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General Comments

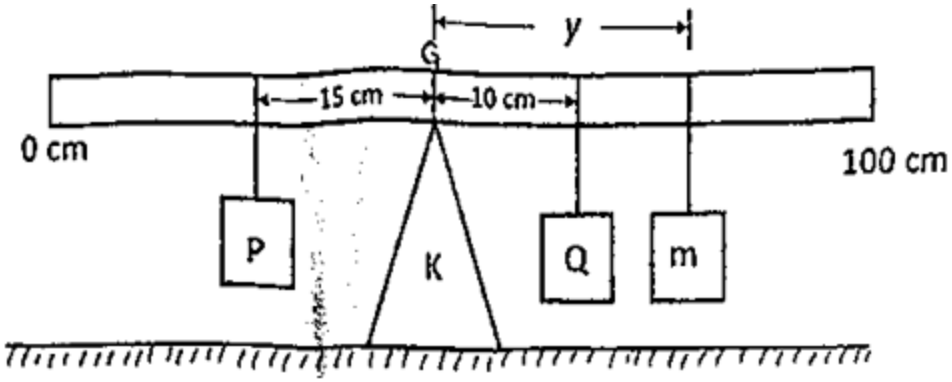
Weakness/Remedies

Candidate's Strength

Alternative A

Question 1A

(a)



You are provided with a metre rule, **two** loads, **P** and **Q**, a knife edge, **K**, a set of masses, m and a piece of string.
Use the diagram above as a guide to perform the experiment.

1. With no loads hanging on the metre rule, balance the metre rule horizontally on the knife edge. Record the position, **G,** of the knife edge on the balanced metre rule.
2. Suspend **P** securely at 15 *cm* from **G**, and **Q** securely at 10 *cm* from **G**.The positions of G, P and Q should **not** be altered throughout the experiment.
3. Using a mass, = 40 , balance the metre rule horizontally. Measure and record the distance, *y*, of *m* from **G**.
4. Evaluate *m-1.*
5. Repeat the procedure for *m* = 50 *g*, 60 *g*, 70 *g* and 80 *g.* In each case, record the distance, y, and evaluate *m-1.*
6. Tabulate the results.
7. Plot a graph with *m-1* as ordinate and y as abscissa.
8. Determine the slope, s, of the graph.
9. Determine the value of given that 15
10. From the graph, deduce the mass, m, that would produce a balance distance, .

11. State **two** precautions taken to ensure good results.

(b) (i) State the two conditions necessary for a body to be in equilibrium

(ii) Two forces 4 N and 3 N act at right angles to each other, calculate the equilibrant of the system of forces.

Observation

WEAKNESSES: The candidates mistakenly swapped the axes because they could not tell the difference between the y-axis (ordinate) and the x-axis (abscissa).
STRENGTH: Ability to carry out the instructions and record observations as required.
EXPECTED RESPONSE:

OBSERVATIONS [09]

- Reasonable value of *G* **correctly** determined and recorded to at **least** 1 d.p. in cm.

(ii) **Five** values of *m* **correctly** recorded in grams
(Deduct ½ mark for **each** wrong or missing value)

- **Five** values of *y* **correctly** determined and recorded to **at least** 1 d.p. and in trend.
Trend: As *m* increases, *y* decreases.
(Award 1 mark **each**)
- **Five** values of *m-1* **correctly** evaluated to at **least** 3 d.p.
(Deduct ½ mark for **each** wrong or missing value)
- Composite table showing *m*, *m-1* and *y*.

GRAPH [06]

- Axes **correctly** distinguished (Award ½ mark **each**)
- Reasonable scales (Award ½ mark **each**)
- **Five** points **correctly** plotted
(Deduct 1 mark for **each** wrong or missing point)
- Line of **best** fit

SLOPE (02)

- Large right-angled triangle

(ii) D*m-1* **correctly** determined
(iii) D*y* **correctly** determined
(iv) **correctly** evaluated

DETERMINATION OF mp [01]

- **Correct** substitution
- **Correct** calculation

DEDUCTION OF m [01]

- Value of *m-1* corresponding to y = 27.5 cm **correctly** shown
- *m* **correctly** evaluated

PRECAUTIONS [02]
Award 1 mark **each** for any 2 reasonable precautions stated in acceptable tense.
E.g.:

- Avoided draught
- Avoided parallax error in taking metre rule readings
- Repeated readings shown on table.

