7.0 PHYSICS (232)

The year 2007 was the second time the revised syllabus for physics was tested. Three papers were offered in the year 2007 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 in this paper 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 CANDIDATES' GENERAL PERFORMANCE

Performance of candidates in the year 2007 KCSE Physics examination is given in Table 10 below. Performance for year 2006 is also given for comparison.

Table 10: Candidates Overall Performance in Physics for the Last Two Years

Year	Paper	Candidature	Maximum Score	Mean Score	Standard Deviation
	1		80	24.00	15.62
2006	2		80	35.75	17.05
	3		40	20.88	7.22
	Overall	**72,299**	**200**	**80.63**	**37.00**
	1		80	23.46	13.43
2007	2		80	33.33	17.93
	3		40	25.85	7.14
	Overall	**83,162**	**200**	**82.63**	**35.00**

From the table above, it can be observed that:

7.1.1 The candidature increased from *72,299* in the year 2006 to ***83,162*** in the year 2007, an increase of ***10,863*** candidates ***(15.1%)***.

7.1.2 Candidates performed better in ***paper 2 (232/2)*** than in ***paper 1 (232/1)*** with means of ***33.33*** and ***23.46*** respectively.

7.1.3 The overall performance of candidates was better in the year 2007 when compared to performance in the year 2006 with means of ***82.63*** and ***80.63*** respectively.

7.1.4 Performance in ***paper 3 (232/3)*** was better in the year 2007 than in the year 2006 as attested by a mean of ***25.85*** in the year 2007 against ***20.88*** in the year 2006.

7.2 PAPER 1 (232/1)

This was a theory paper testing the ***Mechanics*** and ***Heat*** part of the syllabus. It consisted of two sections: A and B. ***Section A*** consisted of 14 short answer questions, while ***section B*** had 5 structured questions. Candidates were to answer all questions. The following is a discussion of the questions in which candidates performed poorly.

Question 1

Figure 1 shows a metal cube of mass 1.75 g placed between the jaws of a micrometer screw gauge. The magnified portion of the scale is also shown. The reading on the gauge when the jaws were fully closed without the cube was 0.012 cm. Use this information and the figure to answer questions 1 and 2.

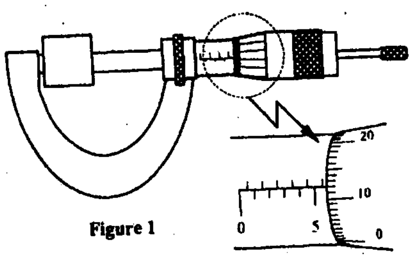


Figure 1

What is the length of the cube?

Candidates were required to determine the length of the cube by reading the two scales on the diagram of figure 1. The thimble scale reading added to the main scale reading equals to the length of the cube plus the initial (zero) reading of the micrometer screw gauge.

Weaknesses

- Candidates failed to relate the initial reading (error) with the final reading of the instrument.
- Some candidates added the error instead of subtracting.
- Candidates recorded the wrong value of the main scale as 6.0 instead of 5.5.
- Candidates confused ***"centimeters"*** and ***"millimeters"*** and used them interchangeably ending up with wrong figures.

Expected Responses

0.562 - 0.012 = 0.550 cm

OR

5.62 - 0.12 = 5.50 mm

Advice to Teachers

Teachers are advised to give adequate practice on measurements using the measuring instruments. This should be done throughout the course and not only towards the examination period.

Question 4

Figure 3 shows the levels of two liquids A and B after some air has been sucked out of the tubes through the tap. Use this information and the figure to answer questions 4 and 5.

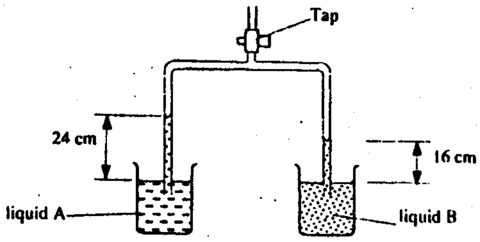


Figure 3

State the reason for the rise in the levels of the liquids when air is sucked from the tubes.

Candidates were required to give a reason for the rise of the liquids in the tube bearing in mind the presence of Atmospheric Pressure.

Weaknesses

Candidates failed to recognize the role of the Atmospheric Pressure in the rising of the liquids up the tube and that relative height of the columns is dependent on the density of the liquids.

Expected Responses

Sucking air in the tube reduces the pressure inside the tube. Atmospheric Pressure on the surface of the liquid forces liquid up the tube until the pressure in the column of liquid equals the atmospheric pressure.

Question 7

Figure 4 shows two identical baloons A and B. The baloons were filled with equal amounts of the same type of gas. The baloons are suspended at distances X_1 and X_2 from a metal cube filled with boiling water and placed on an insulating material. Use this information to answer questions 6 and 7.

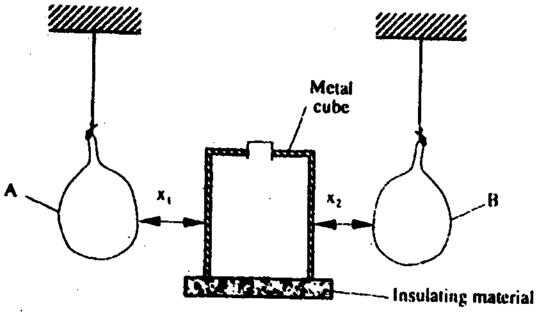


Figure 4

The face of the cube towards A is bright and shiny and the face towards B is dull black. State with reason the adjustments that should be made on the distances X_1 and X_2 so that the rate of change of temperature in both baloons is the same.

