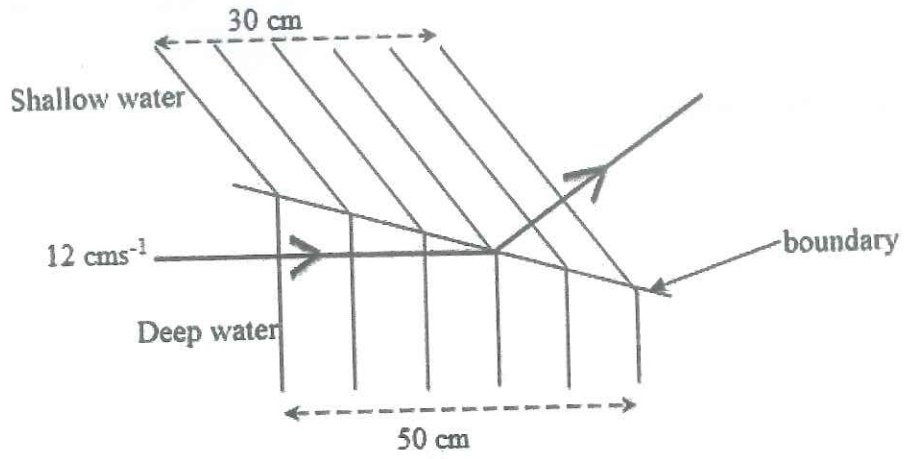
3) Wavefronts are seen to cross a boundary from deep to shallow water as shown below. The arrow shows the direction of the waves as they move from deep water to shallow water.



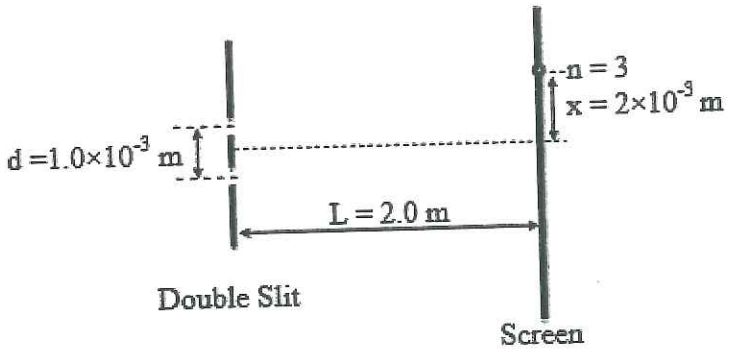
Use the information in the diagram above to answer the questions that follow.

(i) Determine the wavelength of the waves in deep water. **(1 mark)**

(ii) Calculate the frequency of the waves in deep water. **(1 mark)**

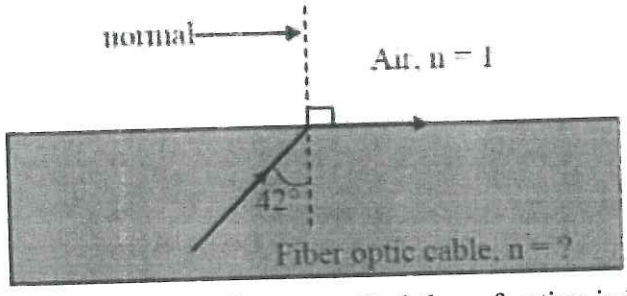
(iii)Find the velocity of the waves in shallow water. **(1 mark)**

4) In Young's double slit experiment, the screen is located 2.0 m from the double slit. The slits are separated by a distance of 1.0×10^{-3} m and the position of the 3rd dark band from the central antinodal line is 2×10^{-3} m.



Calculate the **wavelength** of the light source used in this experiment. **(2 marks)**

5) A straight length of fiber optic cable is shown below.



