ 1

22. $ax^2 + 7x + b$

Sum of zeroes $= \dfrac{-7}{a} = \dfrac{-7}{3}$ $1\frac{1}{2}$

$\therefore \quad a = 3$

Product of zeroes $= \dfrac{b}{a} = -2$

$\therefore \quad b = -6.$ $1\frac{1}{2}$

SECTION D

23.

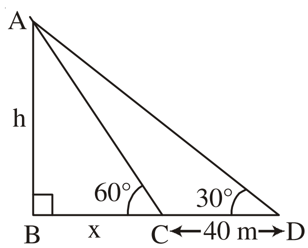
Class interval	**Cumulative Frequency**
More than or equal to 20	100
More than or equal to 30	90
More than or equal to 40	82
More than or equal to 50	70
More than or equal to 60	46
More than or equal to 70	40
More than or equal to 80	15

Correct Table $1\frac{1}{2}$

Plotting of points (20, 100), (30, 90), (40, 82), (50, 70), (60, 46), (70, 40) and (80, 15) $1\frac{1}{2}$

Joining the points to get a curve 1

24. Correct Figure 1



Let AB = h be the height of tower

In ΔABC, $\frac{h}{x} = \tan 60°$

$h = x\sqrt{3}$ 1

In ΔABD, $\frac{h}{x+40} = \tan 30°$

$\Rightarrow h\sqrt{3} = x + 40$ $\frac{1}{2}$

$3x = x + 40$

$\therefore x = 20$ $\frac{1}{2}$

So, height of tower $= h = 20\sqrt{3}$ m $\frac{1}{2}$

$= 20 \times 1.732$ m

$= 34.64$ m $\frac{1}{2}$

25. Correct figure, given, to prove and construction $\frac{1}{2}\times4=2$

Correct proof. 2

OR

Correct figure, given, to prove and construction $\frac{1}{2}\times4=2$

Correct proof. 2

26. $ma_m = na_n$

$\Rightarrow \quad ma + m(m-1)d = na + n(n-1)d$ 1

$\Rightarrow \quad (m-n)a + (m^2 - m - n^2 + n)d = 0$ 1

$(m-n)a + [(m-n)(m+n) - (m-n)d] = 0$ 1

Dividing by $(m-n)$

So, $a + (m + n - 1)d = 0$

or $a_{m+n} = 0$ 1

OR

Let first three terms be $a - d$, a and $a + d$ $\frac{1}{2}$

$a - d + a + a + d = 18$

So $a = 6$ $\frac{1}{2}$

$(a - d)(a + d) = 5d$

$\Rightarrow \quad 6^2 - d^2 = 5d$ 1

or $d^2 + 5d - 36 = 0$

$(d + 9)(d - 4) = 0$

so $d = -9$ or 4 1

For $d = -9$ three numbers are 15, 6 and -3 $\frac{1}{2}$

For $d = 4$ three numbers are 2, 6 and 10 $\frac{1}{2}$

27. (a) Total surface area of block

= TSA of cube + CSA of hemisphere – Base area of hemisphere 1

$= 6a^2 + 2\pi r^2 - \pi r^2$

$= 6a^2 + \pi r^2$

$= \left(6 \times 6^2 + \frac{22}{7} \times 2.1 \times 2.1\right) \text{cm}^2$ $\frac{1}{2}$

$= (216 + 13.86)\ \text{cm}^2$

$= 229.86\ \text{cm}^2$ $\frac{1}{2}$

(b) Volume of block

$= 6^3 + \frac{2}{3} \times \frac{22}{7} \times (2.1)^3$ 1

$= (216 + 19.40)\ \text{cm}^3$

$= 235.40\ \text{cm}^3$ 1

OR

Volume of frustum = $12308.8\ \text{cm}^3$

$\therefore \quad \frac{1}{3}\pi h(r_1^2 + r_2^2 + r_1 r_2) = 12308.8$

$\Rightarrow \quad \frac{1}{3} \times 3.14 \times h(20^2 + 12^2 + 20 \times 12) = 12308.8$ 1

$h = \frac{12308.8 \times 3}{784 \times 3.14}$

$h = 15$ cm 1

$l = \sqrt{15^2 + (20-12)^2} = 17$ cm. 1

Area of metal sheet used $= \pi l\ (r_1 + r_2) + \pi r_2^2$

$= 3.14[17 \times 32 + 12^2]$

$= 3.14 \times 688\ \text{cm}^2$

$= 2160.32\ \text{cm}^2$ 1

28. Correct construction of given triangle 2

Correct construction of triangle similar to given triangle 2

29. LHS $= \frac{\tan^3\theta}{1+\tan^2\theta} + \frac{\cot^3\theta}{1+\cot^2\theta}$

$= \frac{\frac{\sin^3\theta}{\cos^3\theta}}{1+\frac{\sin^2\theta}{\cos^2\theta}} + \frac{\frac{\cos^3\theta}{\sin^3\theta}}{1+\frac{\cos^2\theta}{\sin^2\theta}}$ 1

$= \frac{\sin^3\theta}{\cos\theta} + \frac{\cos^3\theta}{\sin\theta}$

$= \frac{\sin^4\theta + \cos^4\theta}{\cos\theta\sin\theta}$ 1

$$= \frac{(\sin^2\theta + \cos^2\theta)^2 - 2\sin^2\theta\cos^2\theta}{\cos\theta\sin\theta}$$ 1

$$= \frac{1 - 2\sin^2\theta\cos^2\theta}{\cos\theta\sin\theta} = \sec\theta\,\text{cosec}\,\theta - 2\sin\theta\cos\theta$$ 1

= R.H.S.

30. Let speed of stream be x km/hr.

Speed in downstream = (9 + x) km/hr. $\frac{1}{2}$

Speed in upstream = (9 – x) km/hr. $\frac{1}{2}$

$$\frac{15}{9+x} + \frac{15}{9-x} = 3\frac{45}{60} = 3\frac{3}{4}$$ 1

$$\frac{15(9-x+9+x)}{(9+x)(9-x)} = \frac{15}{4}$$

$\Rightarrow$ $72 = 81 - x^2$ 1

$x^2 = 9$

$x = 3$ or -3 Rejected

$\therefore$ Speed of stream = 3 km/hr 1

Strictly Confidential: (For Internal and Restricted use only)
Secondary School Examination
March 2019
MARKING SCHEME – MATHEMATICS (SUBJECT CODE -041)
PAPER CODE: 30/4/1, 30/4/2, 30/4/3

General Instructions: -

1. You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully. **Evaluation is a 10-12 days mission for all of us. Hence, it is necessary that you put in your best efforts in this process.**
2. Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration. Marking Scheme should be strictly adhered to and religiously followed. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and marks be awarded to them.**
3. The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
4. If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled.
5. If a question does not have any parts, marks must be awarded in the left hand margin and encircled.
6. If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out.
7. No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
8. A full scale of marks 1-80 has to be used. Please do not hesitate to award full marks if the answer deserves it.
9. Every examiner has to necessarily do evaluation work for full working hours i.e. 8 hours every day and evaluate 25 answer books per day.
10. Ensure that you do not make the following common types of errors committed by the Examiner in the past:-
    - Leaving answer or part thereof unassessed in an answer book.
    - Giving more marks for an answer than assigned to it.
    - Wrong transfer of marks from the inside pages of the answer book to the title page.
    - Wrong question wise totaling on the title page.
    - Wrong totaling of marks of the two columns on the title page.
    - Wrong grand total.
    - Marks in words and figures not tallying.
    - Wrong transfer of marks from the answer book to online award list.
    - Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.)
    - Half or a part of answer marked correct and the rest as wrong, but no marks awarded.

11. While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as (X) and awarded zero (0) Marks.

12. Any unassessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.

13. The Examiners should acquaint themselves with the guidelines given in the Guidelines for spot Evaluation before starting the actual evaluation.

14. Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.

15. The Board permits candidates to obtain photocopy of the Answer Book on request in an RTI application and also separately as a part of the re-evaluation process on payment of the processing charges.

QUESTION PAPER CODE 30/4/1

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. For equal roots, $4k^2 - 4k \times 6 = 0$ $\frac{1}{2}$

Hence $k = 6$ $\frac{1}{2}$

2. Here $-47 = 18 + (n-1)\left(-\frac{5}{2}\right)$ $\frac{1}{2}$

$\Rightarrow n = 27$ $\frac{1}{2}$

3. $\frac{\tan 65°}{\cot 25°} = \frac{\tan(90° - 25°)}{\cot 25°}$ $\frac{1}{2}$

$= \frac{\cot 25°}{\cot 25°} = 1$ $\frac{1}{2}$

OR

$\sin 67° + \cos 75° = \sin (90° - 23°) + \cos (90° - 15°)$ $\frac{1}{2}$

$= \cos 23° + \sin 15°$ $\frac{1}{2}$

4. Here $\frac{BC}{EF} = \frac{8}{11}$ $\frac{1}{2}$

$\therefore$ BC = $\frac{8}{11} \times 15.4 = 11.2$ cm $\frac{1}{2}$

5. Required distance = $\sqrt{(-a-a)^2 + (-b-b)^2}$ $\frac{1}{2}$

$= \sqrt{4(a^2+b^2)}$ or $2\sqrt{a^2+b^2}$ $\frac{1}{2}$

6. Here $1.41 < x < 2.6$

Any rational number lying between 1.4 ... & 2.6 ... 1

(variable answer)

OR

$2^2 \times 5^2 \times 5 \times 3^2 \times 17 = (10)^2 \times 5 \times 3^2 \times 17$

$\therefore$ No. of zeroes in the end of the number = Two 1

SECTION B

7. 12, 16, 20, ..., 204 $\frac{1}{2}$

Let the number of multiples be n.

$\therefore\ t_n = 12 + (n - 1) \times 4 = 204$ 1

$\Rightarrow n = 49$ $\frac{1}{2}$

OR

Here $t_3 = 16$ and $t_7 = t_5 + 12$ $\frac{1}{2}$

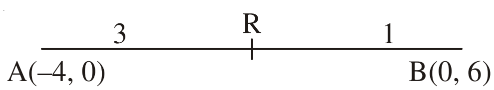
$\Rightarrow\ a + 2d = 16$ (i) and $a + 6d = a + 4d + 12$ (ii) $\frac{1}{2}$

From (ii), d = 6

From (i), a = 4 1

$\therefore$ A.P. is 4, 10, 16, ...

8.



$\frac{AR}{AB} = \frac{3}{4} \Rightarrow \frac{AR}{RB} = \frac{3}{1}$ 1

$\therefore\ R = \left(\frac{3\times 0 + 1(-4)}{4}, \frac{3\times 6 + 1\times 0}{4}\right)$, i.e., $\left(-1, \frac{9}{2}\right)$ 1

9.
$$\left.\begin{aligned} 867 &= 3\times 255 + 102 \\ 255 &= 2\times 102 + 51 \\ 102 &= 2\times 51 + 0 \end{aligned}\right\}$$ $1\frac{1}{2}$

$\therefore$ HCF = 51 $\frac{1}{2}$

10. The possible number of outcomes are 8 {HHH, HHT, HTH, THH, HTT, THT, TTH, TTT} 1

P (exactly one head) = $\frac{3}{8}$ 1

11. No. of spade cards + 3 other kings = 13 + 3 = 16 $\frac{1}{2}$

$\therefore$ Cards which are neither spade nor kings = 52 – 16 = 36 $\frac{1}{2}$

Hence P (neither spade nor king) = $\frac{36}{52}$ or $\frac{9}{13}$ 1

12. $\frac{3}{x}+\frac{8}{y}=-1$ ...(i)

$\frac{1}{x}-\frac{2}{y}=2$ ...(ii)

Multiply (ii) by 3 and subtract from (i), we get

$\frac{14}{y}=-7 \Rightarrow y = -2$ 1

Substitute this value of y = –2 in (i), we get x = 1

Hence, x = 1, y = –2 1

OR

For unique solution $\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \Rightarrow \frac{k}{3} \neq \frac{2}{6}$ 1

$\Rightarrow k \neq 1$ 1

The pair of equations have unique solution for all real values of k except 1.

SECTION C

13. Let $3+2\sqrt{5}=a$ where a is a rational number. $\frac{1}{2}$

Then $\sqrt{5}=\frac{a-3}{2}$ 1

which is contradiction as LHS in irrational and RHS is rational. 1

$\therefore$ $3+2\sqrt{5}$ can not be rational

Hence $3+2\sqrt{5}$ is irrational. $\frac{1}{2}$

14. Let the normal speed of the train be x km/hr

As per question, $\frac{480}{x-8} - \frac{480}{x} = 3$ 1

$\Rightarrow 480x - 480(x - 8) = 3(x - 8)x$

$\Rightarrow x^2 - 8x - 1280 = 0$ 1

$\Rightarrow (x - 40)(x + 32) = 0$

$\Rightarrow x = 40$

$\therefore$ Speed of the train = 40 km/hr. 1

15. Here $\alpha + \beta = 4,\ \alpha\beta = 3$ 1

$\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta = 16 - 6 = 10$ 1

$\therefore\ \alpha^4\beta^2 + \alpha^2\beta^4 = \alpha^2\beta^2(\alpha^2 + \beta^2) = 9 \times 10 = 90$ 1

16. LHS $= (\sin\theta + \cos\theta + 1)(\sin\theta + \cos\theta - 1)\sec\theta\ \mathrm{cosec}\,\theta$

$= [(\sin\theta + \cos\theta)^2 - 1]\sec\theta\ \mathrm{cosec}\,\theta$ 1

$= 2\sin\theta\cos\theta\sec\theta\ \mathrm{cosec}\,\theta$ 1

$= 2 = $ RHS 1

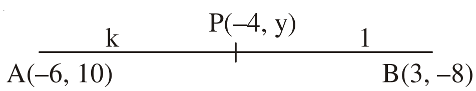
OR

LHS $= \sqrt{\frac{\sec\theta - 1}{\sec\theta + 1}} + \sqrt{\frac{\sec\theta + 1}{\sec\theta - 1}} = \frac{(\sec\theta - 1) + (\sec\theta + 1)}{\sqrt{\sec^2\theta - 1}}$ 1

$= \frac{2\sec\theta}{\tan\theta}$ 1

$= \frac{2}{\sin\theta} = 2\,\mathrm{cosec}\,\theta = \mathrm{RHS}$ 1

17.



Let point P divides the line segment AB in the ratio k : 1

$\therefore\ \frac{3k-6}{k+1} = -4$ 1

$\Rightarrow\ 3k - 6 = -4k - 4$

$\Rightarrow\ 7k = 2$ i.e., $k = \frac{2}{7}$ $\therefore$ Ratio is 2 : 7 1

Again $\frac{2\times(-8) + 7\times 10}{2+7} = y \Rightarrow y = 6$ 1

Hence y = 6

OR

The points are collinear if the area of triangle formed is zero.

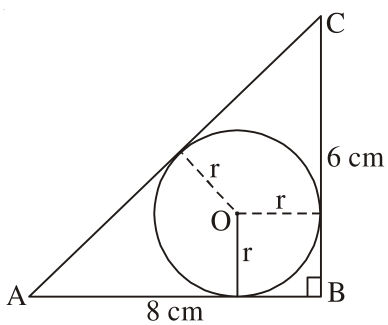
i.e., $-5(p + 2) + 1(-2 - 1) + 4(1 - p) = 0$ $1\frac{1}{2}$

$-5p - 10 - 3 + 4 - 4p = 0$

$-9p = 9$

$p = -1$ $1\frac{1}{2}$

18.



$AC = \sqrt{AB^2 + BC^2} = \sqrt{64 + 36} = 10\text{ cm}$ $\frac{1}{2}$

Area of $\Delta ABC = \frac{1}{2} \times 8 \times 6 = 24\text{ cm}^2$ $\frac{1}{2}$

Let r be the radius of inscribed circle.

