7.0 PHYSICS (232)

In the year 2009, the KCSE Physics examination was tested in three papers: Paper 1 (232/1), Paper 2 (232/2) and Paper 3 (232/3). Paper 1 and Paper 2 were theory papers that consisted of two sections A and B. Section A had short answer questions and section B had structured questions.

Candidates were required to answer all questions from both sections. Questions in paper 1 (232/1) were drawn from heat and mechanics parts of the syllabus while questions in paper 2 (232/2) were drawn from optics, waves, electricity, magnetism and modern physics.

Paper 3 (232/3) was a practical paper testing on a variety of skills in all areas of the physics syllabus.

7.1 GENERAL CANDIDATES' PERFORMANCE

The candidates' performance statistics in the KCSE Physics examination since the year 2006 when the syllabus was revised are as shown in the table below.

Table 12: Candidates' Overall Performance in Physics in the year 2007, 2008 and 2009

Year	Paper	Candidature	Maximum Score	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**
2007	1		80	23.46	13.43
	2		80	23.33	17.93
	3		40	25.85	7.14
	Overall	**83,162**	**200**	**82.62**	**35.00**
2008	1		80	25.32	14.66
	2		80	24.17	16.34
	3		40	23.92	7.31
	Overall	**93,692**	**200**	**73.42**	**35.43**
2009	1		80	26.72	16.17
	2		80	20.77	14.23
	3		40	15.22	6.29
	Overall	**104,883**	**200**	**62.62**	**34.02**

From the table above, it can be observed that:

7.1.1 the candidature increased from 93,692 in 2008 to 104,883 in 2009, an increase of 11,191 candidates (11.94%).

7.1.2 there was an improvement in the performance of paper 1 (232/1) from a mean of 25.32 in 2008 to 26.72 in 2009.

7.1.3 paper 2 (232/2) and paper 3 (232/3) recorded a decline in performance in the year 2009.

7.1.4 the overall performance declined when compared to the previous year. In the year 2009 the overall mean was 62.62 as compared to 2008 when the mean was 73.42.

The following is a discussion of some the questions that candidates found challenging in the three papers that were offered in Physics.

7.2 PAPER 1 (232/1)

Question 6

A clinical thermometer has a constriction in a bore just above the bulb. State the use of this constriction.

Candidates were required to state the use of the constriction in a clinical thermometer.

Weaknesses
Candidates treated the constriction as a safety bulb to hold the thermometer during expansion.

Expected response
It stops return of the mercury to bulb when the thermometer is removed from the particular body to the surrounding.

Questions 7 and 8
Use the following information to answer questions 7 and 8

Two identical empty metal containers P and Q are placed over identical bunsen burners and the burners lit. P is dull black while Q is shiny bright. After each container attains a temperature of 100°C the burners are turned off. Identical test tubes containing water are suspended in each container without touching the sides as shown in Figure 3.

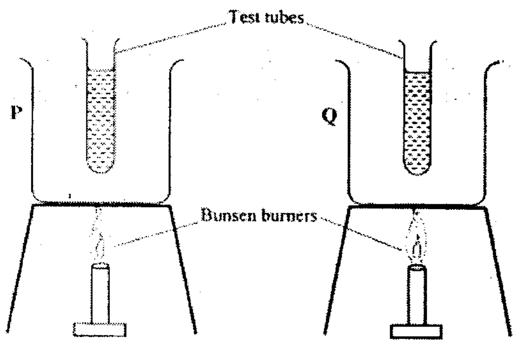


Figure 3

Question 7
Explain why the container Q may become hot faster than P.

Candidates were required to explain why a shinny surface may become hotter than a dull one when heated by identical burners.

Weaknesses
Most candidates talked of absorption and reflection instead of emission and radiation.

Expected Response
Dull surfaces radiate faster than bright surfaces, hence P looses more of the heat supplied than Q does.

Question 8
Explain why the water in test tube in P becomes hot faster than in Q.

Candidates were required explain why the water in the dull can becomes hot faster than in the shinny one.

Weaknesses
Candidates confused the mode of heat transfer from the cans to the test tubes and were unable to relate more heat emitted by the dull surface.

Expected Response
Heat travels from container to test tube by radiation hence P radiates more heat to the test tube than Q.

Question 12

Figure 7(a) shows the acceleration-time graph for a certain motion.

