

INJSO - 2019

ROLL NO.

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Indian National Junior Science Olympiad 2019**ANSWER KEY**

Duration: Three Hours

Date: 02/02/2019

Maximum Marks: 180

Centre: _____

(Please do NOT write anything below)

| Sec A [MCQ] | Correct (X) | Wrong (Y) | Not attempted | Marks(3X-Y) |
|-------------|-------------|-----------|---------------|-------------|
| | | | | |

| Sec B [Theory] | | Q 31 | Q 32 | Q 33 | Q 34 | Q 35 | Total |
|-------------------|-------|------|------|------|------|------|-------|
| | Marks | | | | | | |
| | Marks | | | | | | |
| | Marks | | | | | | |
| | | Q 36 | Q 37 | Q 38 | | | |
| | Marks | | | | | | |
| | Marks | | | | | | |
| | Marks | | | | | | |

Total A + B _____

HOMI BHABHA CENTRE FOR SCIENCE EDUCATION

Tata Institute of Fundamental Research

V.N. Purav Marg, Mankhurd, Mumbai, 400 088

Instructions overleaf

Instructions

- Use only black or blue pen in this answer sheet. **Do not use a pencil.**
- Graphs/Diagrams may be drawn with pencil or pen.
- Write your roll number on top of every page in the space provided.
- Before starting, ensure that you have received a copy of this Answer Sheet containing a total of 16 pages (16 sides on 8 sheets).
- Answers for Section A have to be marked in the boxes provided in page 3 of this Answer Sheet.
- For Section A, you have to indicate the answers by putting a 'X' in the appropriate box against the relevant question number, as indicated below:

| Q. No. | (A) | (B) | (C) | (D) |
|--------|--------------------------|-------------------------------------|--------------------------|--------------------------|
| 22 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Marking a cross ☒ means affirmative response (selecting the particular choice).

Do not use ticks or any other signs to mark the correct answers.

- Once marked, the answer should not be changed as far as possible. However in an extreme case, if you want to change the answer you can do so as shown below:

| Q. No. | (A) | (B) | (C) | (D) |
|--------|--------------------------|-------------------------------------|--------------------------|-------------------------------------|
| 22 | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |

- For Section B, boxes are provided where you can show the calculations. Additional blank page is provided for rough work.
- In case you need extra space for rough work, you may request for additional blank sheets from the invigilator. Remember to write your roll number on the extra sheets and get them attached to your answer sheets.
- **This Answer Sheet must be returned to the invigilator.**

SECTION A: ANSWER KEY

| Q. No. | (A) | (B) | (C) | (D) | Q. No. | (A) | (B) | (C) | (D) |
|--------|-----|-----|-----|-----|--------|-----|-----|-----|-----|
| 1. | | | X | | 16. | | | | X |
| 2. | | | X | | 17. | X | | | |
| 3. | X | | | | 18. | | | | X |
| 4. | X | | | | 19. | | | X | |
| 5. | | | | X | 20. | | | X | |
| 6. | | | | X | 21. | | X | | |
| 7. | | X | | | 22. | | | | X |
| 8. | X | | | | 23. | | | X | |
| 9. | | | X | | 24. | | X | | |
| 10. | | X | | | 25. | | | | X |
| 11. | | | | X | 26. | | | | X |
| 12. | | X | | | 27. | | X | | |
| 13. | | X | | | 28. | | | X | |
| 14. | | | | X | 29. | | | | X |
| 15. | | | | X | 30. | X | | | |

| | X | Y | Not attempted | |
|-----------|---|---|---------------|----------|
| SECTION A | | | | 3X – Y = |

SECTION B: ANSWER KEY**QUESTION 31 (9 MARKS)**

(A)

(1.5 MARKS)

| | | | |
|----|----|----|----|
| a. | b. | c. | d. |
| | | X | |

(B)

(i) Value of the ratio obtained for plants in the sun: 1.71

(1.5 MARKS)

(ii) Value of the ratio obtained for plants in shade condition: 2.236 or 2.24

(1.5 MARKS)

(C)

(1.5 MARKS)

