

SC5122&1
WASSCE 2016
PHYSICS 2&1
Essay and Objective
2¾ hours

2&1

Name.....

Index Number.....

THE WEST AFRICAN EXAMINATIONS COUNCIL

**West African Senior School Certificate Examination
For School Candidates**

SC 2016

PHYSICS 2 & 1

2¾ hours

Do not open this booklet until you are told to do so. While you are waiting, read the following instructions carefully. Write your name and index number in the spaces provided above.

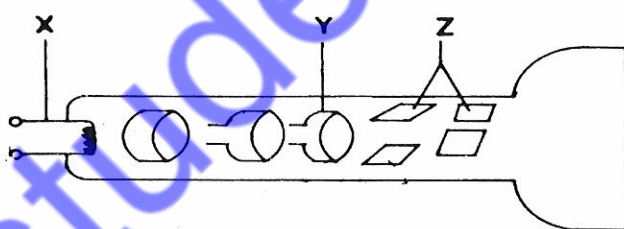
This booklet consists of two papers. Answer Paper 2 which comes first, in your answer booklet and Paper 1 on your Objective Test answer sheet. Paper 2 will last 1½ hours after which the answer booklets will be collected. Do not start Paper 1 until you are told to do so. Paper 1 will last 1¼ hours.

Answer **eight** questions in all; **five** questions from Part I and **three** questions from Part II.

PART I
[15 marks]

Answer any **five** questions from this part.
All questions carry equal marks.

1. State the dimensions of:
 - (a) impulse;
 - (b) acceleration;
 - (c) work.
2. A projectile is fired with a velocity of 20 m s^{-1} at an angle of 40° to the horizontal. Determine the components of the velocity of the projectile at its maximum height.
3. State **three** different materials that can be used to demonstrate Brownian motion.
4. An electron enters perpendicularly into a uniform magnetic field which has a flux density of 0.12 T . This results in a magnetic force of $9.6 \times 10^{-12} \text{ N}$ on the electron. Calculate the speed of the electron as it enters the magnetic field. $[e = 1.6 \times 10^{-19} \text{ C}]$
5. List **three** uses of rockets.
6.
 - (a) What is *doping*?
 - (b) Explain how doping improves the conductivity of a semi-conductor.
- 7.



The diagram above illustrates a cathode ray tube. Identify the components X, Y and Z.

Part II
[45 marks]

Answer **three** questions from this part.
All questions carry equal marks.

8.
 - (a) Explain the term *net force*. [2 marks]
 - (b) Define the principle of conservation of linear momentum and state **one** example of it. [3 marks]

- (c) A ball of mass 200 g released from a height of 2.0 m hits a horizontal floor and rebounds to a height of 1.8 m. Calculate the impulse received by the floor. [$g = 10 \text{ m s}^{-2}$] [4 marks]
- (d) A body of mass 20 g performs a simple harmonic motion at a frequency of 5 Hz. At a distance of 10 cm from the mean position, its velocity is 200 cm s^{-1} . Calculate its:
- maximum displacement from the mean position;
 - maximum velocity;
 - maximum potential energy.
- [$g = 10 \text{ m s}^{-2}$; $\pi = 3.14$] [6 marks]

9.

- (a) Explain the terms:
- thermal equilibrium;
 - fundamental interval.
- [4 marks]
- (b) List **two** uses of the hydraulic press. [2 marks]
- (c) Name the material used to reset the steel index in the Six's maximum and minimum thermometer. [1 mark]
- (d) (i) A nursing mother prepared her baby's milk mixture at 85°C , in a feeding bottle. In order to cool it to 40°C , she immersed the bottle in an aluminium bowl of heat capacity 90 JK^{-1} containing 500 g of water at 26°C . If the mass of the mixture is 300 g, calculate the specific heat capacity of the mixture. Neglect heat losses and heat capacity of the bottle.
[Specific heat capacity of water = $4200 \text{ J kg}^{-1} \text{ K}^{-1}$] [4 marks]
- (ii) (α) Name **two** ways through which the bottle loses heat. [2 marks]
- (β) Name **two** industrial processes in which heat exchanger is used. [2 marks]

10.