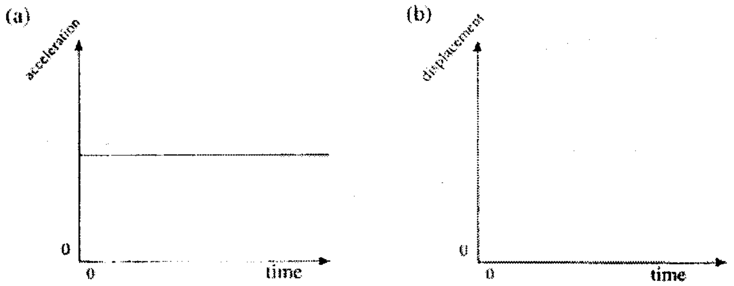


Figure 7

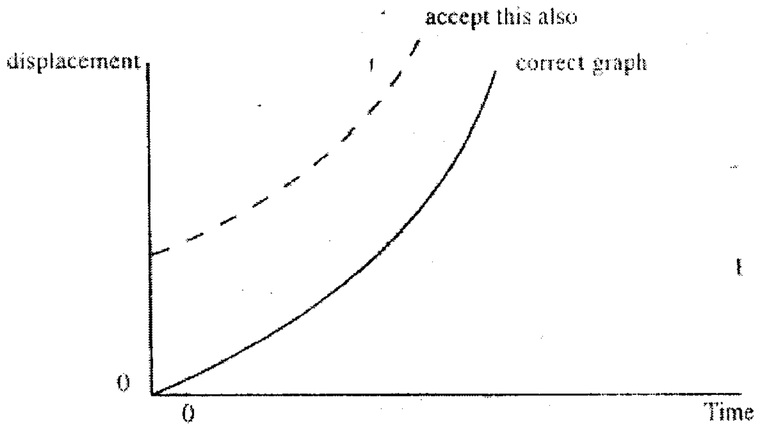
On the axes provided in Figure 7 (b), sketch the displacement-time graph for the same motion.

Candidates were required to sketch a displacement – time graph for uniform acceleration.

Weaknesses

This was a higher order thinking skill that required the candidates to relate the uniform acceleration to the displacement. This was not well interpreted by the candidates most of whom sketched lines instead of a curve.

Expected Response



Question 16

(a) Define the term efficiency of a machine

(b) Figure 9 shows a drum of mass 90 kg being rolled up a plane inclined at 25° to the horizontal. The force F applied is 420N and the distance moved by the drum along the plane is 5.2m.

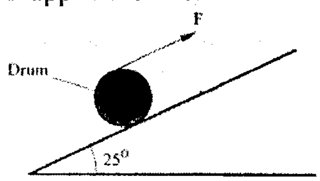


Figure 9

Determine:

(i) the work done by the effort;

(ii) the work done in raising the drum;

(iii) the efficiency of the inclined plane as a machine

Candidates were required to define the term efficiency and determine the work done in raising a drum along an inclined plane hence determine the efficiency.

Weaknesses
Most candidates did not understand the term efficiency. They were unable to differentiate work in and work out. They used mechanical advantage and velocity ratio as work out.

Expected Response

(a) Efficiency = $\frac{\text{Work output}}{\text{Work input}} \times 100$

(b) (i) Work done by effort = F x S
= 420 x 5.2
= 2184J

(ii) Distance raised = 5.2 Sine 25^0 = 2.2M
Work done = 900 x 2.2
= 1980J

(iii) Efficiency = $\frac{\text{Work output}}{\text{Work input}} \times 100$
= $\frac{1980}{2184} \times 100$
= 90.7%

Question 18

(a) State the pressure law for an ideal gas.

(b) An air bubble is released at the bottom of a tall jar containing a liquid. The height of the liquid column is 80cm. The volume of the bubble increases from $0.5cm^3$ at the bottom of the liquid to $1.15cm^3$ at the top. Figure 11 shows the variation of pressure, P, on the bubble with the reciprocal of volume, $\frac{1}{v}$, as it rises in the liquid.

