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.

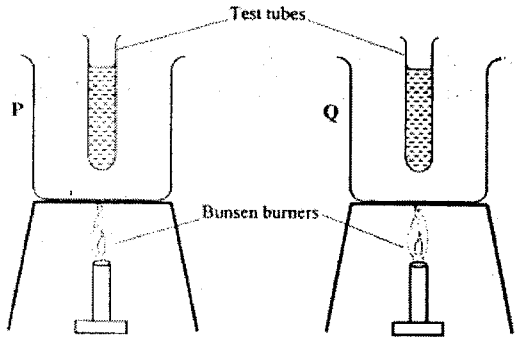


Figure 3

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.

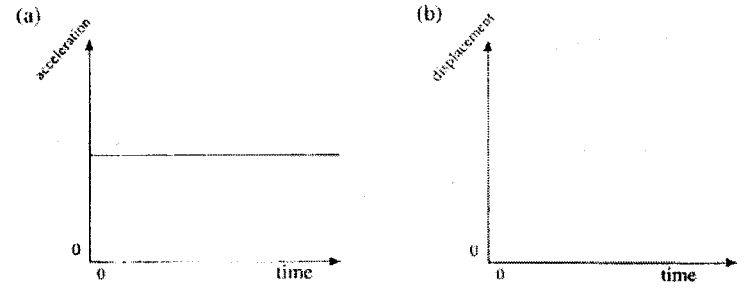


Figure 7

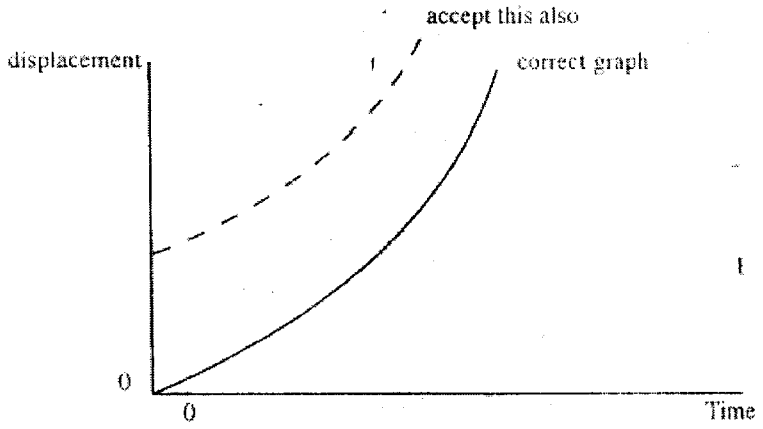
On the axes provided in Figure 7 (b), sketch the displacement-time graph for the same motion.

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.

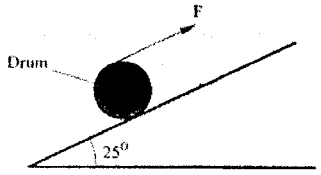


Figure 9

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 receiprocal of volume, $1/v$, as it rises in the liquid.

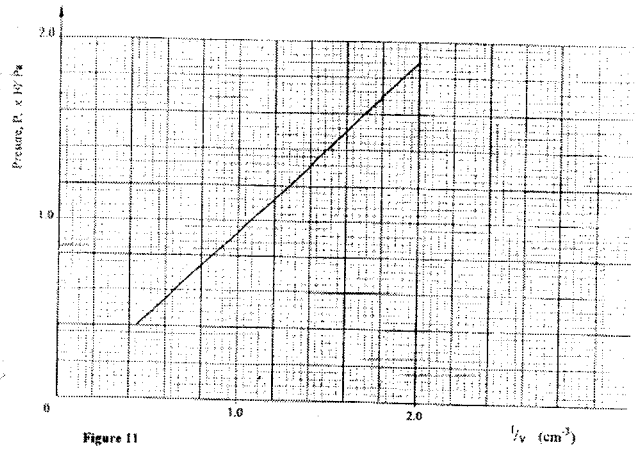


Figure 11

(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 2.7×10^5 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 2.5×10^5 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 $1/V$ 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 $1/V$ 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, $1/V = 1/0.5cm^3 = 2cm^3$

Corresponding pressure = $1.88\times10^5\,Pa$.

II at top $1/V = 1/1.15cm^3 = 0.87cm^3$

Corresponding pressure = $0.8\times10^5\,Pa$.

(iii) $\Delta P = (1.88-0.8)\times10^5$

$= 1.08\times10^5\,Pa$

$\Delta P = \rho.gh$

$1.08\times10^5 = \rho\times0.8\times10$

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

(iv) Pressure at top equal atmospheric pressure = $0.8\times10^5\,Pa$.

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

$\frac{2.7\times10^5\times3800}{298} = \frac{2.5\times10^5\times V_2}{288}$

$V_2 = 3966cm^3$

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) $V^2 = u^2 + 2as$

$V^2 = 0 + 2(0.28)h$

$V = \varpi r$

$0.84 = 0.14 \times \varpi$

$\varpi = \frac{0.84}{0.14} = 6 rads^{-1}$

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.

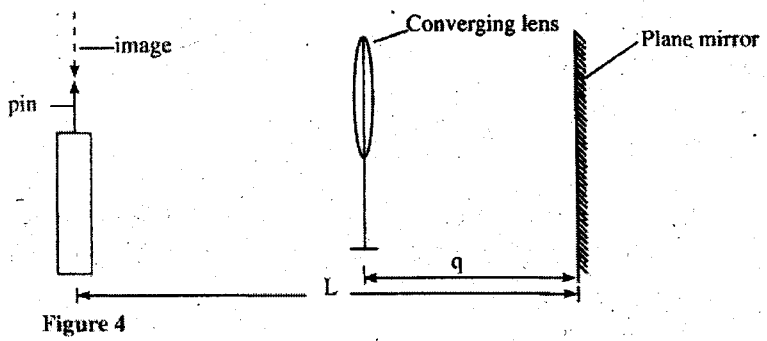


Figure 4

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.

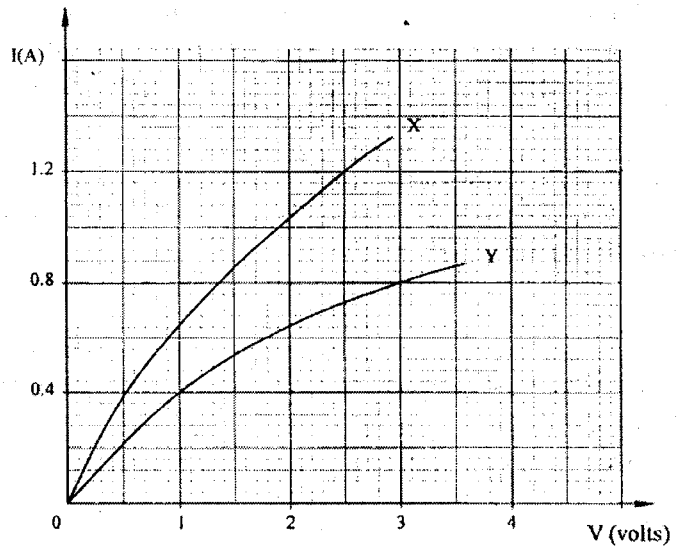


Figure 9

(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
= 0.8×3
= 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.

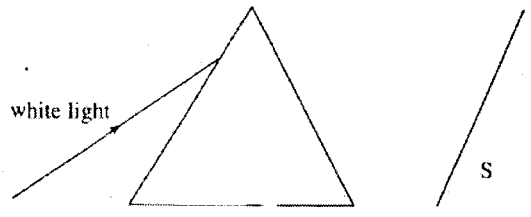


Figure 10

(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.

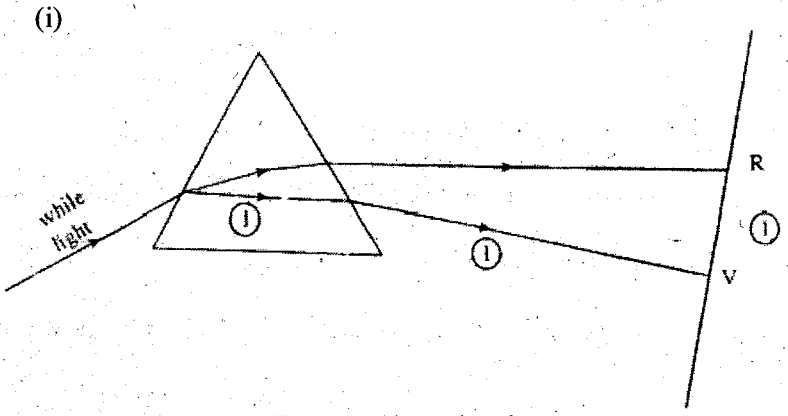
Candidates were expected to have knowledge on dispersion, refraction and deviation of white light. They also needed to know detection of electromagnetic waves using blackened thermometer and determination of refractive index by real depth and apparent depth method.

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.

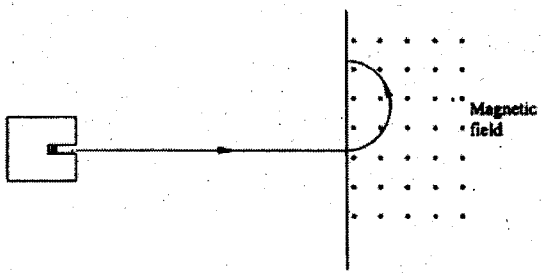


Figure 11

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.

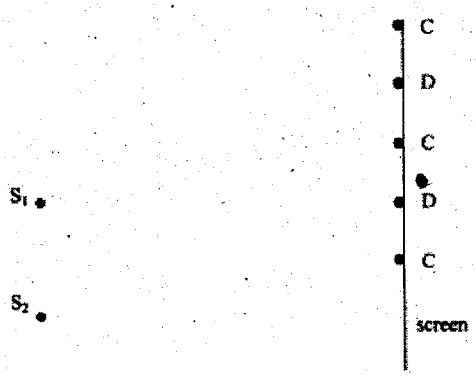


Figure 12

(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.

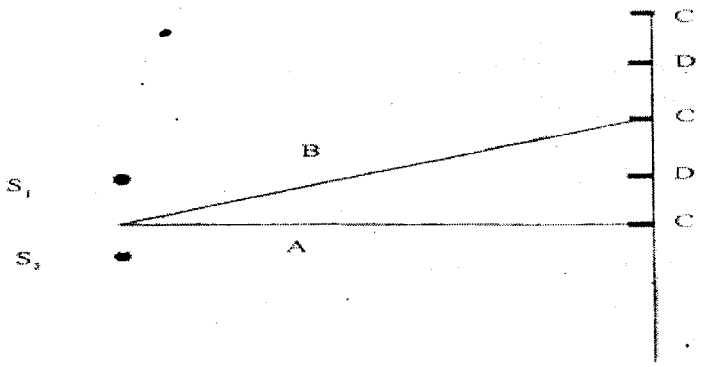
Candidates were required to have knowledge on interference of waves and coherent sources.

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.