Candidates were required to apply their knowledge on rates of emission of radiant heat by shiny and dull surfaces to estimate the relative distances X_1 and X_2. Since B faces a dull black surface, it receives more heat energy per unit area per second than A which faces a bright and shiny surface.

Weaknesses

Most of the candidates did not score in this question. Candidates failed to relate the radiating power properties of the surfaces to the temperatures attained by A and B. They also had problems identifying the variables involved: the temperature, the rate of emission and the inverse square law concept (the energy received reduces as distance increases). Candidates needed to use common sense in relating distances X_1 and X_2 not stating the inverse square law.

Expected Responses

A dull black surface is a better radiator than a shiny surface. If X_1 and X_2 are the same then temperature of A will be lower than that of B. X_2 should be increased ($X_2>X_1$) so that the temperatures of A and B could be the same.

Question 8

Figure 5 shows a uniform bar of length 1.0 m pivoted near one end. The bar is kept in equilibrium by a spring balance as shown.

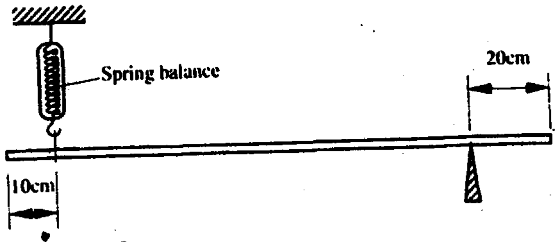


Figure 5

Given that the reading of the spring balance is 0.6 N, determine the weight of the bar.

Candidates were expected to use the principle of moments to determine the weight of the uniform bar.

Weaknesses

- Candidates were unable to apply the principle of moments correctly using the information provided.
- Candidates used the condition of equilibrium: Σ upwards forces = Σ downwards forces without success because some of the forces are not provided, for example: reaction at the fulcrum.
- Some candidates substituted incorrect values of distances for forces involved.

Expected Responses

Clockwise moments = Anticlockwise moments

$$mg \times 30 = 0.6 \times 70$$

$$mg = \frac{0.6 \times 70}{30}$$

$$= 1.4$$

Therefore weight = 1.4 N

Question 9

The graph in figure 6 shows the velocity of a car in the first 8 seconds as it accelerates from rest along a straight line. Use the graph to answer questions 9 and 10.

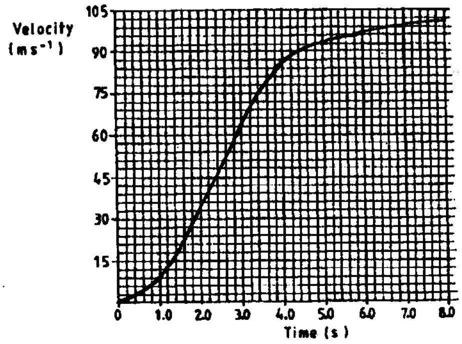


Figure 6

Determine the distance travelled 3.0 seconds after the start.

Candidates were expected to recall that the distance traveled in a velocity - time graph is given by the area under the curve (graph) between the time limits in consideration; in this case the time between 0 and 3.0 seconds.

Weaknesses

Most of the candidates got this question wrong. The concept of area under the curve seemed not to have been understood by candidates during the learning process.

Expected Responses

Distance = area under the curve between 0 and 3.0 seconds
= 120 x 3 x 0.2 = 72 m

Question 10

Determine the acceleration of the car at 4.0 seconds.

Candidates were expected to once again recall that in a velocity - time graph acceleration is given by

$$\frac{\text{Change in velocity}}{\text{Change in time}} = \text{the slope/gradient of the graph.}$$

Since the graph is a curve the acceleration at a point (instantaneous acceleration) is given by the slope/gradient of the curve at that point.

Weaknesses

The candidates were unable to:

- Relate acceleration to the gradient of the curve at the point t = 4.0s.
- Calculate gradient of the tangent to the curve (tangent 0 at t = 4.0s.
- Draw accurately the tangent to the curve at t = 4.0 seconds.

Expected Responses

Acceleration = Slope of graph at t = 4.0s

$$= \frac{16 \times 3}{17 \times 0.2} = 14.11 m/s^2$$

Question 14

Figure 8 shows a uniform light bar resting horizontally on corks floating on water in two beakers A and B.

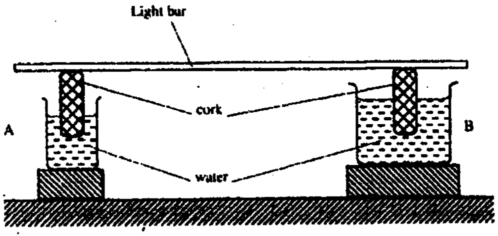


Figure 8

Explain why the bar tilts towards side A when equal amount of heat is supplied to each beaker.

Candidates were expected to make a comparison of the effect equal amounts of heat supplied to each of the beakers A and B containing water which (as shown in the diagram) differs in amounts (mass). Once the temperature of the water increases, what effect does it have on the volume of water? Eventually the candidate was to state the effect on the sinking and floating of the cork as the volume changed.

Weaknesses

Candidates were unable to analyze the effect of heat on temperature of water, expansion of water, reduction of density and the sinking more of A.

Expected Responses

Since the quantity of water in A is smaller, heat produces greater change of temperature in A. This causes greater decreases in density causing the cork to sink further.

Question 15 (a)

Brownian motion of smoke particles can be studied by using the apparatus shown in figure 9. To observe the motion, some smoke is enclosed in the smoke cell and then observed through the microscope.

