3.4 PHYSICS (232)

The revised KCSE physics syllabus was tested for the Eighth time in 2013. It was tested in two theory papers (232/1 and 232/2) and one practical paper (232/3).

3.4.1 GENERAL CANDIDATES PERFORMANCE

The candidate's performance statistics in the KCSE physics examination for the last five years are as shown in the table below.

Table 11: candidates overall performance in the years 2009 to 2013

Year	Paper	Candidature	Maximum score	Mean score	Standard Deviation
2009	1		80	26.72	16.17
	2		80	20.77	14.23
	3		40	15.22	06.29
	overall	**104,883**	**200**	**62.62**	**34.02**
2010	1		80	26.11	16.95
	2		80	21.82	13.82
	3		40	22.37	07.81
	overall	**109,811**	**200**	**70.22**	**35.73**
2011	1		80	21.64	14.49
	2		80	29.43	16.41
	3		40	22.24	8.84
	overall	**120,074**	**200**	**73.28**	**36.72**
2012	1		80	26.46	13.72
	2		80	31.91	17.00
	3		40	17.40	6.88
	overall	**119,654**	**200**	**75.72**	**34.58**
2013	1		80	36.03	19.66
	2		80	21.34	14.37
	3		40	22.85	7.98
	overall	**119,819**	**200**	**80.20**	**38.07**

From the table it can be observed that:

(i) The candidature increased to 119,819 in 2013 from 119, 654 in 2012. This was an increase of 165 candidates (0.14 %); this is quite low compared to the overall increase in candidature.

(ii) There was improvement in the performance of papers 1 and 3. Paper 1 improved from a mean of 26.46 in the year 2012 to 36.03 in the year 2013 while Paper 3 improved from a mean of 17.40 in the year 2012 to 22.85 in the year 2013.

(iii) Paper 2 (232/2) recorded a decline in performance in the year 2013, from a mean of 31.91 in 2012 to 21.34 in 2013.

(iv) There overall performance of physics improved from a mean of 75.72 in 2012 to 80.20 in 2013.

The following is a discussion of the questions in which candidates performed poorly.

3.4.2 Physics Paper 1 (232/1)

Question 3

Figure 2 shows some air trapped by mercury in a glass tube. The tube is inverted in a dish containing mercury.

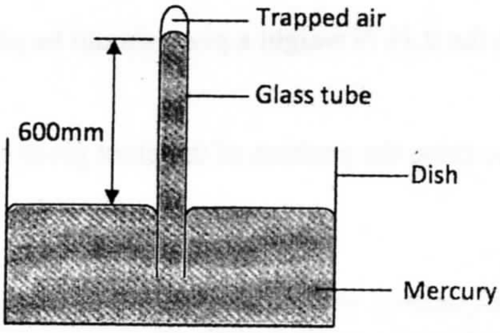


Figure 2

Given that the atmospheric pressure is 760 mmHg and the height of mercury column in the tube is 600 mm, determine the pressure of the air trapped in the tube in mmHg. (3 marks)

Candidates were required to determine the pressure of air trapped by a mercury column in mmHg.

Weakness
Most students were not able to show the relationship between the atmospheric pressure from the pressure due to the mercury column and the pressure due to the gas.

Expected response

$P_{atmosphere} = P_{mercury} + P_{air\ enclosed}$;

$P_{air} = 760 - 600$;
$= 160$ mm Hg;

Question 8

Figure 4 shows a uniform metre rule of weight I N with two weights of 0.18 N and 0.12 N suspended from its ends.

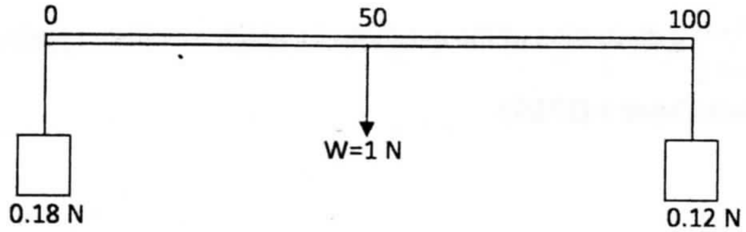


Figure 4

Determine how far from the 0.18 N weight a pivot should be placed in order to balance the meter rule. (3 marks)

Candidates were required to determine the position of the pivot given the various weights that are applied.