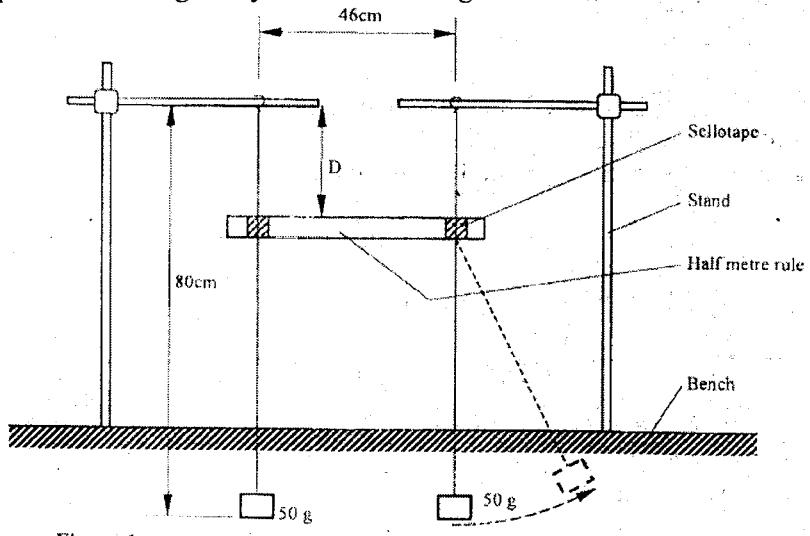


Figure 1

(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_h, 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_h, given that $f_h = \frac{n}{t}$

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

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.

29.5.1 Physics Paper 1 (232/1)

SECTION A (25 marks)

*Answer **all** questions in this section in the spaces provided.*

1 In an experiment to measure the density of a liquid, a student filled a burette with a liquid to the 0cm³ mark. Figure 1 shows a section of the burette showing the level of the liquid after 54.5g of the liquid had been run out.

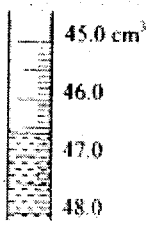


Figure 1

Determine the density of the liquid. (3 marks)

2 In an experiment to determine the acceleration due to gravity, g, a student measured the period, T, and length, L, of a simple pendulum. For a length L = 70.5cm, the period T obtained was 1.7s. Given that $T = 2\pi\sqrt{L/g}$, determine the value of g correct to two significant figures. (2 marks)

3 A steel needle when placed carefully on water can be made to float. When a detergent is added to the water it sinks. Explain this observation. (2 marks)

4 Figure 2 shows two cylinders containing a liquid and connected with a tight-fitting flexible tube. The cylinders are fitted with air-tight pistons A and B as shown.

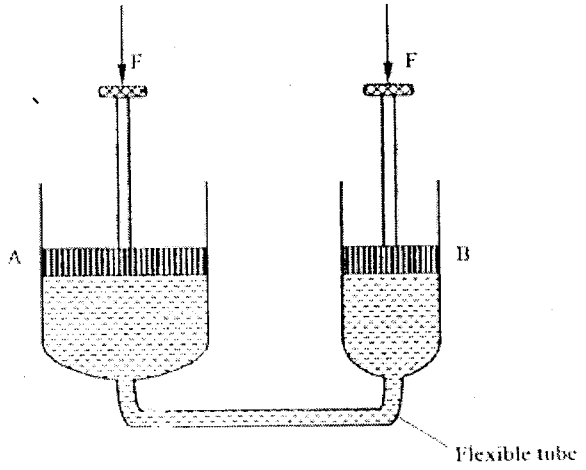


Figure 2

When equal forces, F, are applied on the pistons as shown, it is observed that piston A moves up while B moves down. Explain this observation. **(2 marks)**

5 Two identical beakers A and B containing equal volumes of water are placed on a bench. The water in A is cold while in B it is warm. Identical pieces of potassium permanganate are placed gently at the bottom of each beaker inside the water. It is observed that the spread of colour in B is faster than in A. Explain this observation. **(2 marks)**

6 A clinical thermometer has a constriction in the bore just above the bulb. State the use of this constriction. **(1 mark)**

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.

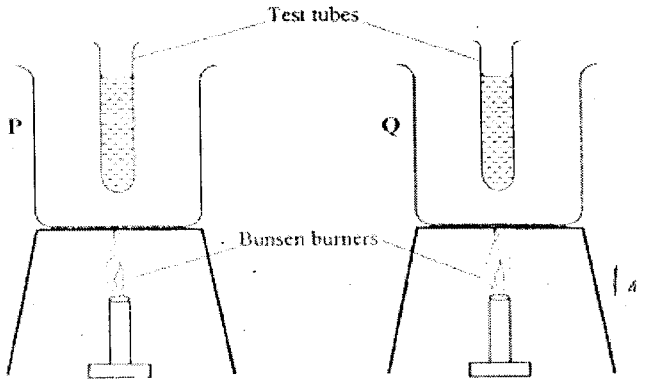


Figure 3

7 Explain why the container Q may become hot faster than P. **(2 marks)**

8 Explain why the water in test-tube in P becomes hot faster than in Q. (2 marks)

9 Figure 4 shows a uniform cardboard in the shape of a parallelogram.

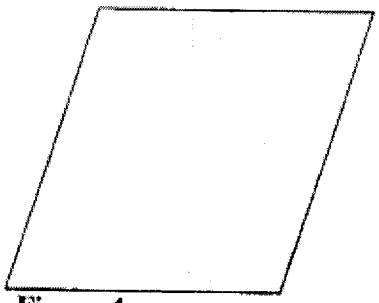


Figure 4

Locate the centre of gravity of the cardboard. (1 mark)

10 The three springs shown in Figure 5 are identical and have negligible weight. The extension produced on the system of springs is 20cm.

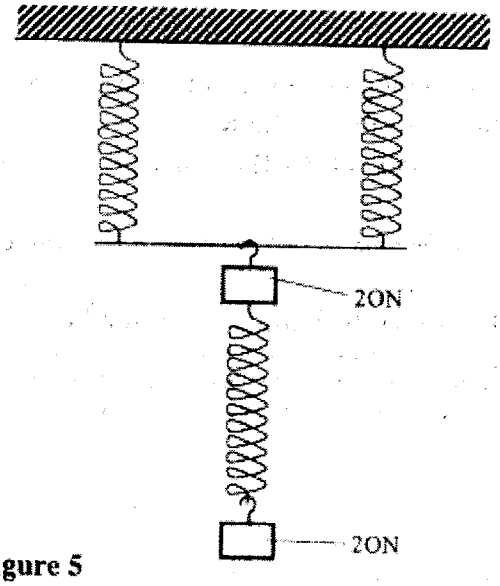


Figure 5

Determine the constant of each spring. (2 marks)

11 Figure 6 shows two inflated balloons hanging vertically on light threads.

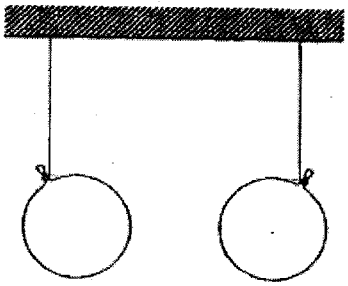


Figure 6

When a stream of air is blown in the space between the balloons, they are observed to move towards each other. Explain this observation. (1 mark)

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

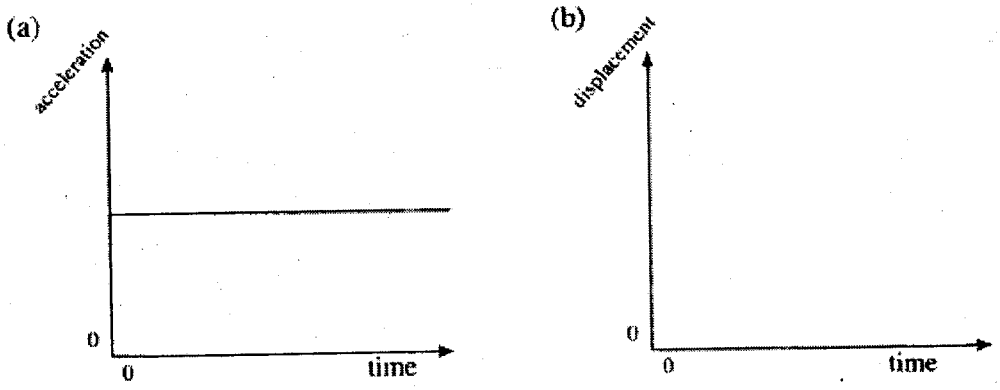


Figure 7

On the axes provided in Figure 7 (b), sketch the displacement-time graph for the same motion. (1 mark)

13 State what is meant by *absolute zero temperature* (Zero kelvin or –273°C). **(1 mark)**

14 A turntable of radius 8cm is rotating at 33 revolutions per second. Determine the linear speed of a point on the circumference of the turntable. **(3 marks)**

SECTION B (55 marks)

*Answer **all** the questions in this section in the spaces provided.*

15 (a) State **two** factors that affect the boiling point of a liquid. **(2 marks)**

(b) 100g of a liquid at a temperature of 10°C is poured into a well lagged calorimeter. An electric heater rated 50W is used to heat the liquid. The graph in Figure 8 shows the variation of the temperature of the liquid with time.

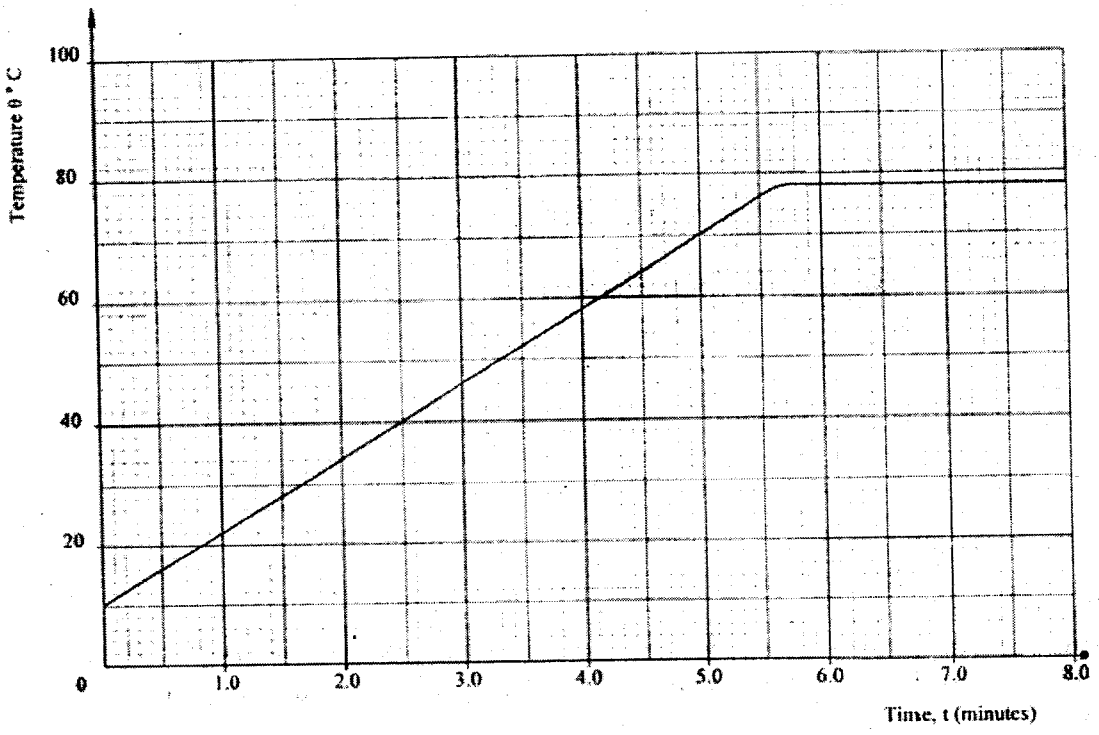


Figure 8

(i) From the graph, determine the boiling point of the liquid. (1 mark)

(ii) (I) Determine the heat given out by the heater between the times t = 0.5 minutes and t = 5.0 minutes. (2 marks)

(II) From the graph determine the temperature change between the times t = 0.5 minutes and t = 5.0 minutes. (1 mark)

(III) Hence determine the specific heat capacity of the liquid. (2 marks)

(iii) 1.8g of vapour was collected from above the liquid between the times t = 6.8 minutes and t = 7.3 minutes. Determine the specific latent heat of vaporization of the liquid. (4 marks)

16 (a) Define the term efficiency of a machine. (1 mark)

(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.