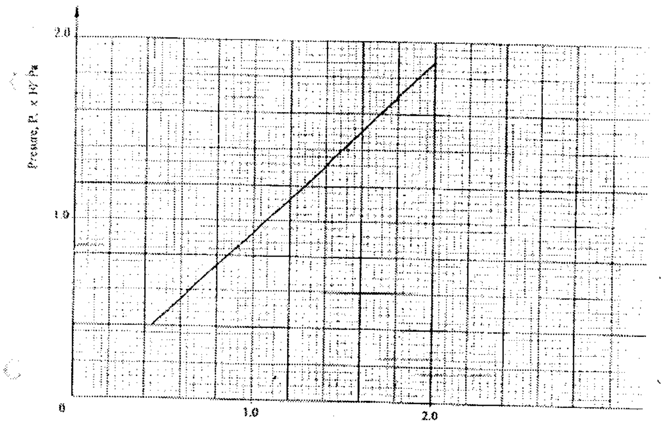


Figure 11

(i) State the reason why the volume increases as the bubble rises in the liquid column

(ii) From the graph, determine the pressure on the bubble:

(I) at the bottom of the liquid colum;

(II) at the top of the liquid column.

(iii) Hence determine the density of the liquid in kgm^{-3}.

(iv) What is the value of the atmospheric pressure of the surrounding?

(c) A rubber tube is inflated to pressure of 2.7 x 10^5 Pa and volume $3800cm^3$ at a temperature of 25°C. It is then taken to another place where the temperature is 15°C and the pressure is 2.5 x 10^5 Pa. Determine the new volume.

Candidates were required to:

(i) State and use the pressure law for an ideal gas

(ii) Use the graph of P against $\frac{1}{V}$ to determine the pressure at given points.

Weaknesses

Many candidates confused between the three laws with some stating Boyle's or Charles law. They were not able to relate V to $\frac{1}{V}$ and use change in pressure to calculate the density of the liquid.

Expected Response

(a) The pressure of a fixed mass of an ideal gas is directly proportional to the absolute temperature if the volume is kept constant.

(b) (i) Volume increases as bubble rises because pressure due to liquid column is lowered. Therefore pressure inside bubble exceeds that outside thus expansion.

(ii) I at bottom, $\frac{1}{V} = \frac{1}{0.5cm^3} = 2cm^3$

Corresponding pressure = $1.88 \times 10^5 Pa.$

II at top $\frac{1}{V} = \frac{1}{1.15cm^3} = 0.87cm^3$

Corresponding pressure = $0.8 \times 10^5 Pa.$

(iii) $\Delta P = (1.88 - 0.8) \times 10^5$

$= 1.08 \times 10^5 Pa$

$\Delta P = \rho .gh$

$1.08 \times 10^5 = \rho \times 0.8 \times 10$

$\rho = 13500 kgm^{-3}$

(iv) Pressure at top equal atmospheric pressure = $0.8 \times 10^5 Pa.$

(c) $$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{2.7 \times 10^5 \times 3800}{298} = \frac{2.5 \times 10^5 \times V_2}{288}$$

$V_2 = 3966cm^3$

Question 19

(a) Define angular velocity

(b) Three masses are placed on a rotating table at distances 6cm, 9cm and 12cm respectively from the centre of rotation. When the frequency of rotation is varied, it is noted that each mass slides off at a different frequency of rotation of the table. Table 1 shows the frequency at which each mass slides off.

Table 1

Radius r (cm)	12	9	6
Sliding off Frequency, f, (rev/s)	0.68	0.78	1.0

(i) State **two** factors that determine the frequency at which each mass slides off.

(ii) Oil is now poured on the table before placing the masses. Explain the effect of this on the frequency at which each mass slides off.

Candidates were expected to define angular velocity, state factors that affect frequency at which given masses slide off, state the effect of oil on the surface of the rotating table and effect on the frequency.

Weaknesses
Candidates were unable to relate linear and angular velocity. Most of them stated that oil increases the frequency for sliding off.

Expected Responses
(a) Rate of change of angular displacement with time.

(b) (i) Mass, force of friction, radius
(ii) Oil will reduce friction, since friction provides centripetal force, the frequency of sliding off is lowered.

(c)
$$V^2 = u^2 + 2as$$
$$V^2 = 0 + 2(0.28)h$$
$$V = \varpi r$$
$$0.84 = 0.14 \times \varpi$$
$$\varpi = \frac{0.84}{0.14} = 6rads^{-1}$$

Advice to Teachers
- Learners should be guided on meaning of terms properly for them to be able to define the terms in Physics with ease.
- All laws must be properly explained for learners to understand their applications in various situations besides being able to state them verbatively.
- Learners should be guided on proper use of formulae and language when responding to questions to show clearly their knowledge on certain skills and concepts.