(i) The values obtained in (B) support Hypothesis 1: _____

(ii) The values obtained in (B) do not support Hypothesis 1: ____X____

(D)

(1.5 MARKS)

| | | | |
|----|----|----|----|
| a. | b. | c. | d. |
| X | | | |

(E)

(1.5 MARKS)

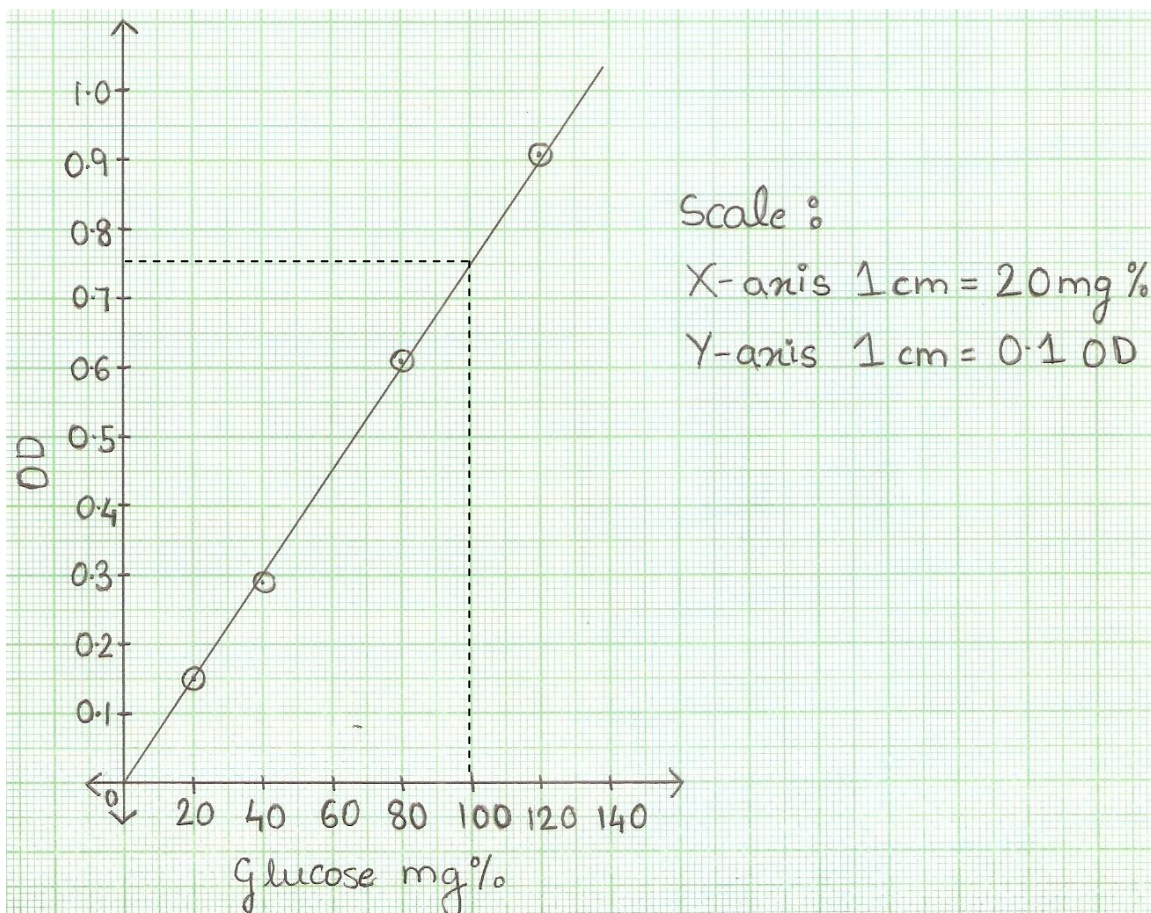
| | | | |
|----|----|----|----|
| a. | b. | c. | d. |
| | | X | |

QUESTION 32 (12 MARKS)

(A) Molar concentration of glucose in Rajesh's blood: 0.0055 or 0.0056

Show extrapolation in the graph and calculations in the box.