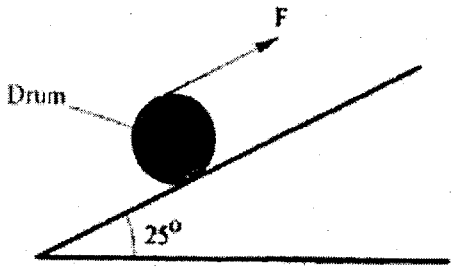


Figure 9

Determine:

(i) the work done by the effort; (3 marks)

(ii) the work done in raising the drum; (3 marks)

(iii) the efficiency of the inclined plane as a machine. (2 marks)

17 (a) State the law of flotation. (1 mark)

(b) Figure 10 shows a rectangular metal block of density 10500 kgm^{-3} and dimensions 30cm x 20cm x 20cm suspended inside a liquid of density 1200 kgm^{-3} by a string attached to a point above the liquid. The three forces acting on the block are; the tension T, on the string, the weight W, of the block, and the upthrust, U, due to the liquid.

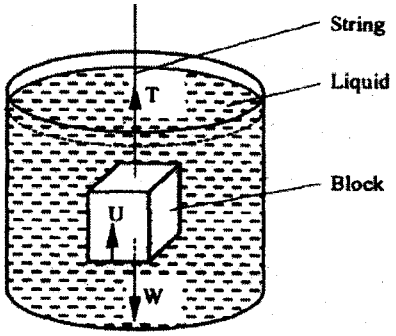


Figure 10

(i) Write the expression relating T, W and U when the block is in equilibrium inside the liquid. (1 mark)

(ii) Determine the weight, W, of the block. (3 marks)

(iii) Determine the weight of the liquid displaced by the fully submerged block. (2 marks)

(iv) Hence determine the tension, T, in the string. (1 mark)

(c) A certain solid of volume 50cm^3 displaces 10cm^3 of kerosene (density 800 kgm^{-3}) when floating. Determine the density of the solid. (4 marks)

18 (a) State the pressure law for an ideal gas. (1 mark)

(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 1.15 cm^3 at the top. Figure 11 shows the variation of pressure, P, on the bubble with the reciprocal of volume, $^1/_v$, as it rises in the liquid.

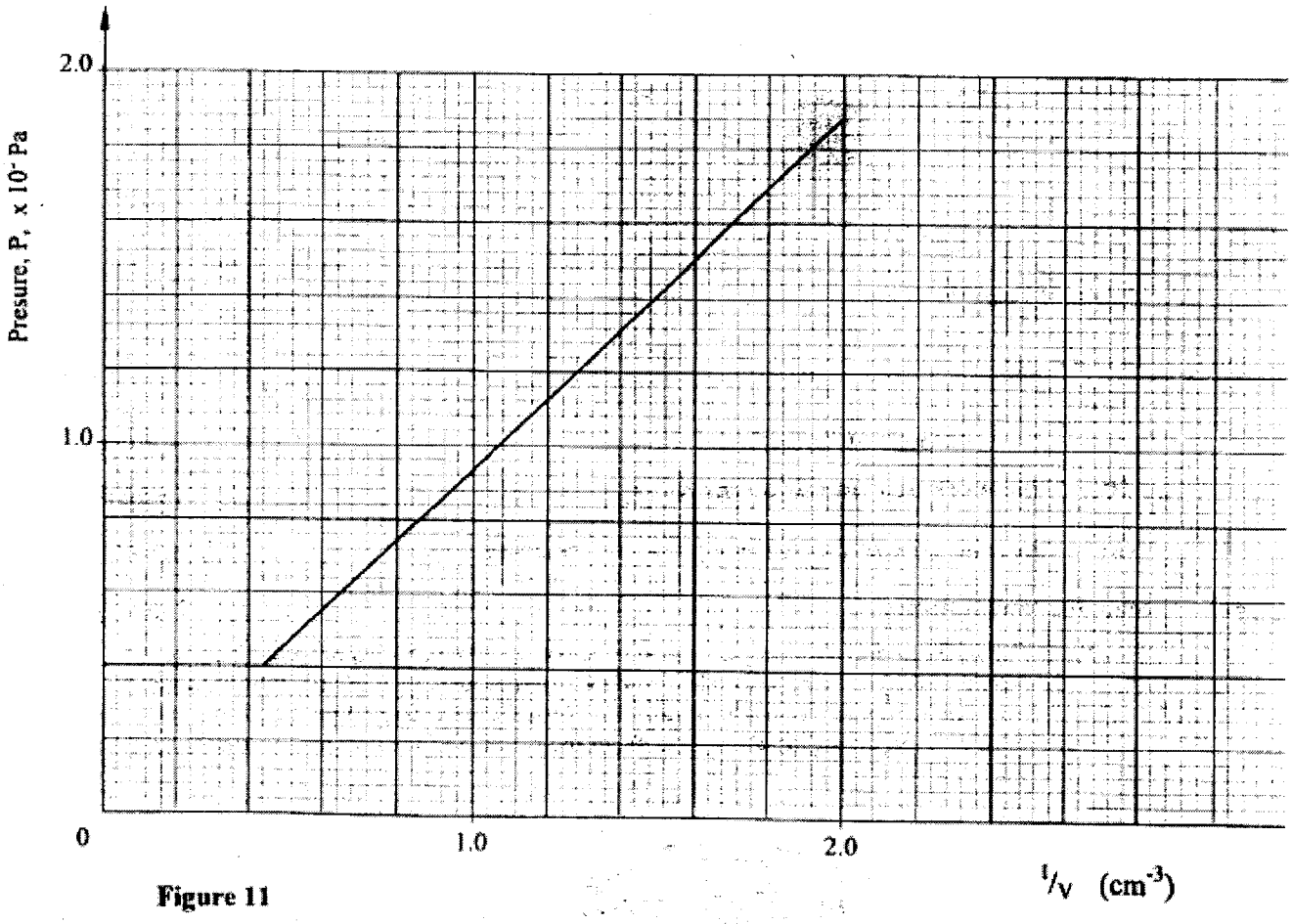


Figure 11

(i) State the reason why the volume increases as the bubble rises in the liquid column. (1 mark)

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

(I) at the bottom of the liquid column; (2 marks)

(II) at the top of the liquid column. (1 mark)

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

(iv) What is the value of the atmospheric pressure of the surrounding? (1 mark)

(c) A rubber tube is inflated to pressure of 2.7×10^5 Pa and volume 3800 cm^3 at a temperature of 25°C. It is then taken to another place where the temperature is 15°C and the pressure 2.5×10^5 Pa. Determine the new volume. (4 marks)

19 (a) Define angular velocity. (1 mark)

(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. (2 marks)

(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. (2 marks)

(c) Figure 12 shows a flywheel of radius 14cm suspended about a horizontal axis through its centre so that it can rotate freely about the axis. A thread is wrapped round the wheel and a mass attached to its loose end so as to hang at a point 1.26m above the ground.

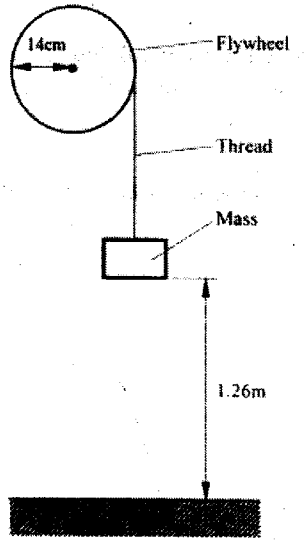


Figure 12

When the mass is released, it accelerates at $0.28ms^{-2}$. Determine the angular velocity of the wheel just before the mass strikes the ground. (4 marks)

29.5 PHYSICS (232)

29.5.2 Physics Paper 2 (232/2)

SECTION A (25 marks)

*Answer **all** the questions in this section in the spaces provided.*

1 State the number of images formed when an object is between two plane mirrors placed in parallel. **(1 mark)**

2 Figure 1 shows a ray of light incident on a mirror at an angle of 45°. Another mirror is placed at an angle of 45° to the first one as shown.

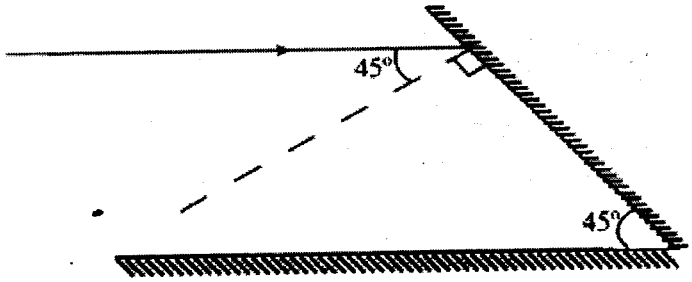


Figure 1

Sketch the path of the ray until it emerges. **(2 marks)**

3 A conductor is slowly brought near the cap of a positively charged electroscope. The leaf first collapses and then diverges. State the charge on the conductor. **(1 mark)**

4 Give a reason why it is necessary to leave the caps of the cells open when charging an accumulator. **(1 mark)**

5 An electromagnet is made by winding insulated copper wire on an iron core. State two changes that could be made to increase the strength of the electromagnet. **(2 marks)**

6 Figure 2 shows how the displacement varies with time for a certain wave.

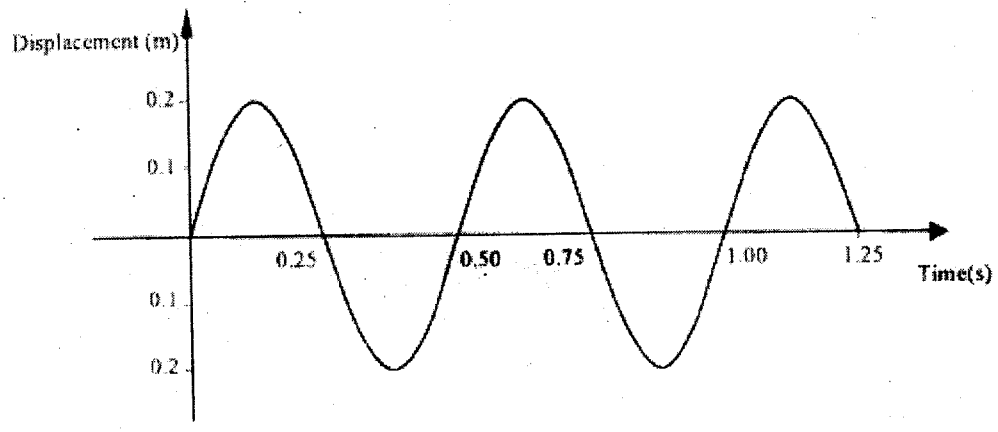


Figure 2

Determine the frequency of the wave. (3 marks)

