7.0 PHYSICS (232)

The year 2006 was the first time the revised syllabus for the Physics examination was tested. Three papers were offered in the year 2006 KCSE Physics examination. These were:

- **Paper 1 (232/1):** This was a theory paper consisting of two sections: ***Section A*** which had short answer questions and ***Section B*** which had structured questions. Candidates were required to answer questions from both sections, which had questions drawn from the ***Heat*** and ***Mechanics*** parts of the syllabus.
- **Paper 2 (232/2):** This was also a theory paper consisting of two sections: ***Section A,*** which had short answer questions while ***Section B*** had structured questions. Questions which were all compulsory were drawn from ***Optics, Waves, Electricity, Magnetism*** and ***Modern Physics.***
- **Paper 3 (232/3):** A practical paper testing a variety of skills in all areas of the syllabus. The paper consisted of two questions each worth ***20 marks***.

7.1 GENERAL CANDIDATES' PERFORMANCE

Performance statistics for the year 2006 KCSE examination are shown in the table below.

Table 10: Candidates' Overall Performance in Physics in the Year 2006

Year	Paper	Candidature	Maximum Mark	Mean Score	Standard Deviation
2006	1		80	24.00	15.62
	2		80	35.75	17.05
	3		40	20.88	7.22
	Overall	**72,299**	**200**	**80.63**	**37.00**

From the table above, it can be observed that candidates performed better in paper 2 (232/2) when compared to paper 1(232/1) despite the fact that both papers are both marked out of 80.

7.2 PAPER 1 (232/1)

Question 1

Figure I shows the change in volume of water in a measuring cylinder when an irregular solid is immersed in it.

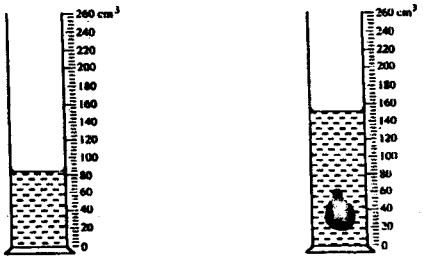


Figure 1

Given that the mass of the solid is 567 g, determine the density of the solid in gcm^{-3} (Give your answer correct to 2 decimal places).

Candidates were expected to consider the levels of liquid in the two cylinders in order to determine the volume of the irregular solid, which they were then expected to use to calculate the

density of the solid.

Weaknesses

Candidates who scored less than three marks in this question either got wrong readings of volumes or failed to get the correct value of density due to wrong substitution. Some candidates used $d=\frac{volume}{mass}$ instead of $d=\frac{mass}{volume}$

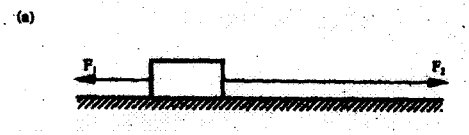
Expected Response

Volume =152 - 84 = $68cm^3$

Density = $\frac{mass}{volume} = \frac{567}{68} = 8.34gcm^{-3}$

Question 2

Figure 2 (a) shows a body being acted on by two forces F_1 and F_2.



On figure 2 (b) draw the force F_3 that has same effect on the body as the two forces.

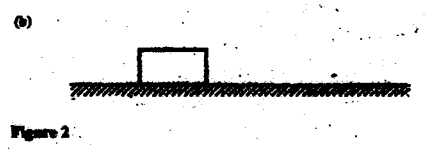


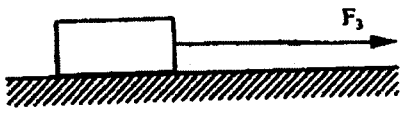
Figure 2

Candidates were expected to draw F_3 the net force when F_1 *and* F_2 act on the body. The direction and magnitude of F_3 should be such as $F_3 = F_2 - F_1$. They were to recognize that forces can be represented both in direction and magnitude as vectors and the resultant force is obtained vertically as the vector sum of the forces acting on the body.

Weaknesses

Majority of the candidates did not understand the question. The concept of adding forces as vectors did not occur to most of them and majority used guesswork to answer the question. Candidates drew F_3 in all manner of sizes and directions which did not bear any relation to the original directions of F_2 *and* F_1. Some candidates used free hand to draw F_3 and therefore obtained incorrect magnitude of F_3.