7.3 PAPER 2 (232/2)

Question 9
In an experiment, a pin, a converging lens and a plane mirror are arranged as shown in Figure 4. The distance between the pin and the plane mirror is L cm while the distance between the lens and the plane mirror is q cm. The position of the pin is adjusted until its tip coincides with its real image.

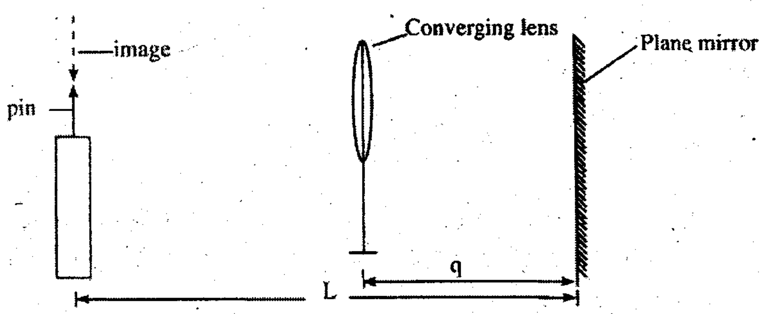


Figure 4

Candidates were required to determine the focal length of a converging lens using the lens-mirror method.

Weaknesses
Candidates were unable to differentiate between curved mirrors and lenses. They failed to distinguish between image distance and object distance i.e. L and q.

Expected Response
F = (L-q) cm

Question 11
In an X-ray tube it is observed that the intensity of X-rays increases when potential difference across the filament is increased. Explain this observation.

Candidates were required to know the factors that affect the quality and quantity of x-rays.

Weaknesses
Most candidates were not able to differentiate between the accelerating voltage and the heater voltage.

Expected Response
Increase in potential difference increases current in filament. This produces more electrons by thermionic emission and hence results in more intense x-rays.

Question 12
A boy standing infront of a cliff blows a whistle and hears the echo after 0.5s. He then moves 17 metres farther away from the cliff and blows the whistle again. He now hears the ech after 0.6s. Determine the speed of the sound.

Candidates were expected to determine the speed of sound by echo method.

Weaknesses
Many of the candidates failed to determine the distance traveled by sound to and fro, some divided the one way distance by the double time.

Expected Response

$$\frac{2d}{0.5} = \frac{2d+34}{0.6}$$

$$0.5(2d+34) = 2d \times 0.6$$

$$1.0d + 17 = 1.2d$$

$$0.2d = 17$$

$$d = \frac{17}{0.2} = 85m$$

$$\therefore Speed = \frac{2 \times 85}{0.5}$$

Question 15
Figure 9 shows the graph of the relationship between current I and potential difference V for two trungsten filament lamps X and Y. The normal working voltage for the lamp X and lamp Y are 2.5V and 3.0V respectively.

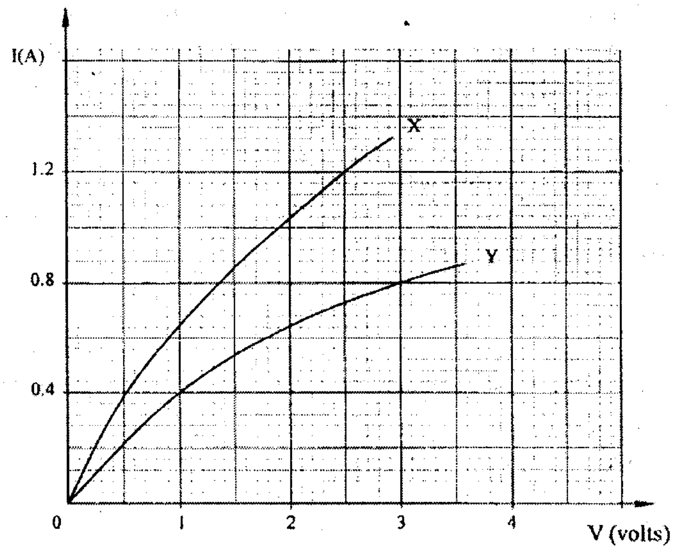


Figure 9

(a) Explain the change in the shape of the curves as the current increases.
(b) Determine the resistance of lamp X at the normal working voltage.
(c) The lamps are now connected in a series circuit in which a current of 0.4A flows. Find the potential difference across lamp Y.
(d) Determine the power at which lamp Y operates under normal working voltage.