7 Determine the speed of light in water given that the speed of light in air is 3.0×10^8 ms^{-1} and the refractive index of water is 1.33. (3 marks)

8 Figure 3 shows part of an electrical circuit. The current through the 18Ω resistor is observed to be 2A.

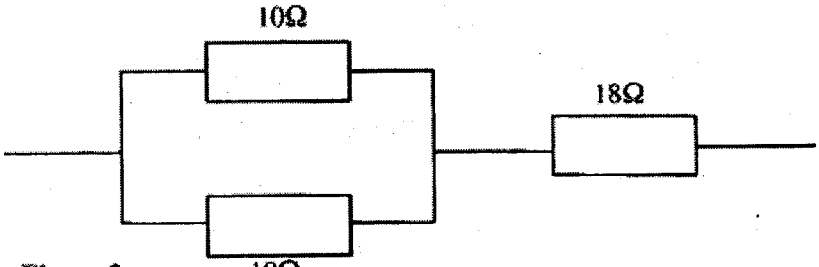


Figure 3

State the value of the current through each of the 10Ω resistors. (1 mark)

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.

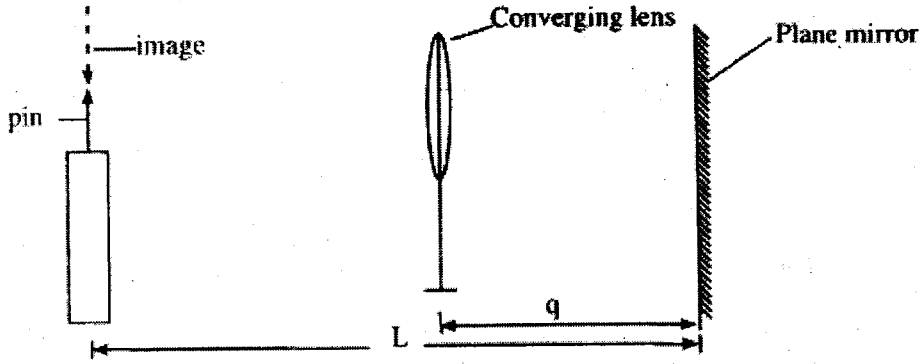


Figure 4

State the focal length of the lens. (1 mark)

10 Figure 5 shows a magnet being moved towards a stationary solenoid. It is observed that a current flows through the circuit in a direction Q to P.

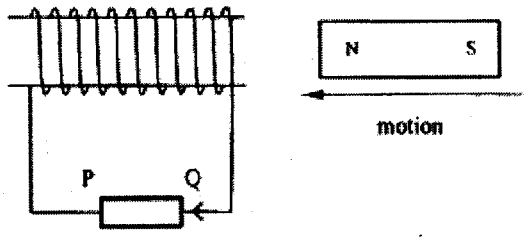


Figure 5

Explain:

(i) how the current is produced; (2 marks)

(ii) why the current flows from Q to P. (1 mark)

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. (3 marks)

12 A boy standing in front 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 echo after 0.6s. Determine the speed of the sound. (3 marks)

13 Figure 6(a) and Figure 6(b) show a p-n junction connected to a battery. It is observed that the current in figure 6(a) is greater than the current in Figure 6(b).

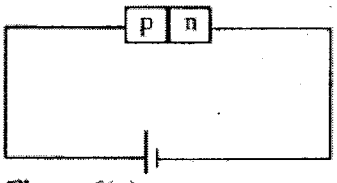


Figure 6(a)

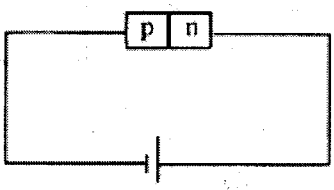


Figure 6(b)

State the reason for this observation. (1 mark)

SECTION B (55 marks)

*Answer **all** the questions in this section in the spaces provided.*

14 (a) Figure 7 shows a pair of parallel plates of a capacitor connected to a battery. The upper plate is displaced slightly to the left.

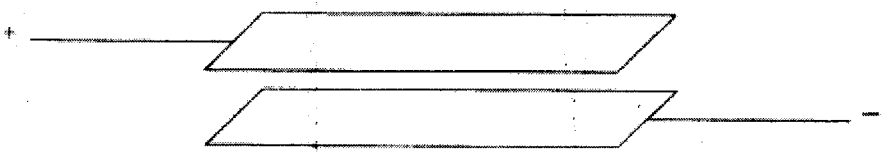


Figure 7

State with reason the effect of this movement on the capacitance. (2 marks)

(b) Figure 8 shows an electrical circuit with three capacitors A, B and C of capacitance 4.0μF, 5.0μF and 3.0μF respectively connected to a 12V battery.

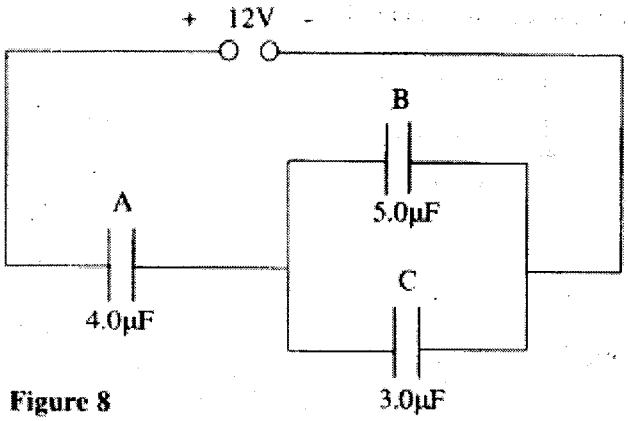


Figure 8

Determine:

(i) the combined capacitance of the three capacitors; (3 marks)

(ii) the charge on the capacitor A; (2 marks)

(iii) the potential difference across the capacitor B. (2 marks)

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 voltages for the lamp X and lamp Y are 2.5V and 3.0V respectively.

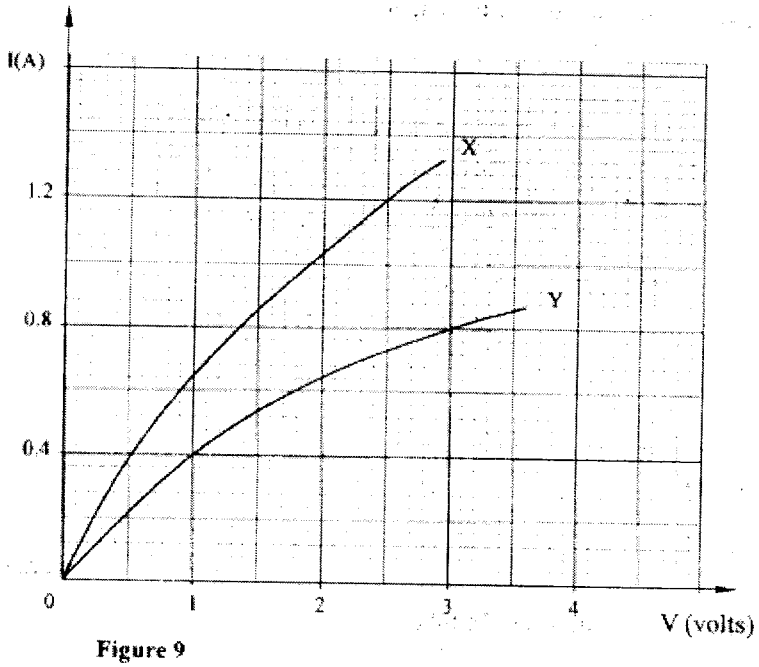


Figure 9

(a) Explain the change in the shape of the curves as the current increases. (2 marks)

(b) Determine the resistance of lamp X at the normal working voltage. (3 marks)

(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. (1 mark)

(d) Determine the power at which lamp Y operates under normal working voltage. (2 marks)

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

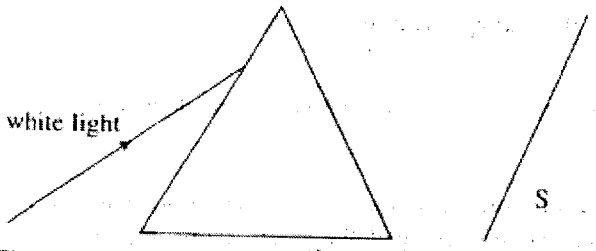


Figure 10

(i) Complete the path of the ray through the prism to show how a spectrum is formed on the screen. (3 marks)

(ii) A thermometer with a blackened bulb is placed at various parts of the spectrum. State with reason the region where the thermometer indicates the highest reading. (2 marks)

(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. **(4 marks)**

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.

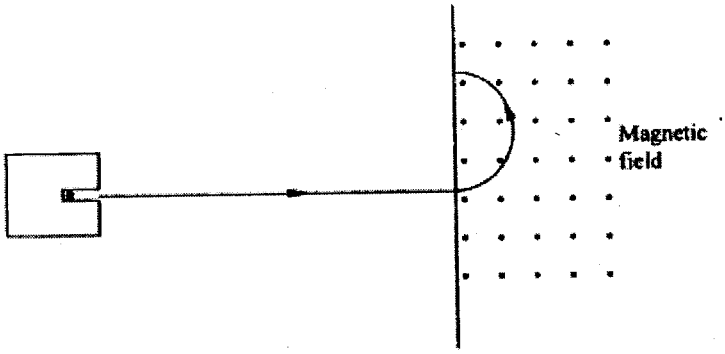


Figure 11

Identify the radiation. **(1 mark)**

(b) Radiation from a radioactive source enters a G.M tube.

(i) State the effect of the radiation on the gas inside the tube. **(1 mark)**

(ii) Explain how the large discharge current is created. **(2 marks)**

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

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

(i) Determine the values of x and y. **(2 marks)**

(ii) State the source of the energy released. **(1 mark)**

(iii) Explain how this reaction is made continuous in a nuclear reactor. **(2 marks)**

18 (a) It is observed that when ultra-violet radiation is directed onto a clean zinc plate connected to the cap of a negatively charged leaf electroscope, the leaf falls.

(i) Explain this observation. **(2 marks)**

(ii) State why this observation does not occur if the electroscope is positively charged. **(1 mark)**

(iii) Explain why the leaf of the electroscope does not fall when infra-red radiation is directed onto the zinc plate. **(1 mark)**

(b) State the effect on the electrons emitted by the photoelectric effect when:

(i) the intensity of incident radiation is increased; (1 mark)

(ii) the frequency of the incident radiation is increased. (1 mark)

(c) The maximum wavelength of light required to cause photoelectric emission on a metal surface is 8.0×10^{-7}m. The metal surface is irradiated with light of frequency 8.5×10^{14} Hz.