Expected Response



Question 4

Figure 3 shows a bimetallic strip with a wooden handle, suspended horizontally using a thin thread.

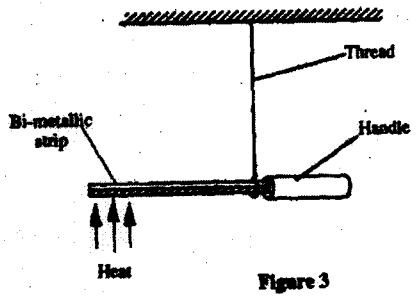


Figure 3

The strip is heated at the point shown. Explain why the system tips to the right.

Candidates were expected to use their knowledge of expansion of metals when heated and explain the effect this will have on the equilibrium of the set up. Knowledge of the relation between the position of the centre of gravity and equilibrium was essential in this question.

Weaknesses

The term ***"bimetallic strip"*** was not understood by a number of candidates. This therefore meant that these candidates could not describe the effect of heat on the strip. Another group of candidates could not relate equilibrium of the set up with the position of the centre of gravity. For instance, some candidates used the greater up thrust in air as the reason for tilting of the system which was incorrect. Others wrongly argued that the sanity of the strip reduces on heating and therefore tipping.

Expected Response

On heating, the bimetallic strip bends. This causes the position of the centre of gravity of the section to the left to shift to the right causing imbalance and so tips to the right.

Question 5

The spiral springs shown in figure 4 are identical. Each spring has a spring constant $k = 300$ N/m.

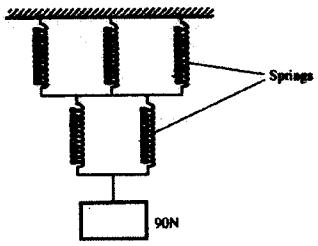


Figure 4

Determine the total extension caused by the 90N weight. (Ignore the weight of the springs and connecting rods).

Candidate were expected to understand the application of F = Ke in a situation where springs in parallel share the force applied. In this set-up the three upper springs were parallel. Two springs formed a parallel set as well. The lower and the upper sets formed a series connection of springs.

Therefore the total extension is the sum of the extension of individual sets. $e = \frac{1}{3}\frac{F}{K} + \frac{1}{2}\frac{F}{K}$

Weaknesses

Candidates were able to state the relation F = Ke, but majority failed to proceed to give correct interpretation of the expression in the situation presented in the question. Most of the candidates who did not score well in this question failed to recognize the springs in parallel share the load equally and since they are identical (k = same), then force on each is a third of the downward force ($\frac{1}{3}$ x 90). Similarly for the lower set the force on each spring = $\frac{1}{2}$ x 90N. Another group failed to isolate the two sets and wrongly assumed that each of the five springs experience the same force of $\frac{90}{5}N$.

There is need for teachers to teach this topic practically so that students get the opportunity to experience the effect of parallel or series spring combination.

Expected Response

Lower spring extend by 15cm;
Upper springs extended by 10cm;
Total = 15 + 10 = 25cm

Question 7

Figure 5 shows two pulley systems being used to raise different load. .The pulleys are identical.

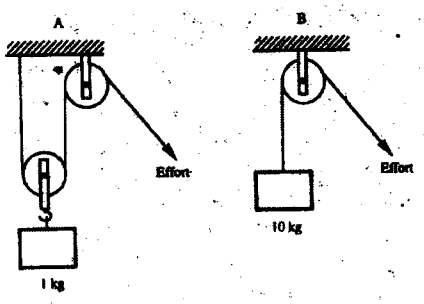


Figure 5

*State **one** reason why system B may have a higher efficiency than system A.*

Candidates were expected to show their reasoning and understanding of the word efficiency which is the ratio of work output to the work input. Comparing the two set ups, A and B and assuming work out put is the same (i.e. raising the load through a height h), then it is clear that the work input for A is more since more energy is used in opposing friction as well as raising the extra pulley than in B. Efficiency in B must be more.

Weaknesses

Candidates failed to bring out this argument which implies that they did not understand the term efficiency as applied specifically in this question. Majority used terms V.R and M.A to explain without success.