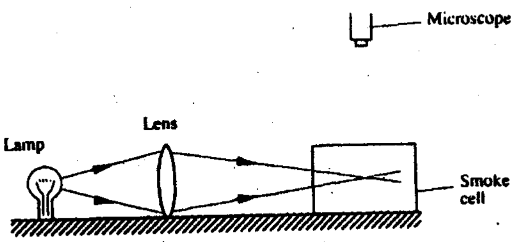


Figure 9

(a) Explain the role of the smoke particles, lens and microscope in the experiment.

Smoke particles

Lens

Microscope

Candidates were expected to recall the functions or role of the lens, the smoke particles and the microscope in the set up for observing Brownian motion.

Weaknesses

It was noted that most of the candidates did not know these functions. It was evident from the candidates' responses that teachers don't demonstrate this experiment in class; instead it is taught theoretically.

Expected Responses

- ***Smoke particles***: are larger than air molecules and light enough to move when bombarded by air molecules. They are used to show behavior of air molecules.
- ***Lens:*** focuses light from the lamp on the smoke particles causing them to be observable.
- ***Microscope***: magnifies/enlarges the smoke particles so that they are visible.

Question 16(a)

(a) State Newtons first law of motion.

This question required candidates to state Newton's first law of motion.

Weaknesses

Candidates were simply asked to recall the statement on Newton's law of motion but most of the candidates were unable to do this. The candidates did not know the conditions under which the law applies.

Expected Responses

A body at rest or in motion at uniform velocity tends to stay in that state unless acted upon by an unbalanced force.

Question 17

(a) Define the term *specific latent heat of vaporization* of a substance.

(b) Figure 11 shows the features of a domestic refrigerator. A volatile liquid circulates through the capillary tubes under the action of the compression pump.

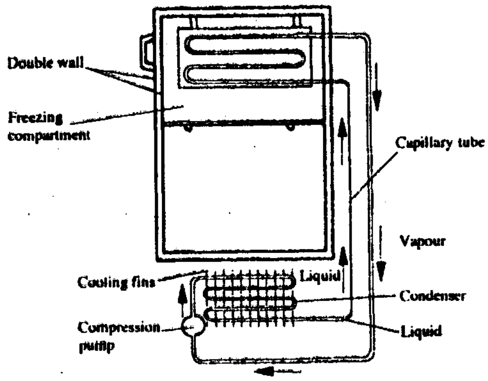


Figure 11

(i) **State the reason for using a volatile liquid.**

(ii) **Explain how the volatile liquid is made to vaporize in the cooling compartment and to condense in the cooling fins.**

(iii) **Explain how cooling takes place in the refrigerator.**

(iv) **What is the purpose of the double wall?**

(c) **Steam of mass 3.0 g at 100° C is passed into water of mass 400 g at 10°C. The final temperature of the mixture is T. The container absorbs negligible heat. (Specific latent heat of vapourisation of steam = 2260 kJ/kg, specific heat capacity of water = 4200 $Jkg^{-1}K^{-1}$)**

(i) **Derive an expression for the heat lost by the steam as it condenses to water at temperature T.**

(ii) **Derive an expression for the heat gained by the water.**

(iii) **Determine the value of T.**

Candidates were required to recall the statement of definition of specific latent heat of vapourization. By answering b (i), (ii), (iii) and (iv), candidates were to demonstrate their understanding of the working of a refrigerator, that is, the cooling processes in a refrigerator.

Weaknesses

Candidates showed the following weaknesses. They:

- used the word ***"mass"*** instead of ***"unit mass"***;
- confused ***"specific heat capacity"*** with ***"specific latent heat of vapourization"***;
- used the term ***"one mole"*** in place of ***"unit mass"***;
- were not able to provide details as demanded by the part (b) of the question.

Expected Responses

(a) ***Specific latent heat of vaporization*** of a substance is the quantity of heat required to change completely into vapour 1 kg of a substance at its normal boiling point without change of temperature.

(b)

(i) So that it vapourizes readily.

(ii) In the freezing compartment, the pressure in the volatile liquid is lowered suddenly by increasing the diameter of the tube. This causes vapourization; heat is drawn from the surroundings. In the cooling tins the pressure is increased by the compression pump and heat is lost to the outside.

(iii) When the volatile liquid evaporates, it takes away heat of vapourization from the freezing compartment, reducing the temperature.

(iv) Reduces rate of heat transfer to or from the outside (insulates).

(c)

(i) Heat lost by steam = $0.003 \times 2.26 \times 10^6$
Heat lost by steam water = 0.003 x 4200 (100-T);
Total = 6780 + 12.6 (100-T);

(ii) Heat gained by water = $MC\theta$;
= 0.4 x 4200 (T-10)}

(iii) Heat lost = heat gained
1680 (T-10) = 6780 + 12.6 (100-T);
1680T – 16800 =6780 + 1260 -12.6T
1692.6T = 24840
T = 14.7^0 C

Question 18 (a)

State what is meant by *centripetal acceleration.*

Candidates were required to recall the definition of the term ***"centripetal acceleration"***.

Weaknesses

Most of the candidates did not score in this part of the question. Some candidates defined the more common term ***"centripetal force"*** instead of ***"centripetal acceleration"***. Since a particle moving in a circular path has its velocity changing every second, then it is said to be accelerating and further, the force acting on it is directed towards the centre, the acceleration is also towards the centre. Candidates' responses indicated that they did not have knowledge on the concept of centripetal acceleration.

Expected Responses

Centripetal acceleration is the acceleration towards the centre of motion.