$ar(\Delta ABC) = ar(AOB) + ar(\Delta BOC) + ar(\Delta AOC)$

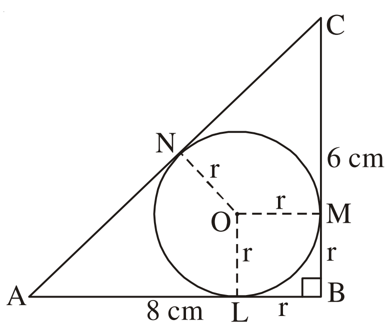
$= \frac{1}{2} \times 8r + \frac{1}{2} \times 6r + \frac{1}{2} \times 10r$ 1

$= \frac{1}{2} r(8 + 6 + 10) = 12r$

$12r = 24 \Rightarrow r = 2\text{ cm}$ $\frac{1}{2}$

$\therefore$ Diameter = 4 cm $\frac{1}{2}$

Alternate method:



Here BL = BM = r (sides of squares)

$AC = \sqrt{AB^2 + BC^2} = 10\text{ cm}$ 1

$AL = AN = 8 - r$ and $CM = CN = 6 - r$ $\frac{1}{2}$

$AC = AN + NC$

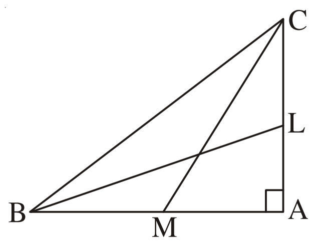
$\Rightarrow \quad 10 = 8 - r + 6 - r$

$\Rightarrow \quad 2r = 4$

$\Rightarrow \quad r = 2$ $\frac{1}{2}$

$\therefore$ Diameter = 4 cm 1

19. In right angled triangle CAM,



$$CM^2 = CA^2 + AM^2 \quad ...(i)$$

Similarly, $BC^2 = AC^2 + AB^2 \quad ...(ii)$ 1

and $BL^2 = AL^2 + AB^2 \quad ...(iii)$

Now $4(BL^2 + CM^2) = 4(AL^2 + AB^2 + AC^2 + AM^2)$ 1

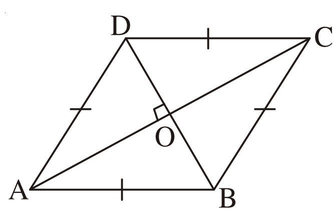
But $AL = LC = \frac{1}{2}AC$ and $AM = MB = \frac{1}{2}AB$

$$\therefore\ 4(BL^2 + CM^2) = 4\left(\frac{AC^2}{4} + AB^2 + AC^2 + \frac{AB^2}{4}\right)$$

$$= 4\left(\frac{5}{4}AB^2 + \frac{5}{4}AC^2\right)$$

$= 5(AB^2 + AC^2) = 5BC^2$ 1

OR



Let ABCD be rhombus and its diagonals intersect at O.

In ΔAOB, $AB^2 = AO^2 + OB^2$ 1

$$= \left(\frac{AC}{2}\right)^2 + \left(\frac{BD}{2}\right)^2$$

$= \frac{1}{4}(AC^2 + BD^2)$ 1

$\Rightarrow 4AB^2 = AC^2 + BD^2$

$\Rightarrow AB^2 + BC^2 + CD^2 + AD^2 = AC^2 + BD^2$ (ABCD being rhombus) 1

20. Area of shaded region

$= \left[\pi(42)^2 - \pi(21)^2\right]\frac{300°}{360°}$ 1

$= \frac{22}{7} \times 63 \times 21 \times \frac{5}{6}.$ 1

$= 3465 \text{ cm}^2$ 1

21. Volume of cone = $\frac{1}{3}\pi r^2 h = \frac{1}{3}\pi(6)^2 \times 24 \text{ cm}^3$ 1

Let the radius of the sphere be R cm

$\therefore \ \frac{4}{3}\pi R^3 = \frac{1}{3}\pi \times 36 \times 24$ 1

$\Rightarrow R^3 = 6 \times 6 \times 6$

$\Rightarrow R = 6$ cm $\frac{1}{2}$

Surface area = $4\pi R^2 = 144\pi \text{ cm}^2$ $\frac{1}{2}$

OR

Water required to fill the tank = $\pi(5)^2 \times 2 = 50\pi \text{ m}^3$ 1

Water flown in 1 hour = $\pi\left(\frac{1}{10}\right)^2 \times 3000 \text{ m}^3$

$= 30\pi \text{ m}^3$ 1

Time taken to fill $30\pi \text{ m}^3$ = 60 minutes

Time taken to fill $50\pi \text{ m}^3 = \frac{60}{30} \times 50 = 100$ minutes 1

22. Here the modal class is 20 – 25 $\frac{1}{2}$

Mode $= 20 + \frac{20-7}{40-7-8} \times 5$ 2

$= 20 + \frac{13}{25} \times 5 = 22.6$ Hence mode = 22.6 $\frac{1}{2}$

SECTION D

23. $\frac{1}{2a+b+2x} - \frac{1}{2x} = \frac{1}{2a} + \frac{1}{b}$

or $\frac{2x-2a-b-2x}{2x(2a+b+2x)} = \frac{b+2a}{2ab}$ 1

or $\frac{-(2a+b)}{2x(2a+b+2x)} = \frac{2a+b}{2ab}$ 1 or $2x^2 + x(2a + b) + ab = 0$

$(x + a)(2x + b) = 0$ 1

$\Rightarrow x = -a \text{ or } -\dfrac{b}{2}$ 1

OR

Let x and y be lengths of the sides of two squares.

$\therefore x^2 + y^2 = 640$ and $4(x - y) = 64$ i.e., $x - y = 16$ 1

$x^2 + (x - 16)^2 = 640$ 1

or $x^2 + x^2 - 32x + 256 - 640 = 0$

or $2x^2 - 32x - 384 = 0$

or $x^2 - 16x - 192 = 0$

or $(x + 8)(x - 24) = 0 \Rightarrow x = 24$ 1

$\therefore y = x - 16 = 24 - 16 = 8$

Hence lengths of sides of the squares are 24 cm and 8 cm. 1

24. Here $\dfrac{p}{2}\{2a + (p-1)d\} = \dfrac{q}{2}\{2a + (q-1)d\}$ 1

$\Rightarrow pa + \dfrac{p(p-1)d}{2} - qa - \dfrac{q(q-1)d}{2} = 0$

$\Rightarrow (p-q)a + \dfrac{d}{2}(p^2 - p - q^2 + q) = 0$ 1

$\Rightarrow (p-q)a + \dfrac{d}{2}(p-q)(p+q-1) = 0$

$\Rightarrow a + \dfrac{d}{2}(p+q-1) = 0$

$\Rightarrow 2a + (p + q - 1)d = 0 \quad ...(i)$ 1

Now $S_{p+q} = \dfrac{p+q}{2}\{2a + (p+q-1)d\}$

$= 0$ (using (i)) 1

25. In ΔABD, $AB^2 = AD^2 + BD^2 \Rightarrow AD^2 = AB^2 - BD^2$ 1

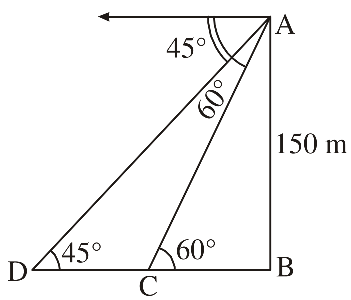
In ΔADC, $AC^2 = AD^2 + CD^2$

$= AB^2 - BD^2 + (BC - BD)^2$ 1

$= AB^2 - BD^2 + BC^2 + BD^2 - 2BC \times BD$ 1

$= AB^2 + BC^2 - 2BC \times BD$ 1

26. Correct Figure 1



$\frac{150}{BC} = \tan 60° = \sqrt{3}$

$\Rightarrow \; BC = \frac{150}{\sqrt{3}} = 50\sqrt{3}$ m $\frac{1}{2}$

Also $\frac{AB}{BD} = \tan 45° = 1 \Rightarrow AB = BD = 150$ m $\frac{1}{2}$

Now $CD = BD - BC = (150 - 50\sqrt{3})$ m $\frac{1}{2}$

Distance travelled in 2 minutes $= (150 - 50\sqrt{3})$ m

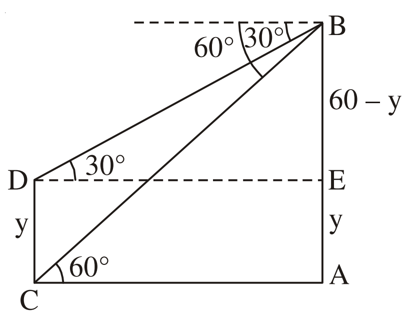
$\therefore$ Distance travelled in 1 minute $= (75 - 25\sqrt{3})$ m 1

or $75 - 25(1.732) = 75 - 43.3 = 31.7$ m/minute

Hence speed of boat is $(75 - 25\sqrt{3})$ m/minutes or 31.7 m/minutes $\frac{1}{2}$

OR

Correct Figure 1



In ΔABC, $\frac{AB}{AC} = \tan 60°$

$\frac{60}{AC} = \sqrt{3}$

$AC = 20\sqrt{3}$ m 1

In ΔBED, $\frac{60 - y}{DE} = \tan 30° = \frac{1}{\sqrt{3}}$ 1

i.e., $\frac{60 - y}{20\sqrt{3}} = \frac{1}{\sqrt{3}} \Rightarrow 60 - y = 20$ i.e., $y = 40$ m $\frac{1}{2}$

$\left.\begin{array}{l}\text{Hence width of river} = 20\sqrt{3} \text{ m and} \\ \text{height of other pole} = 40 \text{ m}\end{array}\right\}$ $\frac{1}{2}$

27. Correct Construction of triangle 1

Correct Construction of similar triangle 3

28. LHS = $\sin^8\theta - \cos^8\theta = (\sin^4\theta)^2 - (\cos^4\theta)^2$

$= (\sin^4\theta + \cos^4\theta)(\sin^4\theta - \cos^4\theta)$ 1

$= (\sin^4\theta + \cos^4\theta + 2\sin^2\theta\cos^2\theta - 2\sin^2\theta\cos^2\theta)(\sin^2\theta + \cos^2\theta)(\sin^2\theta - \cos^2\theta)$ 1

$= [(\sin^2 + \cos^2\theta)^2 - 2\sin^2\theta\cos^2\theta](\sin^2\theta - \cos^2\theta)$ 1

$= (1 - 2\sin^2\theta\cos^2\theta)(\sin^2\theta - \cos^2\theta)$

$= (1 - 2\sin^2\theta\cos^2\theta)(1 - 2\cos^2\theta) = \text{RHS}$ 1

29. Volume of the container $= \dfrac{\pi}{3}h(r_1^2 + r_2^2 + r_1 r_2)$

$= \dfrac{3.14}{3} \times 16\,(20^2 + 8^2 + 20 \times 8)$ $\frac{1}{2}$

$= 3.14 \times 16 \times 208 = 10450 \text{ cm}^3$ 1

$= 10.45$ litres

Cost of milk = $10.45 \times 50 =$ ₹ 522.50 $\frac{1}{2}$

Slant height of frustum = $\sqrt{16^2 + 12^2} = 20\,\text{cm}$ $\frac{1}{2}$

Surface area $= \pi[(r_1 + r_2)l + r_2^2]$

$= 3.14[(8 + 20)\ 20 + 8^2]$

$= 3.14 \times 624 = 1959.36 \text{ cm}^2$ 1

$\therefore$ Cost of metal used $= \dfrac{10}{100} \times 1959.36 =$ ₹195.93 $\frac{1}{2}$

30.

Classes	**Class mark (X)**	**Frequency (f_i)**	$f_i\ x_i$
10-30	20	5	100
30-50	40	8	320
50-70	60	12	720
70-90	80	20	1600
90-110	100	3	300
110-130	120	2	240

Correct Table 2

$$\left.\begin{aligned} \text{Mean} &= \frac{\Sigma f_i x_i}{\Sigma f_i} \\ &= \frac{3280}{50} \\ &= 65.6 \end{aligned}\right\}$$ 2

Alternate methods by assuming mean are acceptable.

OR

	cf	
More than or equal to 65	24	
More than or equal to 60	54	
More than or equal to 55	74	Table $1\frac{1}{2}$
More than or equal to 50	90	
More than or equal to 45	96	
More than or equal to 40	100	

Plotting graph of (40, 100), (45, 96), (50, 90), (55, 74), (60, 54)

and (65, 24) and joining the points $1\frac{1}{2}+1$

QUESTION PAPER CODE 30/4/2

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. Disc. = 144 – 4 × 4 × (–k) < 0 $\frac{1}{2}$

16k < –144

k < –9 $\frac{1}{2}$

2. Required distance = $\sqrt{(-a-a)^2+(-b-b)^2}$ $\frac{1}{2}$

$= \sqrt{4(a^2+b^2)}$ or $2\sqrt{a^2+b^2}$ $\frac{1}{2}$

3. Here 1.41 < x < 2.6

Any rational number lying between 1.4 ... & 2.6 ... 1

(variable answer)

OR

$2^2 \times 5^2 \times 5 \times 3^2 \times 17 = (10)^2 \times 5 \times 3^2 \times 17$

∴ No. of zeroes in the end of the number = Two 1

4. Here $\frac{BC}{EF} = \frac{8}{11}$ $\frac{1}{2}$

∴ BC = $\frac{8}{11} \times 15.4 = 11.2$ cm $\frac{1}{2}$

5. $\frac{\tan 65°}{\cot 25°} = \frac{\tan(90° - 25°)}{\cot 25°}$ $\frac{1}{2}$

$= \frac{\cot 25°}{\cot 25°} = 1$ $\frac{1}{2}$

OR

sin 67° + cos 75° = sin (90° – 23°) + cos (90° – 15°) $\frac{1}{2}$

= cos 23° + sin 15° $\frac{1}{2}$

6. Here $-47 = 18 + (n-1)\left(-\frac{5}{2}\right)$ $\frac{1}{2}$

$\Rightarrow$ n = 27 $\frac{1}{2}$

SECTION B

7. Let the number of white balls = x

$\therefore$ The number of black balls = 15 – x

P(Black) = $\frac{2}{3}$

$\Rightarrow \frac{15-x}{15} = \frac{2}{3}$ 1

$\Rightarrow$ 45 – 3x = 30

$\Rightarrow$ x = 5 1

Hence number of white balls = 5.

8. No. of spade cards + 3 other kings = 13 + 3 = 16 $\frac{1}{2}$

$\therefore$ Cards which are neither spade nor kings = 52 – 16 = 36 $\frac{1}{2}$

Hence P (neither spade nor king) = $\frac{36}{52}$ or $\frac{9}{13}$ 1

9. $\frac{3}{x} + \frac{8}{y} = -1$ ...(i)

$\frac{1}{x} - \frac{2}{y} = 2$ ...(ii)

Multiply (ii) by 3 and subtract from (i), we get

$\frac{14}{y} = -7 \Rightarrow y = -2$ 1

Substitute this value of y = –2 in (i), we get x = 1

Hence, x = 1, y = –2 1

OR

For unique solution $\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \Rightarrow \frac{k}{3} \neq \frac{2}{6}$ 1

$\Rightarrow k \neq 1$ 1

The pair of equations have unique solution for all real values of k except 1.

10. 12, 16, 20, ..., 204 $\frac{1}{2}$

Let the number of multiples be n.

$\therefore\ t_n = 12 + (n - 1) \times 4 = 204$ 1

$\Rightarrow n = 49$ $\frac{1}{2}$

OR

Here $t_3 = 16$ and $t_7 = t_5 + 12$ $\frac{1}{2}$

$\Rightarrow\ a + 2d = 16$ (i) and $a + 6d = a + 4d + 12$ (ii) $\frac{1}{2}$

From (ii), d = 6

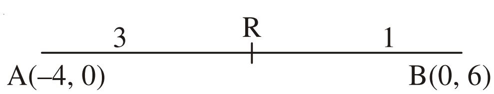
From (i), a = 4 1

$\therefore$ A.P. is 4, 10, 16, ...