Use the information provided in the diagram to find the refractive index of the fiber optic material used. **(1 mark)**

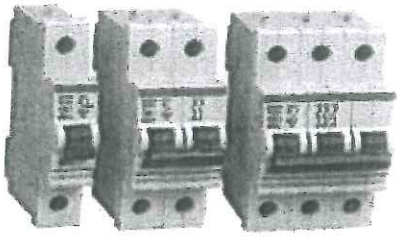
6) The properties of light can be explained by the two models of light, namely, the particle model and the wave model.
   (i) State one weakness of the particle model of light. **(1 mark)**
   (ii) Explain what is meant by the dual nature of light. **(1 mark)**

STRAND 5 ELECTRICITY

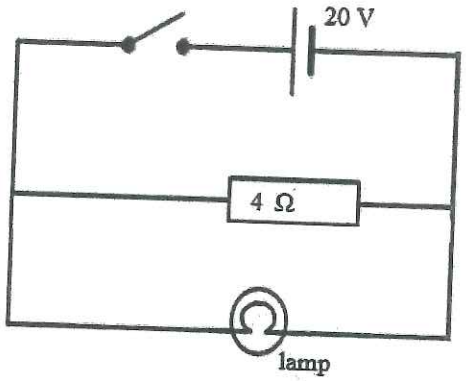
[14 marks]

- This strand has 7 Questions.
- Show necessary working for questions 4 – 7 as partial marks will be awarded for correct working.

1) The electrical safety device commonly found in households shown in the diagram given below is a
   A. fuse.
   B. diode.
   C. resistor.
   D. circuit breaker.



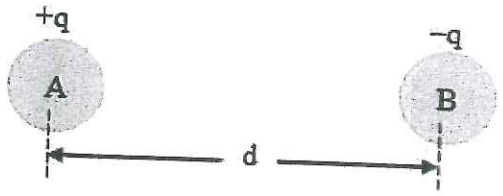
2) A parallel circuit is shown below. **(1 mark)**



The voltage across the lamp when the switch is closed is
A. 4 V
B. 5 V
C. 20V
D. 80 V

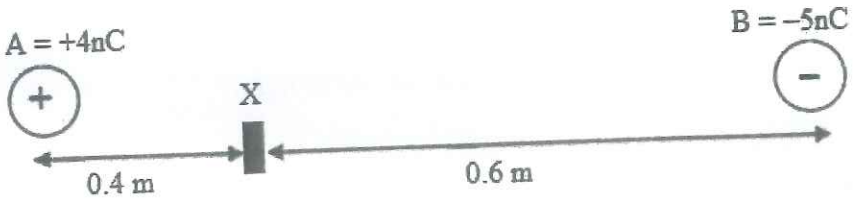
(1 mark)

3) The diagram below shows two oppositely charged spheres A and B each carrying an electric charge of q coulombs. They are separated by a distance, d metres. The type of force exerted by one charge on the other is
   A. normal.
   B. neutral.
   C. repulsion.
   D. attraction.



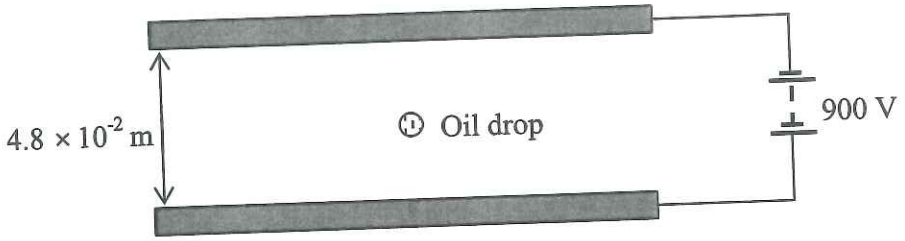
(1 mark)

4) Two charges A and B are placed 1 m apart as shown below.



Calculate the net electric field at point X which is midway between A and B. **(2 marks)**

5) This question is about an experiment designed to measure the charge on an electron. In this experiment, 'Millikan's Oil Drop Experiment', two parallel metal plates, 4.8×10^{-2} m apart, are connected to a 900 V power supply.



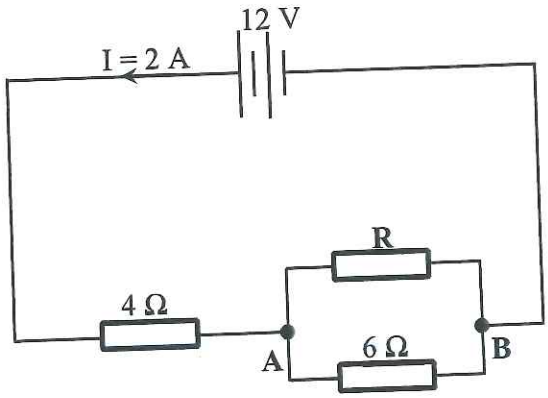
(i) State the main purpose of 'Millikan's Oil Drop Experiment'. **(1 mark)**

(ii) Calculate the electric field strength between the two plates. **(1 mark)**

(iii) The electric field between the plates just supports the weight of an oil drop of mass 2.7×10^{-15} kg, which has acquired a charge due to a few excess electrons. Given that the oil drop is stationary, calculate the charge on the oil drop. **(1 mark)**

(iv) What is the most likely number of excess electrons acquired by the oil drop? **(1 mark)**

6) Consider the circuit given below and answer the questions that follow.