(3 MARKS)



Calculations:

MW of glucose = 180

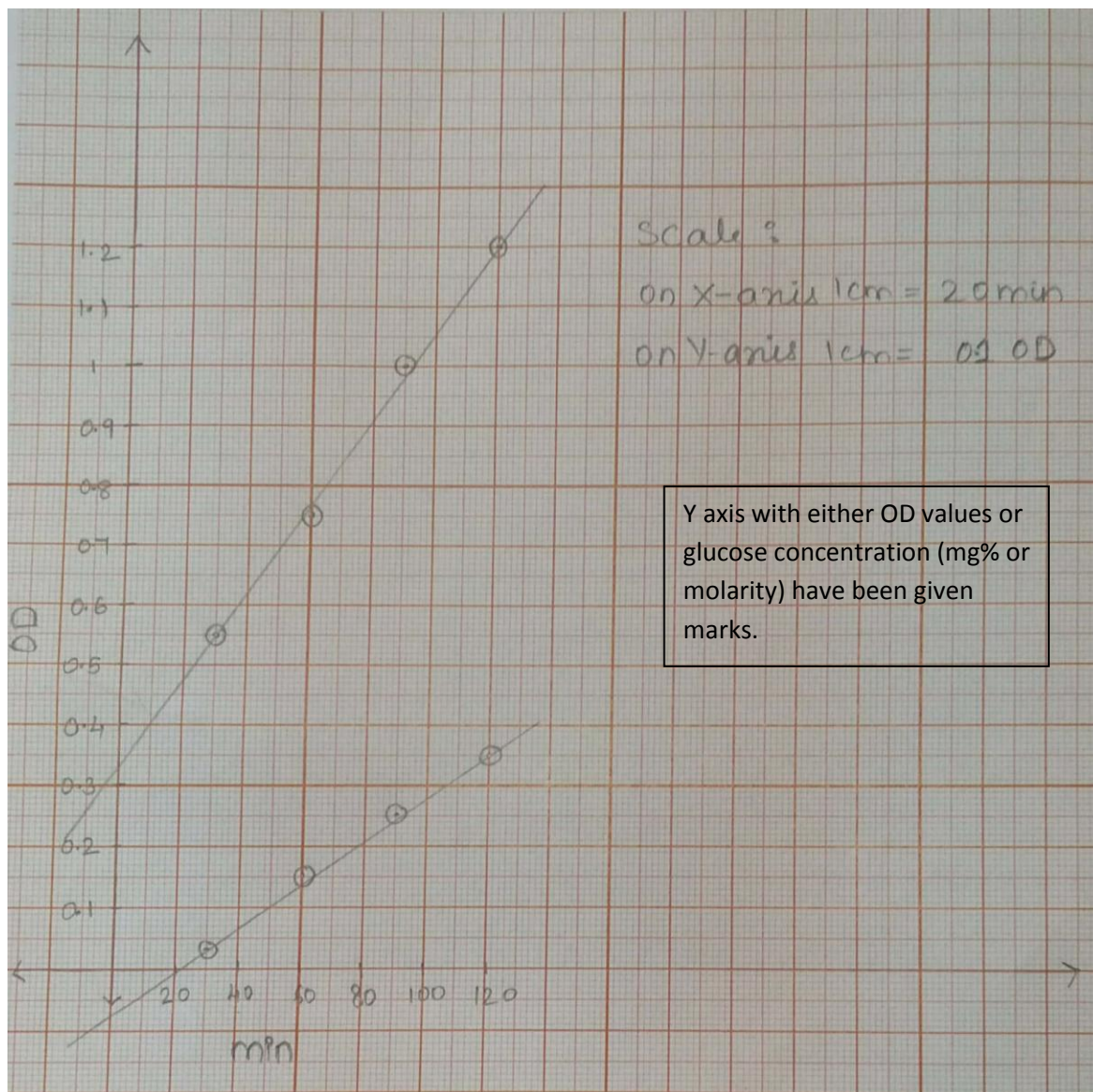
180 gm in 1 litre = 1M

0.1 gm in 100 ml = 0.0055M

Alternate representations of the answer have been given marks.