Weakness

Most candidates worked out the question without considering the weight of the meter rule which was acting at the 50 cm mark, hence obtaining a value of 40 cm.

Expected response

Clockwise moments = anticlockwise moments;

$$0.18x = 1(50 - x) + 0.12(100 - x)$$
$$0.18x = 50 - x + 12 - 12x$$
$$0.18x = 62 - 1.12x$$
$$7.30x = 62$$
$$x = 47.69 \text{ cm};$$

Question 14 b (i)

Figure 7 shows an object at the end of a light spring balance connected to a peg using a string. The object is moving in a circular path on a smooth horizontal table with a constant speed.

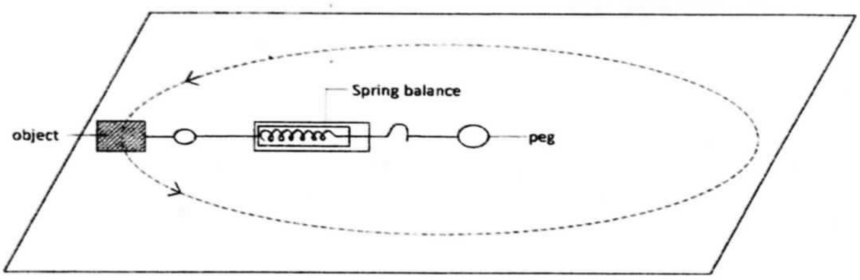


Figure 7

(i) State what provides the centripetal force. (1 mark)

Candidates were required to state the source of the centripetal force for an object undergoing circulation motion.

Weakness

Some students were not aware of the fact that the tension in the spring was the source of the centripetal force.

Expected response

(i) Tension in the string;

Question 16 b (i)

Figure 9 shows a graph of velocity against time for a ball bearing released at the surface of viscous liquid.

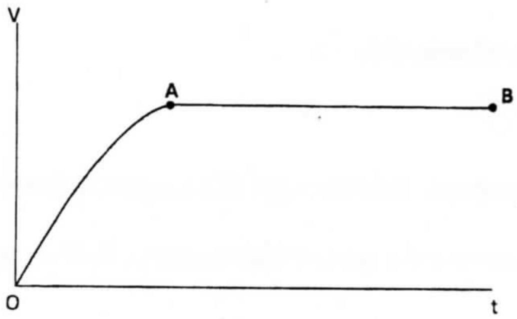


Figure 9

Explain the motion of the ball bearing for parts

(i) OA (2 marks)

Candidates were required to explain the motion of a ball bearing just before attaining terminal velocity.

Weakness

Though students had knowledge of the forces in play, they were unable explain reducing acceleration experienced by a ball bearing before attaining terminal velocity, due to the viscous drag increasing to a maximum.

Expected response

(i) OA - the ball bearing decelerates; as the upthrust increases to a maximum;

3.4.3 Physics Paper 2 (232/2)

Question 1

State the reason why when a ray of light strikes a mirror at 90^0, the reflected ray travels along the same path as the incident ray. (1 mark)

Candidates were required to state the reason why a ray of light that strikes a mirror at 90^0 travels along the same path after reflection.

Weakness
Many students were unable to state the fact that if the ray strikes the mirror at 90^0 then the angle of incidence is zero and hence the angle of reflection is also zero.

Expected response

angle of incidence = angle of reflection = 0

Question 3

State the reason why the magnetic field strength of a magnet is greatest at the poles. (1 mark)

Candidates were required to state the reason why magnetic field strength is greatest at the poles.

Weakness
All the students gave their response in terms of the concentration of the field lines at the poles without mentioning the fact that the poles of the internal dipoles cancel out within the magnet.

Expected response

Within the magnet, N and S poles of the dipoles cancel out but at the end of the poles they don't.

Question10

Figure 5 shows a narrow beam of x-rays passing between two metal plates in air. The plates are connected in series with a switch, a cell and a milliameter.

