1408/312
PHYSICS TECHNIQUES
June/July 2009
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

SCIENCE LABORATORY TECHNOLOGY CRAFT

PHYSICS TECHNIQUES

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet
Mathematical tables/calculator
Take $g = 9.8\ m/s^2$

*This paper consists of **TWO** sections; **A** and **B**.*
*Answer **ALL** the questions in section **A** and any **TWO** questions from section **B**.*
*Each question in section **A** carries **4** marks, while each question in section **B** carries 20 marks.*

This paper consists of 5 printed pages.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

SECTION A (60 Marks)

Answer ALL questions in this section.

1. Differentiate the following apparatus in terms of their application in a physics laboratory:

   (a) Ammeter and voltmeter; (1 mark)
   (b) Metre rule and micrometer screw gauge; (1 mark)
   (c) Baurdon gauge and thermometer; (1 mark)
   (d) Lever balance and spring balance. (1 mark)

2. A concave spherical mirror of radius of curvature 20cm forms an erect image 30cm from the mirror and 3cm high. Determine:

   (a) the position; (2 marks)
   (b) size of the object. (2 marks)

3. An electric heater operated from the 240V a.c. main supply is rated at 1200 watts.

   Calculate:
   (a) the current used by the heater; (1 mark)
   (b) the cost of running the heater for 20 hours if the cost per kwh is 50 cents. (3 marks)

4. A piece of plastic material floats with 2/5 of its volume submerged in water. If the relative density of a liquid is 0.75, determine the fraction of the material that floats in this liquid. (4 marks)

5. (a) State the importance of vacuum in X-ray and cathode ray tubes. (1 mark)

   (b) Differentiate between hard and soft X-rays. (3 marks)

6. (a) Sketch a circuit diagram that can be used to achieve half-wave rectification. (1 mark)

   (b) Describe operation of the circuit in (a), above. (3 marks)

7. The air pressure at the top of a mountain was observed to be 60.00cm Hg and the pressure difference between the top and bottom of the mountain is 6125 Nm^{-2}.

   Determine:
   (a) the pressure at the bottom of the mountain in Nm^{-2}; (1 mark)

   (b) the height of the mountain (average density of air is 1.25 kg/m^3 and that of mercury is 13600 kgm^{-3}). (3 marks)

8. (a) A cell of an e.m.f 1.5V and an internal resistance of 0.5Ω is connected to three resistors of 2Ω, 3Ω, and 4Ω in series.

Determine:

(i) the current flowing; (1½ mark)

(ii) potential difference across the ends of each external resistor. (2 marks)

(b) State the reason for the difference between the total external potential difference and the e.m.f of the cell. (½ marks)

9. (a) Define the following terms:

(i) dielectric constant; (1 mark)

(ii) surface density. (1 mark)

(b) State **two** physical factors that influence the capacitance of a parallel plate capacitor. (2 marks)

10. The spring constant of a spring balance is 100 N/m. A cylindrical metal block of diameter 10cm and height 5cm hangs on the balance and stretches by 30cm. Calculate:

(a) the weight of the block; (1 mark)

(b) density of the metal from which the block is made. (3 marks)

11. (a) The difference between steam point and ice point on an ungraduated thermometer is found to be 176mm.
Determine the temperature in °C when the thread of mercury is 62mm. (2 marks)

(b) State why a clinical thermometer should not be sterilized in boiling water. (2 marks)

12. Describe how an electroscope can be used to test the insulating properties of various materials. (4 marks)

13. (a) Define:

(i) radioactivity; (1 mark)

(ii) half life. (1 mark)

(b) The half life of a radioactive element is 22 days.
Determine the fraction remaining after 88 days. (2 marks)

14. Outline the domain theory of magnetism. (4 marks)

15. (a) Define wave intensity. (1 mark)

(b) Describe the phenomenon of refraction in light wave. (3 marks)

SECTION B (40 Marks)

*Answer any **TWO** questions from this section.*

16. (a) An electric kettle which produces energy at a rate of 2750 watts contains 1 kg of water. It takes 160 seconds to heat the water from 10 to 100°C.