(B) Graph:

(3 MARKS)



(C) Answer: 120 mg% (118 – 122 mg% will be awarded full marks)

(2 MARKS)

(D) Answer: 78 mg% or $4.3 \times 10^{-4} \text{M}$

(4 MARKS)

QUESTION 33 (9 MARKS)

(A)

i. Primary producer __Z__ (1.5 MARKS)

ii. Herbivore __Y__ (1.5 MARKS)

iii. Carnivore __X__ (1.5 MARKS)

(B)

(3 MARKS)

Calculations:

$$0.006 \times 200 = 1.2 \text{ g}$$

$$0.0025 \times 40 = 0.1 \text{ g}$$

$$\text{Hence } 0.1/1.2 \times 100 = 8.33 \%$$

Answer: 8.33%

(C) Answer: Day: 13-17 (0.5 MARK)

Activity: a (1 MARK)

QUESTION 34 (13.5 MARKS)

(B) (i) KMnO_4 is an oxidising agent. (1.5 MARKS)

(ii) $\text{H}_2\text{C}_2\text{O}_4$ is a reducing agent. (1.5 MARKS)

(C) Calculate the number of moles of oxalic acid reacted with the KMnO_4 . (3 MARKS)

Calculations:

$$17.8 \times 10^{-3} \times 0.1 \times 5/2 = 4.45 \times 10^{-3} \text{ Moles of Oxalic acid}$$

Answer: 4.45×10^{-3} moles of oxalic acid

(D) Calculate the mass (in g) of CaCO_3 in the original sample. (2 MARKS)

Calculations:

$$100 \times 4.45 \times 10^{-3}$$

Answer: 0.445 g of CaCO_3

(E) Find the percent (%) of Na_2SO_4 present in the original sample. (2 MARKS)

Calculations:

$$(0.626 - 0.445) = 0.181 \text{ g}$$
$$(100 \times 0.181) / 0.626 = 28.9\% \text{ or } 29\%$$

Answer: 28.9 or 29%

QUESTION 35 (6 MARKS)

(A) The heat absorbed by the water.

(4 MARKS)

Calculations:

$$q = (\text{specific heat}) \times m \times \Delta t$$

Where q is heat absorbed by the water, m is mass of water in grams = 90 g Δt is the temperature change = $30.5 - 29 = 1.5^\circ\text{C}$

$$q_{\text{water}} = [4.18 (\text{J/g}\cdot^\circ\text{C}) \times 90 \text{ g} \times 1.5^\circ\text{C}] = 564.3 \text{ J}$$

Answer: $q_{\text{water}} = 564.3 \text{ J}$ OR 135 cal OR 567 J(B) Heat evolved during the reaction of 17 g OH^- with 1 g H^+ .

(2 MARKS)

Calculations:

$$17 \text{ g } \text{OH}^- \equiv 1 \text{ mole } \text{OH}^-$$

$$\text{and } 1 \text{ g } \text{H}^+ \equiv 1 \text{ mole } \text{H}^+.$$

when 0.010 mol of H^+ and OH^- reacts, heat evolved is -564.3 J Hence 1 mole of H^+ and 1 mole OH^- on reacting may evolve

$$-564.3 / 0.01 = -56430 \text{ J} = -56.43 \text{ kJ}$$

Answer: $-$ or $+ 56.43 \text{ kJ}$ OR 56.7 kJ OR 13500 cal

QUESTION 36 (10.5 MARKS)

- (A) Calculate the number of moles of carbon atoms present in 100g of compound. (2 MARKS)

Calculations:

$$\frac{(85.7 \text{ g C})(1\text{mol of C})}{(12.0 \text{ g C})} = 7.14 \text{ mol C}$$

Answer: 7.14 mol C

- (B) Calculate the number of moles of hydrogen atoms present in 100g of compound. (2 MARKS)

Calculations:

$$\frac{(14.3 \text{ g H})(1\text{mol of H})}{(1.008 \text{ g H})} = 14.2 - 14.3 \text{ mol H}$$

Answer: 14.2mol

- (C) The empirical formula of the compound is : CH₂ (1 MARK)

- (D) Moles /Litre of the compound at NTP = 0.04065 OR 0.0409 (2 MARKS)