Question 18 (c)

A block of mass 200 g is placed on a frictionless rotating table while fixed to the centre of the table by a thin thread. The distance from the centre of the table to the block is 15 cm. If the maximum tension the thread can withstand is 5.6 N, determine the maximum angular velocity the table can attain before the thread cuts.

Candidates were expected to use the expression $a = \omega^2 r$ in the relation $F = m\frac{v^2}{r}$, where $\omega = \frac{v}{r}$ is used to calculate the value ω.

Weaknesses

- Candidates used wrong formula e.g. $T = \frac{mv^2}{r} + mg$.

- Candidates failed to differentiate between angular velocity ω and velocity v, with some stating the units for ω as m/s.

Expected Responses

F = mω2r
For thc thread to cut
F = 5.6 N
$5.6 = 0.20 \times \omega^2 \times 0.15$
ω = 13.7 radian per second

7.3 PAPER 2 (232/2)

This is a theory paper that tested three main areas of the Physics syllabus; ***Electricity (Electrostatics, Current electricity, Electromagnetic induction, Electromagnetic spectrum, Mains electricity),*** Optics ***(Waves, Reflection, Refraction, Sound), Modern Physics (Photoelectric effect, Radioactivity, Electronics, X-rays, Cathode Rays, & C.R.O).*** The paper format was similar to paper 1(232/1) and was marked out of 80. The following is a discussion of the questions in which candidates performed poorly in this paper.

Question 2

State **one** advantage of an alkaline cell over a lead-acid cell.

Many candidates did not score in this question. Candidates were expected to compare the advantages of alkaline cells over the lead acid cells.

Weaknesses

From the candidates' responses it was evident that the candidates were not familiar with the alkaline cells and they were therefore unable to distinguish between their advantages and disadvantages.

Expected Responses

- Alkaline cells last longer than lead acid cells.
- Alkaline cells are more rugged than the lead acid cells.
- Alkaline cells are lighter than lead acid cells

Advice to Teachers

Teachers are advised to expose their candidates to both types of cells while teaching this topic.

Question 5

Figure 4 shows the displacement-time graph for a certain wave.

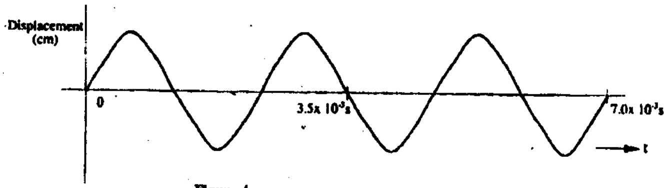


Figure 4

Determine the frequency of the wave.

Candidates were expected to interpret the graph provided by establishing the value of periodic time T from the plot. They were then to determine the frequency f of the wave using the relationship $f = \frac{1}{T}$

Weaknesses

Most of the candidates did not have a problem with the question but some scored poorly in the question. Many of those who scored poorly were not able to identify the value of time corresponding to one wavelength while others wrote incorrect relationship between f and T.

Expected Responses

$$T = \frac{0.0075}{3}$$

$$f = \frac{1}{T} = \frac{3}{0.007} = 429Hz$$

Advice to Teachers

When taught through demonstration using a Ripple tank and slinky the concept of f, λ and T is easily understood. Teachers should take time to make sure that these terms are understood by candidates.

Question 6

Figures 5 (a) and (b), show wavefronts incident on barriers blocking part of the path.

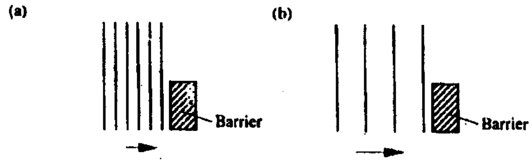


Figure 5

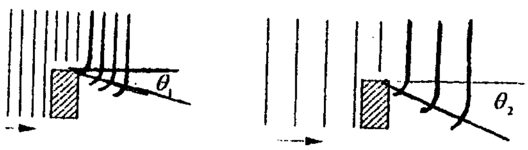
On the same figures sketch the wavefronts to show the behaviour of the waves as they pass each barrier and after passing the barrier.

Candidates were expected to differentiate between diffraction of two waves of different wavelengths by identical obstacles.

Weaknesses

The concept of diffraction was not understood adequately as majority of the candidates did not score in the question.

Expected Responses



Advice to Teachers

Teachers are once again advised to teach diffraction of waves through demonstration so as to make the concepts less abstract.

Question 7

Figure 6 shows a ray of light incident on the face of a water prism.

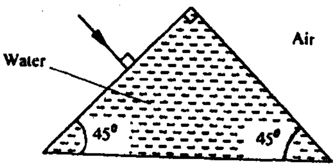


Figure 6

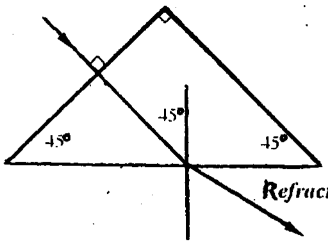
Sketch the path of the ray as it passes through the prism.
Critical angle for water is 49°.

In this question the ray of light is incident on first surface at an angle of incidence = 0. Candidates were expected to show that the ray goes through this surface undeviated. On the second surface the ray is incident at i = 45° which is less than the critical angle hence it emerges to the air away from the normal.

Weaknesses

Many candidates failed to use their knowledge on relationship between the angle of incidence and critical angle to trace the path of the ray and therefore did not score in the question.

Expected Responses



Advice to Teachers

Teachers need to take time in this area to demonstrate the relationship between critical angle, angle of incident and refraction involving different media.