A current of 2 A leaves the 12 V battery.

(i) Calculate the total resistance of the circuit. **(1 mark)**

(ii) What is the value of the unknown resistor R? **(2 marks)**

(iii) Find the power dissipated by the 4 Ω resistor. **(1 mark)**

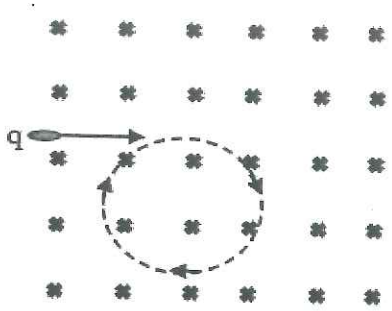
7) A man has a 3kW heater which operates on a 240V supply. He has available at home fuses rated at 3A, 5A, 10A, and 13A. Which fuse should he use in the plug for the heater above?

(1 mark)

STRAND 6 ELECTROMAGNETISM [10 marks]

- This strand has **6** Questions.
- Show necessary working for questions **3 – 6** as partial marks will be awarded for correct working.

1) A charged particle, q, is moving through a uniform magnetic field in circular motion as shown below.



If the charged particle moves with a faster velocity, the radius of the circular motion will

A. increase.
B. decrease.
C. become zero.
D. remain the same.

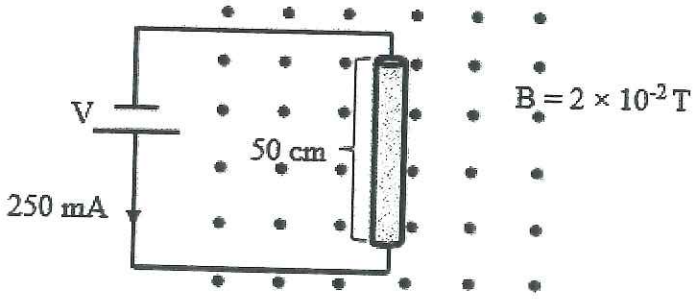
(1 mark)

2) Which one of the following changes would not affect the magnitude of the voltage induced by the motion of the conductor?

A. decreasing the length of the conductor
B. increasing the velocity of the conductor
C. reversing the direction of the magnetic field
D. increasing the strength of the magnetic field

(1 mark)

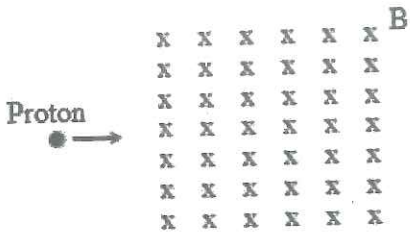
3) A conductor of length 50 cm is placed in a magnetic field of strength 2×10^{-2} T. The current in the wire is 250 mA as shown in the diagram below.



(i) State the direction of the magnetic force experienced by the wire. **(1 mark)**

(ii) Calculate the magnitude of the magnetic force experienced by the conductor. **(1 mark)**

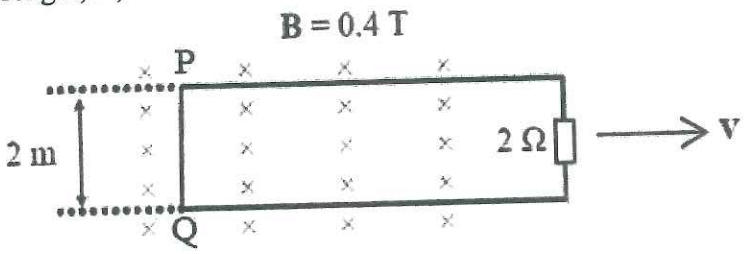
4) A proton enters a uniform magnetic field, **B**, of intensity 2.5 T at right angles with a speed of 2.1×10^3 ms^{-1} as shown below.