- (a) Define *critical angle*. [2 marks]
- (b) How are *anti-nodes* created in a stationary wave? [2 marks]
- (c) The angle of minimum deviation of an equilateral triangular glass prism is 46.2° . Calculate the refractive index of the glass. [3 marks]
- (d) An illuminated object is placed in front of a concave mirror and the position of a screen is adjusted in front of the mirror but no image is obtained on the screen. Give **two** possible reasons for this observation. [2 marks]
- (e) An illuminated body is placed at a distance of 75 cm from a converging lens of focal length 30 cm.
- Determine the image distance.
 - If the lens is replaced by another converging lens the object has to be moved 25 cm further away to have its sharp image on the screen. Determine the focal length of the second lens.
- [6 marks]

Turn over

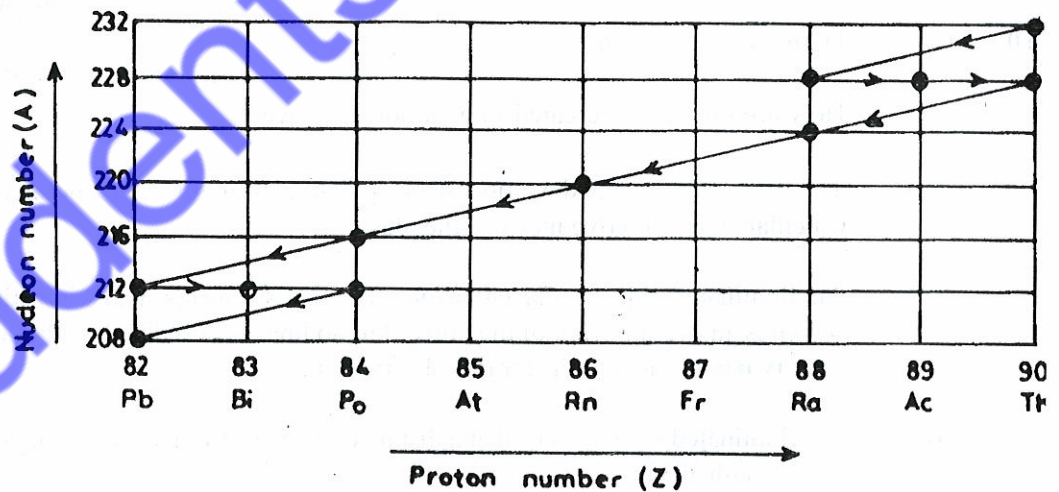
11. (a) Explain briefly *dielectric strength*. [2 marks]
- (b) An electromagnetic wave has its wavelength shorter than those of radiowave and microwave but longer than that of visible light.
- Identify the wave.
 - Name **one** suitable detector for the wave.
 - Name **one** source of the wave.
- [3 marks]
- (c) An oil drop carrying a charge of $1.0 \times 10^{-19} \text{ C}$ is found to remain at rest in a uniform electric field of intensity 1200 N C^{-1} . Calculate the weight of the oil drop. [3 marks]
- (d) An *RLC* series circuit consists of a 100Ω resistor, a 0.05 H inductor and a $25 \mu\text{F}$ capacitor. A mains voltage of 220 V , 50 Hz is applied across the circuit. Calculate the:
- impedance;
 - current.

$$[\pi = 3.14]$$

[7 marks]

12. (a) Explain the following terms:
- mass defect;
 - binding energy of a nucleus.
- [4 marks]
- (b) (i) Assuming the wave nature of an electron, what is the effect of decreasing the speed of a photoelectron on its
- wavelength?
 - energy?
- [3 marks]
- (ii) A particle of mass $4.4 \times 10^{-23} \text{ kg}$ moves with a velocity of 10^5 m s^{-1} . Calculate its wavelength. [$h = 6.6 \times 10^{-34} \text{ J s}$] [2 marks]

(c)



The diagram above shows part of a radioactive decay series. Use it to answer the following:

- Name a pair of isotopes;
- Name the isotopes with which the series starts;
- Write down a nuclear equation for **two** examples each of:
 - alpha decay;
 - beta decay.