Candidates were expected to interpret the graph and use the values to calculate resistance of lamp X, potential difference across lamp Y and the power of lamp Y at normal voltage.

Weaknesses
Candidates were not able to read the graph properly and used wrong values. Most described the nature of the curves instead of explaining.

Expected Responses
(a) Increase of current causes rise in temperature which then caused rise in resistance.
(b) Lamp X resistance $= \frac{V}{I} = \frac{2.5\Omega}{1.2} = 2.1\Omega$
(c) P.d. across lamp Y = 1.0V (directly read from the graph)
(d) Power on lamp Y $= IV$
$= 0.8 \times 3$
$= 2.4W$

Question 16
(a) Figure 10 shows a ray of light incident on a triangular glas prism and a white screen S placed after the prism.

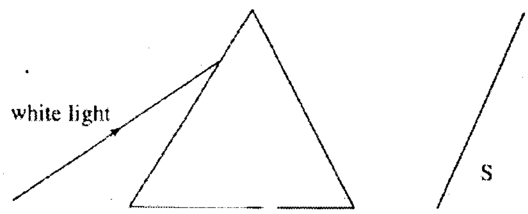


Figure 10

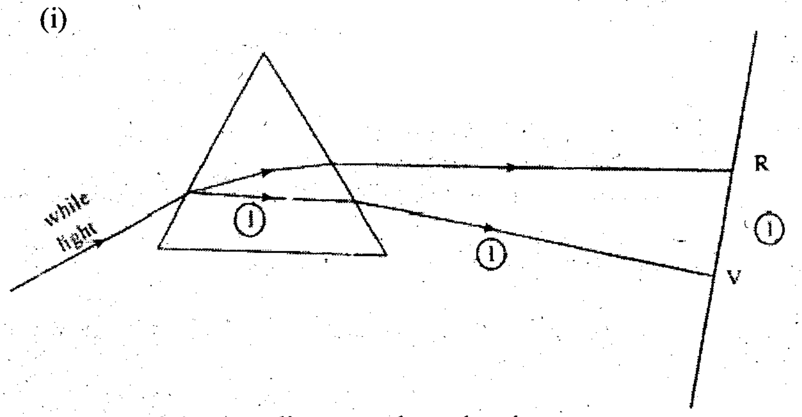
(i) Complete the path of the ray through the prism to show how a spectrum is formed on the screen.
(ii) A thermometer with a blackened bulb is placed at various parts of the spectrum. State with reasons the region where the thermometer indicates the highest reading.

(b) A pin is placed at the bottom of a beaker of depth 11.5cm. The beaker is then filled with kerosene. By using another pin on the side of the beaker and observing from the top, the distance of the image of the pin in the beaker is found to be 3.5cm from the bottom. Determine the refractive index of kerosene.

Candidates were expected to have knowledge on dispersion, refraction and deviation of white light. They also needed to know detection of electromagnetic waves using blackened thermometer and determination of refractive index by real depth and apparent depth method.

Weaknesses
Some candidates failed to know that refraction and dispersion occur at interface. Some did not understand refraction in different media of different optical densities. Most candidates could not differentiate between real depth and displacement of the image.

Expected Response
(a) (i)



(ii) Highest reading near the red end
Red light has more heat than violet

(b) Apparent depth = 11.5- 3.5
= 8 cm

Refractive index = $\frac{\text{Real depth}}{\text{Apparent depth}}$

= $\frac{11.5}{8}$ = 1.4375

Question 17
(a) Figure 11 shows the path of radiation from a radioactive source. The field is perpendicular to the paper and directed out of the paper.

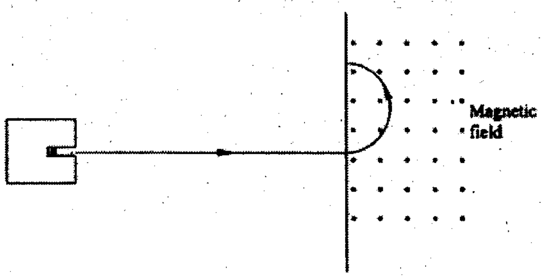


Figure 11

Identify the radiation
(b) Radiation from a radioactive source enters a G.M. tube.
(i) State the effects of the radiation on the gas inside the tube.

(ii) Explain how the large discharge current is created.