11. $\left.\begin{aligned} 867 &= 3 \times 255 + 102 \\ 255 &= 2 \times 102 + 51 \\ 102 &= 2 \times 51 + 0 \end{aligned}\right\}$ $1\frac{1}{2}$

$\therefore$ HCF = 51 $\frac{1}{2}$

12. $\frac{AR}{AB} = \frac{3}{4} \Rightarrow \frac{AR}{RB} = \frac{3}{1}$ 1



$\therefore\ R = \left(\frac{3 \times 0 + 1(-4)}{4}, \frac{3 \times 6 + 1 \times 0}{4}\right)$, i.e., $\left(-1, \frac{9}{2}\right)$ 1

SECTION C

13. LHS $= (\sin\theta + \cos\theta + 1)(\sin\theta + \cos\theta - 1)\sec\theta\,\text{cosec}\,\theta$

$= [(\sin\theta + \cos\theta)^2 - 1]\sec\theta\,\text{cosec}\,\theta$ 1

$= 2\sin\theta\cos\theta\sec\theta\,\text{cosec}\,\theta$ 1

$= 2 = \text{RHS}$ 1

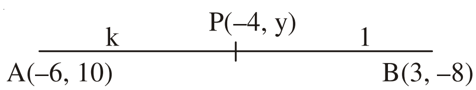
OR

LHS $= \sqrt{\dfrac{\sec\theta - 1}{\sec\theta + 1}} + \sqrt{\dfrac{\sec\theta + 1}{\sec\theta - 1}} = \dfrac{(\sec\theta - 1) + (\sec\theta + 1)}{\sqrt{\sec^2\theta - 1}}$ 1

$= \dfrac{2\sec\theta}{\tan\theta}$ 1

$= \dfrac{2}{\sin\theta} = 2\,\text{cosec}\,\theta = \text{RHS}$ 1

14.



Let point P divides the line segment AB in the ratio k : 1

$\therefore\ \dfrac{3k - 6}{k + 1} = -4$ 1

$\Rightarrow\ 3k - 6 = -4k - 4$

$\Rightarrow\ 7k = 2$ i.e., $k = \dfrac{2}{7}$ $\therefore$ Ratio is 2 : 7 1

Again $\dfrac{2 \times (-8) + 7 \times 10}{2 + 7} = y \Rightarrow y = 6$ 1

Hence $y = 6$

OR

The points are collinear if the area of triangle formed is zero.

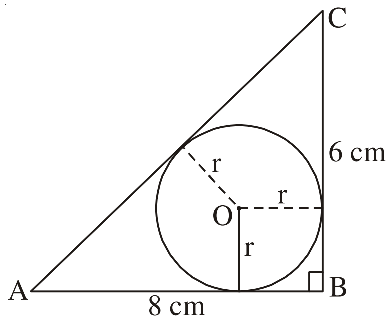
i.e., $-5(p + 2) + 1(-2 - 1) + 4(1 - p) = 0$ $1\frac{1}{2}$

$-5p - 10 - 3 + 4 - 4p = 0$

$-9p = 9$

$p = -1$ $1\frac{1}{2}$

15. $AC = \sqrt{AB^2 + BC^2} = \sqrt{64 + 36} = 10\text{ cm}$ $\frac{1}{2}$



Area of $\Delta ABC = \frac{1}{2} \times 8 \times 6 = 24\text{ cm}^2$ $\frac{1}{2}$

Let r be the radius of inscribed circle.

ar(ΔABC) = ar(AOB) + ar(ΔBOC) + ar(ΔAOC)

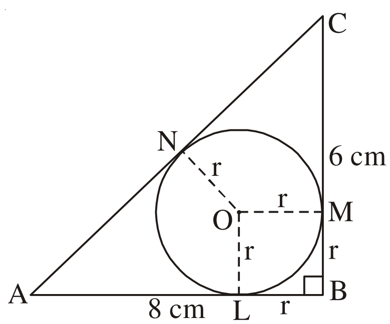
$= \frac{1}{2} \times 8r + \frac{1}{2} \times 6r + \frac{1}{2} \times 10r$ 1

$= \frac{1}{2} r(8 + 6 + 10) = 12r$

$12r = 24 \Rightarrow r = 2$ cm $\frac{1}{2}$

$\therefore$ Diameter = 4 cm $\frac{1}{2}$

Alternate method:



Here BL = BM = r (sides of squares)

$AC = \sqrt{AB^2 + BC^2} = 10$ cm 1

AL = AN = 8 – r and CM = CN = 6 – r $\frac{1}{2}$

AC = AN + NC

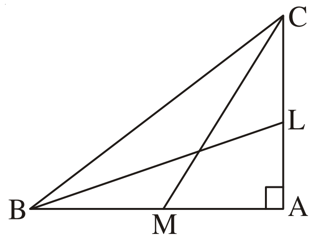
$\Rightarrow$ 10 = 8 – r + 6 – r

$\Rightarrow$ 2r = 4

$\Rightarrow$ r = 2 $\frac{1}{2}$

$\therefore$ Diameter = 4 cm 1

16. In right angled triangle CAM,



$CM^2 = CA^2 + AM^2$ ...(i)

Similarly, $BC^2 = AC^2 + AB^2$ ...(ii) 1

and $BL^2 = AL^2 + AB^2$ ...(iii)

Now $4(BL^2 + CM^2) = 4(AL^2 + AB^2 + AC^2 + AM^2)$ 1

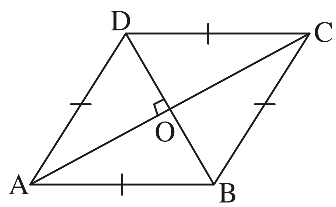
But $AL = LC = \frac{1}{2}AC$ and $AM = MB = \frac{1}{2}AB$

$$\therefore\ 4(BL^2 + CM^2) = 4\left(\frac{AC^2}{4} + AB^2 + AC^2 + \frac{AB^2}{4}\right)$$

$$= 4\left(\frac{5}{4}AB^2 + \frac{5}{4}AC^2\right)$$

$$= 5(AB^2 + AC^2) = 5BC^2 \qquad 1$$

OR



Let ABCD be rhombus and its diagonals intersect at O.

In ΔAOB, $AB^2 = AO^2 + OB^2$ 1

$$= \left(\frac{AC}{2}\right)^2 + \left(\frac{BD}{2}\right)^2$$

$$= \frac{1}{4}(AC^2 + BD^2) \qquad 1$$

$$\Rightarrow 4AB^2 = AC^2 + BD^2$$

$\Rightarrow AB^2 + BC^2 + CD^2 + AD^2 = AC^2 + BD^2$ (ABCD being rhombus) 1

17. Area of shaded region

$$= \left[\pi(42)^2 - \pi(21)^2\right]\frac{300°}{360°} \qquad 1$$

$$= \frac{22}{7} \times 63 \times 21 \times \frac{5}{6}. \qquad 1$$

$$= 3465 \text{ cm}^2 \qquad 1$$

18. Here the modal class is 20 – 25 $\frac{1}{2}$

$$\text{Mode} = 20 + \frac{20-7}{40-7-8} \times 5 \qquad 2$$

$= 20 + \frac{13}{25} \times 5 = 22.6$ Hence mode = 22.6 $\frac{1}{2}$

19. Volume of cone $= \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi(6)^2 \times 24 \text{ cm}^3$ 1

Let the radius of the sphere be R cm

$$\therefore\ \frac{4}{3}\pi R^3 = \frac{1}{3}\pi \times 36 \times 24 \qquad 1$$

$\Rightarrow R^3 = 6 \times 6 \times 6$

$\Rightarrow R = 6$ cm $\frac{1}{2}$

Surface area $= 4\pi R^2 = 144\pi$ cm^2 $\frac{1}{2}$

OR

Water required to fill the tank $= \pi(5)^2 \times 2 = 50\pi$ m^3 1

Water flown in 1 hour $= \pi\left(\frac{1}{10}\right)^2 \times 3000$ m^3

$= 30\pi$ m^3 1

Time taken to fill 30π m^3 = 60 minutes

Time taken to fill 50π m^3 $= \frac{60}{30} \times 50 = 100$ minutes 1

20. Let $2 + 3\sqrt{3} = a$ where a is a rational number $\frac{1}{2}$

Then $\sqrt{3} = \frac{a-2}{3}$ 1

Which is contradiction as LHS in irrational and

RHS is rational 1

$\therefore$ $2 + 3\sqrt{3}$ is irrational $\frac{1}{2}$

21. Let x and y be length of the sides of two squares.

$\therefore$ $x^2 + y^2 = 157$ and $4(x + y) = 68 \Rightarrow x + y = 17$ 1

$\therefore$ $x^2 + (17 - x)^2 = 157$ 1

$x^2 + 289 + x^2 - 34x - 157 = 0$

or $x^2 - 17x + 66 = 0$

$(x - 6)(x - 11) = 0$

$\therefore$ $x = 6$ or 11

$\therefore$ $y = 11$ or 6

Hence length of sides of squares are 6 m and 11 m. 1

22. If α, β are zeroes of the polynomial, then

$\alpha + \beta = -1, \ \alpha\beta = -20$

$\therefore$ Polynomial is $(x^2 + x - 20)$ $1\frac{1}{2}$

$(x + 5)(x - 4)$

$\therefore$ Zeroes of the polynomial are 4 and –5 $1\frac{1}{2}$

SECTION D

23. Let x km/hr be the usual speed of the plane

$\therefore \ \frac{1500}{x} - \frac{1500}{x+250} = \frac{1}{2}$ $1\frac{1}{2}$

$\Rightarrow \ x^2 + 250x - 750000 = 0$ 1

$\Rightarrow \ x = -1000$ or 750 1

$\therefore$ Speed of the plane = 750 km/h $\frac{1}{2}$

OR

Let l be the length and b be the breadth of the park

$\therefore \ 2(l + b) = 60 \Rightarrow l + b = 30$ and $l \times b = 200$ 1

$l(30 - l) = 200$ 1

$\Rightarrow \ l^2 - 30l + 200 = 0$

$\Rightarrow \ (l - 20)(l - 10) = 10$ 1

$\Rightarrow \ l = 20$ or 10

Hence length = 20 m, breadth = 10 m 1

24. Let x be the nth term

$\therefore \ t_n = x = 2 + (n - 1)4$ i.e. $x = 4n - 2$ 1

Also $S_n = 1800 = \frac{n}{2}\{4 + (n-1)4\}$ 1

i.e. $\frac{4n^2}{2} = 1800$

$n^2 = 900 \Rightarrow n = 30$ 1

$\therefore \quad x = 30 \times 4 - 2 = 118$ 1

25. $\sec\theta + \tan\theta = m \qquad \text{...(i)}$

We know that $\sec^2\theta - \tan^2\theta = 1$ 1

$\sec\theta - \tan\theta = \dfrac{1}{m} \qquad \text{...(ii)}$ 1

From (i) and (ii), $2\sec\theta = m + \dfrac{1}{m}$ and $2\tan\theta = m - \dfrac{1}{m}$ 1

Now $\sin\theta = \dfrac{2\tan\theta}{2\sec\theta} = \dfrac{m - \frac{1}{m}}{m + \frac{1}{m}} = \dfrac{m^2 - 1}{m^2 + 1}$ 1

26. In ΔABD, $AB^2 = AD^2 + BD^2 \Rightarrow AD^2 = AB^2 - BD^2$ 1

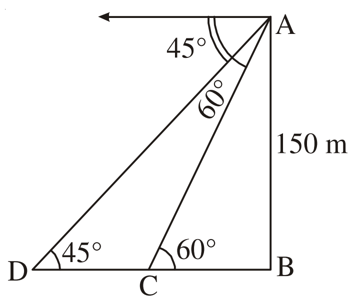
In ΔADC, $AC^2 = AD^2 + CD^2$

$= AB^2 - BD^2 + (BC - BD)^2$ 1

$= AB^2 - BD^2 + BC^2 + BD^2 - 2BC \times BD$ 1

$= AB^2 + BC^2 - 2BC \times BD$ 1

27. Correct Figure 1



$\dfrac{150}{BC} = \tan 60° = \sqrt{3}$

$\Rightarrow \quad BC = \dfrac{150}{\sqrt{3}} = 50\sqrt{3}$ m $\frac{1}{2}$

Also $\dfrac{AB}{BD} = \tan 45° = 1 \Rightarrow AB = BD = 150$ m $\frac{1}{2}$

Now $CD = BD - BC = (150 - 50\sqrt{3})$ m $\frac{1}{2}$

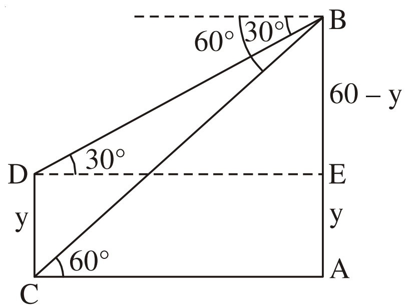
Distance travelled in 2 minutes = $(150 - 50\sqrt{3})$ m

$\therefore$ Distance travelled in 1 minute = $(75 - 25\sqrt{3})$ m 1

or $75 - 25(1.732) = 75 - 43.3 = 31.7$ m/minute

Hence speed of boat is $(75 - 25\sqrt{3})$ m/minutes or 31.7 m/minutes $\frac{1}{2}$

OR



Correct Figure 1

In ΔABC, $\frac{AB}{AC} = \tan 60°$

$\frac{60}{AC} = \sqrt{3}$

$AC = 20\sqrt{3}$ m 1

In ΔBED, $\frac{60 - y}{DE} = \tan 30° = \frac{1}{\sqrt{3}}$ 1

i.e., $\frac{60 - y}{20\sqrt{3}} = \frac{1}{\sqrt{3}} \Rightarrow 60 - y = 20$ i.e., $y = 40$ m $\frac{1}{2}$

$\left.\begin{array}{l}\text{Hence width of river} = 20\sqrt{3} \text{ m and} \\ \text{height of other pole} = 40 \text{ m}\end{array}\right\}$ $\frac{1}{2}$

28. Correct Construction of triangle 1

Correct Construction of similar triangle 3

29.

Classes	**Class mark (X)**	**Frequency (f_i)**	**$f_i x_i$**		
10-30	20	5	100		
30-50	40	8	320		
50-70	60	12	720		
70-90	80	20	1600	Correct Table	2
90-110	100	3	300		
110-130	120	2	240		

$$\left.\begin{aligned} \text{Mean} &= \frac{\Sigma f_i x_i}{\Sigma f_i} \\ &= \frac{3280}{50} \\ &= 65.6 \end{aligned}\right\}$$ 2

Alternate methods by assuming mean are acceptable.

OR

	cf	
More than or equal to 65	24	
More than or equal to 60	54	
More than or equal to 55	74	Table $1\frac{1}{2}$
More than or equal to 50	90	
More than or equal to 45	96	
More than or equal to 40	100	

Plotting graph of (40, 100), (45, 96), (50, 90), (55, 74), (60, 54)

and (65, 24) and joining the points $1\frac{1}{2}+1$

30. Volume of the container $= \frac{\pi}{3}h(r_1^2 + r_2^2 + r_1r_2)$

$= \frac{3.14}{3} \times 16\,(20^2 + 8^2 + 20 \times 8)$ $\frac{1}{2}$

$= 3.14 \times 16 \times 208 = 10450\text{ cm}^3$ 1

$= 10.45$ litres

Cost of milk = 10.45 × 50 = ₹ 522.50 $\frac{1}{2}$

Slant height of frustum $= \sqrt{16^2 + 12^2} = 20\,\text{cm}$ $\frac{1}{2}$

Surface area $= \pi[(r_1 + r_2)l + r_2^2]$

$= 3.14[(8 + 20)\ 20 + 8^2]$

$= 3.14 \times 624 = 1959.36\text{ cm}^2$ 1

$\therefore$ Cost of metal used $= \frac{10}{100} \times 1959.36 = ₹\,195.93$ $\frac{1}{2}$

QUESTION PAPER CODE 30/4/3

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. Let nth term of the A.P. be 101.