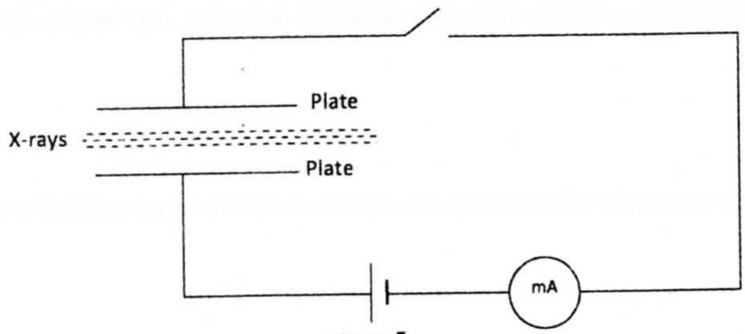


Figure 5

It is observed that when the switch is closed a current flows in the milliameter. Explain this observation. (2 marks)

Candidates were required to explain the course of current where there is no connection but passing x rays.

Weakness
Candidates were unable to give reasons based on ionizing effects of x rays. Those who did were not able to complete the explanation by stating the ions that move to the upper or lower plates.

Expected response

X rays ionise air molecules between plates
Ions move to plates of opposite sign

Question18

(a) **Figure 11** shows plane light waves in air incident on a convex lens whose principal focus is **F**, the waves move past point **G**.

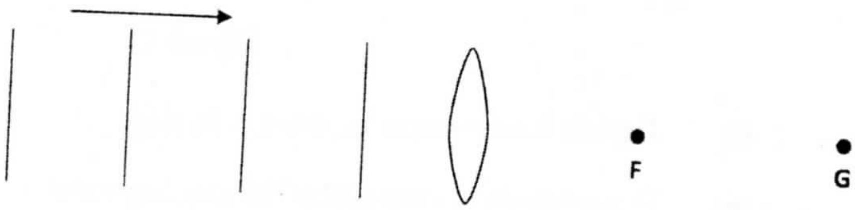


Figure 11

Complete the diagram to show the pattern of the emergent waves between the lens and point **G**. (2 marks)

(b) **Figure 12** shows crests of circular water waves spreading from two points **A** and **B** due to a vibrator. **C** and **D** are points on the surface of the water.

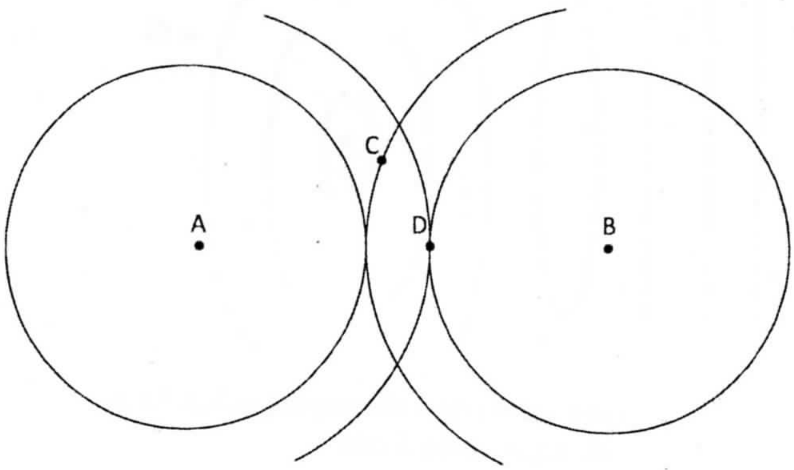


Figure 12

Given that the amplitude of each wave is 5 cm, state with a reason the amplitudes of the waves at point:

(i) **C**; (2 marks)

(ii) **D**. (2 marks)

(c) **Figure 13** shows a standing wave formed when a string of length 1.5 m stretched between two supports is plucked in the middle.