Question 9

A heater of resistance R_1 is rated P watts, V volts while another of resistance R_2 is rated 2P watts, $^V/_2$ volts. Determine R_1/R_2.

Candidates were required to relate the power P and resistance R from their knowledge of expression for power P = VI and ohms law relationship $I = \frac{V}{R}$

Weaknesses

Candidates went as far as substituting for R_1 and R_2 but were unable to simplify the final expression for R_1/R_2.

Expected Responses

$R_1 = \frac{V^2}{P}$ $\qquad\qquad$ $R_2 = \frac{V^2}{8P}$

$$\frac{R_1}{R_2} = \frac{V^2}{P} \times \frac{8P}{V_2}$$
$$= 8$$

Advice to Teachers

This was a case of simple algebraic application which students are expected to have mastered at this level. Physics teachers should ensure that their students are able to transfer skills learnt in Mathematics to the learning of physics. Teachers should explain clearly the conditions under which internal reflection occurs at a boundary of two media.

Question 11 and 12

The graph in Figure 8 shows the variation of photoelectric current with applied voltage when a surface was illuminated with light of a certain frequency. Use the information in the figure to answer questions 11 and 12.

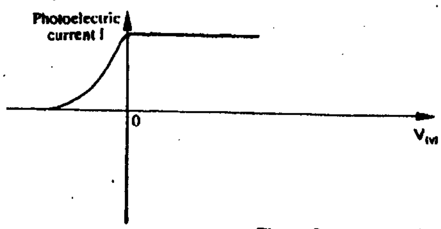


Figure 8

On the same axes, sketch the graph when light of higher intensity but same frequency is used to illuminate the surface.
Explain your answer in 11 above.

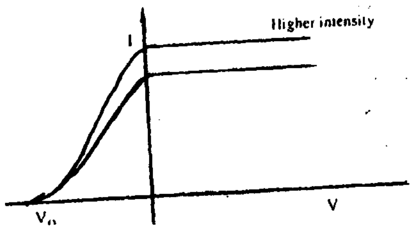
In this question, candidates were expected to have drawn the curve for light of higher intensity. The curve should intersect with vertical axis at a higher value than the existing one. The photo electric current saturates at a higher value since higher light intensity means more photoelectrons are produced.

Weaknesses

Candidates had problems showing the saturation current and the intercept.

Expected Responses

11.



12. The higher the intensity implies greater number of electrons and hence higher saturation current.

Advice to Teachers

Teachers need to explain the photoelectric emission concept with more emphasis on the variables that are involved, for example: frequency of the radiation, intensity of radiation, applied voltage and the other related factors that affect photoelectric emission.

Question 15

(a) State Ohm's Law.
(b) The graph in Figure 9 shows the current-voltage characteristic of a certain device, X.

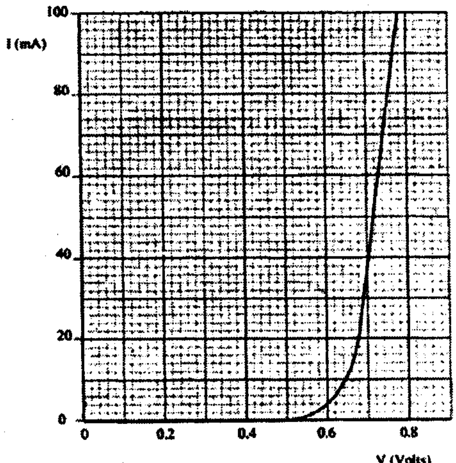
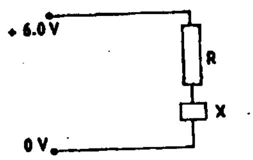


Figure 9

(i) State with a reason whether the device obeys Ohm's law.

(ii) Determine the resistance of the device, X, when the current through it is 60 mA.

(iii) When the device, X, is connected in the circuit below, the voltage across it is 0.70V.



Calculate the value of the resistance R.

(c) The cell in Figure 10 has an emf of 2.1V and negligible internal resistance.

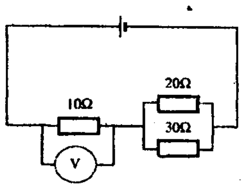


Figure 10

Determine the

(i) total resistance in the circuit
(ii) current in the circuit
(iii) reading on the voltmeter.

Weaknesses

In part (a) of the question, candidates were required to simply recall and state ohms law. However, some of the candidates could not state the law. Most of them wrote V = IR which is a mathematical expression of the law but not the statement of the law. The statement of the law should also include the conditions under which the law applies.

Candidates scored fairly well in part (b) (i) of the question, but in part (b) (ii) candidates were unable to determine the resistance of the device from the graph. Most of the candidates could not score maximum marks in this part of the question. Most of them substituted the value of V corresponding to I = 60mA instead of using the gradient of the curve at I = 60mA.

In part (c) of the question, candidates performed fairly well with only a small number of candidates who were unable to get the effective resistance using $\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}$

Expected Responses

(a) ***Ohm's law:*** the current passing through a wire at a constant temperature is proportional to the potential difference between its ends.

(b) (i) It does not obey Ohm's law because the current – voltage graph is not linear throughout.

(ii) Resistance $=\frac{V}{I}$ = inverse of slope of the graph.

$$=\frac{(0.78-0.70)V}{(100-40)mA}=\frac{0.08}{60\times10^{-3}}A$$

$$=1.33\Omega$$

(iii) $R=6.0-0.7=5.3V$

$$R=\frac{5.3V}{35mA}$$

$$=151.4\Omega$$

(c) (i) Parallel circuit $\frac{1}{30}+\frac{1}{20}=\frac{5}{60}$

R = 12Ω

Total resistance = 10+12 = 22Ω

(ii) $I = \frac{V}{R} = \frac{2.1}{22} = 0.095A$

(iii) $V = IR = 10 \times \frac{2.1}{22}$
$= 0.95V$

Question 17

(a) State Lenz's Law of electromagnetic induction.