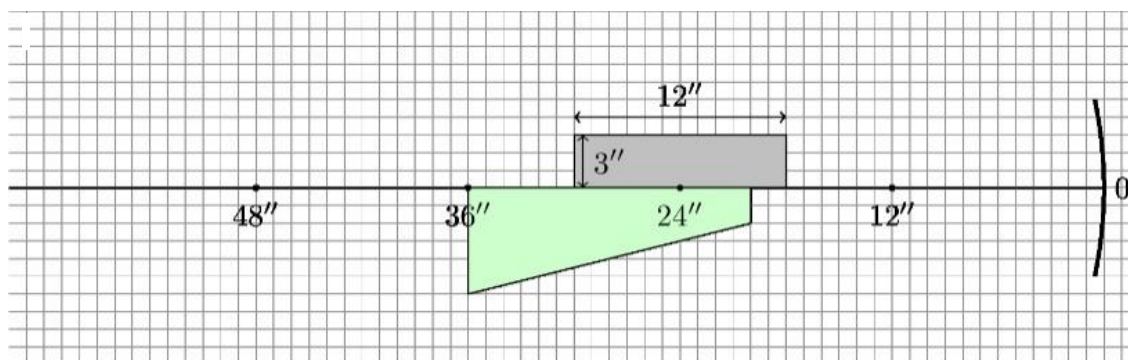
Calculations:

$$n = \frac{PV}{RT} = \frac{(1.00 \text{ atm}) (1.00 \text{ L})}{(0.0820 \text{ L atm K}^{-1} \text{ mol}^{-1})(300 \text{ K})} = 0.04065 \text{ mol}$$

Temperature of 273K will be considered for partial marks.

- (E) Empirical formula units = 4 (2 MARKS)

- (F) Molecular formula : C₄H₈ (1.5 MARKS)

QUESTION 37 (12 MARKS)

Calculations: Image distances and the magnifications at the various points are shown below.

| | | | | | | |
|--|----|-----|---------------|----|-----------------|---------------|
| Object distance, u'' | 18 | 20 | 21 | 24 | 27 | 30 |
| Image distance, v'' | 36 | 30 | 28 | 24 | $\frac{108}{5}$ | 20 |
| Linear magnification, $m = \frac{v}{u}$ | 2 | 1.5 | $\frac{4}{3}$ | 1 | 0.8 | $\frac{2}{3}$ |
| Size of image, $I = (m.3)''$ | 6 | 4.5 | 4 | 3 | 2.4 | 2 |

This shows that magnification increases linearly as object distance decreases from the mirror.

Alternate solutions may exist. Correct methods to draw the image on the grid will be credited accordingly.

QUESTION 38 (18 MARKS)

(A)

(4 MARKS)