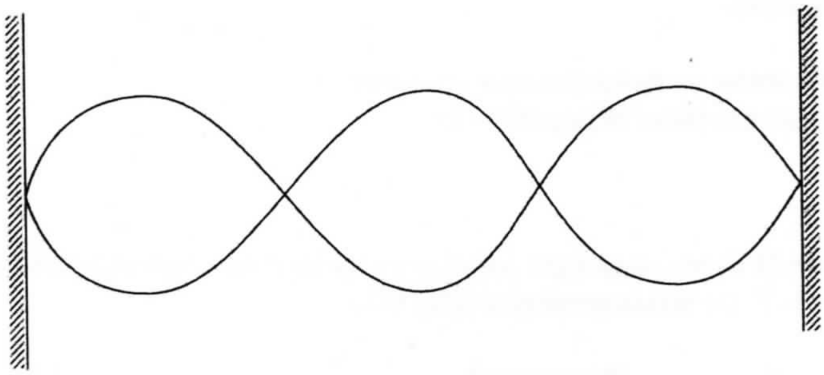


Figure 13

(i) Explain how the standing wave is formed. (3 marks)

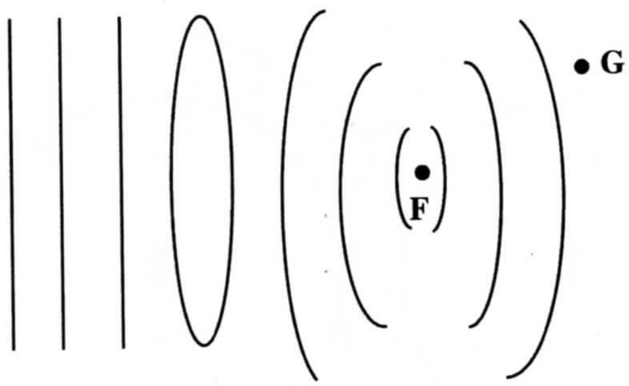
(ii) Determine the wavelength of the standing wave. (1 mark)

Candidates were required to exhibit knowledge on refraction of waves and interference of waves.

Weakness
Candidates were not able to draw waves after refraction, interpret the amplitudes after constructive and destructive interference and explain how standing waves arise.

Expected response

(a)



- curved waves - converging before focus
- diverging after focus.

(b) (i) O cm - trough and crest interference

(ii) +10 - crest and crest interference

(c) (i) Waves produced are reflected at the fixed ends.
Incident and reflected waves interfer constructively at antinodes.
and destructively at nodes.

(ii) $\lambda = \frac{2}{3} \times 1.5$

$= 1m$

Question19

(a) **Figure 14** shows an E shaped steel block being magnetised by a current through two coils in series.

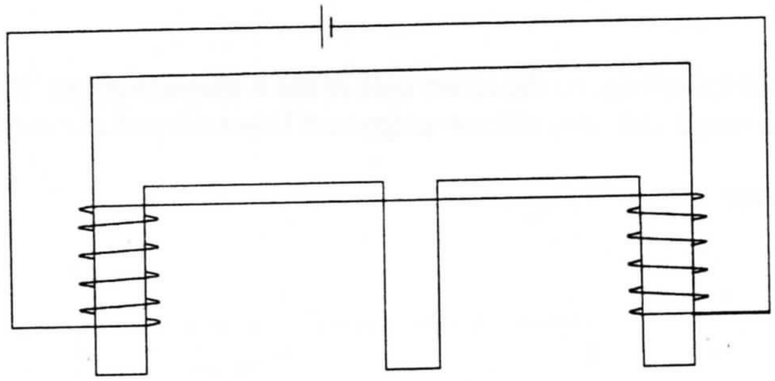


Figure 14

On the figure, indicate

(i) the north and south poles of the resulting magnet (1 mark)

(ii) the complete magnetic field pattern between the poles. (1 mark)

(b) **Figure 15** shows the permanent magnet made in part (a) above.

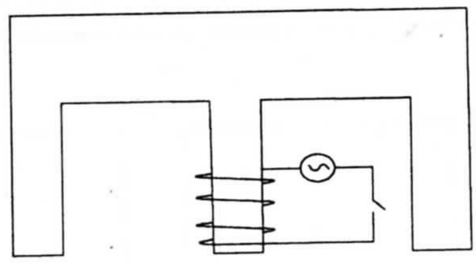


Figure 15

A coil wound loosely on the middle limb is connected in series with a low voltage a.c. and a switch. State and explain the observation made on the coil when the switch is closed. (2 marks)

(c) In a simple cell, the zinc plate gets negatively charged and the copper plate gets positively charged.