[6 marks]

END OF ESSAY TEST

Answer all the questions.

Each question is followed by four options lettered A to D. Find out the correct option for each question and shade in pencil on your answer sheet, the answer space which bears the same letter as the option you have chosen. Give only one answer to each question. An example is given below.

A series LC circuit has capacitance $50 \mu\text{F}$ and inductance of $500 \mu\text{H}$. Calculate the frequency at which the circuit will resonate. [$\pi = 3.142$]

- A. 6365 Hz
- B. 3183 Hz
- C. 1006 Hz
- D. 503 Hz

The correct answer is 3183 Hz, which is lettered B, and therefore answer space B would be shaded.

A B C D

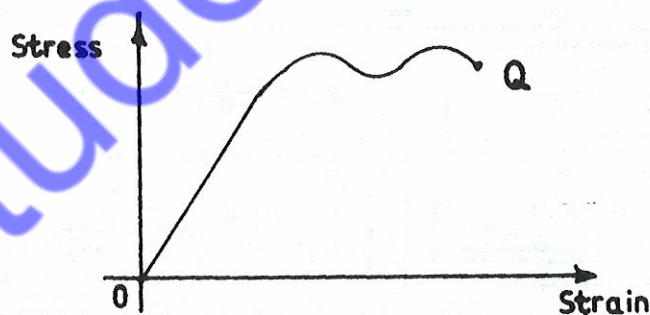
Think carefully before you shade the answer spaces; erase completely any answer(s) you wish to change.

Do all rough work on this question paper.

Now answer the following questions.

1. The dimensions of momentum are
 - A. MLT.
 - B. $\text{ML}^{-1}\text{T}^{-1}$.
 - C. MLT^{-1} .
 - D. ML^{-1}T .
2. A student measures the volume of a liquid using a measuring cylinder. What else needs to be measured by the student in order to determine the density of the liquid?
 - A. Depth of the liquid in the the cylinder
 - B. Mass of the cylinder
 - C. Mass of the liquid
 - D. Temperature of the liquid

3.



The diagram above represents the graph of stress versus strain for an elastic wire. The point Q on the graph is the

- A. elastic limit.
- B. breaking point.
- C. yield point.
- D. proportional limit.

4. A ball is dropped from the top of a tower. Due to air resistance, it reaches terminal velocity. Which of the following statement(s) about its motion is/are **correct**?

I. The acceleration of the ball is zero.
 II. The net force on the ball is zero.
 III. The velocity of the ball increases.

- A. I only
 B. I and II only
 C. II and III only
 D. I, II and III

5. The surface tension of water can be lowered by which of the following substances?

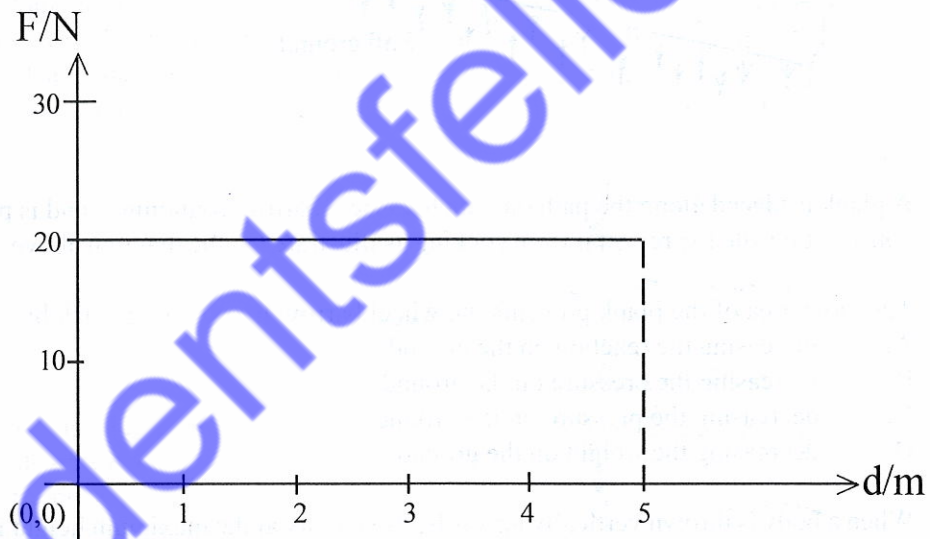
- A. Metal
 B. Sand
 C. Detergent
 D. Paper