$\therefore \quad t_n = -4 + (n - 1)3 = 101$ $\frac{1}{2}$

$3n - 7 = 101$

$n = \frac{108}{3} = 36$ $\frac{1}{2}$

2. $\frac{\tan 65°}{\cot 25°} = \frac{\tan(90° - 25°)}{\cot 25°}$ $\frac{1}{2}$

$= \frac{\cot 25°}{\cot 25°} = 1$ $\frac{1}{2}$

OR

$\sin 67° + \cos 75° = \sin(90° - 23°) + \cos(90° - 15°)$ $\frac{1}{2}$

$= \cos 23° + \sin 15°$ $\frac{1}{2}$

3. For equal roots, $4k^2 - 4k \times 6 = 0$ $\frac{1}{2}$

Hence $k = 6$ $\frac{1}{2}$

4. Here $1.41 < x < 2.6$

Any rational number lying between 1.4 ... & 2.6 ... 1

(variable answer)

OR

$2^2 \times 5^2 \times 5 \times 3^2 \times 17 = (10)^2 \times 5 \times 3^2 \times 17$

$\therefore$ No. of zeroes in the end of the number = Two 1

5. Required distance = $\sqrt{(-a-a)^2 + (-b-b)^2}$ $\frac{1}{2}$

$= \sqrt{4(a^2 + b^2)}$ or $2\sqrt{a^2 + b^2}$ $\frac{1}{2}$

6. Here $\frac{BC}{EF} = \frac{8}{11}$ $\frac{1}{2}$

$\therefore$ BC $= \frac{8}{11} \times 15.4 = 11.2$ cm $\frac{1}{2}$

SECTION B

7. $\frac{3}{x} + \frac{8}{y} = -1$ ...(i)

$\frac{1}{x} - \frac{2}{y} = 2$ ...(ii)

Multiply (ii) by 3 and subtract from (i), we get

$\frac{14}{y} = -7 \Rightarrow y = -2$ 1

Substitute this value of $y = -2$ in (i), we get $x = 1$

Hence, $x = 1$, $y = -2$ 1

OR

For unique solution $\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \Rightarrow \frac{k}{3} \neq \frac{2}{6}$ 1

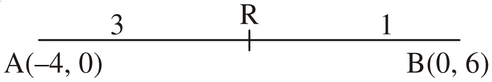
$\Rightarrow k \neq 1$ 1

The pair of equations have unique solution for all real values of k except 1.

8. $$\left.\begin{aligned} 867 &= 3 \times 255 + 102 \\ 255 &= 2 \times 102 + 51 \\ 102 &= 2 \times 51 + 0 \end{aligned}\right\}$$ $1\frac{1}{2}$

$\therefore$ HCF $= 51$ $\frac{1}{2}$

9.



$\frac{AR}{AB} = \frac{3}{4} \Rightarrow \frac{AR}{RB} = \frac{3}{1}$ 1

$\therefore$ R $= \left(\frac{3 \times 0 + 1(-4)}{4}, \frac{3 \times 6 + 1 \times 0}{4}\right)$, i.e., $\left(-1, \frac{9}{2}\right)$ 1

10. 12, 16, 20, ..., 204 $\frac{1}{2}$

Let the number of multiples be n.

$\therefore\ t_n = 12 + (n - 1) \times 4 = 204$ 1

$\Rightarrow n = 49$ $\frac{1}{2}$

OR

Here $t_3 = 16$ and $t_7 = t_5 + 12$ $\frac{1}{2}$

$\Rightarrow\ a + 2d = 16$ (i) and $a + 6d = a + 4d + 12$ (ii) $\frac{1}{2}$

From (ii), $d = 6$

From (i), $a = 4$ 1

$\therefore$ A.P. is 4, 10, 16, ...

11. The possible number of outcomes are 8 {HHH, HHT, HTH, THH, HTT, THT, TTH, TTT} 1

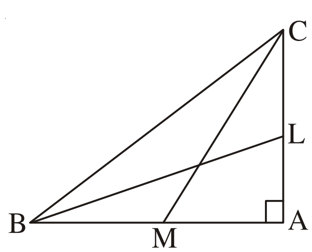
P (exactly one head) = $\frac{3}{8}$ 1

12. (a) P(a prime no.) = $\frac{3}{6}$ or $\frac{1}{2}$ 1

(b) P(odd no.) = $\frac{3}{6}$ or $\frac{1}{2}$ 1

SECTION C

13. In right angled triangle CAM,



$CM^2 = CA^2 + AM^2$ ...(i)

Similarly, $BC^2 = AC^2 + AB^2$ ...(ii)

and $BL^2 = AL^2 + AB^2$ ...(iii) 1

Now $4(BL^2 + CM^2) = 4(AL^2 + AB^2 + AC^2 + AM^2)$ 1

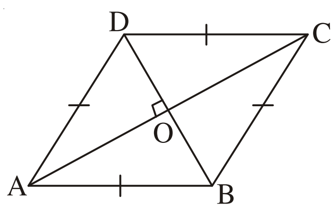
But $AL = LC = \frac{1}{2}AC$ and $AM = MB = \frac{1}{2}AB$

$\therefore\ 4(BL^2 + CM^2) = 4\left(\frac{AC^2}{4} + AB^2 + AC^2 + \frac{AB^2}{4}\right)$

$$= 4\left(\frac{5}{4}AB^2 + \frac{5}{4}AC^2\right)$$

$= 5(AB^2 + AC^2) = 5BC^2$ 1

OR



Let ABCD be rhombus and its diagonals intersect at O.

In ΔAOB, $AB^2 = AO^2 + OB^2$ 1

$$= \left(\frac{AC}{2}\right)^2 + \left(\frac{BD}{2}\right)^2$$

$= \frac{1}{4}(AC^2 + BD^2)$ 1

$\Rightarrow 4AB^2 = AC^2 + BD^2$

$\Rightarrow AB^2 + BC^2 + CD^2 + AD^2 = AC^2 + BD^2$ (ABCD being rhombus) 1

14. Area of shaded region

$= \left[\pi(42)^2 - \pi(21)^2\right]\frac{300°}{360°}$ 1

$= \frac{22}{7} \times 63 \times 21 \times \frac{5}{6}.$ 1

$= 3465 \text{ cm}^2$ 1

15. Volume of cone $= \frac{1}{3}\pi r^2 h = \frac{1}{3}\pi(6)^2 \times 24 \text{ cm}^3$ 1

Let the radius of the sphere be R cm

$\therefore \frac{4}{3}\pi R^3 = \frac{1}{3}\pi \times 36 \times 24$ 1

$\Rightarrow R^3 = 6 \times 6 \times 6$

$\Rightarrow R = 6$ cm $\frac{1}{2}$

Surface area $= 4\pi R^2 = 144\pi \text{ cm}^2$ $\frac{1}{2}$

OR

Water required to fill the tank $= \pi(5)^2 \times 2 = 50\pi \text{ m}^3$ 1

Water flown in 1 hour = $\pi\left(\frac{1}{10}\right)^2 \times 3000 \text{ m}^3$

$= 30\pi \text{ m}^3$ 1

Time taken to fill $30\pi \text{ m}^3$ = 60 minutes

Time taken to fill $50\pi \text{ m}^3$ = $\frac{60}{30} \times 50 = 100$ minutes 1

16. Here the modal class is 20 – 25 $\frac{1}{2}$

Mode $= 20 + \frac{20-7}{40-7-8} \times 5$ 2

$= 20 + \frac{13}{25} \times 5 = 22.6$ Hence mode = 22.6 $\frac{1}{2}$

17. Let $\frac{2+3\sqrt{2}}{7}$ be a rational number say 'a'

$\therefore \quad \frac{2+3\sqrt{2}}{7} = a$ 1

$\Rightarrow \quad 3\sqrt{2} = 7a - 2$

$\Rightarrow \quad \sqrt{2} = \frac{7a-2}{3}$ 1

This is a contradiction because $\sqrt{2}$ is an irriational number and $\frac{7a-2}{3}$ is a rational number. 1

Hence $\frac{2+3\sqrt{2}}{7}$ is an irrational number.

18. The polynomial whose zeroes are 2 and –2 is

$(x - 2)(x + 2)$ i.e. $x^2 - 4$ 1

$\therefore \quad 2x^4 - 5x^3 - 11x^2 + 20x + 12 = (x^2 - 4)(2x^2 - 5x - 3)$ 1

$= (x + 2)(x - 2)(2x + 1)(x - 3)$

$\therefore$ Zeroes are 2, –2, 3 and $-\frac{1}{2}$ 1

19. Let the speed of stream = x km/hr.

$$\therefore \quad \frac{24}{18-x} - \frac{24}{18+x} = 1 \qquad 1\frac{1}{2}$$

$\Rightarrow$ $x^2 + 48x - 324 = 0$ 1

$\Rightarrow$ $(x - 6)(x + 54) = 0$

$\Rightarrow$ $x = 6$

i.e. speed of stream = 6 km/hr $\frac{1}{2}$

20. LHS $= (\sin\theta + \cos\theta + 1)(\sin\theta + \cos\theta - 1)\sec\theta \operatorname{cosec}\theta$

$= [(\sin\theta + \cos\theta)^2 - 1]\sec\theta \operatorname{cosec}\theta$ 1

$= 2\sin\theta\cos\theta\sec\theta\operatorname{cosec}\theta$ 1

$= 2 = $ RHS 1

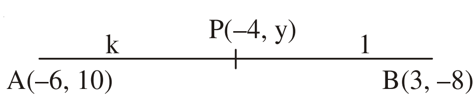
OR

$$\text{LHS} = \sqrt{\frac{\sec\theta - 1}{\sec\theta + 1}} + \sqrt{\frac{\sec\theta + 1}{\sec\theta - 1}} = \frac{(\sec\theta - 1) + (\sec\theta + 1)}{\sqrt{\sec^2\theta - 1}} \qquad 1$$

$$= \frac{2\sec\theta}{\tan\theta} \qquad 1$$

$$= \frac{2}{\sin\theta} = 2\operatorname{cosec}\theta = \text{RHS} \qquad 1$$

21. Let point P divides the line segment AB in the ratio k : 1



$$\therefore \frac{3k-6}{k+1} = -4 \qquad 1$$

$\Rightarrow$ $3k - 6 = -4k - 4$

$\Rightarrow$ $7k = 2$ i.e., $k = \frac{2}{7}$ $\therefore$ Ratio is 2 : 7 1

Again $\frac{2\times(-8) + 7\times 10}{2+7} = y \Rightarrow y = 6$ 1

Hence $y = 6$

OR

The points are collinear if the area of triangle formed is zero.

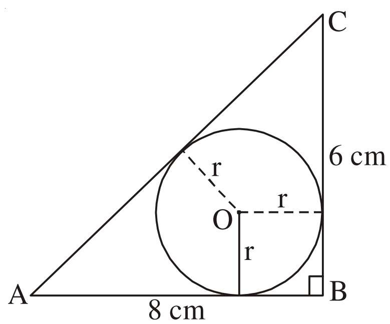
i.e., $-5(p + 2) + 1(-2 - 1) + 4(1 - p) = 0$ $1\frac{1}{2}$

$-5p - 10 - 3 + 4 - 4p = 0$

$-9p = 9$

$p = -1$ $1\frac{1}{2}$

22.



$AC = \sqrt{AB^2 + BC^2} = \sqrt{64 + 36} = 10 \text{ cm}$ $\frac{1}{2}$

Area of $\Delta ABC = \frac{1}{2} \times 8 \times 6 = 24 \text{ cm}^2$ $\frac{1}{2}$

Let r be the radius of inscribed circle.

$ar(\Delta ABC) = ar(AOB) + ar(\Delta BOC) + ar(\Delta AOC)$

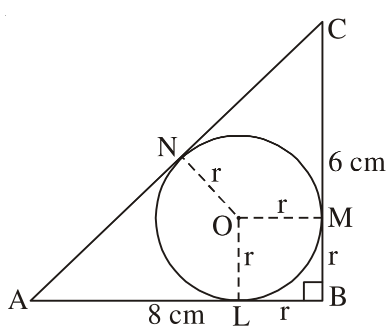
$= \frac{1}{2} \times 8r + \frac{1}{2} \times 6r + \frac{1}{2} \times 10r$ 1

$= \frac{1}{2} r(8 + 6 + 10) = 12r$

$12r = 24 \Rightarrow r = 2 \text{ cm}$ $\frac{1}{2}$

$\therefore$ Diameter = 4 cm $\frac{1}{2}$

Alternate method:



Here BL = BM = r (sides of squares)

$AC = \sqrt{AB^2 + BC^2} = 10 \text{ cm}$ 1

$AL = AN = 8 - r$ and $CM = CN = 6 - r$ $\frac{1}{2}$

$AC = AN + NC$

$\Rightarrow$ $10 = 8 - r + 6 - r$

$\Rightarrow$ $2r = 4$

$\Rightarrow$ $r = 2$ $\frac{1}{2}$

$\therefore$ Diameter = 4 cm 1

SECTION D

23. Here $a_1 = -4$, $a_n = 29$ and $S_n = 150$

Now $29 = -4 + (n-1)d = (n-1)d = 33$ ...(i) $1\frac{1}{2}$

Also $S_n = 150 = \frac{n}{2}(-4+29) \Rightarrow n = 12$ $1\frac{1}{2}$

From (i), d = 3

Hence common difference = 3 1

24. Drawing circle of radius 4 cm and taking a point 6 cm away from the centre $1\frac{1}{2}$

Drawing two tangents 2

Length of tangents = 4.5 cm (approx.) $\frac{1}{2}$

25. LHS $= 2(\sin^6\theta + \cos^6\theta) - 3(\sin^4\theta + \cos^4\theta) + 1$

$= 2[(\sin^2\theta)^3 + (\cos^2\theta)^3] - 3[(\sin^2\theta)^2 + (\cos^2\theta)^2 + 2\cos^2\theta\sin^2\theta - 2\cos^2\theta\sin^2\theta] + 1$ 1

$= 2[(\sin^2\theta + \cos^2\theta)(\sin^4\theta + \cos^4\theta - \sin^2\theta\cos^2\theta)] - 3[(\sin^2\theta + \cos^2\theta)^2 - 2\cos^2\theta\sin^2\theta] + 1$

$= 2(\sin^4\theta + \cos^4\theta - \sin^2\theta\cos^2\theta) - 3(1 - 2\cos^2\theta\sin^2\theta) + 1$ 1

$= 2[(\sin^2\theta + \cos^2\theta)^2 - 3\sin^2\theta\cos^2\theta] - 3(1 - 2\cos^2\theta\sin^2\theta) + 1$

$= 2(1 - 3\sin^2\theta\cos^2\theta) - 3(1 - 2\cos^2\theta\sin^2\theta) + 1$ 1

$= 2 - 6\sin^2\theta\cos^2\theta - 3 + 6\sin^2\theta\cos^2\theta + 1$

$= 0 =$ RHS 1

26. $\frac{1}{2a+b+2x} - \frac{1}{2x} = \frac{1}{2a} + \frac{1}{b}$

or $\frac{2x-2a-b-2x}{2x(2a+b+2x)} = \frac{b+2a}{2ab}$ 1

or $\frac{-(2a+b)}{2x(2a+b+2x)} = \frac{2a+b}{2ab}$ 1

or $2x^2 + x(2a+b) + ab = 0$

$(x+a)(2x+b) = 0$ 1

$\Rightarrow x = -a$ or $-\frac{b}{2}$ 1

OR

Let x and y be lengths of the sides of two squares.