(b) Figure 13 shows a simple microphone in which sound waves from the person talking cause the cardboard diaphragm to vibrate.

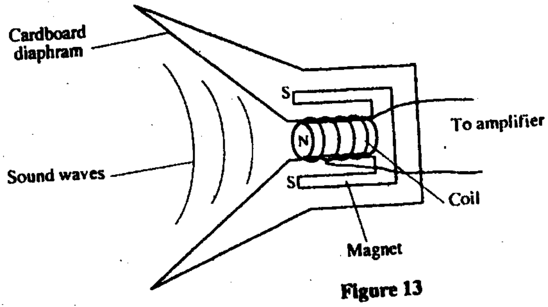


Figure 13

(i) Explain how a varying current is induced in the coil when the diaphragm vibrates.

(ii) State **two** ways in which the induced current in (i) above can be increased.

(c) A transformer with 1200 turns in the primary circuit and 120 turns in the secondary circuit has its primary circuit connected to a 400V a.c source. It is found that when a heater is connected to the secondary circuit, it produces heat at the rate of 600w. Assuming 100% efficiency, determine the:

(i) voltage in the secondary circuit;
(ii) current in the primary circuit;
(iii) the current in the secondary circuit;

Weaknesses

In question 17 (a), most of the candidates failed to state Lenz's law correctly. The level of testing here was simply recall of the statement. In part (b) of the question, candidates were not able to relate the mechanical movement of the diaphragm and the coil to the production of the varying current. It is worth noting that some of those who failed to explain part b (i) of the question were able to answer b (ii). It is possible that candidates did not understand the diagram adequately enough to answer the question. In part (c) of the question, candidates' performance was fairly good.

Expected Responses

(a) The induced current flows in such a direction that its magnetic effect opposes the change producing it.

(b)

(i) As the diaphragm vibrates, it causes the coil to move back and forth; in the magnetic field cutting the field lines; this causes a varying to be induced in the coil which causes a varying current to flow.

(ii)

- Increasing number of turns in the coil.
- Increasing the strength of the magnet.

(c) (i) $\frac{V_p}{V_s} = \frac{N_p}{N_s}$

$$\frac{400}{V_S} = \frac{1200}{120}$$

$V_s = 40V$

(ii) $P_s = P_p = 600w$

$$I_s = \frac{600}{40} = 15A$$

(iii) $$I_P = \frac{600}{400} = 1.5A$$

Advice to Teachers

Teachers need to take time to explain the principle involved in the applications of electromagnetic induction.

7.3 PAPER 3 (232/3)

This was the Physics Practical paper which consisted of two compulsory questions testing a variety of skills. The maximum score for the paper was 40 marks.

Question 1

You are provided with the following:

- **a metre rule.**
- **an optical pin fixed to a piece of cork.**
- **two retort stands, two bosses and two clamps.**
- **two wooden blocks.**
- **a stop watch.**
- **some thread tied to a mass.**

Proceed as follows:

(a) Set up the apparatus as shown in figure 1.

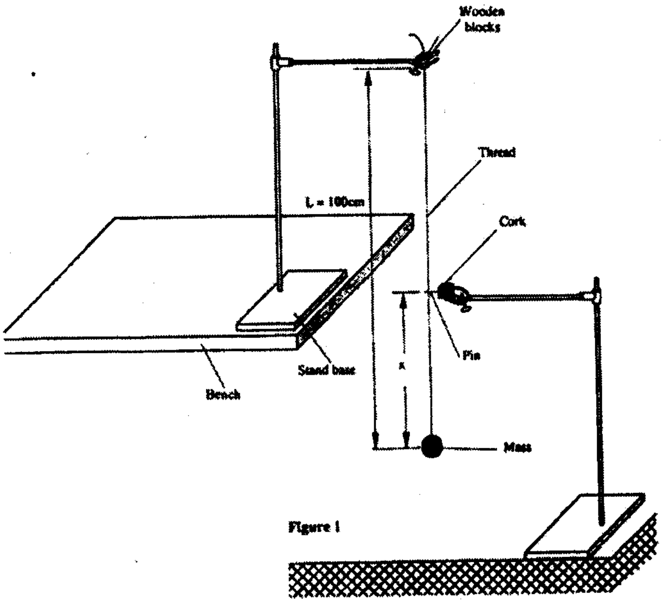


Figure 1

The thread tied to the mass should be held firmly between the two blocks of wood and clamped to the upper end of the stand so that the mass hangs freely. The distance L between the point of support and the centre of the mass is 100 cm. **Ensure that L remains constant throughout the experiment.**

Adjust the lower clamp so that the optical pin **just** touches the thread when the hanging mass is at rest.

(b) Adjust the position of the lower clamp so that the pin is at a distance X = 35 cm above the centre of the mass. Displace the mass slightly to one side and release it so that it swings in a plane perpendicular to the pin and the thread hits the pin as shown in Figure 2.

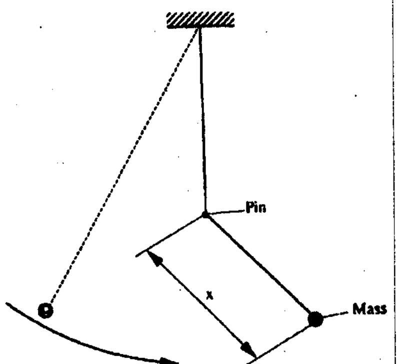


Figure 2

Measure and record in **table 1** the time t for 20 oscillations.