Expected Response

Effect of weight of second pulley reduces efficiency of A. Load in B is larger and so effect of friction is less in B increasing efficiency.

Question 10

Figure 6 shows the path taken by a matatu travelling on a horizontal level ground (a windmg road).

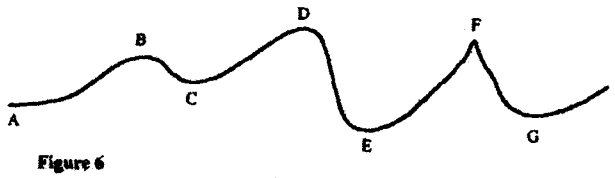


Figure 6

The speed of the matatu is constant. Identify with reason the point along the path at which a load placed loosely on the rack (carrier) of the matatu is most likely to roll off.

This question tested a practical situation whereby experience has shown that luggage placed loosely at the rack (carrier) of a vehicle is likely to slide off as the vehicle negotiates a sharp bend. At constant speed the sharper the bend, the higher the chances of the luggage falling off.

Candidates were to identify the point (bend) where the bend was sharpest and give an explanation for the choice. Centripetal force is greatest where the radius is smallest. $\left(From\ F = \frac{mr^2}{r}\right)$.

Weaknesses

Candidates failed to see that since the speed and mass of the matatu is constant, the only factor that will affect the centripetal force is the radius of the path. Candidates who chose a section of the path, for example: DE or EF may not have understood the question. However very many candidates wrote F as the answer but gave the wrong explanation.

Teachers are once again reminded that while teaching this area of the syllabus, practical examples should be discussed.

Expected Response

At F, radius of curve is smallest and so greatest centripetal force is required to keep luggage on carrier;

$(F = \frac{mv^2}{r})$.

Question 12

The uniform bar in figure 7 is pivoted at its midpoint. It is in equilibrium under the action of two identical balloons filled with equal volumes of different light gases at the same temperature.

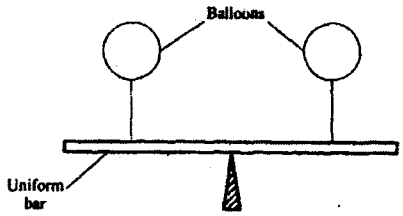


Figure 7

Explain why the bar may not remain in equilibrium if the temperature of the surrounding changes.

The concept being tested here is the effect of temperature change on different gases. The two gases will expand at different rates. Once this happens, the candidates were expected to understand that the forces (up thrust) which initially held the bar at equilibrium will now change and will act differently on the balloons making the beam tip over one side.

Weaknesses

Candidates showed weaknesses in the following areas:

- Failure to recognize that the initial forces acting on the beam were due to up thrust on balloons in air.
- Some candidates argued that the balloons themselves expanded and not the gases. Of course both did expand but the difference is as a result of expansion of the gases since the balloons were identical.
- Increase in up thrust was not well discussed.

Expected Response

As the temperature changes, the volumes of the gases in the balloons change differently. The change in volume and hence the change in up thrust will differ.

Question 13

A footballer kicks a ball of mass 0.6 kg initially at rest using a force of 720N. If the foot was in contact with the ball for 0.1 seconds, what was the take off speed of the ball?

This is a case of force acting on a body for a short period of force. This force is referred to as the impulse and is equal to the change of momentum. Candidates were expected to apply their knowledge of Newton's second law of motion in this situation.

Weaknesses

The following weak points were noted:

- Candidates' using unconventional symbols without explaining them.
- Failure to equate the impulse with change of momentum and instead writing $Ft = mv$.

Expected Response

$Ft = \Delta mv$;
$720 \times 0.1 = 0.6 \times v$;
$v = 120\ ms^{-1}$.

7.3 PAPER 2 (232/2)

Question 1

Figure I shows two bar magnets placed with the south poles close together.

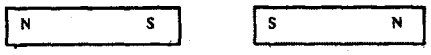


Figure 1

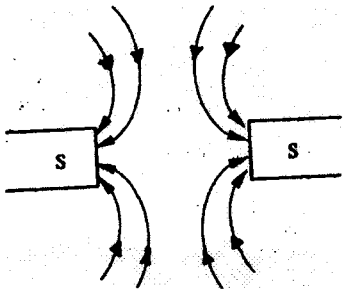
In figure 1 sketch the magnetic field pattern between the two south poles.