$\therefore\ x^2 + y^2 = 640$ and $4(x - y) = 64$ i.e., $x - y = 16$ 1

$x^2 + (x - 16)^2 = 640$ 1

or $x^2 + x^2 - 32x + 256 - 640 = 0$

or $2x^2 - 32x - 384 = 0$

or $x^2 - 16x - 192 = 0$

or $(x + 8)(x - 24) = 0 \Rightarrow x = 24$ 1

$\therefore\ y = x - 16 = 24 - 16 = 8$

Hence lengths of sides of the squares are 24 cm and 8 cm. 1

27. In ΔABD, $AB^2 = AD^2 + BD^2 \Rightarrow AD^2 = AB^2 - BD^2$ 1

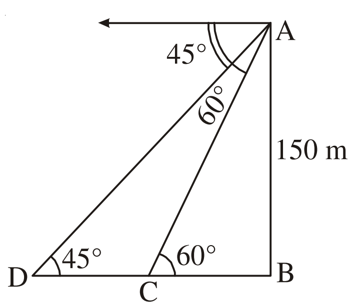
In ΔADC, $AC^2 = AD^2 + CD^2$

$= AB^2 - BD^2 + (BC - BD)^2$ 1

$= AB^2 - BD^2 + BC^2 + BD^2 - 2BC \times BD$ 1

$= AB^2 + BC^2 - 2BC \times BD$ 1

28.



Correct Figure 1

$$\frac{150}{BC} = \tan 60° = \sqrt{3}$$

$$\Rightarrow\ BC = \frac{150}{\sqrt{3}} = 50\sqrt{3}\ \text{m}$$ $\frac{1}{2}$

Also $\frac{AB}{BD} = \tan 45° = 1 \Rightarrow AB = BD = 150$ m $\frac{1}{2}$

Now $CD = BD - BC = (150 - 50\sqrt{3})$ m $\frac{1}{2}$

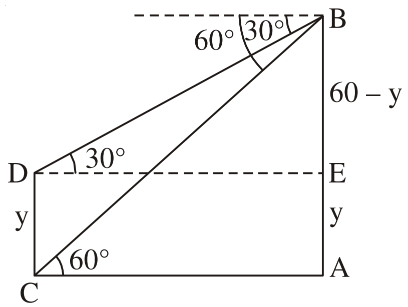
Distance travelled in 2 minutes = $(150 - 50\sqrt{3})$ m

$\therefore$ Distance travelled in 1 minute = $(75 - 25\sqrt{3})$ m 1

or $75 - 25(1.732) = 75 - 43.3 = 31.7$ m/minute

Hence speed of boat is $(75 - 25\sqrt{3})$ m/minutes or 31.7 m/minutes $\frac{1}{2}$

OR



Correct Figure 1

In ΔABC, $\frac{AB}{AC} = \tan 60°$

$\frac{60}{AC} = \sqrt{3}$

$AC = 20\sqrt{3}$ m 1

In ΔBED, $\frac{60 - y}{DE} = \tan 30° = \frac{1}{\sqrt{3}}$ 1

i.e., $\frac{60-y}{20\sqrt{3}} = \frac{1}{\sqrt{3}} \Rightarrow 60 - y = 20$ i.e., $y = 40$ m $\frac{1}{2}$

$\left.\begin{array}{l}\text{Hence width of river} = 20\sqrt{3}\text{ m and}\\ \text{height of other pole} = 40\text{ m}\end{array}\right\}$ $\frac{1}{2}$

29.

Classes	Class mark (X)	Frequency (f_i)	$f_i\ x_i$
10-30	20	5	100
30-50	40	8	320
50-70	60	12	720
70-90	80	20	1600
90-110	100	3	300
110-130	120	2	240

Correct Table 2

$$\left.\begin{aligned} \text{Mean} &= \frac{\Sigma f_i x_i}{\Sigma f_i} \\ &= \frac{3280}{50} \\ &= 65.6 \end{aligned}\right\} \quad 2$$

Alternate methods by assuming mean are acceptable.

OR

	cf	
More than or equal to 65	24	
More than or equal to 60	54	
More than or equal to 55	74	Table $1\frac{1}{2}$
More than or equal to 50	90	
More than or equal to 45	96	
More than or equal to 40	100	

Plotting graph of (40, 100), (45, 96), (50, 90), (55, 74), (60, 54)

and (65, 24) and joining the points $1\frac{1}{2}+1$

30. Volume of the container $= \frac{\pi}{3}h(r_1^2 + r_2^2 + r_1r_2)$

$= \frac{3.14}{3} \times 16\,(20^2 + 8^2 + 20 \times 8)$ $\frac{1}{2}$

$= 3.14 \times 16 \times 208 = 10450 \text{ cm}^3$ 1

= 10.45 litres

Cost of milk = 10.45 × 50 = ₹ 522.50 $\frac{1}{2}$

Slant height of frustum $= \sqrt{16^2 + 12^2} = 20\,\text{cm}$ $\frac{1}{2}$

Surface area $= \pi[(r_1 + r_2)l + r_2^2]$

$= 3.14[(8 + 20)\ 20 + 8^2]$

$= 3.14 \times 624 = 1959.36 \text{ cm}^2$ 1

$\therefore$ Cost of metal used $= \frac{10}{100} \times 1959.36 = ₹\,195.93$ $\frac{1}{2}$

Strictly Confidential: (For Internal and Restricted use only)
Secondary School Examination
March 2019
Marking Scheme – MATHEMATICS (SUBJECT CODE -041)

PAPER CODE: 30/5/1, 30/5/2, 30/5/3

General Instructions: -

1. You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully. **Evaluation is a 10-12 days mission for all of us. Hence, it is necessary that you put in your best efforts in this process.**
2. Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration. Marking Scheme should be strictly adhered to and religiously followed. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and marks be awarded to them.**
3. The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
4. If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled.
5. If a question does not have any parts, marks must be awarded in the left hand margin and encircled.
6. If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out.
7. No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
8. A full scale of marks 1-80 has to be used. Please do not hesitate to award full marks if the answer deserves it.
9. Every examiner has to necessarily do evaluation work for full working hours i.e. 8 hours every day and evaluate 25 answer books per day.
10. Ensure that you do not make the following common types of errors committed by the Examiner in the past:-
    - Leaving answer or part thereof unassessed in an answer book.
    - Giving more marks for an answer than assigned to it.
    - Wrong transfer of marks from the inside pages of the answer book to the title page.
    - Wrong question wise totaling on the title page.
    - Wrong totaling of marks of the two columns on the title page.
    - Wrong grand total.
    - Marks in words and figures not tallying.
    - Wrong transfer of marks from the answer book to online award list.
    - Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.)
    - Half or a part of answer marked correct and the rest as wrong, but no marks awarded.

11. While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as (X) and awarded zero (0) Marks.

12. Any unassessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.

13. The Examiners should acquaint themselves with the guidelines given in the Guidelines for spot Evaluation before starting the actual evaluation.

14. Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.

15. The Board permits candidates to obtain photocopy of the Answer Book on request in an RTI application and also separately as a part of the re-evaluation process on payment of the processing charges.

QUESTION PAPER CODE 30/5/1

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. a.b = 1000 1

2. $k(2)^2 + 2(2) - 3 = 0$ $\frac{1}{2}$

$k = -\frac{1}{4}$ $\frac{1}{2}$

OR

For real and equal roots

$k^2 - 4 \times 3 \times 3 = 0$ $\frac{1}{2}$

$k = \pm 6$ $\frac{1}{2}$

3. $15 + (n - 1)(-3) = 0$ $\frac{1}{2}$

$n = 6$ $\frac{1}{2}$

4. $\sin 30° + \cos y = 1$

$\cos y = \frac{1}{2}$ $\frac{1}{2}$

$\Rightarrow \quad y = 60°$ $\frac{1}{2}$

OR

$\cos 48° - \sin 42°$

$= \cos 48° - \cos (90° - 42°)$ $\frac{1}{2}$

$= 0$ $\frac{1}{2}$

5. 5 : 11 1

6. $6 - 3a = 5$ $\frac{1}{2}$

$a = \frac{1}{3}$ $\frac{1}{2}$

SECTION B

7. $a_1 = S_1 = 2(1)^2 + 1 = 3$ $\frac{1}{2}$

$a_2 = S_2 - S_1 = 10 - 3 = 7$ $\frac{1}{2}$

AP 3, 7 ..., $\Rightarrow d = 4$

$a_n = 3 + (n - 1)4 = (4n - 1)$ 1

OR

$a_{17} = a_{10} + 7$ $\frac{1}{2}$

$a + 16d = a + 9d + 7$ $\frac{1}{2}$

$d = 1$ 1

8. $\frac{2a-2}{2} = 1$

$\Rightarrow a = 2$ 1

$\frac{4+3b}{2} = 2a + 1$

$\Rightarrow b = 2$ 1

9. (i) P (getting A) = $\frac{3}{6}$ or $\frac{1}{2}$ 1

(ii) P (getting B) = $\frac{2}{6}$ or $\frac{1}{3}$ 1

10. $612 = 2^2 \times 3^2 \times 17$ $\frac{1}{2}$

$1314 = 2 \times 3^2 \times 73$ $\frac{1}{2}$

HCF (612, 1314) $= 2 \times 3^2 = 18$ 1

OR

Let a be any +ve integer

and $b = 6$

$\Rightarrow$ a = 6m + r $\quad 0 \leq r < 6$, for any +ve integer m 1

Possible forms of 'a' are

6m, 6m + 1, 6m + 2, 6m + 3, 6m + 4, 6m + 5 $\frac{1}{2}$

Out of which 6m, 6m + 2 and 6m + 4 are even.

Hence, any +ve odd integer can be 6m + 1, 6m + 3 or 6m + 5 $\frac{1}{2}$

11. Total cards = 46 $\frac{1}{2}$

(i) P [Prime number less than 10(5, 7)] = $\frac{2}{46}$ or $\frac{1}{23}$ $\frac{1}{2}$

(ii) P [A number which is perfect square (9, 16, 25, 36, 49)] = $\frac{5}{46}$ 1

12. For infinitely many solutions

$$\frac{2}{k-1} = \frac{3}{k+2} = \frac{7}{3k}$$ 1

2k + 4 = 3k − 3; $\quad$ 9k = 7k + 14

k = 7 $\quad$ k = 7

Hence k = 7 1

SECTION C

13. Let $\sqrt{5}$ be rational.

$\therefore \sqrt{5} = \frac{a}{b}$, b ≠ 0. a, b are positive integers, HCF (a, b) = 1 $\frac{1}{2}$

On squaring,

$$5 = \frac{a^2}{b^2}$$

$$b^2 = \frac{a^2}{5}$$

$\Rightarrow$ 5 divides a^2

$\Rightarrow$ 5 divides a also.

$a = 5m$, for some +ve integer m. 1

$$b^2 = \frac{25m^2}{5}$$

$$b^2 = 5m^2$$

$\Rightarrow$ 5 divides b^2

$\Rightarrow$ 5 divides b also

$\Rightarrow$ 5 divides a and b both. 1

Which is the contradiction to the fact that HCF (a, b) = 1

Hence our assumption is wrong. $\frac{1}{2}$

$\sqrt{5}$ is irrational.

14. Given $\sqrt{2}$ and $-\sqrt{2}$ are zeroes of given polynomial.

$\therefore$ $(x-\sqrt{2})$ and $(x+\sqrt{2})$ are two factors i.e. $x^2 - 2$ is a factor $\frac{1}{2}$

$$\begin{array}{r|l|l}
x^2 - 2 & \cancel{x^4} + x^3 - 14x^2 - 2x + 24 & x^2 + x - 12 \\
 & \cancel{x^4} \quad\quad -2x^2 & \\
 & - \quad\quad\quad + & \\
\hline
 & \cancel{x^3} - 12x^2 - \cancel{2x} + 24 & \\
 & \cancel{x^3} \quad\quad\quad \cancel{-2x} & \\
 & - \quad\quad\quad\quad + & \\
\hline
 & -12\cancel{x^2} + \cancel{24} & \\
 & -1\cancel{2}x^2 + \cancel{24} & \\
 & + \quad\quad - & \\
\hline
 & 0 & \\
\hline
\end{array}$$

$1\frac{1}{2}$

$x^2 + x - 12 = x^2 + 4x - 3x - 12$

$= (x + 4)(x - 3)$ $\frac{1}{2}$

$\therefore$ –4, 3 are the zeroes.

Hence, all zeroes are –4, 3, $\sqrt{2}, -\sqrt{2}$ $\frac{1}{2}$

15. $\frac{AP}{AB} = \frac{1}{3} \Rightarrow \frac{AP}{PB} = \frac{1}{2}$ 1

Coordinates of P are $\left(\frac{5+4}{3}, \frac{-8+2}{3}\right) = (3, -2)$ 1

Now, P lies on $2x - y + k = 0$

$\therefore \quad 2(3) - (-2) + k = 0$

$\Rightarrow \quad k = -8$ 1

OR

Three points are collinear ⇒ area of Δ formed by these points is zero. 1

$\therefore \ \frac{1}{2}[2(-1-3)+p(3-1)-(1+1)] = 0$ 1

$-8 + 2p - 2 = 0$

$p = 5$ 1

16. LHS $= \frac{\tan\theta}{1-\tan\theta} - \frac{\cot\theta}{1-\cot\theta}$

$= \frac{\frac{\sin\theta}{\cos\theta}}{1-\frac{\sin\theta}{\cos\theta}} - \frac{\frac{\cos\theta}{\sin\theta}}{1-\frac{\cos\theta}{\sin\theta}}$ 1

$= \frac{\sin\theta}{\cos\theta-\sin\theta} + \frac{\cos\theta}{\cos\theta-\sin\theta}$ $1\frac{1}{2}$

$= \frac{\sin\theta+\cos\theta}{\cos\theta-\sin\theta}$ = RHS $\frac{1}{2}$

OR

$\sin\theta = (\sqrt{2}-1)\cos\theta$ 1

$(\sqrt{2}+1)\sin\theta = (\sqrt{2}-1)(\sqrt{2}+1)\cos\theta$ 1

$(\sqrt{2}+1)\sin\theta = \cos\theta$

$\Rightarrow \ \sqrt{2}\sin\theta = \cos\theta - \sin\theta$ 1

Alternate method

$\cos\theta + \sin\theta = \sqrt{2}\cos\theta$

On squaring

$\cos^2\theta + \sin^2\theta + 2\cos\theta\sin\theta = 2\cos^2\theta$ 1

$\sin^2\theta + 2\cos\theta\sin\theta = \cos^2\theta$

$2\cos\theta\sin\theta = \cos^2\theta - \sin^2\theta$ 1

$2\cos\theta\sin\theta = (\cos\theta - \sin\theta)(\cos\theta + \sin\theta)$

$2\cos\theta\sin\theta = (\cos\theta - \sin\theta)(\sqrt{2}\cos\theta)$

$\sqrt{2}\sin\theta = \cos\theta - \sin\theta$ 1

17. Let the fixed charges per student = ₹ x

Cost of food per day per student = ₹ y

$x + 25y = 4500$ 1

$x + 30y = 5200$ 1

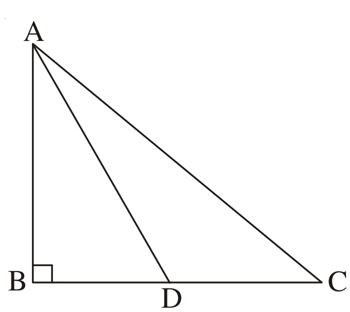
On solving $5y = 700$

$\therefore\ y = 140$

$x = 1000$ 1

$\therefore$ Fixed charges = ₹ 1000 & cost of food per day ₹ 140

18. Correct Figure $\frac{1}{2}$



ΔABC is right angled at B

$\therefore\ AC^2 = AB^2 + BC^2$

$AC^2 = AB^2 + (2CD)^2$

$AC^2 - 4CD^2 = AB^2$ ...(1) 1

ΔABD is right angled at B,

$\therefore\ AD^2 - BD^2 = AB^2$ ...(2) $\frac{1}{2}$

By (1) & (2) $AC^2 - 4CD^2 = AD^2 - BD^2$ $\frac{1}{2}$

$AC^2 = AD^2 - CD^2 + 4CD^2 = AD^2 + 3CD^2$ $(\because\ BD = CD)$ $\frac{1}{2}$

OR

$AB = AC \Rightarrow \angle C = \angle B$ ...(1) 1

In ΔABD & ΔECF,

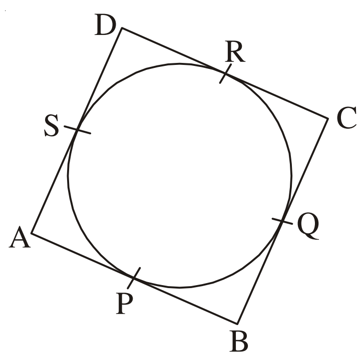
$\angle ADB = \angle EFC$ (each 90°)

$\angle ABD = \angle ECF$ (by (1)) 1

By AA similarity

$\Delta ABD \sim \Delta ECF$ 1

19. Correct Figure $\frac{1}{2}$



Let parallelogram ABCD circumscribes a circle

$\left.\begin{array}{l} AP = AS \\ PB = BQ \\ DR = DS \\ CR = CQ \end{array}\right\}$ tangents from an external point to a circle. 1

$AP + PB + DR + RC = AS + BQ + DS + CQ$

$AB + DC = AD + BC$ 1

$AB + AB = AD + AD$ (opp. sides equal)

$2AB = 2AD$

$\Rightarrow AB = AD$ $\frac{1}{2}$

$\Rightarrow$ ABCD is a rhombus.