(i) State the direction of the magnetic force experienced by the proton. **(1 mark)**

(ii) Calculate the radius of the circular path followed by the proton in the magnetic field. **(1 mark)**

5) A rectangular loop of copper wire connected to a 2 Ω resistor is pulled to the right through a magnetic field strength, **B**, of 0.4 T.

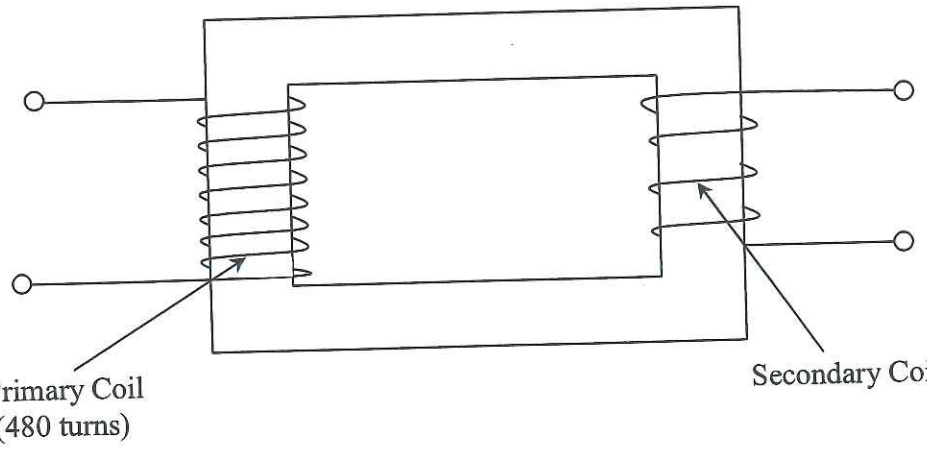


(i) With what speed, **v**, should the loop be pulled so that there is an induced voltage of 10 V? **(1 mark)**

(ii) State the direction in which the current would flow through the side PQ. **(1 mark)**

(iii) Calculate the value of the induced current through the rectangular loop. **(1 mark)**

6) The transformer shown below is used to convert 240 V AC to 24 V AC.



Using the information above, calculate the number of turns on the secondary coil. **(1 mark)**

STRAND 7 **ATOMIC PHYSICS** **[8 marks]**

- This strand has **6** Questions.
- Show necessary working for questions **3 – 6** as partial marks will be awarded for correct working.

1) Which of the following has the greatest penetrating power?
   A. Alpha particles
   B. Beta particles
   C. Gamma Rays
   D. X-rays

(1 mark)

2) The maximum kinetic energy of the photoelectrons depends on lights
   A. intensity.
   B. direction.
   C. frequency.
   D. amplitude.

(1 mark)

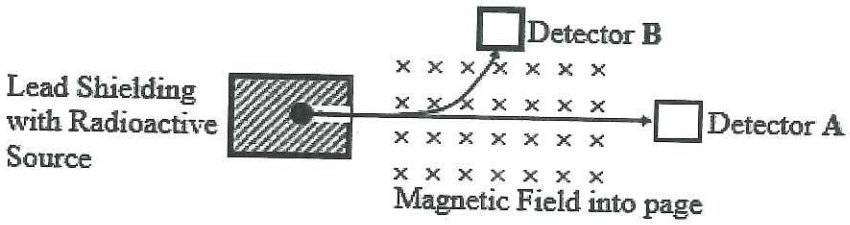
3) When a sample of a radioactive nuclide decays, its mass falls from 1600 mg to 100 mg in ten minutes. What is the half-life of the radioactive nuclide? **(1 mark)**

4) The following equation shows β-decay of an isotope of oxygen.

$$^{a}_{8}O \rightarrow {}^{19}_{b}F + {}^{0}_{-1}e$$

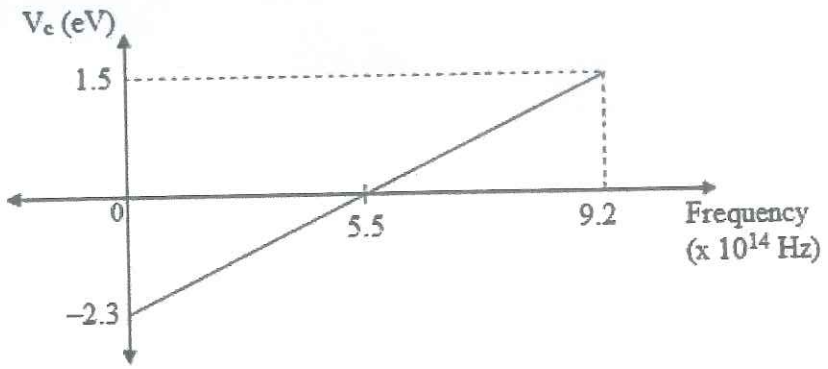
Complete the equation by stating the values of $\boldsymbol{a}$ and $\boldsymbol{b}$. **(1 mark)**