Candidates were expected to recall that magnetic field lines are drawn such that they point towards the south. Since the magnets are close to one another, a neutral point exists.

Weaknesses

Candidates drew lines without arrows. Others drew lines with arrows from the South, while others did not indicate the neutral point.

Expected Response



Question 2

In a certain pinhole camera, the screen is 10cm from the pinhole. When the camera is placed 6m away from a tree, a sharp image of the tree 16cm high is formed on the screen. Determine the height of the tree.

Use of proportion was necessary to determine the height of the image.

Weaknesses

Majority of the candidates found it difficult to form an equation from which to solve for the height of the tree.

Expected Response

$$\text{Magnification} = \frac{\text{Image distance}}{\text{Object distance}} = \frac{\text{Height of Image}}{\text{Height of Object}}$$

$$= \frac{10}{600} = \frac{16}{h};$$

$$h = 9.6\text{m};$$

Question 6

Figure 4 shows a solenoid carrying an electric current.

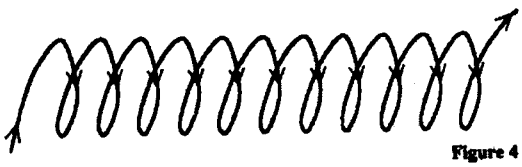


Figure 4

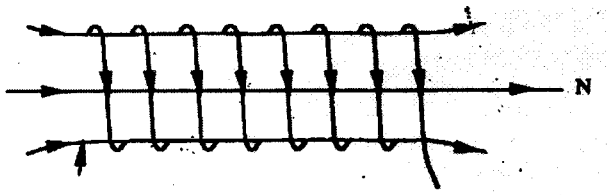
Sketch the magnetic field pattern inside and at the ends of the solenoid.

Candidates were expected to apply the right-hand grip rule to determine the end of the coil that becomes the North Pole when current flows through the coil. Once the north (N) is determined, then the lines of force are drawn in the direction towards the North.

Weaknesses

Candidates could not recall the grip rule and so the North Pole was incorrectly identified. Lines of force were then wrongly determined. Candidates seem to have a problem figuring out the direction of the current in the coil. Other candidates drew lines of force that were not parallel at the middle of the solenoid as they should be.

Expected Response



Question 7

Figure 5 shows wavefronts approaching a concave surface.

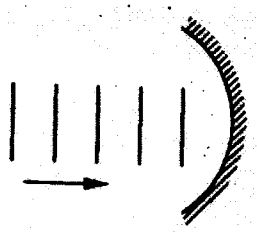


Figure 5

Complete the diagram to show the wavefronts formed after striking the surface. Show how *the focal point of the surface is located.*

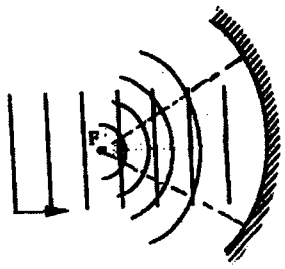
Candidates were required to sketch the reflected waves from the concave surface which emerge from the surface as curved waves focused towards the focal point of the mirror. Lines drawn perpendicular to the surface could be used to locate the position of the focal point.

Weaknesses

Many candidates scored on the correct shape of the reflected waves but failed to locate the focal point. Teachers should demonstrate the reflection of waves by various surfaces using a ripple tank.

Expected Response

Reflected waves are curved. Converging circular reflected waves, Converging to F or two perpendicular lines from the surface of one of the curves meeting at F.



Questions 10 and 11

Use the information given below to answer questions 10 and 11.

The Kinetic energy (K.E) of an electron, ejected from the surface of a metal illuminated by radiation of frequency, f is given by

$K.E = hf - \emptyset$

where h is Planck's constant and Ø is the work function of the surface.

10. What is meant by the term work function?

11. If the frequency of the illuminating radiation is just equal to the threshold frequency of the surface explain why no photoelectric effect is observed.