6. An object of volume 400 cm^3 and density 2.5 g cm^{-3} is suspended from a spring balance with half its volume immersed in water. Determine the reading on the spring balance.

[Density of water = 1 g cm^{-3}]

- A. 1200 g
 B. 1000 g
 C. 800 g
 D. 400 g

7.



The diagram above illustrates a force-distance graph for the motion of a wooden block. Determine the work done on the block when moved through 5 m.

- A. 4 J
 B. 15 J
 C. 25 J
 D. 100 J

8. The two positions of a body undergoing a uniformly accelerated motion are $(10 \text{ s}, 10 \text{ m s}^{-1})$ and $(30 \text{ s}, 50 \text{ m s}^{-1})$ on the velocity - time graph. Calculate the magnitude of the acceleration of the body.

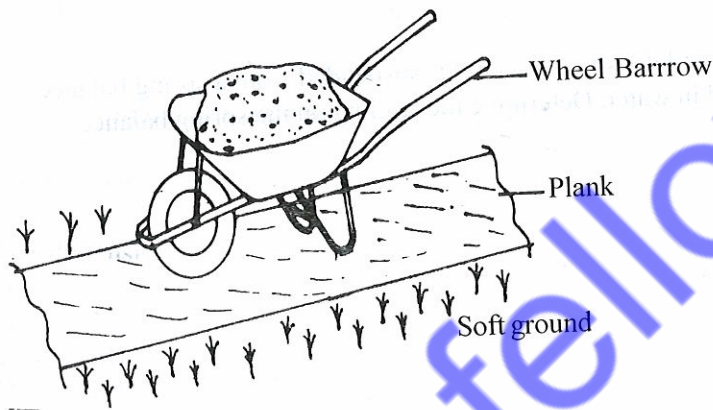
- A. 0.5 m s^{-2}
 B. 2.0 m s^{-2}
 C. 10.0 m s^{-2}
 D. 40.0 m s^{-2}

Turn over

9. At a birthday party, the celebrant pops a corked fruit wine. If the cork shoots out of the bottle at an angle of 40° to the horizontal and travels a horizontal distance of 4.50 m in 1.25 s, calculate the initial speed of the cork.
- 4.2 m s⁻¹
 - 4.7 m s⁻¹
 - 5.6 m s⁻¹
 - 7.1 m s⁻¹

10. A uniform metre rule is balanced on a fulcrum placed at the 35 cm mark by suspending a mass of 120 g at the 10 cm mark. Calculate the mass of the metre rule.
- 60 g
 - 80 g
 - 120 g
 - 200 g

11.



A plank is placed along the path on which a wheel barrow containing sand is pushed at a construction site to prevent it from sticking as illustrated in the diagram above.

The large area of the plank prevents the wheel barrow from getting stuck by

- increasing the reaction on the ground.
 - increasing the pressure on the ground.
 - decreasing the pressure on the ground.
 - decreasing the weight on the ground.
12. When a body is thrown vertically upwards, its velocity at the maximum height is
- maximum.
 - zero.
 - double its initial value.
 - half its initial value.
13. Resonance occurs when one vibrating object causes a second object to vibrate at its own natural
- amplitude.
 - speed.
 - frequency.
 - intensity.
14. The mouth piece of a telephone handset converts energy from
- electrical to sound.
 - sound to electrical.
 - sound to radio wave.
 - radiowave to sound.