(i) Name the electrolyte in the cell. (1 mark)

(ii) Explain how:

(I) Zinc gets negatively charged. (1 mark)
(II) Copper gets positively charged (1 mark)

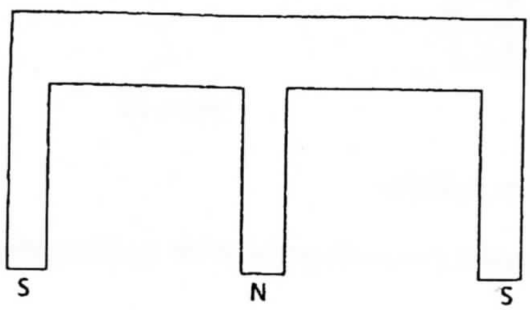
(iii) State what constitutes the current when a wire is used to connect the zinc plate and the copper plate externally. (1 mark)

Candidates were required to show an understanding of magnetic effect of current in parts a & b, and the functioning of a simple cell in part c.

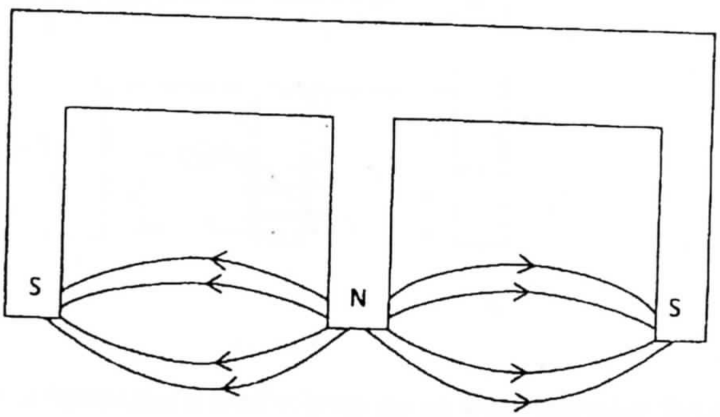
Weakness
Candidates lacked knowledge on the center pole of the E shaped magnet. They were not able to explain the working of a simple cell, they did not understand how each part of a simple cell plays its role.

Expected response

(i)



All must be correct (1)



Correct field direction (1)

(b) coil moves to and fro (1 mark)
force on coil varies direction as current varies in direction. (1 mark)

(c) (i) dilute sulphuric acid (1 mark)

(ii) (I) Zinc ions go into acid leaving electrons on the plate (1 mark)

(II) Give up electrons to discharge hydrogen Ions. (1 mark)

(iii) Electrons flow from zinc plate to the copper plate. (1 mark)

3.4.4 Physics Paper 3 (232/3)

Question 1 part B

You are provided with the following:
- two stands, two clamps and two bosses.
- one meter rule
- one Bar magnet
- a piece of thread
- weighing balance (to be shared)
- stop watch

Proceed as follows.

(e) Using the meter rule measure the length L and breadth b for the magnet. (b is the second largest dimension of the magnet).

L = ... m

b = ... m (1 mark)

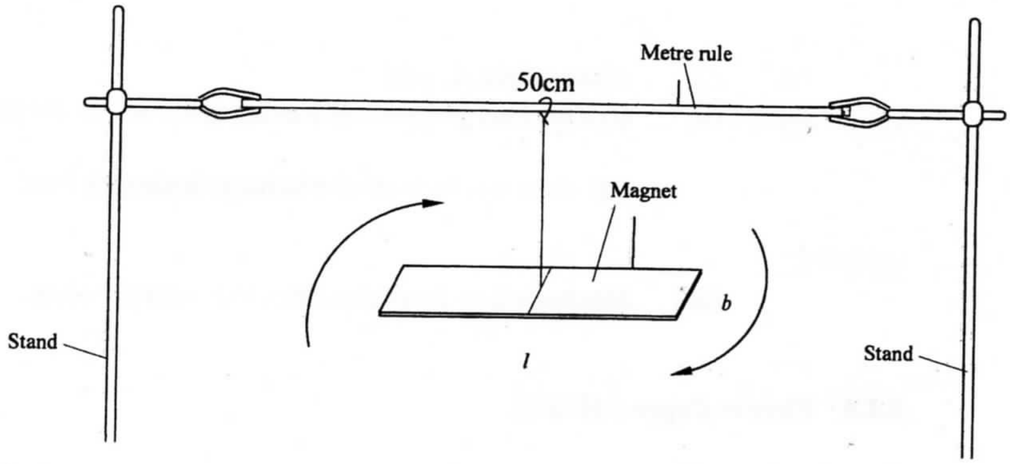
(f) Use the balance to measure the mass M of the magnet.