Candidates were expected to interpret the energy equation provided in relation to the removal of an electron from the surface (work function) and the kinetic energy of the ejected electron. The difference ***hf - Ø (net)*** gives the kinetic energy of the electron and is equal to $\frac{1}{2}mv^2$, where ***v*** is the velocity of the electron and m its mass. When $hf = \emptyset$,

then, $\frac{1}{2}mv^2 = O \longrightarrow V = O.$

Weaknesses

Candidates were not able to distinguish between energy required to release or dislodge an electron and the energy to accelerate the electron. The term threshold frequency was not understood, and at threshold frequency $f_o, hf_o = \emptyset$.

Expected Responses

10. Work function of a metal is the ***minimum energy*** required to set free (release) an electron from the surface of the metal.

11. At threshold frequency K.E. of electron = 0; hence velocity of the electron would be zero (No motion). Thus, photo electric effect cannot be observed. Energy is just enough to dislodge electron.

Questions 12 and 13

Figure 6 shows a tube for investigating the properties of a beam of electrons. Use the information in the figure to answer questions 12 and 13.

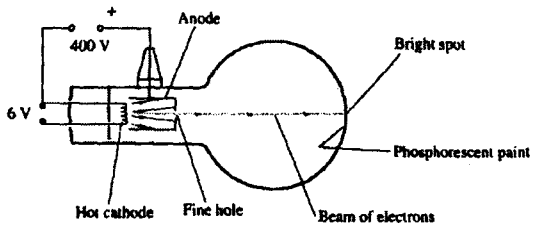


Figure 6

12. What property of the beam of electrons show that the electrons are travelling at a very high speed?

13. The beam of electrons is subjected to a strong uniform magnetic field which is perpendicular to the path and into the paper. Sketch on the same figure, the new path of electrons.

Candidates were expected to show the paths of the electrons when subjected to a magnetic field using the Fleming's left hand rule.

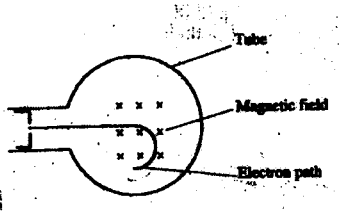
Weaknesses

Candidates used the right hand rule instead of the left hand rule and therefore got the wrong direction of the path.

Expected Responses

12. Straight beam from gun to screen / no gravitational effect on the beam.

13.



Question 14

State with a reason the effect on the X-rays produced in an X-ray tube, when the p.d. across the tube is increased.

Candidates were expected to state that the higher the p.d, the higher the energy of the protons produced and the shorter their wavelengths. X - rays of shorter wavelengths are more penetrating.

Weaknesses

Candidates failed to show the effect of higher p.d on energy of the resulting proton X - rays. Some candidates gave the effect as increase of intensity of the X-rays which was incorrect. Teachers need to discuss X-rays production, including production of Hard and Soft X rays.

Expected Response

Resulting X-rays have shorter wave length//high frequency/high energy/high power - because electrons have higher K.E.

Question 20

Figure 10 shows a simple electric generator.

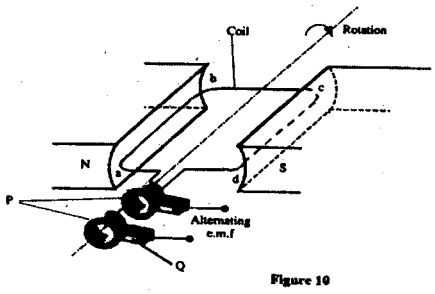


Figure 10

(a) (i) Name the parts labelled P and Q.

(ii) *The emf generated as the coil rotates is represented in the graph in Figure 11.*

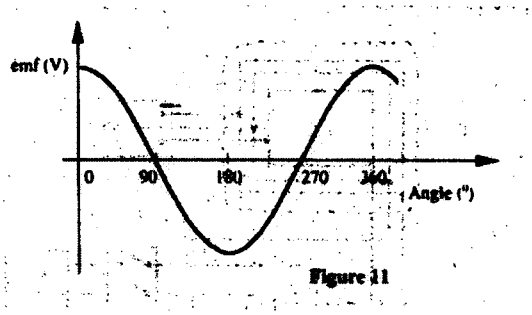


Figure 11

Give reasons for the changes in the emf as the coil rotates from 0° to 90°, and 90° to 180°.