(c) The following is a nuclear equation for a fission process resulting from the reaction of a neutron with a Uranium nuclear.

$$ {}^{1}_{0}n + {}^{235}_{92}U \rightarrow {}^{141}_{56}A + {}^{y}_{x}Q + 3\,{}^{1}_{0}n $$

(i) Determine the values of x and y.
(ii) State the source of the energy released.
(iii) Explain how this reaction is made continuous in a nuclear reactor.

Candidates were required to understand the properties of radioactive radiations, the operation of the G.M tube and write balanced nuclear equations.

Weaknesses
Many candidates lacked understanding on the effect of magnetic fields on emitted radiations and the differences between gas and air.

Expected Responses
(a) β – particle

(b) (i) Ionized the gas
(ii) Ions are attracted towards electrodes and collision with other molecules cause a valance of ions which on attraction to the electrodes causes the discharge.

(c) (i) X = 36
Y = 92

(ii) Energy comes from a small decrease in mass.
(iii) Each of the neutrons produced at each collision causes further collision with uranium atom causing a chain of reaction.

Question 19
Figure 12 shows a set up for observing interference of waves from two sources S_1 and S_2. The points C and D represent positions of the constructive and destructive interference respectively as observed on the screen.

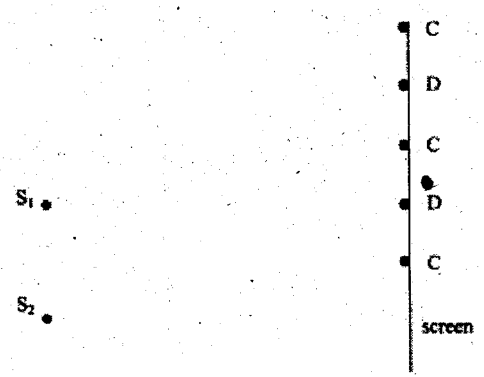


Figure 12

(a) If the observation was made in a ripple tank, describe:
(i) how the two sets of coherent waves were produced;
(ii) how the constructive and destructive interferences are identified.
(b) Explain how the constructive interference C and the destructive interference D patterns are produced.
(c) Draw:
(i) the line joining all points where waves from S_1 and S_2 have travelled equal distance. Label it A.

(ii) the line joining all points where waves from S_2 have travelled one wavelength further than the waves from S_1. Label it B.

Candidates were required to have knowledge on interference of waves and coherent sources.

Weaknesses
Candidates were not able to describe the formation of coherent waves, and draw the interference pattern to get the regions of destructive and constructive interference properly, for lines A and B.

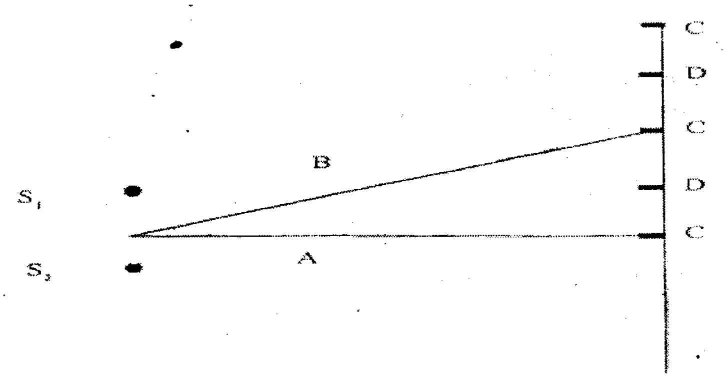
Expected Response

(a) (i) Attach two identical dippers to the same vibrator, switch on and the circular waves produced are coherent.
OR
Use one straight vibrator with two slits to produce coherent waves.

(ii) Constructive interference - bright
Destructive interference - dark

(d) Constructive interference – when two waves arrive at a point in phase i.e. crest and crest meet or trough and trough meet.
Destructive interference – when crest and trough meet to give zero intensity.

(c)



Advice to Teachers
Most of the topics will be best understood if a practical approach is used. Candidates are unable to describe well due to lack of knowledge and poor mastery of content.

Learners should be guided on how to apply the concepts learnt in class in other real life situations.

7.4 PAPER 3 (232/3)

Question 1
You are provided with the following:

- Two retort stands, two clamps, two bosses
- A stop watch
- A half-metre rule
- A metre rule
- Some thread
- Some sellotape
- Two 50g masses

Proceed as follows:

(a) Using the two retort stands, set up two simple pendulums each of length 80cm and 46cm apart such that their points of support are in the same horizontal plane.