(b) (i) **Conditions for a body to be in stable equilibrium**
(α)

- There should be no net force on the object

OR

- The sum of forces in one direction must be equal to the sum of forces in the opposite direction.

(β)

The sum of the clockwise moments about a point is equal to the sum of the anti-clockwise moment about the same point.

OR

The net torque acting on the body must be zero.

II)

$R = \sqrt{F_1{}^2 + F_2{}^2}$

$R = \sqrt{3^2 + 4^2}$

R = 5 N

The equilibrant is 5 N opposite to R

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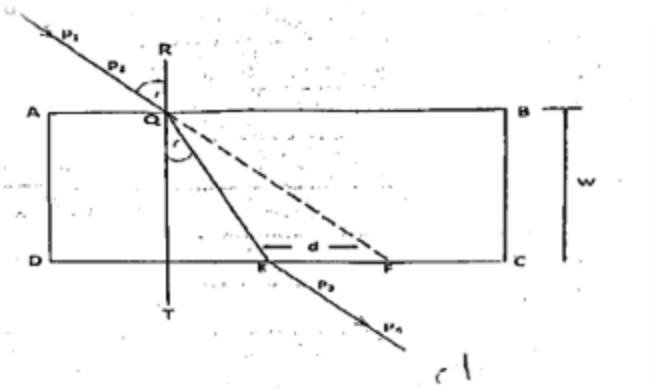
General Comments

Weakness/Remedies

Candidate's Strength

Alternative A

Question 2A



You are provided with a rectangular block, a drawing board, drawing sheets, four optical pins and other necessary materials.

Use the diagram above as a guide to perform the experiment.

i. Measure and record the width of the block.
ii. Draw the outline **ABCD** of the block on a drawing sheet. Mark a point, **Q** on **AB** such that **AQ** = 1.5 cm. Draw the normal **RQT** as shown in the diagram above.
iii. Draw a line **UQ** making an angle *i* = 100 with the normal **RQT**.
iv. Insert pins **P1** and **P2** on the UQ. Look through the side DC of the block and insert two other pins, **P3** and **P4** which appear to be in a straight line with the images of **P** and **P2.**
v. Remove the block and mark the positions of **P3** and **P4.** Draw a straight line joining **P3** and **P4** and extend it to meet **DC** at **E.**
vi. Produce a line **UQ** to meet **DC** at point **F**. Draw a straight line **EQ**.
vii. Measure and record the angle, *r*, length, **EF = d**, and evaluate tan *i*, tan *r* and V = (tan *I* tan *r*).
viii. Using different outlines of the block, repeat the procedure for *i* = 200, 300, 400 and 500. In each case, measure and record r, d and evaluate tan *i*, tan *r* and *V.*

ix. Tabulate the results.
x. Plot a graph with **d** on the vertical axis and *V* on the horizontal axis.
xi. Determine the slope, *s*, of the graph.
xii. State two precautions taken to ensure good results.

[*attach the traces to this booklet*]

(b) (i) State the condition for the occurrence of total internal reflection at air-glass interface
(ii) State *Snell's law*.

Observation

WEAKNESSES: The spacing of the pins is not sufficient.
STRENGTH: Most candidates executed the instructions well.
EXPECTED RESPONSE:

(a) **OBSERVATIONS [10]**

(i) Width of block *W* **correctly** recorded to **at least** 1 *d.p.* in cm
(ii) **Five** complete traces showing **at least** the normal, incident ray, refracted ray, and emergent ray.
(Deduct ½ mark for **each** wrong or missing trace)
(iii) **Five** values of *i* **correctly** recorded in degrees.
(Deduct ½ mark for **each** wrong or missing value)

- **Five** values of *r* **correctly** measured and recorded in degrees and in trend.
  Trend: As *i* increases, *r* increases.

(Deduct ½ mark for **each** wrong or missing value)

- **Five** values of *d* **correctly** measured and recorded to **at least** 1 *d.p.* in cm and in trend.
  Trend: As *i* increases, *d* increases.