(b) *The primary coil of a transformer has 1200 turns and the secondary coil has 60 turns. The transformer is connected to a 240V a.c. source.*
Determine

(i) *the output voltage*

(ii) *the output current when the primary coil has a current of O.5A. (Assume there are no energy losses).*

In part (a) of the question, candidates were expected to explain the sketch graph representing the emf and angle of rotation of the coil in the magnetic field in terms of the magnetic flux linkage as the coil rotates. The graph shows that the flux linkage is decreasing from between $0°$ *to* $90°$ and increasing from $90°$ *to* $180°$. At $0°$ *and* $180°$ the flux change is maximum and emf is at its peak value.

Weaknesses

In part a (i) of the question, some candidates confused the diagram drawn for that of a d.c. generator and so labelled P wrongly, they also labelled P as a communicator.

In part a (ii) of the question, candidates did not understand the demands of the question. They did not explain the variation of emf with angles in terms of change of flux linkage. Part (b) of the question was well done.

Expected Response

a) (i) P = slip rings;, Q = Brushes.

(ii) 0 - 90 magnetic flux cut changes from high to low. (decreasing), 90 - 180 magnetic flux change from low to high (increasing); at each peak 0 - 180 magnetic flux change is maximum though in different directions, (position of coil).

(b) (i) $\frac{\epsilon_s}{\epsilon_p} = \frac{N_s}{N_p}; \Rightarrow \epsilon_s = 240 \dot{x} \frac{60}{1200} = 12 volts.$

(ii) $P_P = P_S$ (Power) or $I_sV_s = I_pV_p$.

Question 21

(a) Figure 12 shows a section of a house wiring system.

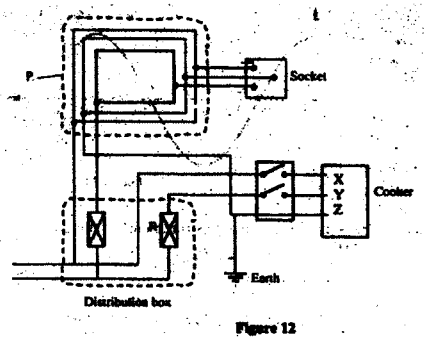


Figure 12

(i) Name:

the circuit labelled P

the terminals labelled X and Y.

(ii) I State the purpose of R in the circuit.

II Give a reason why R is connected to Y but not to X.

(iii) Why is the earthing necessary in such a circuit?

(b) Determine the cost of using an electric iron rated 1500W, for a total of 30 hours given that the cost of electricity per kWh is Ksh. 8.

Candidates performed very poorly in this question. Teachers may have put less emphasis on this part of the syllabus perhaps due to its being technical in nature. However, the syllabus requires that candidates be able to explain the domestic wiring system. Candidates were required to identify the main ring circuit by recognizing that it is the one from which sockets draw power. They were also to identify Live wire (point) Y by recognizing one connected to main fuse R and neutral (point) Z without a fuse.

Weaknesses

Candidates were found to have the following weaknesses:

- Failure to differentiate between lighting and ring circuit.
- Many candidates failed to explain the purpose of R and earthing in the circuit.

This is one of the content areas where teachers should teach by demonstration using a practical situation which includes a visit to a house in the school/use of electricians near the school. All the components are easily available for such a demonstration.

Expected Responses

a) (i) P = Ring circuit; or ring main circuit X = Neutral (point or terminal); Y = Live (point or terminal).

(ii) I Purpose of R - or Fuse; is a safety element in a circuit against excess current.

II R is connected to Y but not to X to ensure that when it breaks a circuit any gadget /appliance connected does not remain live.

(iii) Earthing is necessary in such a circuit to guard against electric shocks; or electrocution

(b) Cost of electricity: 1.5kw x 30h x 8ksh = Ksh 360/=.

7.4 PAPER 3 (232/3)

This was the physics practical paper and it consisted of two questions in which candidates were examined on a variety of skills.