M = ... kg. (1 mark)

(g) Determine P given that $P = \frac{M}{3}(L^2 + b^2)$. (2 marks)

(h) Clamp the meter rule between the two resort stands. Using a piece of thread suspend the bar magnet from the centre of the metre rule so that its length and breadth are both in a horizontal plane as shown in **figure 2**.

Keep away all unnecessary magnetic materials including voltmeter form this experimental set up.



(i) (I) Displace one end of the magnet through a small angle and let it oscillate about a vertical axis through its centre as shown by the arrows. Measure the time t for 10 oscillations. (1 mark)

(a) t = ... s

(II) Determine the period T of the oscillations. (1 mark)

(III) Determine the constant G given that $T = 2\pi\sqrt{\frac{P}{G}}$. (2 marks)

Candidates were required to measure the length and breadth of a bar magnet, set it into motion and determine the magnetic dipole moment from the period of oscillations.

Weakness

Many candidates were not able to get the correct period after successfully obtaining the time of 10 oscillations. They therefore failed to get the correct value of constant G.

Expected response

(e) $l = 0.1$ m
$b = 0.01$ m

(f) $m = 0.06$ kg

(g) $p = \frac{0.06}{3}(0.1^2 + 0.01^2)$
$= 2.02 \times 10^{-4}$

(i) (I) $t = 75$s

(II) $T = 7.5$s

(III) $7.5 = 2\pi\sqrt{\frac{2.02 \times 10^{-4}}{G}}$

$G = 1.42 \times 10^{-4}$

Question 2 part B

You are provided with the following:
- a triangular glass prism
- a metre rule
- a 50 g mass
- some hot water
- some cold water
- some thread
- a thermometer
- one stand, one boss and one clamp
- a beaker

Proceed as follows:

(g) Using a piece of thread suspend the metre rule from the clamp on the stand and adjust the position of the thread until the metre rule balances horizontally. Note this position, O of the thread. ***(This position of the thread must be maintained throughout the experiment).***

(h) Using another piece of thread suspend the glass prism from the meter rule at a point 35 cm from O. Suspend the 50 g mass on the opposite side of O using another piece of thread. Adjust the position of the thread attached to the 50 g mass until the metre rule balances once more. **See figure 4**.

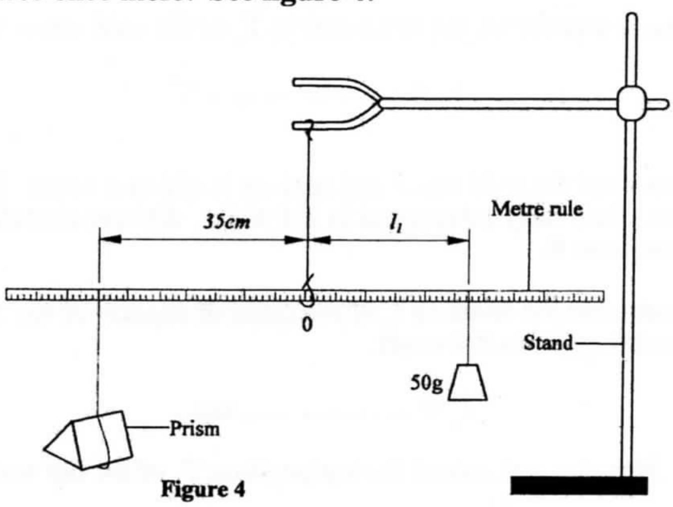


Figure 4

(i) Determine the distance l_1 between O and the point of support of the 50 g mass.

l_1 = ... cm (1 mark)