(Deduct ½ mark for **each** wrong or missing value)

- **Five** values of *Tan i* **correctly** evaluated to **at least** 3 *d.p.*

(Deduct ½ mark for **each** wrong or missing value)
(vii) **Five** values of Tan *r* **correctly** evaluated to **at least** 3 *d.p.*
(Deduct ½ mark for **each** wrong or missing value)
(viii)**Five** values of $V = (\tan i - \tan r)$ **correctly** evaluated.
(Deduct ½ mark for **each wrong or missing value**)
(ix) Composite table showing *i*, *r*, *d*, *tan i* , *tan r* and *V.*

NB: (α) If no traces, score zero for i, ii and iii.
(β) If no pin marks, score zero for i, ii and iii
(ɣ) If traces are in one outline, deduct 1 mark for ***d.i.***
(ɳ) If no arrows on at least one trace, deduct ½ mark

GRAPH [06]

- Both Axes **correctly** distinguished
- Reasonable Scales
- **Five** points **correctly** plotted

(Deduct 1 mark for **each** wrong or missing point)

- Line of **best** fit

SLOPE [02]

- Large right – angled triangle.
- Δd **correctly** determined.
- ΔV **correctly** determined.
- **correctly** evaluated.

ACCURACY [01]
Based on slope, s = candidate's value of *w* ± 10%

PRECAUTIONS [02]
Award 1 mark **each** for any 2 correct precautions stated in acceptable tense.
Eg:

- Used well sharpened pencil/ neat traces

- Parallax error avoided in taking readings with protractor/ruler
- Repeated readings shown on table
- Pins separated at about 5 cm apart
- Cleaned surface of the prism.

(b) (i) **Condition for the occurrence of total internal reflection at air to glass interface**

- Light must travel from glass to air medium
- The angle of incidence(in glass) must be greater than the critical angle (of glass)

(ii) **Snell's Law**

The ratio of the Sine of the angle of incidence to the Sine of the angle of refraction is constant for a given pair of media.

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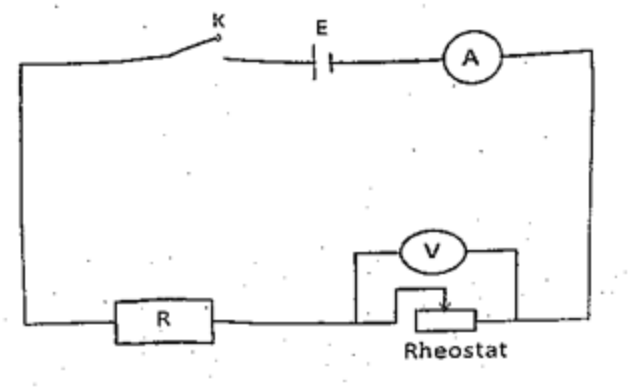
Alternative A

Question 3A

(a)



You are provided with a rheostat, an ammeter, a voltmeter, 1 Ω standard resistor, a key, a source of electricity of *emf*, E and connecting wires.

1. Use the electrical components provided to connect the circuit as shown in the diagram leaving the circuit open.
2. Connect the voltmeter to the terminals of the battery and record the voltmeter reading V0.
3. Close the key and adjust the rheostat so that the ammeter reads, $I = 0.3\ A$.

Record the corresponding voltmeter reading, *V.*

1. Evaluate and G = .
2. Repeat the experiment for **four** other values of $I = 0.5\ A$, $0.7\ A$, $0.9\ A$ and $1.1\ A$. In **each** case, record the corresponding value of *V*, and evaluate and G.
3. Tabulate the results.
4. Plot a graph with on the vertical axis and *G* on the horizontal axis.
5. Determine the slope, *s,* of the graph.
6. Using the graph, determine the value of *V* for *G = 2.5.*
7. State **two** precautions taken to ensure good results

b) (i) A battery of *emf* 4.5 *V* has a voltmeter connected to its terminals. If the combination is connected in series with a standard resistor and a key, it is observed that the voltmeter reading is less than 4.5 *V* when the key is closed. Explain the observation

(ii) An electric device draws 0.50 *A* in a 120 *V* circuit. Calculate the cost of using the device for 24 hours if the rate is *$* 0.25 per *KWh*

Observation

EXPECTED RESPONSE:

(a) **OBSERVATIONS [08]**

(i) Value of *Vo* **correctly** measured and recorded to **at least** 1 *d.p.* in volts.