Question 1

You are provided with the following:

- **a glass marble**
- **a stop watch**
- **a 105 cm plastic tube split open with a mark near one end**
- **vernier callipers (to be shared)**
- **a metre rule or half-metre rule**
- **a balance (to be shared)**
- **retort stand, one boss and one clamp.**

Proceed as follows:

(a) **Use the vernier callipers provided to measure the diameter of the marble and hence determine the radius.**

Diameter of the marble = ...cm

Radius of the marble r = ...cm

(b) **(i)** **Using the balance provided obtain the mass M of the marble.**

M = ...g

(ii) **Determine the constant P given that $P = 0.4 Mr^2$.**

The experiment involves timing a marble as it runs down the split tube as a runway.

(c) Clamp the marked end of the split tube with the inside uppermost. Ensure the end with the mark is on the greater slope. Raise this end such that the mark is at a height h = 8 cm above the bench level. The other end should rest on the bench as shown in figure 1.

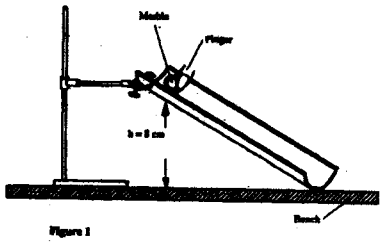


Figure 1

Place the marble at the mark on the runway and hold it in place gently with the finger as shown in the figure 1. By simultaneously releasing the ball and starting the stop watch measure and record in table 1, the time, t, taken by the marble to reach the lower end of the runway. (It is advisable to measure the time twice and record the average value).

Vary the height h, to other values shown in table 1. Measure and record in the table the corresponding average values of t. Complete the table.

Table 1

height, h (cm)	8	9	10	11	12	13	14	15
Average time, t (s)								
t^2 (s^2)								
$\frac{1}{h}$ (cm^{-1})								

(d) (i) On the grid provided plot the graph of t^2 (y-axis) against $\frac{1}{h}$.

(ii) Determine the slope S of the graph.

(iii) Determine the constant G for the marble given that

$$G = Mr^2\left(\frac{S}{20} - 1\right)$$

The following skills were tested:

- Ability to measure the mass and the diameter of the marble using the beam balance and the vernier callipers respectively.
- Ability to measure time of a rolling marble using a stop watch.
- Ability to use mathematical tables to obtain squares and reciprocals of numbers.
- Ability to choose suitable scales in graph drawing.
- Ability to interpret graphs.

Weaknesses

The following weaknesses were noted in the candidates' responses:

- Some candidates recorded values for diameter of the marble whose accuracy was not obtainable from the vernier callipers. For instance, giving the diameter to one decimal place. Quite a number of the candidates failed to score as a result of the error in the accuracy or because of recording values outside the accepted range of 1.70 ± 0.10 cm.
- Candidates also recorded values of masses outside the accepted range of 5.9 ± 0.5g. This could have been due to errors in measurement or from using marbles not specified in the instructions to schools.
- In calculating P, in the equation $p = 0.4\ mr^2$ it became apparent that quite a number of candidates were not able to substitute correctly the values of m and r and therefore failed to score the mark. One of the challenges noted was incorrect placement of decimal points.
- Use of the digital stopwatch was yet another source of error. Many candidates confused the digits for minutes with those for seconds, which is a clear case of lack of exposure. Teachers should give their students sufficient practice in the use of stopwatches.
- In the plotting of graph t^2 *against* $1/h$, candidates lost marks for failing to;

  (a) Label the axes as t^2 *and* $1/h$ and indicating the units as s^2 *and* cm^{-1} respectively.

  (b) Express the $1/h$ as decimal, instead of leaving them as fractions.

  (c) Use simple and uniform scales on their graphs. Simple scales are in form of say 1, 2, 5 and $\times 10^n$. Uniform scales are used when equal intervals represent same quantities. Candidates who used difficult scales found it difficult to accurately plot their points.

  (d) Use the actual points from the experiment. Many candidates instead drew a straight line through a few points then used the line to obtain false points which were then inserted in the table. Such graphs and the corresponding slope could not attract marks.

  (e) Show the computation of slopes as $\frac{\Delta y}{\Delta x}$, and where these were shown candidates left out powers of 10 ending up with wrong values.

  (f) Evaluate the G in the expression $G = Mr^2\left(\frac{s}{20} - 1\right)$. A few candidates were unable to perform algebraic procedures (e.g. subtracting 1 from s before dividing

$\frac{5}{20}$) ending up with the incorrect value of G.