15. Four identical trolleys are loaded with different masses and move along a straight road at the same speed. Which of the trolleys has the **greatest** inertia?

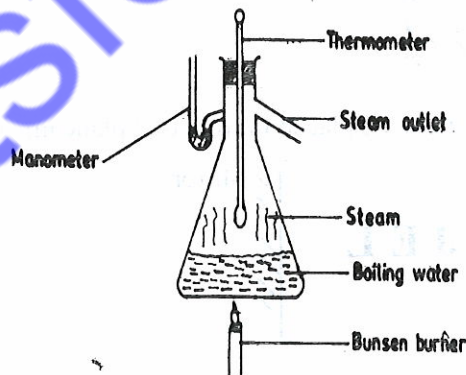


16. In the clinical thermometer, the function of the kink is to
- prevent the back flow of mercury after use.
 - ensure the back flow of mercury after use.
 - maintain the thermometric property of mercury.
 - allow the temperature attained to be read.

Which of the statements above is/are **correct**?

- I only
 - I and II only
 - I and IV only
 - III and IV only
17. Which of the following statements **correctly** defines the boiling point of a liquid?
The temperature at which the
- saturated vapour pressure is equal to the atmospheric pressure.
 - molecules leave the liquid at a rate equal to the rate at which they return.
 - molecules leave the liquid at a rate higher than that at which they return.
 - molecules leave the liquid at a rate lower than the rate at which they return.

18.



The diagram above is used to determine the

- boiling point of water.
 - atmospheric pressure.
 - upper fixed point of a thermometer.
 - amount of water in the atmosphere.
19. An aluminium rod of length 1.8 m at 10 °C is heated to produce a difference in length of 0.007 m. Calculate the temperature to which it is heated.
[Linear expansivity of aluminium = $2.3 \times 10^{-5} \text{ K}^{-1}$]
- 155 °C
 - 160 °C
 - 169 °C
 - 179 °C

20. A mercury-in-glass thermometer reads 4 cm at ice point and 29 cm at steam point. Calculate the temperature when the mercury level is at 9 cm.

- 13 °C
- 20 °C
- 33 °C
- 38 °C

Turn over

21. The continuous stirring in the method of mixtures to determine the specific thermal capacity of a substance ensures
- continuous dissipation of heat to the room.
 - uniform distribution of thermal energy to all parts of the mixture.
 - that thermal energy is confined to the mixture.
 - that there is rapid heat exchange.
22. Which of the following statements about the effect of dissolved salt on the freezing point of water is **correct**?
- The freezing point is lowered.
 - The freezing point is increased.
 - There is no change in the freezing point.
 - The change in the freezing point depends on the temperature of the surrounding.
23. A pressurized perfume bottle is left on the window pane of a room. What happens to the gas molecules of the perfume on a sunny day? They
- expand.
 - collide less often.
 - move more rapidly.
 - contract.
24. Given that v , f and λ are the velocity, frequency and wavelength of a wave, respectively. Which of the following equations is **correct**?
- $v = f^2 \lambda$
 - $f = \frac{v}{\lambda}$
 - $f = \frac{v}{\lambda^2}$
 - $\lambda = \frac{f}{v^2}$
25. Three letters are placed in front of a plane mirror as illustrated in the diagram below.