20. Area of shaded region $= \frac{80°}{360°}\pi(7)^2 + \frac{40°}{360°}\pi(7)^2 + \frac{60°}{360°}\pi(7)^2$ $1\frac{1}{2}$

$= \frac{22}{7} \times 7 \times 7 \left[\frac{180°}{360°}\right]$ 1

$= 77 \text{ cm}^2$ $\frac{1}{2}$

21. Modal class: 50 – 60 $\frac{1}{2}$

mode $= 50 + \left(\frac{90-58}{180-58-83}\right) \times 10$ $1\frac{1}{2}$

$$= 50 + \frac{32}{39} \times 10$$

$$= 58.2 \qquad 1$$

$\therefore$ Modal age = 58.2 years.

22. Apparent capacity $= \pi r^2 h$

$$= 3.14 \times \frac{5}{2} \times \frac{5}{2} \times 10 \qquad 1$$

$$= 196.25 \text{ cm}^3 \qquad \frac{1}{2}$$

Actual capacity $= 196.25 - \frac{2}{3} \times 3.14 \times \frac{5}{2} \times \frac{5}{2} \times \frac{5}{2}$ 1

$= 196.25 - 32.71$

$= 163.54 \text{ cm}^3$ $\frac{1}{2}$

OR

$\pi(18)^2 \times 32 = \frac{1}{3}\pi r^2 \times 24$ 1

$r^2 = (18)^2 \times 4$

$r = 36$ cm 1

$l^2 = (36)^2 + (24)^2$

$l^2 = 1872$

$l = 43.2$ cm 1

SECTION D

23. Let speed of train be x km/h

$\frac{360}{x} - \frac{360}{x+5} = 1$ 2

$360\left[\frac{x+5-x}{x(x+5)}\right] = 1$

$x^2 + 5x - 1800 = 0$ $\frac{1}{2}$

$(x + 45)(x - 40) = 0$ $\frac{1}{2}$

$x = -45, \qquad x = 40$ 1

(Rejected)

Hence, speed of train = 40 km/h

OR

$$\frac{1}{a+b+x}-\frac{1}{x}=\frac{1}{a}+\frac{1}{b}$$ 1

$$\frac{x-a-b-x}{x(a+b+x)}=\frac{b+a}{ab}$$

$-ab = x^2 + (a + b)x$

$x^2 + (a + b)x + ab = 0$ $1\frac{1}{2}$

$(x + a)(x + b) = 0$ 1

$x = -a,\ x = -b$ $\frac{1}{2}$

24. $\frac{p}{2}(2a+(p-1)d=q$

$2a+(p-1)d=\frac{2q}{p}$ ...(1) 1

$\frac{q}{2}[(2a+(q-1)d]=p$

$2a+(q-1)d=\frac{2p}{q}$ ...(2) $\frac{1}{2}$

On solving (1) and (2) for a and d

$d = \frac{-2(p+q)}{pq}$ $\frac{1}{2}$

$a = \frac{q^2+p^2-p+pq-q}{pq}$ $\frac{1}{2}$

$S_{p+q} = \frac{p+q}{2}(2a+(p+q-1)d)$

$$= \frac{p+q}{2}\left[2\left(\frac{q^2+p^2-p+pq-q}{pq}\right)+(p+q-1)\left(\frac{-2(p+q)}{pq}\right)\right]$$ 1

$$= (p+q)\left[\frac{\cancel{a^2} + \cancel{p^2} - \cancel{p} + pq - \cancel{q} - \cancel{p^2} - \cancel{q^2} - 2pq + \cancel{p} + \cancel{q}}{pq}\right]$$

$$= (p+q)\times\frac{-pq}{pq} = -(p+q)$$ $\frac{1}{2}$

Alternatively:

$$\frac{p}{2}(2a+(p-1)d) = q$$

$$\Rightarrow\ 2a+(p-1)d = \frac{2q}{p} \qquad ...(1)$$ 1

$$\frac{q}{2}[(2a+(q-1)d] = p$$

$$\Rightarrow\ 2a+(q-1)d = \frac{2p}{q} \qquad ...(2)$$ $\frac{1}{2}$

Solving (1) and (2) for d

$$d = \frac{-2(p+q)}{pq}$$ 1

$$S_{p+q} = \frac{(p+q)}{2}[2a+(p+q-1)d]$$

$$= \frac{(p+q)}{2}[2a+(p-1)d+qd]$$

$$= \frac{(p+q)}{2}\left[\frac{2q}{p} + \frac{q\times(-2)(p+q)}{pq}\right]$$ 1

$$= \frac{(p+q)}{2}\times 2\left[\frac{q-p-q}{p}\right] = -(p+q)$$ $\frac{1}{2}$

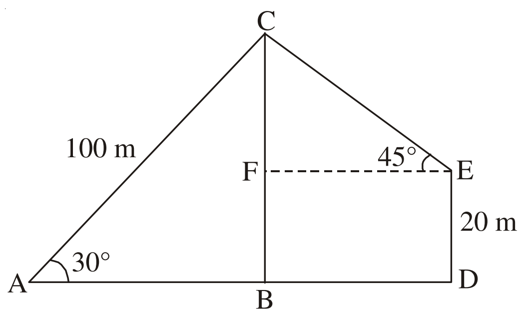
25. For Correct Given, To Prove, Construction, Figure $4\times\frac{1}{2} = 2$

For Correct Proof 2

26. For Correct Construction of triangle 2

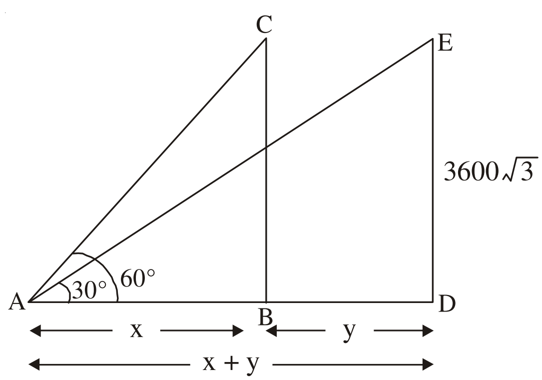
For construction of similar triangle 2

27.



Correct Figure	1
In ΔABC	
$\sin 30° = \frac{BC}{100}$	
$\Rightarrow BC = 50$ m	1
$CF = 50 - 20 = 30$ m	$\frac{1}{2}$
In ΔCFE	
$\sin 45° = \frac{30}{CE}$	
$CE = 30\sqrt{2}$	1
$= 30 \times 1.414$	
$= 42.42$ m	$\frac{1}{2}$

OR



Correct Figure	1
In ΔABC, $\tan 60° = \frac{3600\sqrt{3}}{x}$	
$x = 3600$	1
In ΔADE, $\tan 30° = \frac{3600\sqrt{3}}{x+y}$	
$3600 + y = 3600 \times 3$	
$y = 7200$	1
Speed $= \frac{7200}{30} = 240$ m/s	1

28.

Marks	**fi**	**cf**
0–10	10	10
10–20	x	10 + x
20–30	25	35 + x
30–40	30	65 + x
40–50	y	65 + x + y
50–60	10	75 + x + y
Total	100	

Correct Table 1

Median class = 30 – 40 $\frac{1}{2}$

$75 + x + y = 100$

$x + y = 25$ $\frac{1}{2}$

$32 = 30 + \left(\frac{50 - 35 - x}{30}\right) \times 10$ 1

$2 = \frac{15 - x}{3}$

$x = 9$ $\frac{1}{2}$

$y = 16$ $\frac{1}{2}$

OR

Class	cf
More than or equal to 0	100
More than or equal to 10	95
More than or equal to 20	80
More than or equal to 30	60
More than or equal to 40	37
More than or equal to 50	20
More than or equal to 60	9

Correct Table $\frac{1}{2}$

Plotting of points (0, 100), (10, 95), (20, 80), (30, 60), (40, 37), (50, 20) and (60, 9) $1\frac{1}{2}$

Joining the points to get curve $\frac{1}{2}$

Median = 35 (approx.) $\frac{1}{2}$

29. LHS $= \dfrac{(1+\cot\theta+\tan\theta)(\sin\theta-\cos\theta)}{\sec^3\theta-\text{cosec}^3\theta}$

$$= \frac{\left(1+\dfrac{\cos\theta}{\sin\theta}+\dfrac{\sin\theta}{\cos\theta}\right)(\sin\theta-\cos\theta)}{\dfrac{1}{\cos^3\theta}-\dfrac{1}{\sin^3\theta}} \qquad 1$$

$$= \frac{\dfrac{(\cos\theta\sin\theta+\cos^2\theta+\sin^2\theta)(\sin\theta-\cos\theta)}{\cos\theta\sin\theta}}{\dfrac{\sin^3\theta-\cos^3\theta}{\cos^3\theta\sin^3\theta}} \qquad 1$$

$$= \frac{\sin^3\theta-\cos^3\theta}{\sin\theta\cos\theta}\times\frac{\cos^3\theta\sin^3\theta}{\sin^3\theta-\cos^3\theta} \qquad 1$$

$= \cos^2\theta\ \sin^2\theta$ = RHS $\qquad 1$

30. $l^2 = (24)^2 + \left(\frac{45}{2} - \frac{25}{2}\right)^2$

$l^2 = 576 + 100 = 676$

$l = 26$ cm 1

$\text{TSA} = \frac{22}{7} \times 26\left(\frac{25}{2} + \frac{45}{2}\right) + \frac{22}{7} \times \frac{25}{2} \times \frac{25}{2}$

$= 2860 + 491.07$

$= 3351.07$ cm^2 $1\frac{1}{2}$

$\text{Volume} = \frac{1}{3} \times \frac{22}{7} \times 24\left(\frac{625}{4} + \frac{2025}{4} + \frac{1125}{4}\right)$

$= \frac{1}{\cancel{3}} \times \frac{22}{7} \times \cancel{6}^{2}\,\cancel{24} \times \frac{3775}{\cancel{4}}$

$= \frac{166100}{7}$ cm^3

or 23728.57 cm^3 $1\frac{1}{2}$

QUESTION PAPER CODE 30/5/2

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. 5 : 11 — 1

2. $6 - 3a = 5$ — $\frac{1}{2}$

$a = \frac{1}{3}$ — $\frac{1}{2}$

3. $a.b = 1000$ — 1

4. $k(2)^2 + 2(2) - 3 = 0$ — $\frac{1}{2}$

$k = -\frac{1}{4}$ — $\frac{1}{2}$

OR

For real and equal roots

$k^2 - 4 \times 3 \times 3 = 0$ — $\frac{1}{2}$

$k = \pm 6$ — $\frac{1}{2}$

5. $\sin 30° + \cos y = 1$

$\cos y = \frac{1}{2}$ — $\frac{1}{2}$

$\Rightarrow \quad y = 60°$ — $\frac{1}{2}$

OR

$\cos 48° - \sin 42°$

$= \cos 48° - \cos (90° - 42°)$ — $\frac{1}{2}$

$= 0$ — $\frac{1}{2}$

6. $a_1 = \sqrt{3}$

$a_2 = \sqrt{12} = 2\sqrt{3}$ — $\frac{1}{2}$

$d = \sqrt{3}$ — $\frac{1}{2}$

SECTION B

7. Total cards = 46 $\frac{1}{2}$

(i) P [Prime number less than 10(5, 7)] = $\frac{2}{46}$ or $\frac{1}{23}$ $\frac{1}{2}$

(ii) P [A number which is perfect square (9, 16, 25, 36, 49)] = $\frac{5}{46}$ 1

8. For infinitely many solutions

$\frac{2}{k-1} = \frac{3}{k+2} = \frac{7}{3k}$ 1

$2k + 4 = 3k - 3;\qquad 9k = 7k + 14$

$k = 7 \qquad\qquad k = 7$

Hence $k = 7$ 1

9. $a_1 = S_1 = 2(1)^2 + 1 = 3$ $\frac{1}{2}$

$a_2 = S_2 - S_1 = 10 - 3 = 7$ $\frac{1}{2}$

AP 3, 7 ..., $\Rightarrow d = 4$

$a_n = 3 + (n - 1)4 = (4n - 1)$ 1

OR

$a_{17} = a_{10} + 7$ $\frac{1}{2}$

$a + 16d = a + 9d + 7$ $\frac{1}{2}$

$d = 1$ 1

10. (i) P (getting A) = $\frac{3}{6}$ or $\frac{1}{2}$ 1

(ii) P (getting B) = $\frac{2}{6}$ or $\frac{1}{3}$ 1

11. $612 = 2^2 \times 3^2 \times 17$ $\frac{1}{2}$

$1314 = 2 \times 3^2 \times 73$ $\frac{1}{2}$

HCF (612, 1314) = $2 \times 3^2 = 18$ 1

OR

Let a be any +ve integer

and b = 6

$\Rightarrow$ a = 6m + r $0 \le r < 6$, for any +ve integer m 1

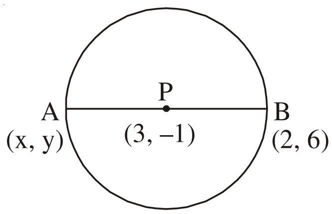
Possible forms of 'a' are

6m, 6m + 1, 6m + 2, 6m + 3, 6m + 4, 6m + 5 $\frac{1}{2}$

Out of which 6m, 6m + 2 and 6m + 4 are even.

Hence, any +ve odd integer can be 6m + 1, 6m + 3 or 6m + 5 $\frac{1}{2}$

12.