(ii) Use the principle of moments to determine the weight W_1 of the prism in air. *(Take $g = 10\ N\ kg^{-1}$)* (1 mark)

(i) Put cold water into the beaker (approximately three quarter ($^3/_4$ full). With the glass prism still at 35 cm from O, determine the distance l_2 of the 50 g mass at which the rule balances when the prism is fully submerged in the cold water. **See figure 5.**

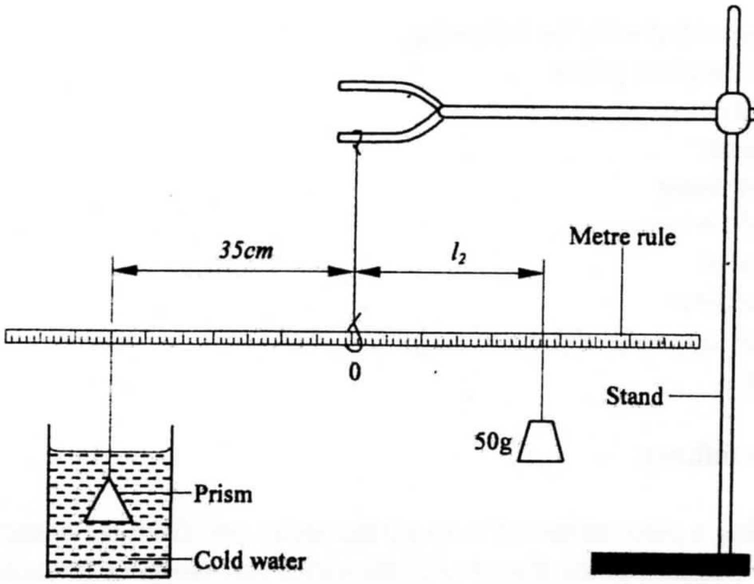


Figure 5

(I) l_2 = ...cm (1 mark)

(II) Determine the weight W_2 of the prism in the cold water. (1 mark)

(j) Measure and record the temperature T_1 of the cold water when the system is balanced.

T_1 = ...°C (1 mark)

(k) Now pour out the cold water and replace it with hot water. Balance the metre rule with the prism fully submerged in hot water. ***Ensure that the prism is still supported at 35 cm from 0.***

(i) Determine the distance l_3 of the point of support of the 50 g mass when the prism is submerged in hot water.

l_3 = ... cm. (1 mark)

(ii) Measure and record the temperature T_2 of the hot water.

T_2 =..........................°C (1 mark)

(iii) Determine the weight W_3 of the prism in hot water. (1 mark)

(l) Determine the constant k for the water given that:

$$k = \frac{(w_1 - w_2) - (w_1 - w_3)}{(w_1 - w_3)(T_2 - T_1)}$$ (2 marks)

Candidates were required to determine the relative density of water using Archimedes principle.

Weakness
Most candidates were unable to use the principle of moments to obtain W_1 and W_2 some obtained unrealistic values of l_1 *and* l_2.

Expected response

h) (i) $L_1 = 47.4$ cm

(ii) $W_1 = \frac{0.474 \times 0.05 \times 10}{0.35}$

$= 0.68$ N

(i) (I) $L_2 \doteq 28$ cm

(II) $W_2 = \frac{0.28 \times 0.05 \times 10}{0.35}$

$= 0.4$ N

(j) T1 = 26°C
Accept (18 - 32°C)

(k) (i) $L_3 = 28.5$ cm

(ii) $T_2 = 83$°C
Accept (60 - 95°C)