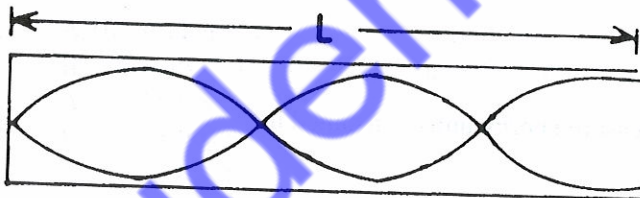


The image formed is illustrated by

- J E J.
 - J E L.
 - J E L.
 - L E J.
26. The distance between two successive troughs of a wave is 0.4 m. If the frequency of the source is 825 Hz, calculate the speed of the wave.
- 165.0 m s⁻¹
 - 330.0 m s⁻¹
 - 412.5 m s⁻¹
 - 825.0 m s⁻¹

27. X-rays and infra-red rays are both electromagnetic. Which common property do the waves have?
Both waves
- are longitudinal.
 - have the same frequency.
 - have the same wavelength.
 - travel at the same speed in vacuum.
28. The image formed by a concave mirror is real, inverted and magnified when the object is placed
- at the focus.
 - at the centre of curvature.
 - beyond the centre of curvature.
 - between the centre of curvature and the focus.
29. Total internal reflection
- is a phenomenon of refraction of light.
 - occurs when light rays travel into a denser medium.
 - occurs when the critical angle is just exceeded.
 - is a phenomenon of reflection of light.
- Which of the statements above are correct?
- I and II only
 - I and III only
 - I, II and III only
 - I, III and IV only
30. Complementary colours are those which
- have the same refractive index.
 - have the same wavelength.
 - add up to produce black light.
 - add up to produce white light.

31

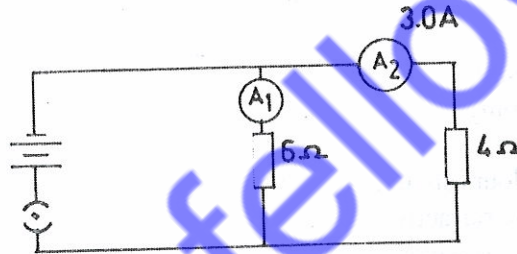


The diagram above illustrates the waveform of a note produced by vibrations in an air column of length L . If the speed of sound in air is v , derive an expression for the frequency of the note.

- $\frac{v}{L}$
- $\frac{5vL}{2}$
- $\frac{5L}{4v}$
- $\frac{5v}{4L}$

32. The pair of musical instruments that work on the vibration of air in pipes are
- piano and the organ.
 - guitar and the flute.
 - trumpet and the violin.
 - flute and the trumpet.
33. An astronomical telescope has objective and eyepiece lenses of focal lengths 3.5 m and 5 cm, respectively. Determine the magnifying power of the telescope when in normal adjustment.
- 70.0
 - 17.5
 - 7.0
 - 0.7
34. An aluminium cable of diameter 4×10^{-3} m and resistivity of $3.0 \times 10^{-8} \Omega \text{ m}$ has a resistance of 21Ω . Calculate the length of the cable. [$\pi = 3.14$]
- 8.0×10^2 m
 - 8.8×10^3 m
 - 8.0×10^4 m
 - 8.8×10^4 m

35.

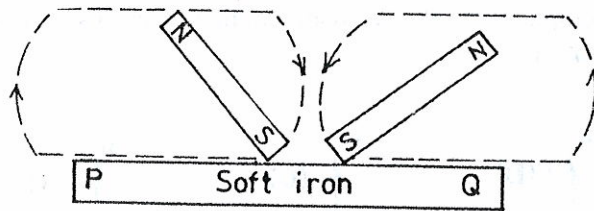


The ammeter A_2 shown in the circuit diagram above reads 3.0 A. Determine the reading of the ammeter A_1 .