Ensure that the retort stands are firmly held on the bench.

Using the sellotape provided, attach a half-metre rule horizontally on to the strings of the pendulum, such that its upper edge is at a distance D = 20cm below the points of suspension. Ensure that the pendulums hang freely without touching the bench.

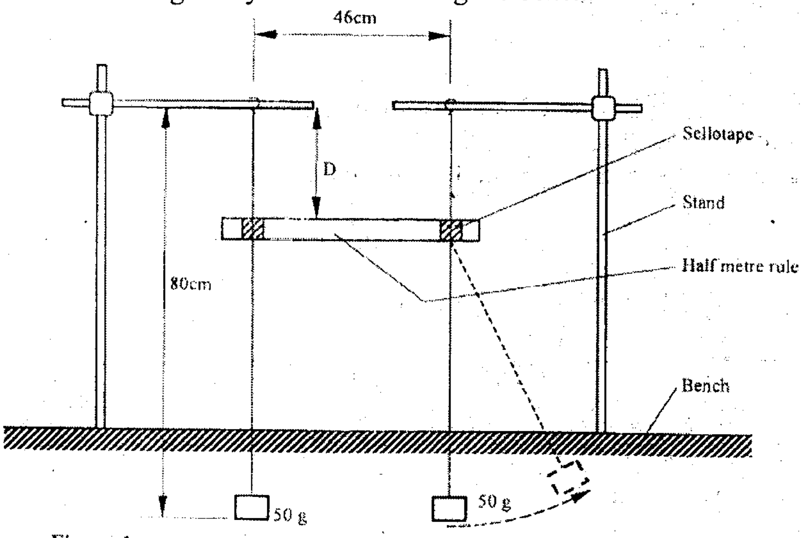


Figure 1

(b) While holding one of the 50kg mass of one pendulum, displace the other 50kg mass to one side. (see the dotted position in figure 1) and then release both pendulums simultaneously.

(e) Observe the motion of the two masses for about 30 seconds and hence;
   (i) describe the pattern of the oscillation of the two masses;
   (ii) state a reason for this pattern in terms of mechanical energy.

(f) Now focus on any one of the two pendulums.
Measure and record in the table 1 the time taken for the motion to change from One zero-amplitude state to the next zero-amplitude state.
(Zero-amplitude is when the pendulum is momentarily at rest.)

(g) Repeat the procedure in (d) for other values of D shown in table 1.
(Hint: D can be varied by sliding the half-metre rule downwards along the strings of the pendulums without removing the sellotape.) Complete the table.

Do not dismantle the apparatus yet.

Table 1

D (cm)	20	25	30	35	40	45	50
T (s)							
$f = \frac{l}{T}(s^{-1})$							

(f) Plot a graph of f (y axis) against D.

(g) Use the graph to determine the frequency f_b, the value of f when D = 38 cm.

(h) Now set the distance D at 38 cm, and repeat the procedure in (b) above.
Measure the time interval ***t*** between two successive zero-amplitudes for one Pendulum and count the number ***n*** of the oscillations in the interval.

(i) Determine f_b, given that $f_b = \frac{n}{t}$

(j) Determine f_1 given that $f_b = f_1 - f_0$

Candidates were required to set up the apparatus as shown in figure 1 and follow the instructions (b) to (h). They were expected to make observations, explain the observations, record data, complete the table, use the calculator or mathematical tables, draw graphs and make some graphical analysis.

Weaknesses

Many candidates were not able to explain the observations made, use the calculator, know the significance figures, draw graphs and extract the slope of the graph.

Expected Response

(c) (i) amplitude of the two pendulums increase from zero to maximum and then decrease to zero alternately.

(ii) alternate interchange of energy from one pendulum to the other.

(e)

D (cm)	20	25	30	35	40	45	50
T (s)	11.5	9.5	6.9	5.6	4.4	3.4	2.8
$f = \frac{1}{T} (S^{-1})$	0.08	0.1	0.13	0.18	0.23	0.30	0.36

(f) See graph
- axes labeled + units
- scale
- points plotted
- smooth curve

7.5 ADVICE TO TEACHERS

More hands on activities and classroom discussions will help the learners to respond well to practical questions. Graphical analysis should be included in the teaching of physics for learners to understand the meaning of the slope. Candidates must be advised to follow instructions in the practical examinations, and use the recorded data appropriately.