Calculate:

(i) the heat produced by the kettle in this time; (2 marks)

(ii) the heat taken in by the water in this time. (2 marks)

(b) State **two** reasons for the difference in the values obtained in (i) and (ii), above. (2 marks)
(specific heat capacity of water = 4200 $Jkg^{-1}K^{-1}$)

(c) Determine the specific latent heat of steam, if 0.12 kg of water is converted to steam when the heater in (a) above continues to supply energy for a further 100 seconds. (4 marks)

(d) When a suitable counter was placed near a radioactive source of α-particles, the following rates of emission were obtained at the times shown.

Time (minutes)	0	10	20	30	40
Count rate	590	316	172	94	50

(i) Plot a graph that can determine the half-life of the source. (7 marks)

(ii) Explain how the half life of radioactive source above can be calculated. (3 marks)

17. (a) (i) Describe, with the aid of a sketch diagram, how an iron bar can be magnetized electrically. (5 marks)

(ii) Describe a method that can confirm the polarity of a magnet. (3 marks)

(b) Determine the angle of incidence of a ray of light on one face of a 60° prism if the ray is just about to be totally internally reflected on meeting the next face.
(refractive index of glass = 1.5) (8 marks)

(c) An object is placed 25cm from a converging lens of focal length 20cm.

Determine:

(i) position; (2 marks)

(ii) magnification; (1 mark)

(iii) nature of the image. (1 mark)

18. A moving coil galvanometer has a resistance of 10Ω and gives a full scale deflection (f.s.d) when a current of 0.0075A flows through it.

(a) Calculate the potential difference across the meter at f.s.d. (2 marks)

(b) (i) Sketch a set-up of resistance and galvanometer coil for it to convert to an ammeter reading upto 1.5A. (2 marks)

(ii) Determine the value of resistor in b(i) above. (3 marks)

(c) (i) Show how a resistor can be connected to the galvanometer to convert it to a voltmeter reading up to 7.5 volts. (2 marks)

(ii) Determine the value of resistor in c(i) above. (3 marks)

(d) (i) Describe the application of the deflection system in a cathode ray oscilloscope. (6 marks)

(ii) State two applications of cathode ray oscilloscope. (2 marks)

19. (a) Figure 1 shows a sketch of a hydraulic press.

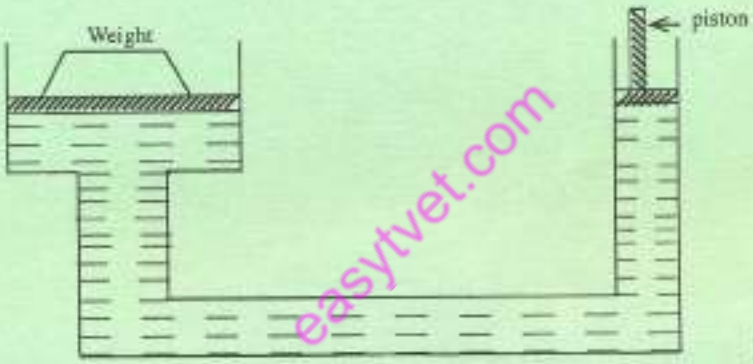

Figure 1

The diameter of side supporting the weight is 8cm while that of piston is 2cm. Determine the ratio of the force applied on the piston to the weight it can support. (6 marks)

(b) Explain why a needle may float in clean water but sink when some detergent is added to the water. (5 marks)

(c) State the importance of a capacitor in a bridge rectification circuit. (1 mark)

(d) Sketch the waveform of the output signal from the bridge rectification circuit when:

(i) there is no capacitor; (2 marks)

(ii) there is a capacitor. (2 marks)

(e) (i) Draw a sketch graph that show the transfer characteristic of a transistor. (3 marks)

(ii) State the importance of the gradient in e(i). (1 mark)