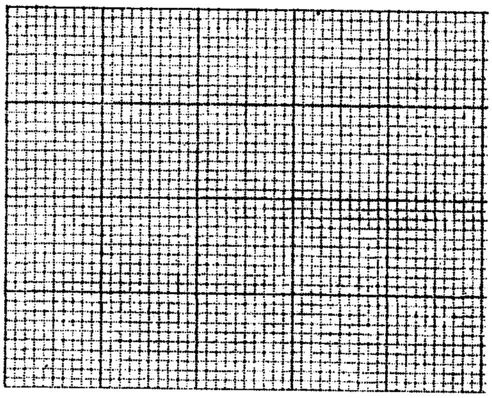
(c) Repeat the procedure in (b) for other values of X shown in **table 1**. Complete the table.

Table 1

Distance X(cm)	35	40	45	50	55	60
Time t for 20 osc (s)						
$T = \frac{t}{20} (s)$						

On the grid provided

(d) Plot the graph of T(y-axis) against X.



(e) Determine the slope S of the graph at a point X = 52 cm.

(f) Determine the constant n given that $n = 52S^2$

(g) Determine the constant P given that $P = \frac{\pi^2}{4n}$

The following skills were tested.

- Ability to measure time of oscillations using a stop watch.
- Ability to choose appropriate scales in graph plotting.
- Ability to interpret graphs.

Weaknesses

- Candidates were expected to show clearly their working by substituting their values in the expressions provided before proceeding to evaluate. Marks were lost by candidates who worked out answers in their calculators and recorded the answers directly.

- In the determination of Reciprocals, quite a number of candidates did not use the correct mode on their calculators. Such candidates ended up with incorrect values such as $1/15 = 6.7$ instead of 6.7×10^{-1}.

- Candidates had difficulty deciding whether their plotted points represented a straight line or a curve. Some candidates ***"forced"*** their graph into a straight line and therefore ended up with no tangent as required in question 1(e). This was as a result of use of an inappropriate scale.

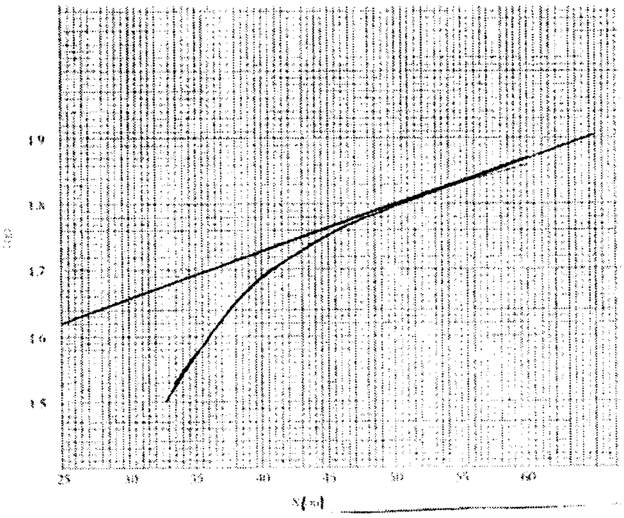
- It was also noted that quite a number candidates obtained values of t that were not varying. This could be as a result of either an error in time measurement or that the length l was not varied as required. Candidates are advised to take time to understand the tasks involved before starting the experiment.

Expected Responses

(c)

Distance x (cm)	35	40	45	50	55	60
Time t for 20 Osc(s)	31.8	33.8	35	36	36.8	37.2
Period $T = \frac{t}{20}(s)$	1.59	1.69	1.75	1.8	1.84	1.86

(d)



(e) Slope: tangent at x = 52cm

$$\frac{\Delta T}{\Delta x}$$

$$S = 6.7x10^{-3}$$

(f) $n = 52x(6.7x10^{-3})2$

$= 2.33x10^{-3}$

(g) $P = \frac{\pi 2}{4x2.33x10^{-3}}$

$= 1.05x10^{3}$

Advice to Teachers

It is important for teachers to give practice on the correct way of determining the time for complete oscillations on a swinging pendulum. Many candidates timed incomplete oscillations and therefore ended up with values that fall outside the accepted range.

Question 2

You are provided with the following:

- a voltmeter.
- two cells and a cell holder.
- a switch.
- a set of six resistors each of resistance 1000Ω.
- connecting wires.

Proceed as follows:

(a) Set up the apparatus as shown in the circuit diagram in Figure 3.

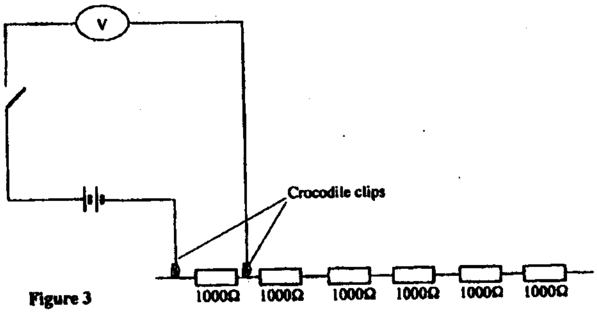


Figure 3

(b) (i) Record the voltmeter reading E, when the crocodile clips are connected together (R= 0).

E = _______________volts.