(ii) **Five** values of *I* **correctly** recorded in Amperes.

(Deduct ½ mark for **each** wrong or missing value)

(iii) **Five** values of *V* **correctly** recorded to **at least** 1 *d.p.* in volts and in trend.

Trend: As *I* increases, *V* decreases.

(Deduct 1 mark for **each** wrong or missing value)

(iv) **Five** values of **correctly** evaluated to **at least** 2 *d.p.*

(Deduct ½ mark for **each** wrong or missing value)

(v) **Five** values of *I-1* **correctly** evaluated to **at least** 3 *s.f.*

(Deduct ½ mark for each wrong or missing value)

GRAPH [06]

(i) Both axes **correctly** distinguished (Award ½ mark **each**)

(ii) Reasonable scales (Award ½ mark **each**)

(iii) **Five** points **correctly** plotted.

(Deduct 1 mark for **each** wrong or missing point)

(iv) Line of **best** fit

SLOPE [02]

(i) Large right-angled triangle

(ii) D *I-1* **correctly** determined

(iii) D*G* **correctly** determined

(iv) **correctly** evaluated

DETERMINATION OF V [02]

(i) Value of I-1 corresponding to G = 2.5 **correctly** shown.

(ii) I **correctly** evaluated

(ii) **correctly** calculated

ACCURACY [01]

Based on s-1 = V0 ± 10%

PRECAUTIONS [02]

Award 1 mark **each** for any 2 correct precautions stated in acceptable tense.

Eg

- Ensured clean terminals.
- Ensured tight terminals/connections.
- Noted/ corrected zero error on ammeter.
- Avoided parallax error when taking readings from ammeter/voltmeter
- Repeated readings shown on table.
- Opened key when readings are not being taken.

(b) (i)

When the key is closed, the battery supplies current in the circuits. The observed drop in the voltmeter reading is due to the voltage drop/lost across the internal resistance of the battery.

OR

Part of the emf is used up within the cell itself.

(ii)

Power of device = IV
= 0.5 × 120
= 60 W = 0.06 kW
Energy consumed in 24 hours, E = 0.06 × 24 kWh = 1.44 kWh
Cost of consumption = 1.44 × $0.25
= $0.36
OR

=

= $0.36

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Alternative B

Question 1B

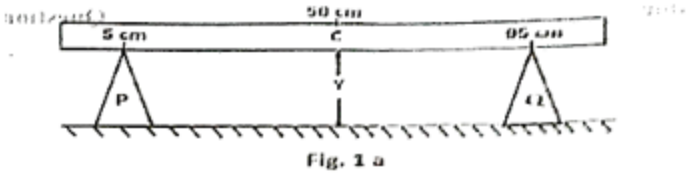

Fig. 1 a

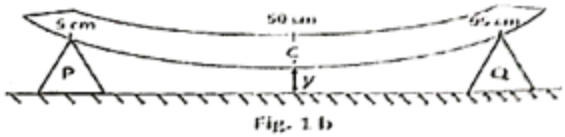

Fig. 1 b

You are provided with **two** knife edges of equal height, a set of masses, a short piece of string with a loop at **each** end, a metre rule and a half-metre rule.

Carry out the following instructions using the diagram above as a guide.

1. Slide the loop of strings onto the metre rule and place it symmetrically on the two knife edges, **P** and **Q**, as shown in **Fig. 1a.**

Do **not** change the positions of P and Q throughout the experiment.

1. Measure and record the height, **Y**, of C above the surface of the bench as shown in **Fig.1a**.
2. Use the loop of string to hang a mass, m = 50 g at C. Measure the new height, **y**, as shown in **Fig. 1b**.
3. Evaluate the depression, $d = (Y – y)$ of C.
4. Evaluate log d and log m.
5. Repeat the procedure for four other masses, m = 100 g, 150 g, 200 g and 250 g.

In **each** case, measure y and evaluate $d = (Y – y)$, log d and log m.

1. Tabulate the results.
2. Plot a graph with log d as ordinate and log m as abscissa.
3. Determine the slope, s, of the graph.

4. Given a mass, , use the graph to determine the value of *y*.
5. State **two** precautions taken to ensure good results.