Determine:

(i) the threshold frequency; (2 marks)

(ii) the work function of the metal in electron volts; (3 marks)

(iii) the maximum kinetic energy of the electrons. (2 marks)

Take: $1eV = 1.6 \times 10^{-19}$ J.
Speed of light = 3.0×10^{8} ms^{-1}.
Plank's constant, $h = 6.63 \times 10^{-34}$ Js

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.

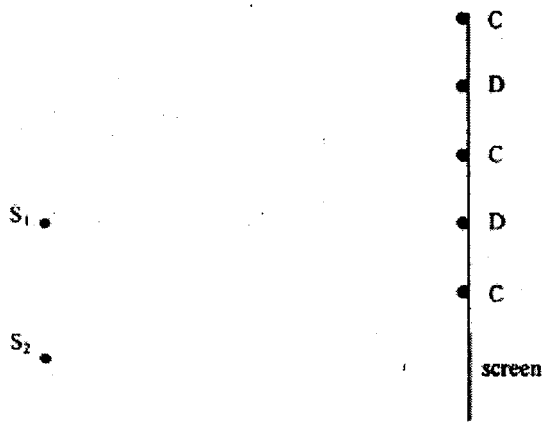


Figure 12

(a) If the observation was made in a ripple tank, describe:

(i) how the two sets of coherent waves were produced; (2 marks)

(ii) how the constructive and destructive interferences are identified. (1 mark)

(b) Explain how the constructive interference C and the destructive interference D patterns are produced. (2 marks)

(c) Draw:

(i) the line joining all points where waves from S_1 and S_2 have travelled equal distance. Label it A. (1 mark)

(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. (1 mark)

29.5.3 Physics Paper 3 (232/3)

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 pendulums, 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 shows the set up.

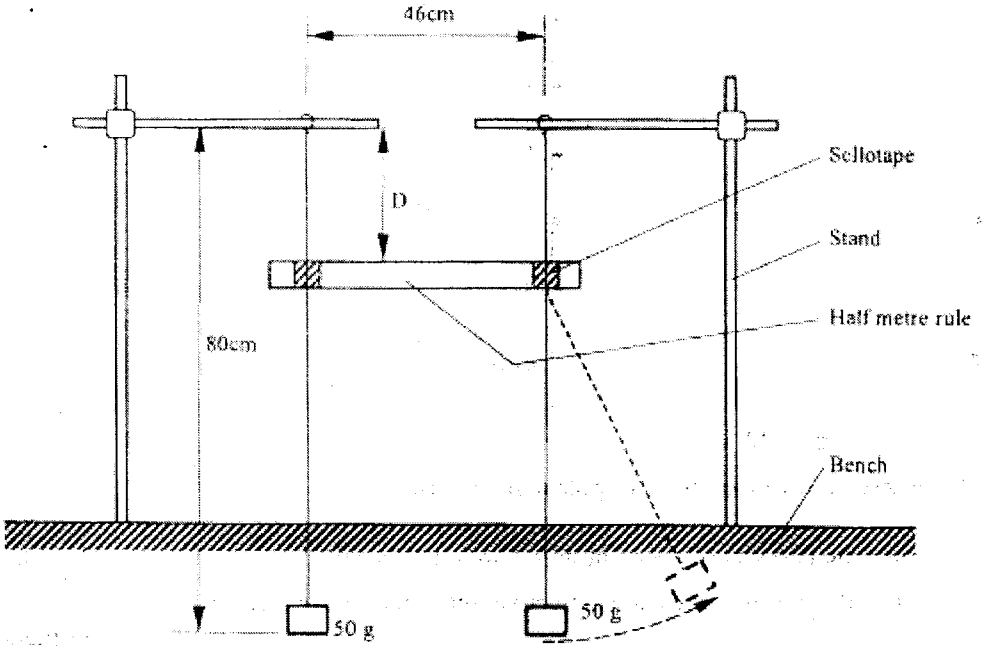


Figure 1

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

(c) Observe the motion of the two masses for about 30 seconds and hence:

(i) describe the pattern of the oscillation of the two masses; **(1 mark)**

(ii) state a reason for this pattern in terms of mechanical energy. **(1 mark)**

(d) Now focus on any **one** of the two pendulums.
Measure and record in table 1 the time T 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.)

(e) 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 down wards 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)							
$f = \frac{1}{T}(s^{-1})$							

(7 marks)

(f) Plot a graph of f (y axis) against D. (5 marks)

(g) Use the graph to determine the frequency f_b , the value of f when D = 38 cm.
f_b = ... (1 mark)

(h) Now set the distance D at 38cm, 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.

n = ... (1 mark)

t = ... (1 mark)

(i) Determine f_o given that, $f_o = \frac{n}{t}$ (1 mark)

(j) Determine f_1 given that $f_b = f_1 - f_o$ (2 marks)

2 You are provided with the following:

- a voltmeter
- an ammeter
- a galvanometer
- two dry cells and a cell holder
- a switch
- eight connecting wires each with a crocodile clip at one end
- a resistance wire labelled **X**
- a resistance wire labelled **AB** mounted on a millimeter scale
- six 10 ohm carbon resistors
- a jockey or crocodile clip

Proceed as follows:

(a) Set up the circuit, with the cells in **parallel** as shown in figure 2.

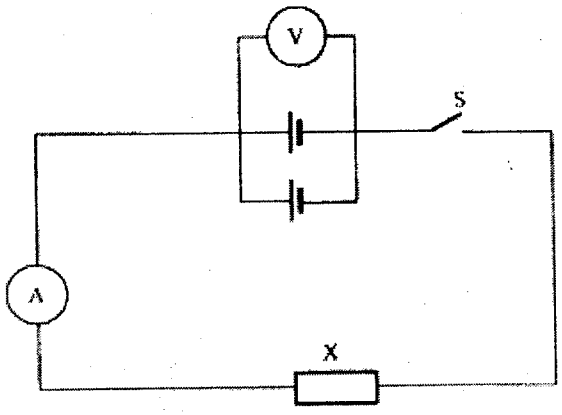


Figure 2

(b) With the switch open, record the reading E of the voltmeter.

E = ... volts. **(1 mark)**

(c) Close the switch. Record the current I flowing in the circuit and the potential difference V across the cells.

I = ... A **(1 mark)**

V = ...volts **(1 mark)**

(d) Given that $E = V + Ir$ and $V = IX$
determine the internal resistance r of the combined cells and the resistance of the wire labelled **X**.

r = ...ohms **(1 mark)**

X = ...ohms **(1 mark)**

(e) Now set up the circuit as shown in figure 3. Z is one of the 10 ohms carbon resistors.

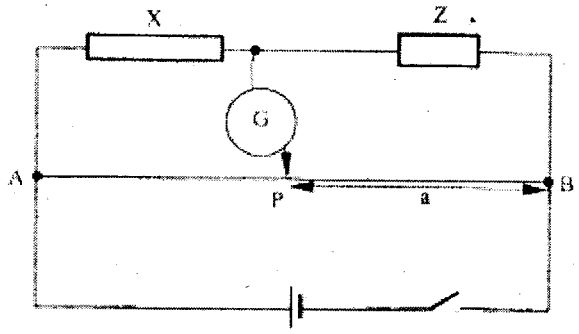


Figure 3

(f) Close the switch. Tap the jockey at various points on the wire AB and locate a point P at which the galvanometer shows zero deflection. Measure and record in table 2 the length a, where $a = PB$.

(g) Repeat the procedure in (f) using **two resistors** in parallel, **three** resistors in parallel, **four** resistors in parallel, **five resistors in parallel and six** resistors in parallel. Record your readings in table 2. Complete the table. R is the effective resistance for the parallel combination.

Table 2

Number of 10Ω carbon resistors	**One**	**Two**	**Three**	**Four**	**Five**	**six**
a (cm)						
$\frac{1}{R}(\Omega^{-1})$						
$\frac{1}{a}(cm^{-1})$						

(6 marks)

(h) Plot a graph of $\frac{1}{a}$ (y-axis) against $\frac{1}{R}$ **(5 marks)**

(i) Determine the slope, m, of the graph. **(2 marks)**

(j) Given that $\frac{1}{a} = \frac{X}{kR} + \frac{1}{k}$, where $k = 100\text{cm}$.

Use the graph to determine X. **(2 marks)**

29.6 CHEMISTRY (233)

29.6.1 Chemistry Paper 1 (233/1)

1 The ionisation energies for three elements A, B and C are shown in the table below:

Element	A	B	C
Ionisation energy (kJ/mole)	519	418	494

(a) What is meant by ionisation energy? **(1 mark)**

(b) Which element is the strongest reducing agent? Give a reason. **(2 marks)**

2 Hardness of water may be removed by either boiling or addition of chemicals.

(a) Write an equation to show how boiling removes hardness of water. **(1 mark)**

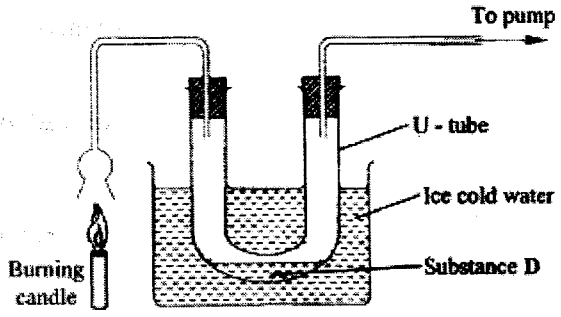
(b) Name **two** chemicals that are used to remove hardness of water. **(2 marks)**

3 The atomic number of sulphur is 16.
Write the electron arrangement of sulphur in the following: **(2 marks)**

(a) H_2S;

(b) SO_3^{2-}.