$\frac{x+2}{2} = 3 \Rightarrow x = 4$ 1

$\frac{y+6}{2} = -1 \Rightarrow y = -8$ $\frac{1}{2}$

$\Rightarrow$ A(4, –8) $\frac{1}{2}$

SECTION C

13. LHS $= \dfrac{\tan\theta}{1-\tan\theta} - \dfrac{\cot\theta}{1-\cot\theta}$

$$= \frac{\frac{\sin\theta}{\cos\theta}}{1-\frac{\sin\theta}{\cos\theta}} - \frac{\frac{\cos\theta}{\sin\theta}}{1-\frac{\cos\theta}{\sin\theta}}$$ 1

$$= \frac{\sin\theta}{\cos\theta-\sin\theta} + \frac{\cos\theta}{\cos\theta-\sin\theta}$$ $1\frac{1}{2}$

$$= \frac{\sin\theta+\cos\theta}{\cos\theta-\sin\theta} = \text{RHS}$$ $\frac{1}{2}$

OR

$\sin\theta = (\sqrt{2}-1)\cos\theta$ 1

$(\sqrt{2}+1)\sin\theta = (\sqrt{2}-1)(\sqrt{2}+1)\cos\theta$ 1

$(\sqrt{2}+1)\sin\theta = \cos\theta$

$\Rightarrow \sqrt{2}\sin\theta = \cos\theta - \sin\theta$ 1

Alternate method

$\cos\theta + \sin\theta = \sqrt{2}\cos\theta$

On squaring

$\cos^2\theta + \sin^2\theta + 2\cos\theta\sin\theta = 2\cos^2\theta$ 1

$\sin^2\theta + 2\cos\theta\sin\theta = \cos^2\theta$

$2\cos\theta\sin\theta = \cos^2\theta - \sin^2\theta$ 1

$2\cos\theta\sin\theta = (\cos\theta - \sin\theta)(\cos\theta + \sin\theta)$

$2\cos\theta\sin\theta = (\cos\theta - \sin\theta)(\sqrt{2}\cos\theta)$

$\sqrt{2}\sin\theta = \cos\theta - \sin\theta$ 1

14. Let the fixed charges per student = ₹ x

Cost of food per day per student = ₹ y

$x + 25y = 4500$ 1

$x + 30y = 5200$ 1

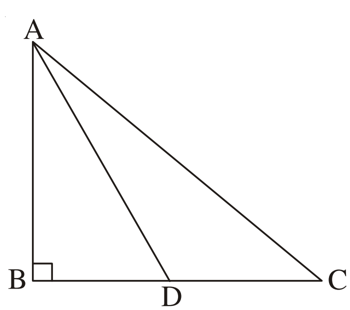
On solving $5y = 700$

$\therefore\ y = 140$

$x = 1000$ 1

$\therefore$ Fixed charges = ₹ 1000 & cost of food per day ₹ 140

15. Correct Figure $\frac{1}{2}$



ΔABC is right angled at B

$\therefore\ AC^2 = AB^2 + BC^2$

$AC^2 = AB^2 + (2CD)^2$

$AC^2 - 4CD^2 = AB^2$ ...(1) 1

ΔABD is right angled at B,

$\therefore\ AD^2 - BD^2 = AB^2$ ...(2) $\frac{1}{2}$

By (1) & (2) $AC^2 - 4CD^2 = AD^2 - BD^2$ $\frac{1}{2}$

$AC^2 = AD^2 - CD^2 + 4CD^2 = AD^2 + 3CD^2$ $(\because\ BD = CD)$ $\frac{1}{2}$

OR

$AB = AC \Rightarrow \angle C = \angle B$ ...(1) 1

In ΔABD & ΔECF,

$\angle ADB = \angle EFC$ (each 90°)

$\angle ABD = \angle ECF$ (by (1)) 1

By AA similarity

$\Delta ABD \sim \Delta ECF$ 1

16. Area of shaded region $= \frac{80°}{360°}\pi(7)^2 + \frac{40°}{360°}\pi(7)^2 + \frac{60°}{360°}\pi(7)^2$ $1\frac{1}{2}$

$= \frac{22}{7}\times 7\times 7\left[\frac{180°}{360°}\right]$ 1

$= 77\ cm^2$ $\frac{1}{2}$

17. Apparent capacity $= \pi r^2 h$

$= 3.14\times\frac{5}{2}\times\frac{5}{2}\times 10$ 1

$= 196.25\ cm^3$ $\frac{1}{2}$

Actual capacity $= 196.25 - \frac{2}{3}\times 3.14\times\frac{5}{2}\times\frac{5}{2}\times\frac{5}{2}$ 1

$= 196.25 - 32.71$

$= 163.54\ cm^3$ $\frac{1}{2}$

OR

$\pi(18)^2\times 32 = \frac{1}{3}\pi r^2\times 24$ 1

$r^2 = (18)^2 \times 4$

$r = 36$ cm 1

$l^2 = (36)^2 + (24)^2$

$l^2 = 1872$

$l = 43.2$ cm 1

18. Let $\sqrt{5}$ be rational.

$\therefore\ \sqrt{5} = \frac{a}{b}$, $b \neq 0$. a, b are positive integers, HCF (a, b) = 1 $\frac{1}{2}$

On squaring,

$$5 = \frac{a^2}{b^2}$$

$$b^2 = \frac{a^2}{5}$$

$\Rightarrow$ 5 divides a^2

$\Rightarrow$ 5 divides a also.

a = 5m, for some +ve integer m. 1

$$b^2 = \frac{25m^2}{5}$$

$$b^2 = 5m^2$$

$\Rightarrow$ 5 divides b^2

$\Rightarrow$ 5 divides b also

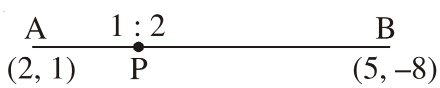
$\Rightarrow$ 5 divides a and b both. 1

Which is the contradiction to the fact that HCF (a, b) = 1

Hence our assumption is wrong. $\frac{1}{2}$

$\sqrt{5}$ is irrational.

19. $\frac{AP}{AB} = \frac{1}{3} \Rightarrow \frac{AP}{PB} = \frac{1}{2}$ 1



Coordinates of P are $\left(\frac{5+4}{3}, \frac{-8+2}{3}\right) = (3, -2)$ 1

Now, P lies on $2x - y + k = 0$

$\therefore\ 2(3) - (-2) + k = 0$

$\Rightarrow\ k = -8$ 1

OR

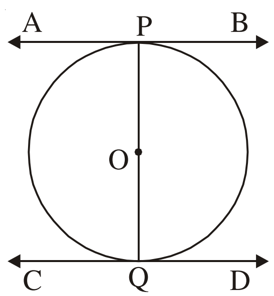
Three points are collinear ⇒ area of Δ formed by these points is zero. 1

$\therefore \ \frac{1}{2}\left[2(-1-3)+p(3-1)-(1+1)\right]=0$ 1

$-8 + 2p - 2 = 0$

$p = 5$ 1

20.



Correct Figure $\frac{1}{2}$

$\angle OPB = 90°$

{radius ⊥ tangent} 1

$\angle OQC = 90°$

But they are forming alternate interior angles. 1

$\Rightarrow AB \parallel CD$ $\frac{1}{2}$

21.

$x^2 - 3x + 2 \ \big) \ x^4 - 2x^3 - x + 2 \ \big(\ x^2 + x + 1$

$\cancel{x^4} - 3x^3 \quad + 2x^2$

$- \quad + \quad -$

$\cancel{x^3} - 2x^2 - x + 2$

$\cancel{x^3} - 3x^2 + 2x$

$- \quad + \quad -$

$x^2 - 3x + 2$

$x^2 - 3x + 2$

$- \quad + \quad -$

0

2

Yes, g(x) is factor of f(x) 1

22.

Class	fi	xi	di	ui	fiui
0 – 20	17	10	–40	–2	–34
20 – 40	28	30	–20	–1	–28
40 – 60	32	50 A	0	0	0
60 – 80	24	70	20	1	24
80 – 100	19	90	40	2	38
Total	120				0

Correct Table 2

$$\text{Mean} = 50 + \frac{0}{120}$$

$$= 50 \qquad 1$$

SECTION D

23. $l^2 = (24)^2 + \left(\frac{45}{2} - \frac{25}{2}\right)^2$

$l^2 = 576 + 100 = 676$

$l = 26$ cm 1

$$\text{TSA} = \frac{22}{7} \times 26\left(\frac{25}{2} + \frac{45}{2}\right) + \frac{22}{7} \times \frac{25}{2} \times \frac{25}{2}$$

$$= 2860 + 491.07$$

$$= 3351.07 \text{ cm}^2 \qquad 1\frac{1}{2}$$

$$\text{Volume} = \frac{1}{3} \times \frac{22}{7} \times 24\left(\frac{625}{4} + \frac{2025}{4} + \frac{1125}{4}\right)$$

$$= \frac{1}{\cancel{3}} \times \frac{22}{7} \times \cancel{6}^{2}\ \cancel{24} \times \frac{3775}{\cancel{4}}$$

$$= \frac{166100}{7} \text{ cm}^3$$

or 23728.57 cm^3 $1\frac{1}{2}$

24.

Marks	fi	cf
0–10	10	10
10–20	x	10 + x
20–30	25	35 + x
30–40	30	65 + x
40–50	y	65 + x + y
50–60	10	75 + x + y
Total	100	

Correct Table 1

Median class = 30 – 40 $\frac{1}{2}$

75 + x + y = 100

x + y = 25 $\frac{1}{2}$

$32 = 30+\left(\frac{50-35-x}{30}\right)\times 10$ 1

$2 = \frac{15-x}{3}$

x = 9 $\frac{1}{2}$

y = 16 $\frac{1}{2}$

OR

Class	cf
More than or equal to 0	100
More than or equal to 10	95
More than or equal to 20	80
More than or equal to 30	60
More than or equal to 40	37
More than or equal to 50	20
More than or equal to 60	9

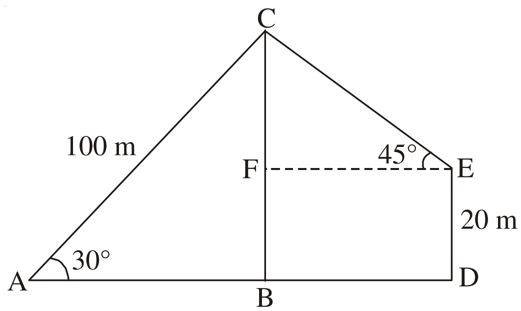
Correct Table $\frac{1}{2}$

Plotting of points (0, 100), (10, 95), (20, 80), (30, 60), (40, 37), (50, 20) and (60, 9) $1\frac{1}{2}$

Joining the points to get curve $\frac{1}{2}$

Median = 35 (approx.) $\frac{1}{2}$

25.



Correct Figure 1

In ΔABC

$\sin 30° = \frac{BC}{100}$

$\Rightarrow BC = 50$ m 1

$CF = 50 - 20 = 30$ m $\frac{1}{2}$

In ΔCFE

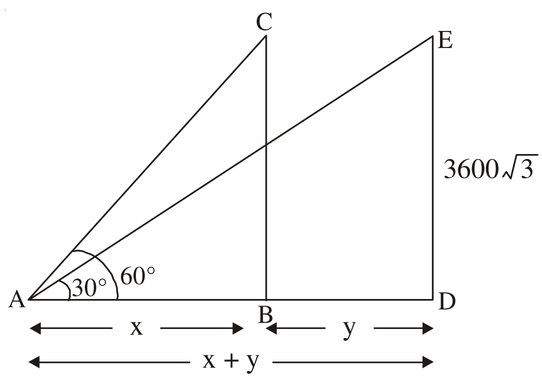
$\sin 45° = \frac{30}{CE}$

$CE = 30\sqrt{2}$ 1

$= 30 \times 1.414$

$= 42.42$ m $\frac{1}{2}$

OR



Correct Figure 1

In ΔABC, $\tan 60° = \frac{3600\sqrt{3}}{x}$

$x = 3600$ 1

In ΔADE, $\tan 30° = \frac{3600\sqrt{3}}{x+y}$

$3600 + y = 3600 \times 3$

$y = 7200$ 1

Speed $= \frac{7200}{30} = 240$ m/s 1

26. For Correct Given, To Prove, Construction, Figure $4\times\frac{1}{2} = 2$

For Correct Proof 2

27. Let speed of train be x km/h

$\frac{360}{x} - \frac{360}{x+5} = 1$ 2

$$360\left[\frac{x+5-x}{x(x+5)}\right]=1$$

$x^2 + 5x - 1800 = 0$ $\frac{1}{2}$

$(x + 45)(x - 40) = 0$ $\frac{1}{2}$

$x = -45$, (Rejected) $x = 40$ 1

Hence, speed of train = 40 km/h

OR

$$\frac{1}{a+b+x}-\frac{1}{x}=\frac{1}{a}+\frac{1}{b}$$ 1

$$\frac{x-a-b-x}{x(a+b+x)}=\frac{b+a}{ab}$$

$-ab = x^2 + (a + b)x$

$x^2 + (a + b)x + ab = 0$ $1\frac{1}{2}$

$(x + a)(x + b) = 0$ 1

$x = -a,\ x = -b$ $\frac{1}{2}$

28. $$\frac{\operatorname{cosec}^2(90°-\theta)-\tan^2\theta}{2(\cos^2 37°+\cos^2(90°-37°))}-\frac{2\tan^2 30°\sec^2 37°\sin^2(90°-37°)}{\operatorname{cosec}^2(90°-27°)-\tan^2 27°}$$ 1

$$=\frac{\sec^2\theta-\tan^2\theta}{2(\cos^2 37°+\sin^2 37°)}-\frac{2\left(\frac{1}{\sqrt{3}}\right)^2\times\frac{1}{\cos^2 37°}\times\cos^2 37°}{\sec^2 27°-\tan^2 27°}$$ $1\frac{1}{2}$

$$=\frac{1}{2\times 1}-\frac{\frac{2}{3}\times 1}{1}$$ 1

$$=\frac{1}{2}-\frac{2}{3}=\frac{-1}{6}$$ $\frac{1}{2}$

29. For Correct Construction of Triangle 2

For Correct Construction of Similar triangle 2

30. Numbers are 12, 17, 22, ..., 97 1

$97 = 12 + (n - 1)5$

$85 = (n - 1)5$

$n = 18$ $1\frac{1}{2}$

$$S_n = \frac{18}{2}(12+97)$$

$= 981$ $1\frac{1}{2}$

QUESTION PAPER CODE 30/5/3

EXPECTED ANSWER/VALUE POINTS

SECTION A

1. $15 + (n - 1)(-3) = 0$ $\frac{1}{2}$

$n = 6$ $\frac{1}{2}$

2. $\sin 30° + \cos y = 1$

$\cos y = \frac{1}{2}$ $\frac{1}{2}$

$\Rightarrow \ y = 60°$ $\frac{1}{2}$

OR

$\cos 48° - \sin 42°$

$= \cos 48° - \cos (90° - 42°)$ $\frac{1}{2}$

$= 0$ $\frac{1}{2}$

3. 5 : 11 1

4. a.b = 1000 1

5. $k(2)^2 + 2(2) - 3 = 0$ $\frac{1}{2}$

$k = -\frac{1}{4}$ $\frac{1}{2}$

OR

For real and equal roots

$k^2 - 4 \times 3 \times 3 = 0$ $\frac{1}{2}$

$k = \pm 6$ $\frac{1}{2}$

6. $(x - 9)^2 + (2 - 8)^2 = 100$ $\frac{1}{2}$

$(x - 9)^2 = 64$

$x - 9 = \pm 8$

$x = 17, \quad x = 1$ $\frac{1}{2}$

SECTION B

7. (i) P (getting A) = $\frac{3}{6}$ or $\frac{1}{2}$ 1

(ii) P (getting B) = $\frac{2}{6}$ or $\frac{1}{3}$ 1

8. $612 = 2^2 \times 3^2 \times 17$ $\frac{1}{2}$

$1314 = 2 \times 3^2 \times 73$ $\frac{1}{2}$

HCF $(612, 1314) = 2 \times 3^2 = 18$ 1

OR

Let a be any +ve integer

and b = 6

$\Rightarrow a = 6m + r \quad 0 \le r < 6$, for any +ve integer m 1

Possible forms of 'a' are

6m, 6m + 1, 6m + 2, 6m + 3, 6m + 4, 6m + 5 $\frac{1}{2}$

Out of which 6m, 6m + 2 and 6m + 4 are even.