(b) (i) Define the term *elasticity*.

(ii) A piece of wood 1.5 *m* long has a cross-sectional area of with one end of the wood fixed to a wall. Calculate the force required to produce a depression of [Young's modulus of wood =]

Observation

WEAKNESSES: Most candidates could not determine the value of from the graph when mass

STRENGTH: Most candidates successfully carried out the given instructions.

EXPECTED RESPONSE:

(a) **OBSERVATIONS [09]**

- Value of *Y* **correctly** recorded to **at least** 1 d.p in cm.
- **Five** values of *m* **correctly** recorded in grams.

(Deduct ½ mark for **each** wrong or missing value)

- **Five** values of *y* **correctly** recorded to **at least** 1 d.p in cm and in trend

Trend: As *m* increases, *y* decreases.

(Deduct 1 mark for **each** wrong or missing value)

- **Five** values of *d* = (*Y- y*) **correctly** evaluated.

(Deduct ½ mark for **each** wrong or missing value)

- **Five** values of *log d* **correctly** evaluated to **at least** 3 d.p.

(Deduct ½ mark for **each** wrong or missing value)

(vi) **Five** values of *log m* **correctly** evaluated to **at least** 3 d.p.

(Deduct ½ mark for **each** wrong or missing value)

- Composite table showing *m*, *y*, *d*, *log d* and *log m*.

GRAPH [06]

(i) Both axes **correctly** distinguished (Award ½ mark **each**)

(ii) Reasonable Scales (Award ½ mark **each**)

(iii) **Five** points **correctly** plotted

(Deduct 1 mark for **each** wrong or missing point)

(iv) Line of **best** fit

SLOPE [02]

(i) Large right-angled triangle

(ii) D*log d* **correctly** determined

(iii) D*log m* **correctly** determined

(iv) **correctly** evaluated

DEDUCTION [02]

log 170 = 2.230

log d corresponding to log 170 **correctly** shown on graph

d **correctly** evaluated

correctly evaluated.

PRECAUTIONS [02]

Award 1 mark **each** for any two correct precautions stated in acceptable tense.

Eg:

- Shielded apparatus from wind/ switched off fans/avoided draught.
- Avoided parallax error in taking readings on metre rule.
- Avoided/noted zero error on metre rule/half-metre rule
- Repeated readings shown on table.
- Ensured the mass did not touch/rest on the table.
- Suspended mass should be stable before taking readings

(b) (i) **Elasticity**
is the ability of a deformed body to return to its original shape and size when the force causing the deformation is no longer present or removed.
(ii)

$$\text{Young's Modulus, E} = \frac{F/A}{e/L} \quad \textbf{OR } F = \frac{EAe}{L}$$
$$= \frac{1.1 \times 10^{10} \times 2.0 \times 10^{-5} \times 0.025}{1.5}$$
$$= 3666.7 \text{ N}$$

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Alternative B

Question 2B

You are provided with a lagged calorimeter with a stirrer, a metal block, a measuring cylinder, a thermometer, a retort stand, clamp and other materials.

Use the diagram above as a guide to perform the experiment.

1. Measure a volume, v = 50.0 of cold water into the calorimeter, assuming the densit of water is 1, determine the mass, of cold water in the calorimeter.
2. Measure and record the temperature of the cold water in the calorimeter.
3. Place the metal block in the beaker and pour sufficient water to cover the metal in it Heat the water to boil for **at least two** minutes.
4. Quickly transfer the heated metal into the calorimeter. Stir quickly and record the **highest** temperature,, of the mixture.

(v) Evaluate $(\theta_f - \theta_i)$, $(100 - \theta_i)$ and $R = \frac{(100-\theta_i)}{(\theta_f-\theta_i)}$

(vi) Repeat the procedure for four other volumes, $v = 100.0\ cm^3, 120.0\ cm^3, 150.0\ cm^3$ and $200.0\ cm^3$. In each case, record m_w, θ_i, θ_f, $(\theta_f - \theta_i)$, $(100 - \theta_i)$ and R.

(vii) Tabulate the results.

(viii) Plot a graph with R as ordinate and m_w as abscissa.

(ix) Determine the slope, s, of the graph.

(x) Calculate the value of C_b in the equation $s = \frac{4.2}{m_b C_b}$.