(i) Variable on x axis (X) : $L + e$ (ii) Variable on y axis (Y) : $\frac{1}{f}$

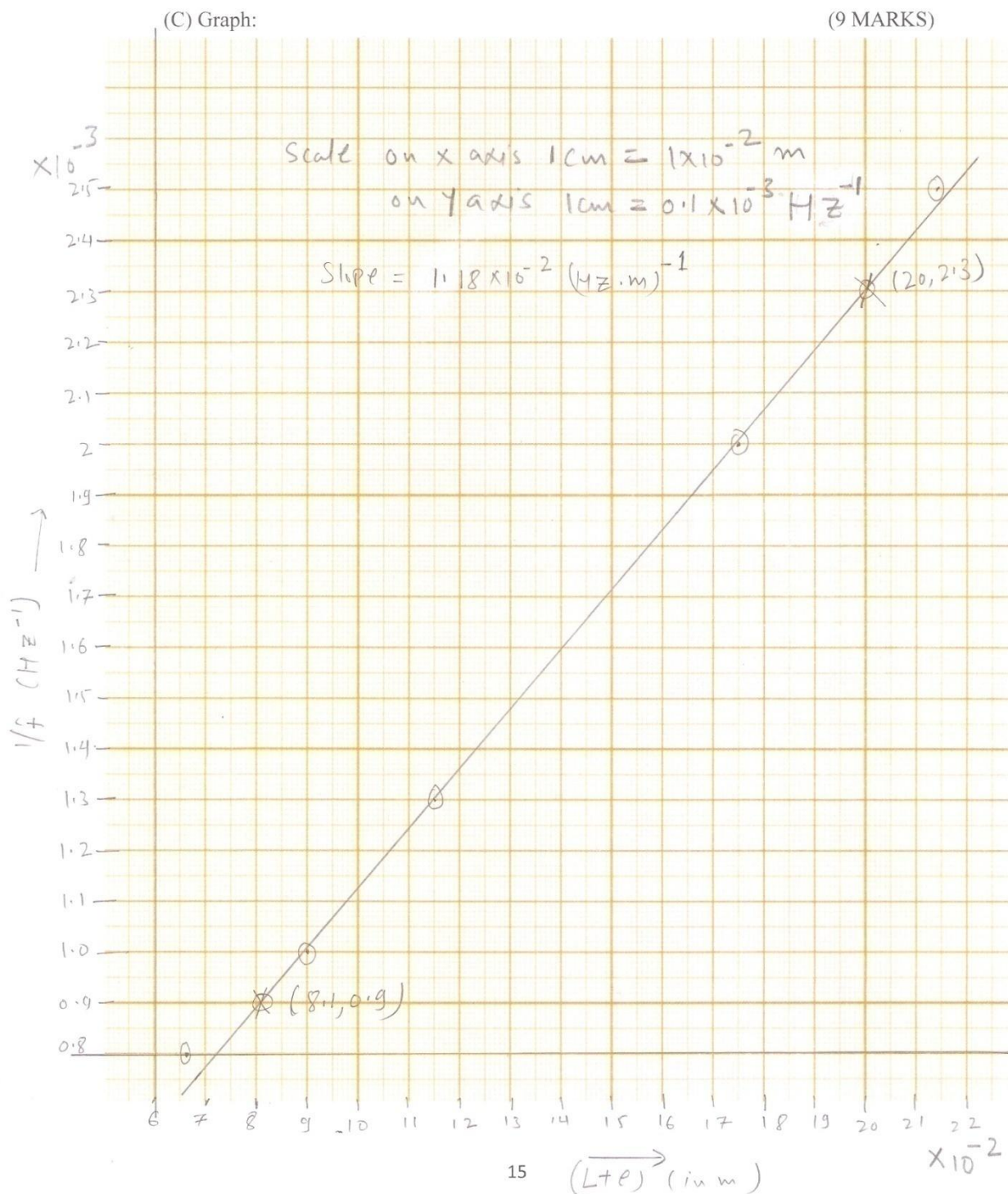
Any correct set of variables which produces linear graph will be equally credited (for example $4(L + e)$ vs $1/f$ etc.).

(B) Table:

(2 MARKS)

| No. | Frequency f (Hz) | $L(\text{cm})$ | X ($L + e$) ($\times 10^{-2} \text{ m}$) | Y ($\frac{1}{f}$) ($\times 10^{-3} \text{ Hz}^{-1}$) |
|-----|-----------------------|----------------|---|---|
| 1 | 400 | 19.9 | 21.4 | 2.50 |
| 2 | 500 | 16.0 | 17.5 | 2.00 |
| 3 | 750 | 10.0 | 11.5 | 1.33 |
| 4 | 1000 | 7.5 | 9.00 | 1.00 |
| 5 | 1250 | 5.1 | 6.60 | 0.80 |

(C) Graph:



Calculations:

$$\frac{1}{f} = \frac{4}{c}(L + e)$$

Where c is the speed of sound. For the plotted graph:

$$\text{Slope of the graph} = \frac{4}{c} = 1.18 \times 10^{-2} (\text{Hz} \cdot \text{m})^{-1}$$

$$\text{Speed of sound in air } c = 3.39 \times 10^2 \text{ m/s}$$

$$\text{Range of slope} = 0.0124 - 0.0108 (\text{Hz} \cdot \text{m})^{-1}$$

(D) Speed of sound in air = $3.23 \times 10^2 - 3.70 \times 10^2$ m/s

(3 MARKS)

***** END OF SECTION B *****