Question 2

You are provided with the following:

- **a voltmeter**
- **two dry cells and a cell holder**
- **a switch**
- **a resistor labelled R (4Ω)**
- **a wire mounted on a mm scale and labelled G**
- **a micrometer screw gauge (to be shared)**
- **six connecting wires with six crocodile clips.**

Proceed as follows:

(a) Record the length L_o of the wire labelled G.

L_o = ...

Use the micrometer screw gauge provided to measure the diameter of the wire labelled G at two different points and determine the average diameter, d.

The diameter d_1 = ... mm, d_2 = ...mm

Average diameter d = ... mm

Determine the radius r of the wire in metres.

Radius r = ... m

(b) Set up the apparatus as shown in the circuit diagram in figure 2.

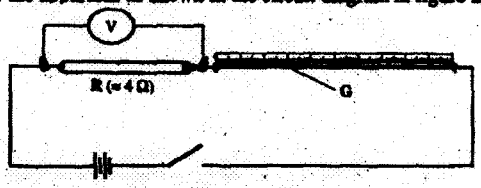


Figure 2

(i) Use the voltmeter provided to measure the p.d, V_R across R and the p.d, V_G across G when the switch is closed.

V_R = ... Volts

V_G = ... Volts

Open the switch.

(ii) Use the value of R provided and the value of V_R in b (i) above to calculate the current I flowing through R when the switch was closed.

I = ... Amperes

(iii) Determine the constant H given that

$$H = \frac{100V_G}{I \times L_o}$$

H = ... Ωm^{-1}

(c) Connect the volmeter across R as shown in figure 3.

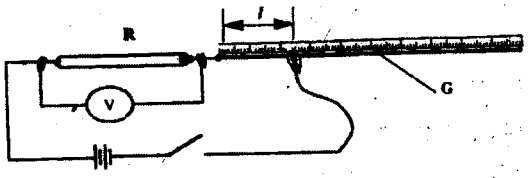


Figure 3

Adjust the position of one crocodile clip on the wire G to a point such that the length *l* of the wire in the circuit is 5 cm. (see figure 3). Close the switch.

Read and record in table 2, the value of the p.d. across R. Open the switch.

(d) Repeat the procedure in (c) above for the other values of *l* shown in table 2.

Table 2

Distance *l* (cm)	0	5	10	20	30	40	60	70
p.d. V across R(V)								

(e) (i) On the grid provided plot the graph of V (y-axis) against *l*.

(ii) From the graph, determine l_1, the value of *l* when $V = \frac{V_o}{2}$ where V_o is the p.d. where $l = 0$.

(f) Determine the constant D for the wire given that

$$D = \frac{R}{l_1} x \frac{300}{v_o}$$

(g) Determine the constant ρ given that

$$\rho = \frac{\pi r^2}{2}(D+H)$$, where r is the radius of the wire in metres.

The following skills were tested in this question:

- Ability to measure the diameter of a wire using a micrometer screw gauge.
- Ability to set up a simple electric circuit.
- Ability to measure potential difference using a voltmeter.
- Ability to plot a graph and carry out interpretation of the same.

Weaknesses

The following weaknesses were noted:

- Accuracy of Measurements: It was noted that candidates have weaknesses in recording measurements in appropriate decimal places depending on the measuring instrument being used. Candidates lost the marks in this part of the question by failing to either record measurements which were outside possible range or writing incorrect decimal places. Teachers should note that their students need adequate practice on use of measuring instruments in both theory and practicals.
- Candidates also lost marks in the table because the recorded readings were found to be impracticable and therefore out of the acceptable range. This could have resulted from use of wrong materials (wire *G* and resistance *R*) or wrong connections in their circuits or both. Such candidates resulted in recording fictitious values in their tables which they eventually used to draw graphs. Teachers should ensure that the apparatus procured by their schools are those specified in the instructions to schools so as to avoid their candidates being penalized. All apparatus must be checked to ensure they are in good working condition.
- It was also noted that a certain group of candidates recorded values of *V* that were not changing with change of *l*. This should not happen if the apparatus were as specified by the Council. Otherwise, it is also possible that candidates were unable to change the length *l* as instructed.