5) A radioactive source emits two types of radioactive particles into a **magnetic field** that's directed into the page. Detector **A** recorded the radioactive particles that went straight through and Detector **B** recorded the radioactive particle that deflected upwards.



(i) What type of charge did Detector **B** record? **(½ mark)**
(ii) Name the radioactive particles that Detector **A** recorded. **(½ mark)**

6) The graph below shows the cut-off voltage of emitted electrons in a photoelectric experiment. The cut-off voltage is plotted against the frequency of the incident light.



Use the graph to determine:

(i) the threshold frequency. **(1 mark)**

(ii) the value of the work function in Joules. **(1 mark)**

(iii)the value of Planck's constant, h in J.s. **(1 mark)**

THE END
ALL THE BEST

Year 12 Physics Formulae & Constants

Mechanics

1. $s = \frac{d}{t}$
2. $v_f = v_i + at$
3. $v_f^2 = v_i^2 + 2as$
4. $s = v_i t + \frac{1}{2}at^2$
5. $\tau = F \times d_\perp$
6. $p = mv$
7. Impulse $= F.\Delta t = m.\Delta v$
8. $F = \frac{Gm_1m_2}{r^2}$
9. $T = \frac{1}{f}$, $f = \frac{1}{T}$
10. $v = \frac{2\pi r}{t}$
11. $F_c = \frac{mv^2}{r}$
12. $a_c = \frac{v^2}{r}$

Atomic Physics

1. $E_k = hf - \phi$
2. $\phi = hf_0$

Fluids

1. $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$
2. $\rho = \frac{m}{V}$
3. $P = \frac{F}{A}$
4. $P = \rho gh$

Geometrical Optics and Wave

1. $v = f\lambda$
2. $\frac{\sin\theta_1}{\sin\theta_2} = \frac{v_1}{v_2} = \frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1}$
3. $pd = d\sin\theta = \frac{dx}{L} = n\lambda$

Energy

1. $W = Fd$
2. $P = \frac{W}{t}$
3. $E_K = \frac{1}{2}mv^2$
4. $E_P = mgh$
5. $E_p(\text{elastic}) = \frac{1}{2}kx^2$
6. $F_s = -kx$
7. $Q = mc\Delta T$
8. $Q = mL$

Electromagnetism

1. $F = BI\ell$
2. $V = Bv\ell$
3. $F = Bvq$
4. $\frac{V_P}{V_S} = \frac{N_P}{N_S} = \frac{I_S}{I_P}$

Electricity

1. $F = \frac{kq_1q_2}{r^2}$
2. $F = Eq$
3. $E = \frac{V}{d}$
4. $W = Eqd = Vq$

Electricity (continued)

5. $I = \frac{q}{t}$
6. $V = \frac{W}{q}$
7. $R_{T\,series} = R_1 + R_2 + R_3 + \ldots$
8. $\frac{1}{R_{T\,parallel}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$
9. $V = IR$
10. $P = VI = I^2R = \frac{V^2}{R}$

Constants

Gravity, g	=	$10\ ms^{-2}$
Electronic charge, e	=	$1.6\times10^{-19}\ C$
Electron mass, m_e	=	$9.1\times10^{-31}\ kg$
Speed of light, c	=	$3.0\times10^{8}\ ms^{-1}$
Mass of proton, m_p	=	$1.67\times10^{-27}\ kg$
Coulomb's Law constant, k	=	$9.0\times10^{9}\ Nm^2C^{-2}$
Gravitational Constant, G	=	$6.67\times10^{-11}\ Nm^2kg^{-2}$
Planck's Constant	=	$6.63\times10^{-34}\ Js$
Rydberg Constant, R	=	$1.097\times10^{7}\ m^{-1}$