- 12 A
 - 9 A
 - 7 A
 - 2 A
36. The electricity meters in houses measure energy units consumed in
- kilowatt-hour.
 - volt.
 - ampere.
 - coulomb.
37. A man and his friend have masses 70 kg and 60 kg, respectively. If they are seated 1.0 m apart, calculate the gravitational force of attraction between them. [$G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$]
- 1.59×10^{-14} N
 - 2.80×10^{-7} N
 - 1.30×10^2 N
 - 6.30×10^{13} N
38. The p.d. across a parallel-plate capacitor is 10^3 V. If the distance between the two plates is 10 cm, calculate the magnitude of the electric field strength between the plates.
- $1.0 \times 10^4 \text{ V m}^{-1}$
 - $1.0 \times 10^5 \text{ V m}^{-1}$
 - $1.5 \times 10^5 \text{ V m}^{-1}$
 - $2.0 \times 10^5 \text{ V m}^{-1}$

39. Two different materials, rubbed against each other, acquire opposite charges when separated. This is an example of charging by
- induction.
 - friction.
 - conduction.
 - convection.
40. Which of the following factors does **not** affect e.m.f. of a primary cell?
- Size
 - Internal resistance
 - Operating temperature
 - Duration of usage

41.

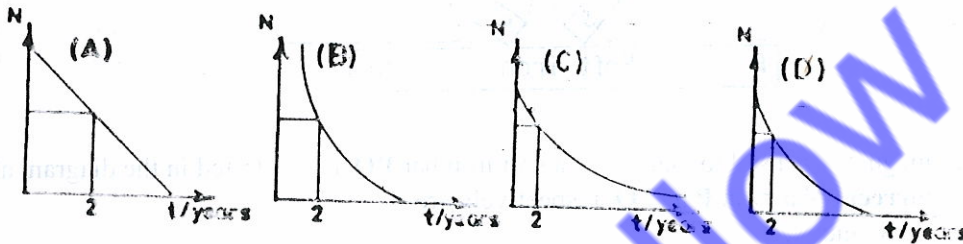


Two magnets are used to magnetize a soft iron bar **PQ** as illustrated in the diagram above.

The **correct** polarity at **P** and **Q**, respectively are

- S and N.
 - N and S.
 - S and S.
 - N and N.
42. In storing magnets, keepers are used to
- reduce self-demagnetization.
 - cancel the effect of the earth's magnet field.
 - protect the magnets from stray electric field.
 - increase the strength of the magnets.
43. A $10 \mu\text{C}$ charge moves with a velocity of $1.0 \times 10^5 \text{ m s}^{-1}$ at right angle to a uniform magnetic field of flux density $5.0 \times 10^{-4} \text{ T}$. Calculate the force on the charge.
- $5.0 \times 10^{-5} \text{ N}$
 - $5.0 \times 10^{-4} \text{ N}$
 - $5.0 \times 10^5 \text{ N}$
 - $5.0 \times 10^6 \text{ N}$
44. Which of the following statements about steel and soft iron is **not** correct?
- Steel is more readily magnetized than soft iron.
 - Permanent magnets are usually made of steel.
 - Soft iron is more readily magnetized than steel.
 - Soft iron more readily loses its magnetism than steel.
45. What determines the polarity at the ends of an electromagnet? The
- magnitude of the current passing through the wire.
 - material of the core of the magnet.
 - material of the coil.
 - direction of current in the wire.

46. How many beta particle(s) are emitted in the radioactive decay of ${}_{79}^{198}\text{Au} \rightarrow {}_{80}^{198}\text{Hg}$?
- 1
 - 2
 - 3
 - 5
47. The phenomenon by which two light atomic nuclei combine to form a heavy nuclide with the release of energy is known as
- radioactivity.
 - nuclear fusion.
 - nuclear fission.
 - chain reaction.
48. Which of the following graphs about the decay of a radioactive substance with a half-life of 2 years is correct.



49. In a p-type semiconductor
- number of holes is equal to the number of electrons.
 - electrical resistivity increases.
 - electrons are the majority charge carriers.
 - holes are the majority charge carriers.
50. Let Δx be the uncertainty in the measurement of position and Δp the uncertainty in the measurement of momentum. Then the uncertainty principle relation is given as
- $\Delta x \cdot \Delta p = h$.
 - $\Delta x \cdot \Delta p \leq h$.
 - $\Delta x \cdot \Delta p \geq h$.
 - $\Delta x \cdot \Delta p > h$.

END OF PAPER