4 An experiment was set up as shown in the diagram below:



(a) Identify substance **D**. **(1 mark)**

(b) Describe how the other product of the burning candle could be prevented from getting into the environment. **(2 marks)**

5 In terms of structure and bonding, explain why the melting point of oxygen is much lower than that of sodium. **(3 marks)**

6 An isotope of element E has 34 neutrons and its mass number is 64. E forms a cation with 28 electrons. Write the formula of the cation indicating the mass and atomic numbers. **(1 mark)**

7 When aluminium oxide was electrolysed, 1800 kg of aluminium metal were obtained.

(a) Write an equation for the formation of aluminium metal. **(1 mark)**

(b) Calculate the quantity of electricity in faradays used. (Al = 27). (2 marks)

8 Using dots (.) and crosses (X), show bonding in:

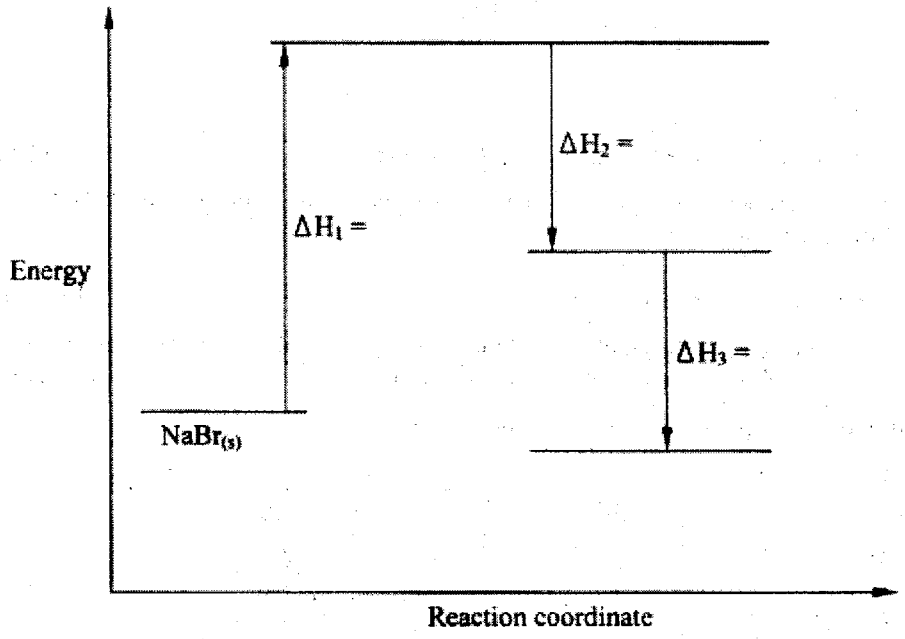
(a) the compound formed when nitrogen reacts with flourine
(Atomic numbers F = 9, N = 7); (1 mark)

(b) sodium oxide.
(Atomic numbers Na = 11, 0 = 8). (1 mark)

9 (a) What is meant by molar heat of solution? (1mark)

(b) The lattice energy of sodium bromide and hydration energies of sodium and bromide ions are: 733,406 and 335 kJmol^{-1} respectively.

(i) Complete the energy cycle diagram below by inserting the values of ΔH_1, ΔH_2 and ΔH_3 (1½ marks)



(ii) Determine the molar heat of solution of solid sodium bromide. (½ mark)

10 Hydrogen and oxygen can be obtained by electrolysis of acidified water.
Using equations for the reactions at the electrodes, explain why the volume of hydrogen obtained is twice that of oxygen. (2 marks)

11 Starting with 50 cm^3 of 2.8 M sodium hydroxide, describe how a sample of pure sodium sulphate crystals can be prepared. (3 marks)

12 The standard reduction potentials of two half-cells are:

$Ag^+_{(aq)} + e \longrightarrow Ag_{(s)}; E^{\ominus} = 0.80V$

$2H_2O_{(l)} + 2e \longrightarrow H_{2(g)} + 2OH^-_{(aq)}; E^{\ominus} = 0.83V$

Draw a labelled diagram of an electrochemical cell that can be constructed using the two half-cells. (3 marks)

13 When 8.53 g of sodium nitrate were heated in an open test-tube, the mass of oxygen gas produced was 0.83 g. Given the equation of the reaction as

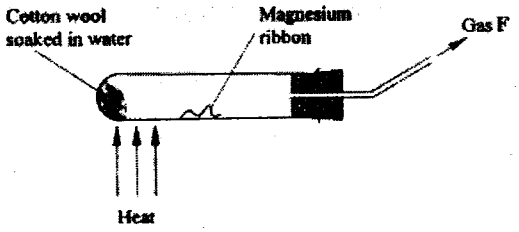
$$2NaNO_{3(s)} \longrightarrow 2NaNO_{2(s)} + O_{2(g)}$$

Calculate the percentage of sodium nitrate that was converted to sodium nitrite (Na = 23.0, N = 14.0, O = 16.0). (3 marks)

14 (a) Draw and name the structure of the compound formed when one mole of ethyne reacts with one mole of hydrogen bromide. (2 marks)

(b) Draw the structures of the alkynes whose molecular formula is C_4H_6. (1 mark)

15 A student used the set up shown in the diagram below in order to study the reactions of some metals with steam. The experiment was carried out for ten minutes.



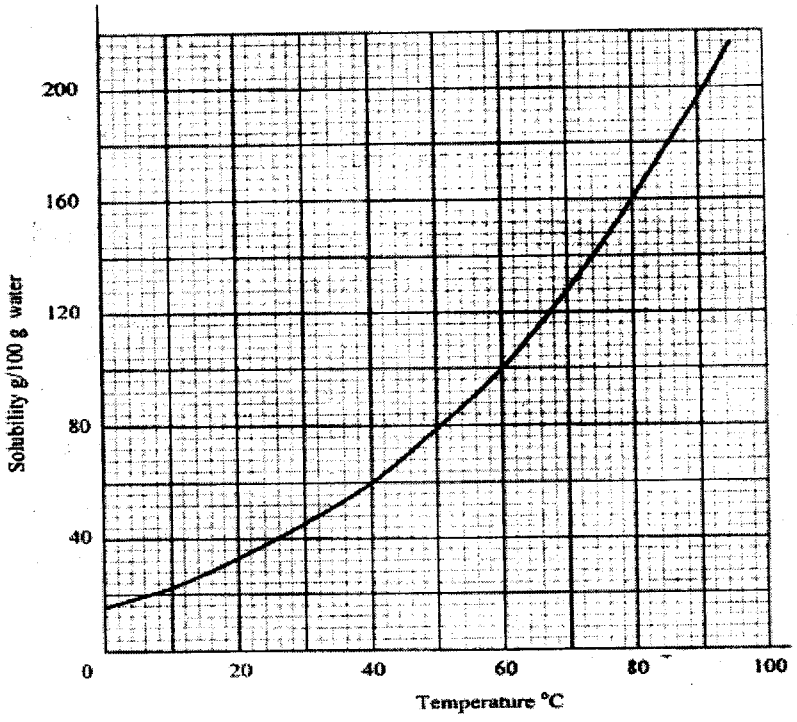
(a) What observation would be made if gas F is ignited? (1 mark)

(b) When the experiment was repeated using iron powder instead of magnesium ribbon, very little gas F was obtained.

(i) Give a reason for this observation. (1 mark)

(ii) What change in the conditions of the experiment should the student have made in order to increase the volume of gas F produced? (1 mark)

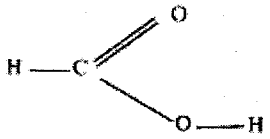
16 The solubility curve of potassium nitrate is shown below.



(a) Determine the solubility of potassium nitrate at 50°C. (1 mark)

(b) Determine the molar concentration of saturated potassium nitrate at 50°C.
(K = 39.0 0 = 16.0 N=14.0 and density of water 1 g/cm³). (2 marks)

17 The structure of methanoic acid is



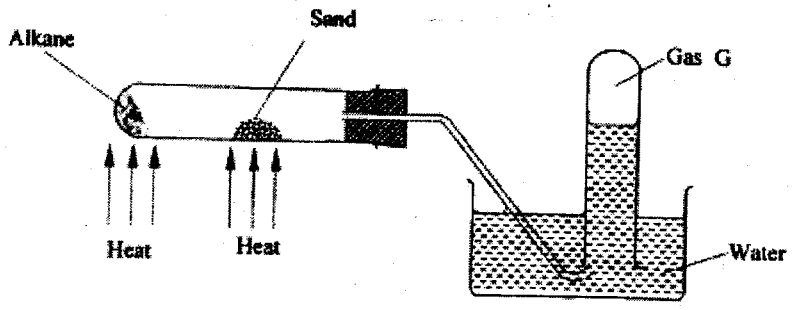
What is the total number of electrons used for bonding in a molecule of methanoic acid? Give reasons. (2 marks)

18 Bottles of sodium carbonate, sodium chloride and sugar have lost their labels. A student prepares and tests an aqueous solution of a sample from each bottle. The results obtained are as shown in the table below.

Bottle	pH	Electrical Conductivity	Correct label
1	7	Conducts	
2	7	Does not conduct	
3	10	Conducts	

Complete the table by filling the correct label for each bottle. (3 marks)

19 The figure below represents the set up that was used to crack an alkane.



(a) What was the purpose of the sand? (1 mark)

(b) After some time, a colourless gas G was collected in the test-tube.
Describe a chemical test and the observations that would be made in order to identify the class of compounds to which gas G belongs. (2 marks)

20 Classify the following processes as either chemical or physical. (3 marks)

Process	Type of change
(a) Heating copper (II) sulphate crystals	
(b Obtaining kerosene from crude oil	
(c) Souring of milk	

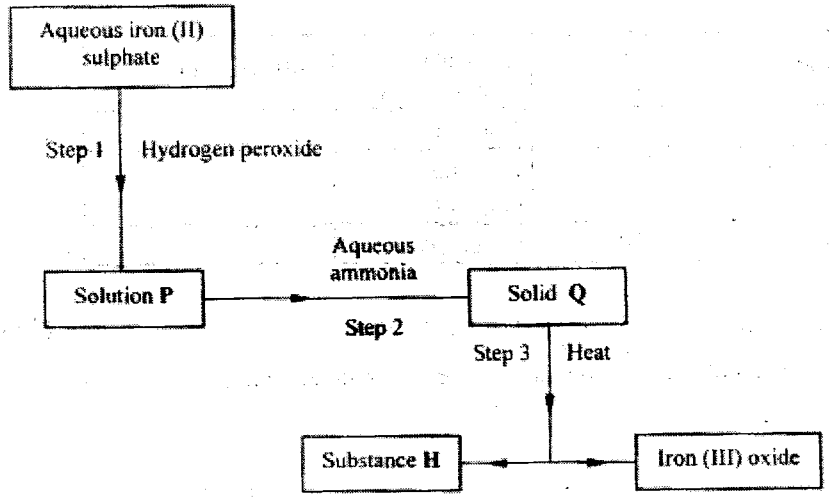
21 Give the name of the product formed when magnesium reacts with phosphorus. (1 mark)

22 A student added very dilute sulphuric (VI) acid to four substances and recorded the observations shown in the table below.

Test	Substance	Gas given off
1	Sodium	Yes
2	Iron	No
3	Carbon	Yes
4	Copper	No

For which tests are the observations wrong? Explain (3 marks)

23 Use the flow chart below to answer the questions that follow.



(a) What observation would be made in step 1? (1 mark)

(b) Name another substance that could be used in step 2. (1 mark)

(c) Give the name of substance H. (1 mark)

24 The boiling points of some compounds of hydrogen with some elements in groups 4 and 6 of the periodic table are given below.