Hence, any +ve odd integer can be 6m + 1, 6m + 3 or 6m + 5 $\frac{1}{2}$

9. For infinitely many solutions

$$\frac{2}{k-1} = \frac{3}{k+2} = \frac{7}{3k}$$ 1

$2k + 4 = 3k - 3; \qquad 9k = 7k + 14$

$k = 7 \qquad\qquad k = 7$

Hence k = 7 1

10. $a_1 = S_1 = 2(1)^2 + 1 = 3$ $\frac{1}{2}$

$a_2 = S_2 - S_1 = 10 - 3 = 7$ $\frac{1}{2}$

AP 3, 7 ..., $\Rightarrow d = 4$

$a_n = 3 + (n - 1)4 = (4n - 1)$ 1

OR

$a_{17} = a_{10} + 7$ $\frac{1}{2}$

$a + 16d = a + 9d + 7$ $\frac{1}{2}$

$d = 1$ 1

11. $\frac{2a-2}{2} = 1$

$\Rightarrow \ a = 2$ 1

$\frac{4+3b}{2} = 2a + 1$

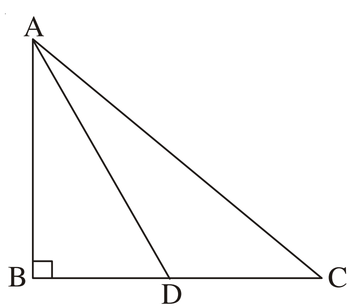
$\Rightarrow \ b = 2$ 1

12. Mean $= \frac{50}{10} = 5$ 1

$P(5) = \frac{2}{10} = \frac{1}{5}$ 1

SECTION C

13. Correct Figure $\frac{1}{2}$



ΔABC is right angled at B

$\therefore \ AC^2 = AB^2 + BC^2$

$AC^2 = AB^2 + (2CD)^2$

$AC^2 - 4CD^2 = AB^2$ ...(1) 1

ΔABD is right angled at B,

$\therefore \ AD^2 - BD^2 = AB^2$ ...(2) $\frac{1}{2}$

By (1) & (2) $AC^2 - 4CD^2 = AD^2 - BD^2$ $\frac{1}{2}$

$AC^2 = AD^2 - CD^2 + 4CD^2 = AD^2 + 3CD^2$ $(\because \ BD = CD)$ $\frac{1}{2}$

OR

$AB = AC \Rightarrow \angle C = \angle B$ ...(1) 1

In ΔABD & ΔECF,

$\angle ADB = \angle EFC$ (each 90°)

$\angle ABD = \angle ECF$ (by (1)) 1

By AA similarity

$\Delta ABD \sim \Delta ECF$ 1

14. Area of shaded region $= \frac{80°}{360°}\pi(7)^2 + \frac{40°}{360°}\pi(7)^2 + \frac{60°}{360°}\pi(7)^2$ $1\frac{1}{2}$

$= \frac{22}{7} \times 7 \times 7 \left[\frac{180°}{360°}\right]$ 1

$= 77 \text{ cm}^2$ $\frac{1}{2}$

15. Apparent capacity $= \pi r^2 h$

$= 3.14 \times \frac{5}{2} \times \frac{5}{2} \times 10$ 1

$= 196.25 \text{ cm}^3$ $\frac{1}{2}$

Actual capacity $= 196.25 - \frac{2}{3} \times 3.14 \times \frac{5}{2} \times \frac{5}{2} \times \frac{5}{2}$ 1

$= 196.25 - 32.71$

$= 163.54 \text{ cm}^3$ $\frac{1}{2}$

OR

$\pi(18)^2 \times 32 = \frac{1}{3}\pi r^2 \times 24$ 1

$r^2 = (18)^2 \times 4$

$r = 36$ cm 1

$l^2 = (36)^2 + (24)^2$

$l^2 = 1872$

$l = 43.2$ cm 1

16. Given $\sqrt{2}$ and $-\sqrt{2}$ are zeroes of given polynomial.

$\therefore$ $(x-\sqrt{2})$ and $(x+\sqrt{2})$ are two factors i.e. $x^2 - 2$ is a factor $\frac{1}{2}$

$$
\begin{array}{r|l}
x^2 - 2 & \cancel{x^4} + x^3 - 14x^2 - 2x + 24 \quad (x^2 + x - 12 \\
 & \underline{\cancel{x^4} \qquad\quad -2x^2} \\
 & {}_{-} \qquad\qquad\quad {}_{+} \\
 & \cancel{x^3} - 12x^2 - \cancel{2x} + 24 \\
 & \underline{\cancel{x^3} \qquad\qquad - \cancel{2x}} \\
 & {}_{-} \qquad\qquad\quad {}_{+} \\
 & -\cancel{12x^2} + \cancel{24} \\
 & \underline{-\cancel{12x^2} + \cancel{24}} \\
 & {}_{+} \qquad\quad {}_{-} \\
 & \underline{\quad 0 \quad}
\end{array}
$$
$1\frac{1}{2}$

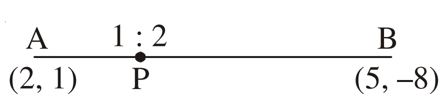
$x^2 + x - 12 = x^2 + 4x - 3x - 12$

$= (x + 4)(x - 3)$ $\frac{1}{2}$

$\therefore$ -4, 3 are the zeroes.

Hence, all zeroes are $-4, 3, \sqrt{2}, -\sqrt{2}$ $\frac{1}{2}$

17. $\frac{AP}{AB} = \frac{1}{3} \Rightarrow \frac{AP}{PB} = \frac{1}{2}$ 1



Coordinates of P are $\left(\frac{5+4}{3}, \frac{-8+2}{3}\right) = (3, -2)$ 1

Now, P lies on $2x - y + k = 0$

$\therefore$ $2(3) - (-2) + k = 0$

$\Rightarrow$ $k = -8$ 1

OR

Three points are collinear $\Rightarrow$ area of Δ formed by these points is zero. 1

$\therefore$ $\frac{1}{2}\left[2(-1-3) + p(3-1) - (1+1)\right] = 0$ 1

$-8 + 2p - 2 = 0$

$p = 5$ 1

18. LHS $= \dfrac{\tan\theta}{1-\tan\theta} - \dfrac{\cot\theta}{1-\cot\theta}$

$$= \frac{\frac{\sin\theta}{\cos\theta}}{1-\frac{\sin\theta}{\cos\theta}} - \frac{\frac{\cos\theta}{\sin\theta}}{1-\frac{\cos\theta}{\sin\theta}} \qquad 1$$

$$= \frac{\sin\theta}{\cos\theta-\sin\theta} + \frac{\cos\theta}{\cos\theta-\sin\theta} \qquad 1\frac{1}{2}$$

$$= \frac{\sin\theta+\cos\theta}{\cos\theta-\sin\theta} = \text{RHS} \qquad \frac{1}{2}$$

OR

$\sin\theta = (\sqrt{2}-1)\cos\theta$ 1

$(\sqrt{2}+1)\sin\theta = (\sqrt{2}-1)(\sqrt{2}+1)\cos\theta$ 1

$(\sqrt{2}+1)\sin\theta = \cos\theta$

$\Rightarrow \sqrt{2}\sin\theta = \cos\theta - \sin\theta$ 1

Alternate method

$\cos\theta + \sin\theta = \sqrt{2}\cos\theta$

On squaring

$\cos^2\theta + \sin^2\theta + 2\cos\theta\sin\theta = 2\cos^2\theta$ 1

$\sin^2\theta + 2\cos\theta\sin\theta = \cos^2\theta$

$2\cos\theta\sin\theta = \cos^2\theta - \sin^2\theta$ 1

$2\cos\theta\sin\theta = (\cos\theta - \sin\theta)(\cos\theta + \sin\theta)$

$2\cos\theta\sin\theta = (\cos\theta-\sin\theta)(\sqrt{2}\cos\theta)$

$\sqrt{2}\sin\theta = \cos\theta - \sin\theta$ 1

19. Let the fixed charges per student = ₹ x

Cost of food per day per student = ₹ y

$x + 25y = 4500$ 1

$x + 30y = 5200$ 1

On solving $5y = 700$

$\therefore\ y = 140$

$x = 1000$ 1

$\therefore$ Fixed charges = ₹ 1000 & cost of food per day ₹ 140

20. Modal class: 26 – 30 $\frac{1}{2}$

$f_1 = 25,\ f_0 = 20,\ f_2 = 22,\ l = 26,\ h = 4$

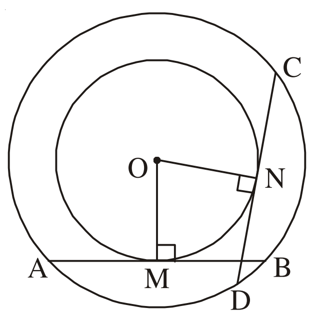
$$\text{Mode} = 26 + \left(\frac{25-20}{50-20-22}\right) \times 4$$ $1\frac{1}{2}$

$$= 26 + \frac{5}{\cancel{8}_2} \times \cancel{4}$$

$= 26 + 2.5$

$= 28.5$ 1

21.



Correct Figure $\frac{1}{2}$

OM = ON (radii of same circle) $\frac{1}{2}$

& OM $\perp$ AB
(tangent $\perp$ radius)
& ON $\perp$ CD 1

Chords equidistant from centre of circle are equal in length

$\Rightarrow$ AB = CD $\frac{1}{2}$

Hence, all chords are equal. $\frac{1}{2}$

22. Let $5-3\sqrt{2}$ be rational

$\therefore\ 5-3\sqrt{2} = \frac{p}{q}$, p & q are integers, $q \neq 0$, HCF (p, q) = 1 1

$$5-\frac{p}{q} = 3\sqrt{2}$$

$$\frac{15q-p}{3q} = \sqrt{2}$$

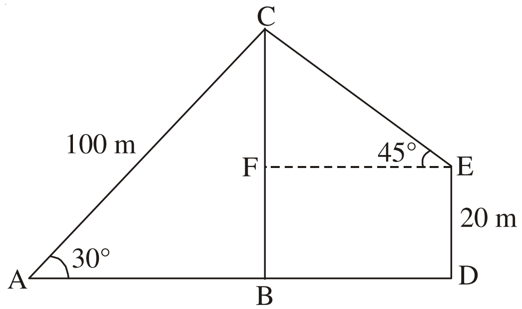
Rational = Irrational $1\frac{1}{2}$

which is a contradiction. $\frac{1}{2}$

Hence, $5-3\sqrt{2}$ is irrational.

SECTION D

23.



Correct Figure 1

In ΔABC

$\sin 30° = \frac{BC}{100}$

$\Rightarrow BC = 50$ m 1

$CF = 50 - 20 = 30$ m $\frac{1}{2}$

In ΔCFE

$\sin 45° = \frac{30}{CE}$

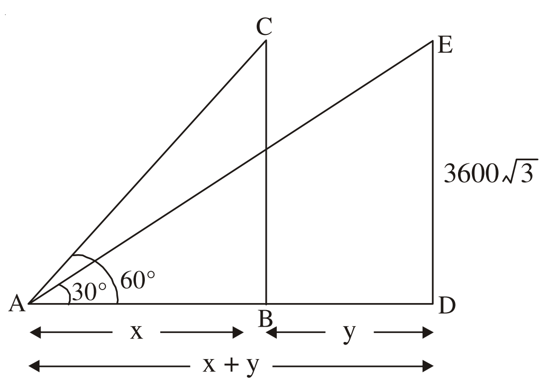
$CE = 30\sqrt{2}$ 1

$= 30 \times 1.414$

$= 42.42$ m $\frac{1}{2}$

OR

Correct Figure 1



In ΔABC, $\tan 60° = \frac{3600\sqrt{3}}{x}$

$x = 3600$ 1

In ΔADE, $\tan 30° = \frac{3600\sqrt{3}}{x+y}$

$3600 + y = 3600 \times 3$

$y = 7200$ 1

Speed $= \frac{7200}{30} = 240$ m/s 1

24.

Marks	fi	cf
0–10	10	10
10–20	x	10 + x
20–30	25	35 + x
30–40	30	65 + x
40–50	y	65 + x + y
50–60	10	75 + x + y
Total	100	

Correct Table 1

Median class = 30 – 40 $\frac{1}{2}$

75 + x + y = 100

x + y = 25 $\frac{1}{2}$

$32 = 30 + \left(\frac{50-35-x}{30}\right) \times 10$ 1

$2 = \frac{15-x}{3}$

x = 9 $\frac{1}{2}$

y = 16 $\frac{1}{2}$

OR

Class	cf
More than or equal to 0	100
More than or equal to 10	95
More than or equal to 20	80
More than or equal to 30	60
More than or equal to 40	37
More than or equal to 50	20
More than or equal to 60	9

Correct Table $\frac{1}{2}$

Plotting of points (0, 100), (10, 95), (20, 80), (30, 60), (40, 37), (50, 20) and (60, 9) $1\frac{1}{2}$

Joining the points to get curve $\frac{1}{2}$

Median = 35 (approx.) $\frac{1}{2}$

25. LHS $= \dfrac{(1+\cot\theta+\tan\theta)(\sin\theta-\cos\theta)}{\sec^3\theta-\operatorname{cosec}^3\theta}$

$$= \frac{\left(1+\dfrac{\cos\theta}{\sin\theta}+\dfrac{\sin\theta}{\cos\theta}\right)(\sin\theta-\cos\theta)}{\dfrac{1}{\cos^3\theta}-\dfrac{1}{\sin^3\theta}} \qquad 1$$

$$= \frac{\dfrac{(\cos\theta\sin\theta+\cos^2\theta+\sin^2\theta)(\sin\theta-\cos\theta)}{\cos\theta\sin\theta}}{\dfrac{\sin^3\theta-\cos^3\theta}{\cos^3\theta\sin^3\theta}} \qquad 1$$

$$= \frac{\sin^3\theta-\cos^3\theta}{\sin\theta\cos\theta}\times\frac{\cos^3\theta\sin^3\theta}{\sin^3\theta-\cos^3\theta} \qquad 1$$

$= \cos^2\theta\ \sin^2\theta =$ RHS $\qquad 1$

26. $l^2 = (24)^2 + \left(\frac{45}{2} - \frac{25}{2}\right)^2$

$l^2 = 576 + 100 = 676$

$l = 26$ cm 1

$\text{TSA} = \frac{22}{7} \times 26\left(\frac{25}{2} + \frac{45}{2}\right) + \frac{22}{7} \times \frac{25}{2} \times \frac{25}{2}$

$= 2860 + 491.07$

$= 3351.07 \text{ cm}^2$ $1\frac{1}{2}$

$\text{Volume} = \frac{1}{3} \times \frac{22}{7} \times 24\left(\frac{625}{4} + \frac{2025}{4} + \frac{1125}{4}\right)$

$= \frac{1}{\cancel{3}} \times \frac{22}{7} \times \cancel{6}^{2}\ \cancel{24} \times \frac{3775}{\cancel{4}}$

$= \frac{166100}{7} \text{ cm}^3$

or 23728.57 cm^3 $1\frac{1}{2}$

27. Let speed of train be x km/h

$\frac{360}{x} - \frac{360}{x+5} = 1$ 2

$360\left[\frac{x+5-x}{x(x+5)}\right] = 1$

$x^2 + 5x - 1800 = 0$ $\frac{1}{2}$

$(x + 45)(x - 40) = 0$ $\frac{1}{2}$

$x = -45$, $x = 40$ 1
(Rejected)

Hence, speed of train = 40 km/h

OR

$$\frac{1}{a+b+x}-\frac{1}{x}=\frac{1}{a}+\frac{1}{b}$$ 1

$$\frac{x-a-b-x}{x(a+b+x)}=\frac{b+a}{ab}$$

$-ab = x^2 + (a + b)x$

$x^2 + (a + b)x + ab = 0$ $1\frac{1}{2}$

$(x + a)\ (x + b) = 0$ 1

$x = -a,\ x = -b$ $\frac{1}{2}$

28. $a_n = \frac{1}{m}$

$a + (n - 1)d = \frac{1}{m}$ $\frac{1}{2}$

$a_m = \frac{1}{n}$

$a + (m - 1)d = \frac{1}{n}$ $\frac{1}{2}$

On solving,

$a = \frac{1}{mn}$ $\frac{1}{2}$

$d = \frac{1}{mn}$ $\frac{1}{2}$

(i) $a_{mn} = \frac{1}{mn}+(mn-1)\times\frac{1}{mn}$

$= \frac{1+mn-1}{mn}=1$ 1

(ii) $S_{mn} = \frac{mn}{2}\left(\frac{1}{mn}+1\right)$

$= \frac{1+mn}{2}$ 1

29.	For Correct Given, To prove, Construction, Figure	$4\times\frac{1}{2}=2$
	For Correct Proof	2
30.	For Construction of Correct Circle	1
	For Construction of Correct Pair of Tangents	3