(xi) Using the graph, deduce θ_f when $m_w = 55\ g$.

12. State **two** precautions taken to ensure good results.

(b) (i) Explain the statement the specific heat capacity of copper is 385 *J Kg*-1 *K*-1.

(ii) A copper ball at 250C is placed in a vessel of water boiling at 1000C until equilibrium is attained. If the mass of the ball is 500g, calculate the thermal energy absorbed by the ball.

[Specific heat capacity of copper = 385 *J Kg*-1 *K*-1]

Observation

WEAKNESSES: There is a lack of depth in the concept of heat practicals as most candidates stayed off this question and the few that attempted it did not do well.

STRENGTH: Most candidates explain the statement the specific heat capacity of copper is 385 *J Kg*-1 *K*-1 correctly.

EXPECTED RESPONSE:

(a) **OBSERVATIONS [07]**

- **Five** values of *mw* **correctly** converted to **at least** 1 d.p in grams.

(Deduct ½ mark for **each** wrong or missing value)

- Value of *θi* **correctly** recorded in °C.
- **Five** values of *θf* **correctly** recorded in °C and in trend.

Trend: As *mw* increases, *θf* decreases.

(Deduct ½ mark for **each** wrong or missing value)

- **Five** values of (*θf* - *θi*) **correctly** evaluated.

(Deduct ½ mark for **each** wrong or missing value)

(v) **Five** values of (*100* - *θf*) **correctly** evaluated.

(Deduct ½ mark for **each** wrong or missing value)

(vi) **Five** values of *R* = **correctly** evaluated to **at least** 2 d.p.

(Deduct ½ mark for **each** wrong or missing value)

(vii) Composite table showing *mw*, *θf*, (*θf* - *θi*), (*100* - *θf*) and *R*.

GRAPH [06]

(i) Both axes **correctly** distinguished (Award ½ mark **each**)

(ii) Reasonable Scales (Award ½ mark **each**)

(iii) **Five** points **correctl**y plotted

(Deduct ½ mark for **each** wrong or missing point)

(iv) Line of **best** fit

SLOPE [02]

(i) Large right-angled triangle

(ii) D *R* **correctly** determined

(iii) D *mw* **correctly** determined

(iv) **correctly** evaluated

CALCULATION OF Cb[01]

- **Correct** substitution

(ii) **Correct** arithmetic

DEDUCTION OF θf [02]

(iii) Value of R corresponding to mw = 55 g **correctly** shown on graph.

(ii) , θf correctly calculated.

ACCURACY [01]

Based on candidate's value of Cb = Teacher's value of specific heat capacity of metallic block ± 10%

PRECAUTIONS [02]

Award 1 mark **each** for any two correct precautions stated in acceptable tense.

Eg:

- Clamped thermometer firmly.
- Avoided splashing of water.
- Avoided parallax error when taking readings on the thermometer.
- Repeated readings(shown on table)

(b) (i) **Meaning of statement**

385 J of thermal energy is needed to increase the temperature of 1 kg of copper by 1°C/1K

OR

1 kg of copper is required to give out 385 J of thermal energy for its temperature to

decrease by 1 °C/1 K.

(ii)
When equilibrium is reached, the temperature of the ball is 100 °C

. Thermal energy absorbed $= mc(100 - 25)$

$$= \frac{500}{1000} \times 385 \times 75$$

$$= 14437.5 \text{ J} = 14.44 \text{ kJ}$$

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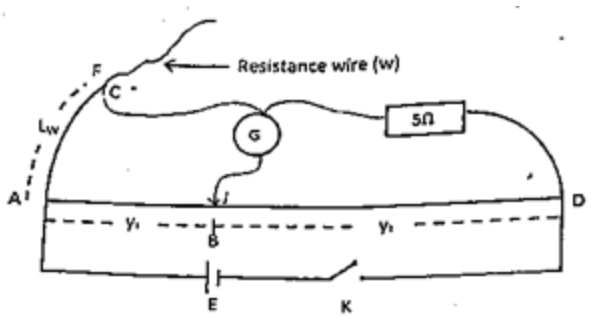
Alternative B

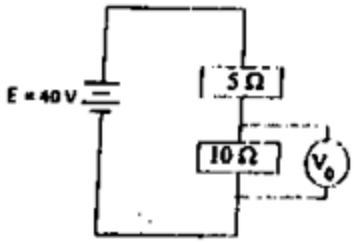
Question 3B



You are provided with a source of electricity of *emf*, E, a centre-zero galvanometer, a metre rule, a key, **K,** a potentiometer of wire, **AD,** a standard resistor *R* =5 Ω, a crocodile clip, C, a bare resistance wire, W, a jockey, J and connecting wires.