Compound	Boiling point (°C)	Compound	Boiling point (°C)
CH_4	-164.0	H_2O	100.0
SiH_4	-112.0	H_2S	-61.0

(a) Which of the compounds CH_4 and SiH_4 has the stronger intermolecular forces? Give a reason. (1 mark)

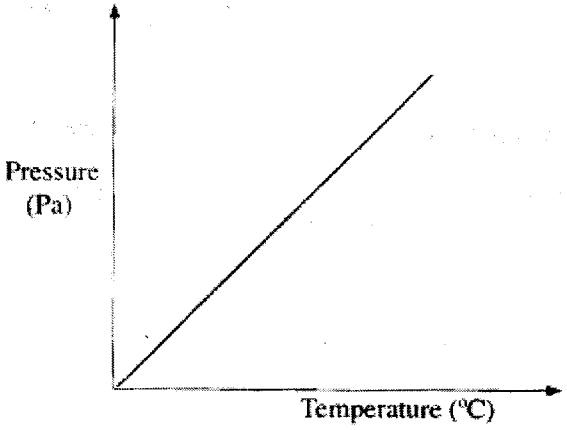
(b) Explain why the boiling points of H_2O and H_2S show different trends from that of CH_4 and SiH_4. (2 marks)

25 For each of the following reactions, state the observation and write the formula of the compound responsible for the observation:

(a) bromine water is added to aqueous potassium iodide; (1½ marks)

(b) excess aqueous ammonia is added to copper (II) hydroxide (precipitate). (1½ marks)

26 The graph below shows the relationship between pressure and the temperature of a gas in a fixed volume container.



(a) State the relationship between pressure and temperature that can be deduced from the graph. (1 mark)

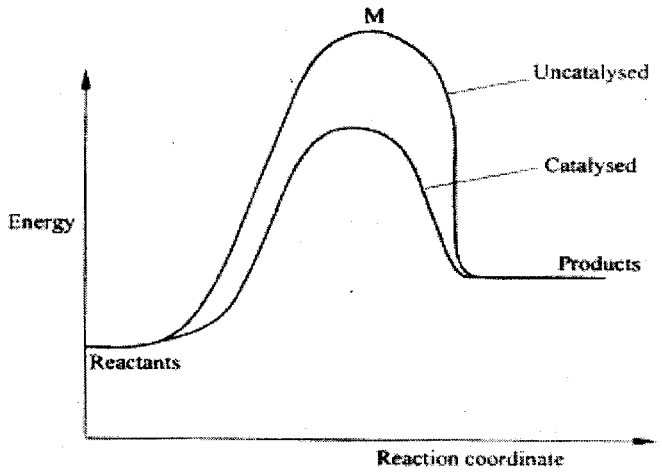
(b) Using kinetic theory, explain the relationship shown in the graph. (2 marks)

27 The following reaction is in equilibrium in a closed container.

$$C_{(s)} + H_2O_{(g)} \rightleftharpoons CO_{(g)} + H_{2(g)}$$

State giving reasons how an increase in pressure would affect the amount of hydrogen. (2 marks)

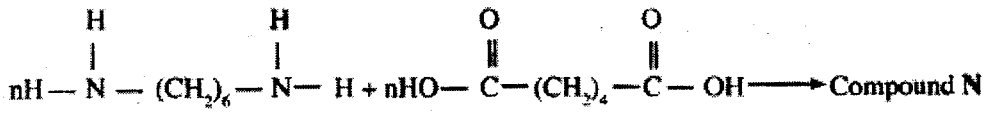
28 The energy level diagram below shows the effect of a catalyst on the reaction path.



(a) What does point **M** represent? (1 mark)

(b) With reference to the energy level diagram, explain how a catalyst increases the rate of a reaction. (2 marks)

29 (a) Draw the structure of compound N formed in the following reaction. (1 mark)



$$nH-\overset{H}{\overset{|}{N}}-(CH_2)_6-\overset{H}{\overset{|}{N}}-H + nHO-\overset{O}{\overset{\|}{C}}-(CH_2)_4-\overset{O}{\overset{\|}{C}}-OH \longrightarrow \text{Compound N} + 2nH_2O.$$

(b) Give **one** use of compound N. (1 mark)

30 Starting with red roses, describe how:

(a) a solution containing the red pigment may be prepared; (1 mark)

(b) the solution can be shown to be an indicator. (2 marks)

30.5 PHYSICS (232)

30.5.1 Physics Paper 1 (232/1)

1. Volume run out = $46.6cm^3$;

$$\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{54.5g}{46.6cm^3}; = 1.17gcm^{-3}; / 1.16952$$

(3 marks)

2. $T^2 = 4\pi^2 L/g$

$$1.7^2 s^2 = \frac{4\pi^2 \times 0.705m}{g};$$

$g = 9.63\ ms^2$

$= 9.6\ ms^2$; (correct no. of sig. fig.)

(2 marks)

3. Needle floats due to surface tension forces;
Detergent reduces surface tension; so that needle sinks. *(2 marks)*

4. When equal forces are applied, pressure on B is greater than on A due to smaller area;
Pressure difference is transmitted through liquid to A causing rise in the upward force on A is greater than that on B; hence upwards motion; *(2 marks)*

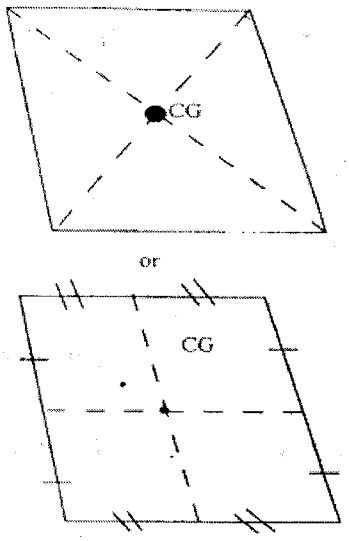
5. Molecules inside the warm water move faster than in cold water; this increases rate of diffusion; *(2 marks)*

6. Stops return of mercury to bulb when the thermometer is removed from particular body to the surroundings; *(1 marks)*

7. Dull surfaces radiate faster than bright surfaces;
P looses most of the heat supplied by burner than Q does; *(2 marks)*

8. Heat travels from container to test-tube by radiation; so the dull surface P give more heat to the test-tube; *(2 marks)*

9.



CG locted at intersection of diagonals; ***(1 mark)***

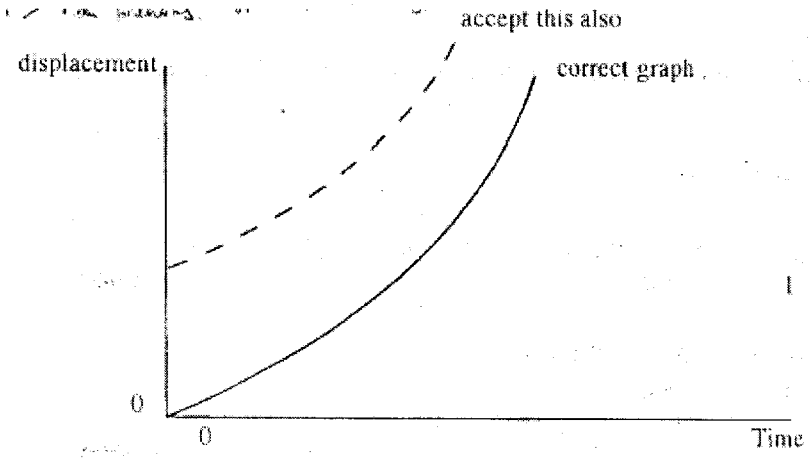
or at intersection of lines joining centres of sides;

10. Extension of each spring = 10cm;

$k = \frac{20N}{10cm} = 2N/cm;$ ***(2 marks)***

11. Air between the balloons is faster than outside. So that there is pressure reduction between; ***(1 marks)***

12.



13. Lowest temperature possible;
or temperature at which ideal gas has zero volume (or zero pressure)
or molecules have zero/minimum energy
(any one for 1 mark) ***(1 mark)***

14. $V = r\omega$
$= r \times 2\pi f$

$= 0.08 \times 2\pi \times 33\ ms^{-1};$
$= 16.6\ ms^{-1};$ ***(3 marks)***

15. (a) Pressure, dissolved impurities ***(2 marks)***

(b) (i) BP $= 79^0C$ ***(1 mark)***

(ii) I $\Delta t = 4.5$ minute
$Q = Pt = 50 \times 4.5 \times 60$ J;
$= 13500$ J; *(2 marks)*

II $\Delta = 70 - 16 = 54^0C$ *(1 mark)*

III $\Delta t = (7.3 - 6.8)$ minutes $= 30s$;
$Q = Pt = 30 \times 50$ J;
$Q = ml$;
$L = \frac{30 \times 50\ J}{0.0018kg}$;
$= 8.33 \times 10^5 Jkg^{-1}$ *(2 marks)*

16. (a) Efficiency $= \frac{\text{work output}}{\text{work input}} \times 100$ (or equivalent); *(1 mark)*

(b) (i) Work done by effort = F x s;
= 420 N x 5.2m;
= 2184 J; *(3 marks)*

(ii) Distance raised = $5.2 \sin 25^o = 2.2$m
= 900N x 2.2m;
= 1980J; *(3 marks)*

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

17. (a) A floating body displaces its own weight of the fluid on which it floats; *(1 mark)*

(b) (i) $W = T + U$ *(1 marks)*
(ii) Volume $= 0.3 \times 0.2 \times 0.2 m^3$
Mass $= v \times \rho$;
Weight $= mg = 0.3 \times 0.2 \times 0.2\ m^3 \times 10500 kgm^{-3} \times 10N/kg$
$= 1260N$ *(3 mark)*

(iii) Volume of liquid = volume of block
Weight of liquid displaced $= V\ \rho\ g$
= 0.3 x 0.2 x 0.2 x 1200 x 10N;
= 144N; *(2 mark)*

(iv) $T = W - U$
$= (1260 - 144)N$
$= 1116N$; *(1 mark)*

(c) Weight of solid = weight of kerosene displaced;
$= 800 \times 10 \times 10^{-6}$
$= 0.08N$
Mass = 0.08 kg;
Volume $= 50cm^2$
Density $= \frac{m}{v}$; $= \frac{0.008kg}{50 \times 10^{-6} m^3}$
$= 160 kgm^{-3}$ *(4 marks)*

18. (a) the pressure of a fixed mass of an ideal gas is directly proportional to the absolute temperature if the volume is kept constant; *(1 mark)*

(b) (i) volume increases as bubble rises because the pressure due to liquid column is lowered therefore pressure inside bubble exceeds that of outside thus expansion. *(1 mark)*

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

Corresponding pressure = 1.88×10^5 Pa; *(2 mark)*

II at top $\frac{1}{v} = \frac{1}{1.15\text{cm}^3} = 0.87\,\text{cm}^3$ *(2 mark)*

Corresponding pressure = 0.8×10^5 Pa; *(1 mark)*

(iii) $\Delta P = (1.88 - 0.8) \times 10^5\,\text{Pa} = 1.08 \times 10^5\,\text{Pa}$;

$\Delta P = \rho gh = \rho \times 0.80 \times 10$

$\rho = \frac{1.08 \times 10^5}{0.80 \times 10} Kgm^{-3}$

$= 13500\,\text{Kgm}^{-3}$; *(3 marks)*

(iv) Pressure at top equal atmospheric
$= 0.8 \times 10^5$Pa; *(1 mark)*

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

$25^\circ\text{C} = 298\text{K}$
$15^\circ\text{C} = 288\text{K}$

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

$V_2 = 3966\text{cm}^3$; *(4 marks)*

19. (a) Rate of change of angular speed with time; *(1 mark)*

(b) (i) mass, force of friction : *(2 marks)*

(iii) oil will reduce friction;
since friction provides centripetal force, the frequency for sliding off is lowered; *(2 marks)*

(c) $v_2 = u^2 + 2as$

$v_2 = 0 + 2\,(0.28)h$

$v = \sqrt{0.56 \times 1.26}$;

$v = r\omega$ ***(4 marks)***

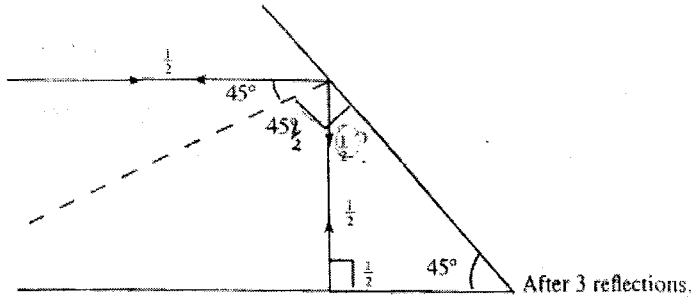
$0.84 = 0.14 \times \omega$

$\omega = \dfrac{0.84}{0.14} = 6 \text{ rads}^{-1}$;

30.5.2 Physics Paper 2 (232/2)

1. Infinite or very many. ***(1 mark)***

2.