(iii) $W_3 = \frac{0.285 \times 0.05 \times 10}{0.35}$

$= 0.41$

(l) $K = \frac{(0.68 - 0.4) - (0.68 - 0.41)}{(0.68 - 0.41)(83 - 26)}$

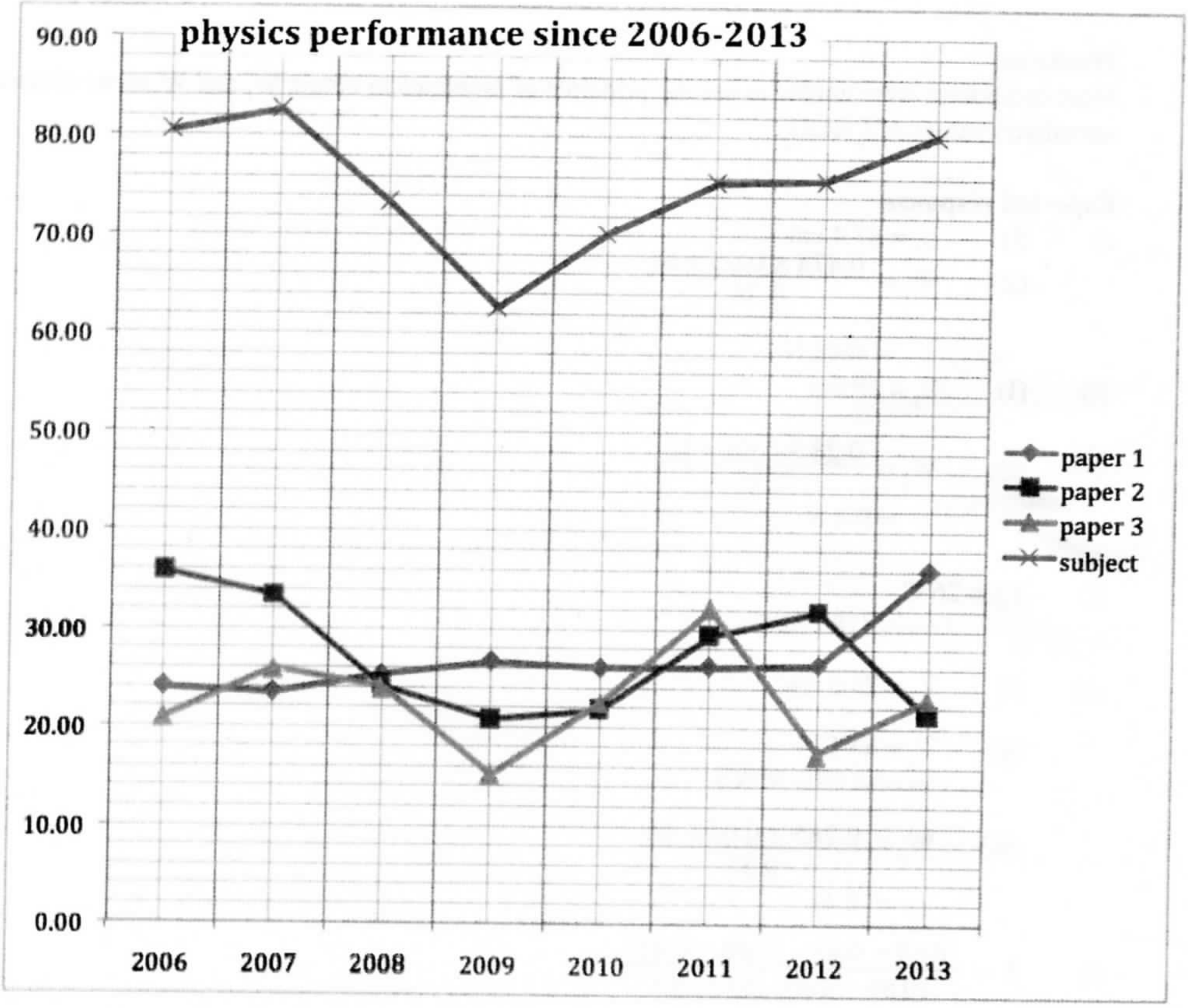
$= \frac{0.28 - 0.27}{0.27 \times 57}$

$= 6.5 \times 10^{-4} K^{-1}$

ADVICE TO TEACHERS

- Graphical analysis should be included in the teaching of physics.
- Candidates must be advised to follow instructions in the practical paper and use the recorded data appropriately.
- During teaching learners must be made to relate the concepts to real life experiences. The Physics behind every concept must be clearly explained during the teaching / learning process and key learning points emphasized.

The graph below shows clearly the performance trends in physics since 2006.


physics performance since 2006-2013
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
2006
2007
2008
2009
2010
2011
2012
2013
paper 1
paper 2
paper 3
subject