1. Using the electrical components provided, connect the circuit as shown in the diagran leaving the circuit open.
2. Connect the crocodile clip at a point, **F**, on the resistance wire such that **AF** = **LW** = 20.0 *cm*.
3. Close the circuit and use the jockey to determine the balance point, **B.**
4. Record the balance lengths, **AB** = and **BD** =
5. Evaluate and .
6. Repeat the procedure for **four** other values, and . In each case, record , and evaluat P and Q.
7. Tabulate the results.
8. Plot a graph with P on the vertical axis and Q on the horizontal axis.
9. Calculate the slope, *s*, of the graph.
10. What is the significance of the slope?
11. State **two** precautions taken to ensure good results.

(b) (i) Two standard resistors A and B have resistance RA and R**B** respectively such that RA > R**B,** using the same axes of a graph, show the relationship between the voltage and current for A and B.



(ii) The diagram above is a potential divider circuit;
1. Determine the value of *V0*, leaving your answer as a fraction.
2. Determine the ratio of the output voltage to the input voltage.

Observation

WEAKNESSES: In question (b), most students failed because they could not show the relationship between voltage and current of resistors A and B.

STRENGTH: The majority of candidates demonstrated a strong comprehension of observations and the creation of tables of values.

EXPECTED RESPONSE:

(a) **OBSERVATIONS [09]**

(i) **Five** values of **correctly** recorded in cm

(Deduct ½ mark for **each** wrong or missing value)

(ii) **Five** values of **correctly** recorded to **at least** 1 d.p in cm and in trend. **Trend**: As *Lw* increases, increases. (Award ½ mark **each**)

(iii) **Five** values of **correctly** recorded to **at least** 1 d.p. in cm and in trend. **Trend**: As *Lw* increases, **decreases**.

(Award ½ mark **each**)

1. **Five** values of *P* = **correctly** evaluated.

(Deduct ½ mark for **each** wrong or missing value)

1. **Five** values of *Q* = **correctly** evaluated.

(Deduct ½ mark for **each** wrong or missing value)

1. Composite table showing *LW*, , , *P* and *Q*.

GRAPH [06]

1. Both axes **correctly** distinguished
2. Reasonable scales
3. **Five** points **correctly** plotted
4. Line of best fit

SLOPE02]

1. Large right – angled triangle
2. △log *V* **correctly** determined
3. △log *I* **correctly** determined
4. **correctly** evaluated

INTERCEPT, c, ON VERTICAL AXIS [01]

1. **Correctly** shown

2. **Correctly** read

CALCULATION OF P [01]

Log (100P) = c, P =
(i) **Correct** substitution
(ii) **Correct** arithmetic
ACCURACY [01]
Based on p = Resistance per unit length of metre bridge wire ± 10%

PRECAUTIONS [02]

Award 1 mark **each** for any two correct precautions stated in acceptable tense.
Eg:
1. Ensured cleaned terminals
2. Ensured tight connections
3. Avoided/ noted/corrected zero error on ammeter/ voltmeter
4. Avoided parallax error in taking readings on ammeter/ voltmeter
5. Repeated readings shown on table

(b) (i) Increase in the external resistance leads to decrease of the current and the terminal voltage due to voltage loss across the internal resistance of the source. The voltage of the source will however remain unchanged.
(ii) R = ρ
= 7.8 x 10-8 x
= 0.099 Ω
Power = I2R
[½]
= (0.5)2 x 0.099
= 0.0248 ≈≈ 0.025 W

(ii) $R = \rho \frac{L}{A}$

$= 7.8 \times 10^{-8} \times \frac{1}{7.85 \times 10^{-7}}$

$= 0.099\ \Omega$

Power = I^2R
[½]
$= (0.5)^2 \times 0.099$
$= 0.0248 \approx\approx 0.025$ W

Prev