(2 marks)

3. Negative charge. ***(1 mark)***

4. To allow for passing – release hydrogen and oxygen produced at the electrodes. ***(1 mark)***

5. Increase magnitude of current/ No. of turns WITE
Increase the number of turns per unit length. ***(1 mark)***

6. T = 0.5 ***(1 mark)***

$f = \dfrac{1}{T} = \dfrac{1}{0.5} = 2Hz$ *(2 marks)*

7. $\dfrac{3.0 \times 10^8}{v} = 1.33$ ***(1 mark)***

$\therefore v = \dfrac{3.0 \times 108}{1.33} \text{ ms}^{-1}$

$2.26 \times 10^8 \text{ ms}^{-1}$ ***(2 marks)***

8. Current = 1A ***(1 mark)***

9. f=L-q cm ***(1 mark)***

10. (i) Magnetic field lines of the magnet links the coil. *(1 mark)*

Movement of magnet causes flux linkage to change. *(1 mark)*

(ii) When current flows from Q to P a north pole is created which opposes the approaching north pole (Lenz's law). *(1 mark)*

11. Increase in pd increases current in the filament:
This produces more electrons by thermionic emission;
and hence result on more intense x-rays: *(3 marks)*

12. $\frac{2d}{0.5} = \frac{2d+34}{0.6}$ or $v = \frac{2\times17}{0.1}$ *(2 marks)*

$= 340$

$0.5(2d+34) = 2dx0.6$

$1.0d + 17 = 1.2d$

$0.2d = 17$

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

$\therefore Speed = \frac{2\times85}{0.5} m/s = 340m/s$

(1 mark)

13. This is because the diode in figure 6(a) is forwarded biased. *(1 mark)*

Or
The battery in 6(a) enhances flow of electrons across the barrier while in 6(b) the barrier potential is increased.

14. (a) Capacitance decreases; *(1 mark)*
Because the area of overlap decreases; *(1 mark)*

(b) (i) for parallel arrangement
$Cp = 5 + 3 = 8\,\mu F$ *(1 mark)*
Hence for whole circuit
$\frac{1}{C} = \frac{1}{4} + \frac{1}{8} = \frac{12}{32}$ *(1 mark)*
$\therefore C = \frac{32}{12} = \frac{8}{3}\mu F = 2.67\mu F$ *(1 mark)*

(ii) $Q = CV = \frac{8}{3}\times12\mu C;$
$= 32\,\mu C$ *(2 marks)*

(iii) If p.d. across A is V_1, then
$V_1 = \frac{Q}{C} = \frac{32\times10^{-6}}{4\times10^{-6}} = 8$ volts *(1 mark)*

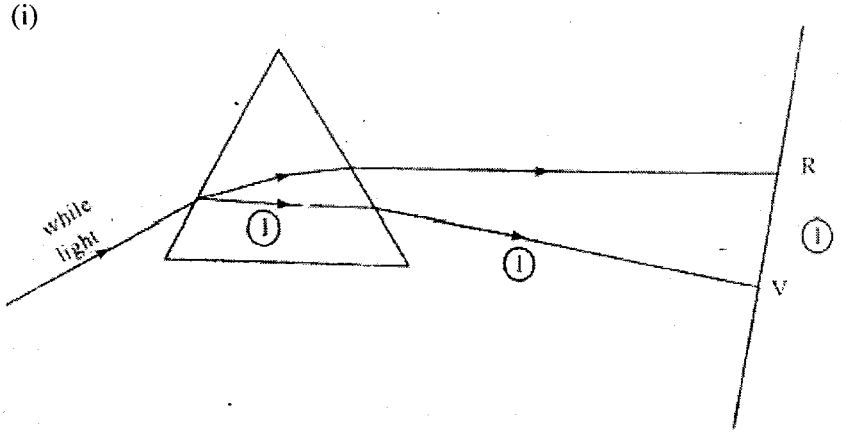
15. (a) Increase of current causes rise in temperature;
Rise in temperature causes rise in resistance; *(2 marks)*

(b) lamp X resistance = $\frac{V}{I} = \frac{2.5}{1.2}\Omega$ *(2 marks)*
$= 2.1\Omega$ *(1 mark)*

(c) p.d. across Y = 1.0V *(1 mark)*
(directly read from the graph)

(d) Power on
Lamp Y = 1V = 0.8 x 3 watts
= 2.4 watts *(2 marks)*

16. (a) (i)



(3 marks)

(ii) highest reading near the red end;
red light has more heat than violet; *(2 marks)*

(b) Apparent depth = (11.5 – 3.5) cm
= 8cm *(1 mark)*

Refractive index = $\frac{\text{Real depth}}{\text{Apparent depth}}$ *(1 mark)*

= $\frac{11.5}{8} = 1.4375$ *(2 marks)*

17. (a) β - particle *(1 mark)*

(b) (i) Ionises the gas *(1 mark)*
(ii) ions are attracted towards electrodes; and collision with other molecules cause avalance of ions which on attraction to the electrons causes the discharge; *(1 mark)*

(c) (i) x = 36, y = 92 *(2 marks)*
(ii) Energy comes from a small decrease in mass. *(1 mark)*
(iii) Each of the neutrons produced at each collision causes further collision; with uranium atom causing chain reaction. *(2 marks)*

18. (a) (i) Electrons are emitted from zinc plate; thus reducing the charge on the leaf. ***(2 marks)***

(ii) Any electron that would have been emitted is attracted back to the electroscope. ***(1 mark)***

(iii) Photon of infrared radiation having lower frequency than ultra-violet has insufficient energy to cause electrons to be emitted. ***(1 mark)***

(b) (i) The number of electrons emitted per unit time will increase. ***(1 mark)***

(ii) The maximum Kinetic energy of the emitted electrons will increase. ***(1 mark)***

(c) (i) $v = f_0 \lambda_0$

$$\therefore fo = \frac{V}{\lambda_0} = \frac{3.0\times10^{8}}{8.0\times10^{-7}} \text{ Hz}$$

$$= 3.75 \times 10^{14} \text{ Hz}$$ ***(2 marks)***

(ii) $W = hf_o$

$$= 6.63\times10^{-34} \times 3.75\times10^{14} \text{ J} = 2.49\times10^{-19} \text{ J}$$

$$= \frac{2.49\times10^{-19}}{1.6\times10^{-19}} \text{ ev}$$

$$= 1.55 \text{ ev}$$ ***(1 mark)***

(iii) Maximum Kimetric Energy = $hf - hf_o$

$= h(8.5 - 3.75) \times 10^{14}$ J

$= 6.63 \times 10^{-34} \times 4.75 \times 10^{14}$ J

$= 3.149 \times 10^{-19}$ J ***(1 mark)***

19. (a) (i) Attach the two identical dippers to same vibrator, switch on and the circular waves produced are coherent. ***(2 marks)***

Or Use one straight vibrator with two slits to produce coherent waves.

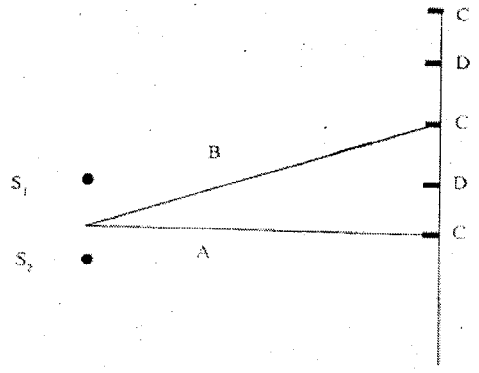
(ii) Constructive interference – bright

Destructive interference – dark ***(1 mark)***

(b) Constructive interference – when two waves arrive at a point in phase i.e. Crest and crest meet or trough and trough meet.

Destructive interference – occurs when crest and trough meet gives zero intensity. ***(1 mark)***

(c)



30.5.3 Physics Paper 3 (232/3)

1. (c) (i) amplitudes of the two pendulums increase from zero to maximum and then decrease to zero alternately. *(1 mark)*

(ii) alternate interchange/transfer of energy from one pendulum to the other. *(1 mark)*

(e)

D (cm)	20	25	30	35	40	45	50
T (s)	12.8	10.2	7.7	5.6	4.4	3.4	2.8
$f = \frac{1}{T}$ (s^{-1})	0.08	0.10	0.13	0.18	0.23	0.30	0.36

Table 1 7 marks

(f) see graph
axes labeled + units *(1 mark)*
scale *(1 mark)*
points plotted *(2 marks)*
smooth curve *(1 mark)*

(g) $f_b = 0.21s^{-1}$ *(1 mark)*

(h) n = 3 *(1 mark)*
t = 4.7s *(1 mark)*

(i) $f_o = \frac{3}{4.7} = 0.64\ s^{-1}$ *(1 mark)*

(j) $f_b = f_1 - f_o$
$0.21 = f_1 - 0.64s^{-1}$ *(1 mark)*
$f_o = 0.85s^{-1}$ *(1 mark)*

2. (b) E = 1.55 ± 0.05V *(1 mark)*

(c) I = 0.35A *(1 mark)*
V = 1.45 ± 0.05V *(1 mark)*

(d) $X = \frac{1.45}{0.35} = 4.1\Omega$ *(1 mark)*
$r = \frac{0.1}{0.35} = 0.29\Omega$ *(1 mark)*

(g)

Number of carbon resistors	One	Two	Three	Four	Five	Six
PB = a (cm)	70.1	56.0	44.2	39.0	33.0	29.1
$\frac{1}{R}$ (Ω^{-1})	0.1	0.2	0.3	0.4	0.5	0.6
a^{-1} (cm^{-1})	1.43	1.79	2.26	2.56	3.03	3.43

Table 2 *(6 marks)*

(h) Graph
Axes labeled + units *(1 mark)*
Scale *(1 mark)*

Points correctly plotted *(2 marks)*
Straight line through points *(1 mark)*

(i) Slope – correct extraction *(1 mark)*
Evaluation
Slope $\approx 4.0 \times 10^{-2}\ \Omega\ cm^{-1}$ *(1 mark)*

(j) $m = \frac{X}{100\ cm} = 4.0 \times 10^{-2}\ \Omega\ cm^{-1}$ *(1 mark)*

$X = 4.0 \pm 0.1\Omega$ *(1 mark)*