Open the switch and separate the crocodile clips.
Indicate by ticking below, the range of the voltmeter used

0 – 3V ☐ 0 – 5V ☐ 0 – 15V ☐

(ii) Now connect the crocodile clips across resistance $R = 1000\Omega$. Close the switch and record in **table 2** the voltmeter reading V. Open the switch.

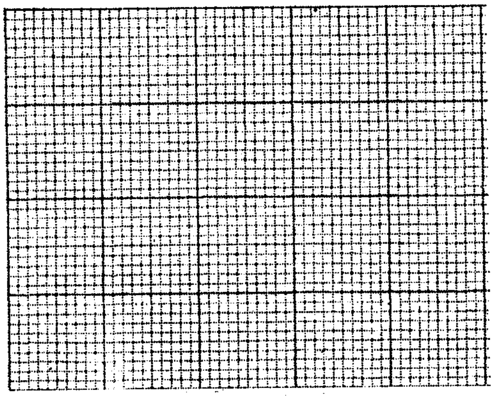
(c) Repeat the procedure in (b)(ii) for other values of resistance R shown in the table. Complete the table.

Table 2

Resistance R (Ω)	1000	2000	3000	4000	5000	6000
V(v)						
$\frac{1}{V}(v^{-1})$						

(d) On the grid provided plot the graph of R (y axis) against $\frac{1}{V}$

Hint: *Draw your axes to include point (0, 0) half way up the page i.e. the $\frac{1}{V}$ axis to run across the middle of the page.*



(e) Determine the slope S of the graph.

(f) Determine the constant G given that $G = \frac{S}{E}$

(g) From the graph determine

(i) V_o, the value of V when R = 0

(ii) R_g the value of R when $\frac{1}{V} = 0$

(iii) Determine $\frac{G}{R_g}$

The following skills were tested:

- Ability to connect a circuit using the circuit diagram provided.
- Ability to measure voltage across resistors using the voltmeter.
- Ability to choose appropriate scales to draw graphs.
- Ability to interpret graphs.

Weaknesses

- Candidates used Voltmeters with more than one range but there is evidence from their work that some candidates actually recorded values from incorrect ranges. The readings of such candidates did not correspond to the expected values based on the number of cells used.

- One skill that candidates are assessed on is the ability to follow the instructions. Although instructions were clear on the number of batteries to be used, a number of candidates used one battery in place of two batteries. It was not clear whether this was what was provided by their teachers or their own decision.

- Candidates still showed weaknesses in plotting values with a power of 10. Teachers need to give practice on this skill.

- The hint given was to caution candidates on the need to include the negative values V on the y axis. However, candidates who ignored the hint but used the equation of a straight line to obtain the value of Vg and Vo were scored accordingly.

Expected Responses

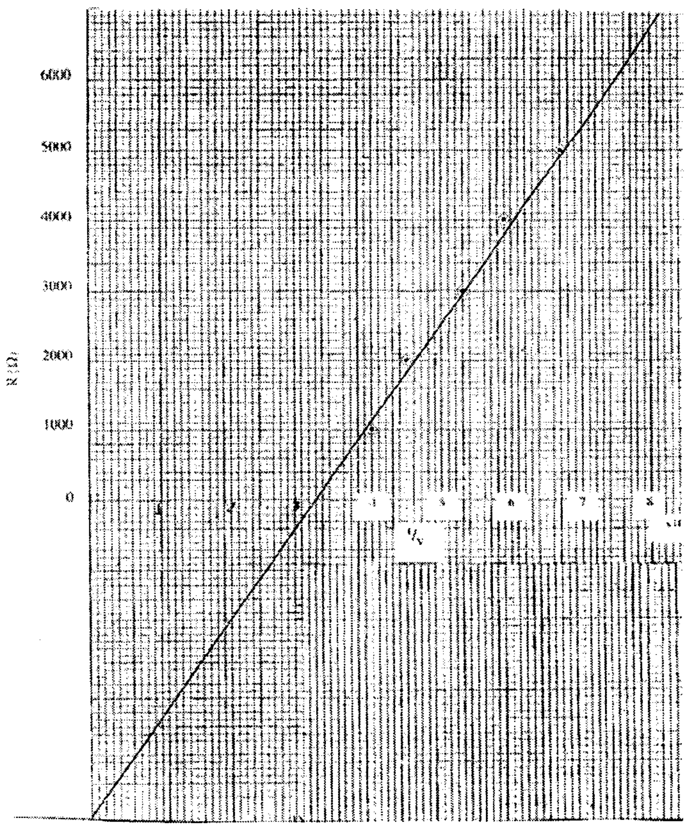
(b) (i) E = 3.1 volts

(c)

For range 0 – 5v

$R(\Omega)$	1000	2000	3000	4000	5000	6000
V	2.5	2.2	1.9	1.7	1.5	1.3
V^{-1}	0.4	0.45	0.53	0.59	0.67	0.77

(d)



(e) Slope = $\dfrac{\Delta R}{\Delta \frac{1}{v}}$

$$= \frac{10.5 \times 1000}{0.75} = 14000$$

(f) $G = \frac{14000}{3.1} = 4.5x10^3 \Omega$

(g) (i) $\frac{1}{V} = 0.32(when \; R = O)$

$V_o = 3.1$

(ii) $R_g = 4.5x10^3 \Omega.$

(iii) $\frac{G}{R_g} = \frac{4516x10^3}{4.5x10^3}$

$= 1.003$

Advice to Teachers

The general performance in this paper has greatly improved, which is an indication that students are now more exposed to practical skills than before. Teachers need to give even more practical exposure to improve on not only practical skills acquisition but also learning of physics as a whole.