RATU NAVULA COLLEGE

YEAR 12 TRIAL EXAMINATION 2020

PHYSICS

QUESTION PAPER

Time Allowed: Three Hours
(An extra 10 minutes is allowed for reading this paper)

INSTRUCTIONS

1. Write all your answers in the **Answer Book** provided.
2. Write your **NAME** and **YEAR LEVEL** on the front **right hand corner** of the Answer Booklet.
3. If you use extra sheets of paper, be sure to show clearly the question numbers being answered and staple sheet securely at the appropriate place.
4. You may use a calculator, provided it is silent, battery-operated and non-programmable.
5. Unless otherwise stated, all rounding off should be corrected to two decimal places. Rounding off decimal answers should be done only at the final step.
6. All questions **are compulsory.**

SUMMARY OF QUESTIONS

	STRAND	MARK	SUGGESTED TIME (MINUTES)
1	Mechanics	40	72
2	Energy	10	18
3	Fluids	8	14
4	Geometrical Optics and Wave Motion	10	18
5	Electricity	14	26
6	Electromagnetism	10	18
7	Atomic Physics	8	14
	TOTAL	**100**	**180 minutes**

STRAND 1 **MECHANICS** **(40 MARKS)**

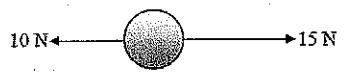
There are **seven multiple choice and thirteen short answer** questions and **all** are **compulsory.**

Section A **Multiple Choice** **(7 marks)**

There **are seven multiple choice questions** in this section and **all** are **compulsory.** Each question is worth **1 mark.**

1. The number of significant figures in 0.080 is
   A. 1
   B. 2
   C. 3
   D. 4

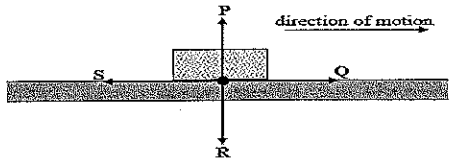
2. The diagram shows two forces acting on a body.



According to Newton, this body should

A. remain stationary.
B. accelerate to the left.
C. accelerate to the right.
D. move with a constant speed.

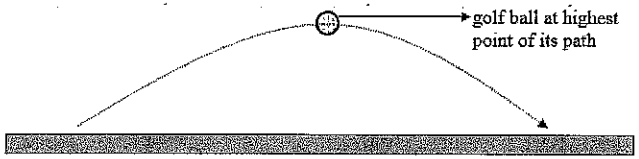
3. The mass shown below is moving to the right as shown. Which of the forces labelled P, Q, R or S on the diagram is the friction force?
   A. P
   B. Q
   C. R
   D. S



4. The force per unit area is known as
   A. torque
   B. energy
   C. density
   D. pressure

5. Precision of a micrometer screw gauge is
   A. 0.01 m
   B. 0.1 cm
   C. 0.1 mm
   D. 0.01 mm

6. The diagram below shows a golf ball hit along a level fairway at the highest point of its path.



At the position shown, the golf ball has

A. only kinetic energy
B. only gravitational potential energy
C. both kinetic and gravitational potential energy
D. neither kinetic nor gravitational potential energy

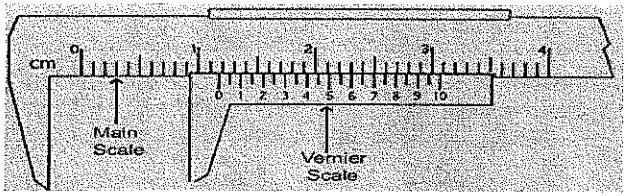
7. The force that keeps an object moving around a circular path without slipping is known as

A. friction force
B. reaction force
C. centripetal force
D. electromotive force

Section B **Short Answer Questions** **(33 Marks)**

There are **thirteen** questions in this section. **All** questions are **compulsory**.

8. The diameter of a coin is measured using the instrument shown below.



(i) Name the instrument used. **(1 mark)**
(ii) What is the main scale reading of the instrument? **(1 mark)**
(iii) What is the uncertainty of the instrument? **(1 mark)**

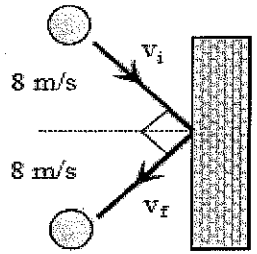
9. The dimensions of a microscopic glass slide are given as follows:

$$l = (7.5 \pm 0.1)\ \text{cm} \qquad w = (2.50 \pm 0.01)\ \text{cm}$$

Calculate the area of the slide with its appropriate absolute uncertainty. **(2 marks)**

10. The Newton's Law of Gravitation states that $F = \frac{Gm_1m_2}{r^2}$, find the factor that new forces increases by if m_1 and m_2 are doubled and distance between the masses is halved. **(2 marks)**

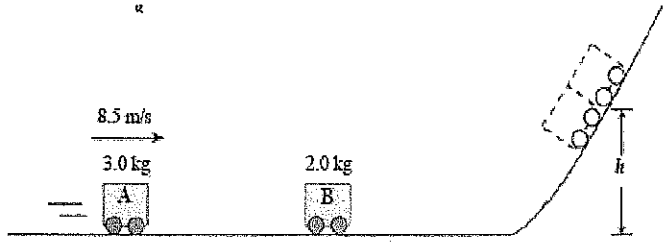
11. A tennis ball which was thrown against a wall rebounds without loss in speed as shown.



Calculate the change in velocity of the tennis ball. **(2 marks)**

12. A force applied to an object for a period of time is _____. **(1 mark)**

13. A 3 kg car, A travelling at 8.5 m/s on a frictionless track collides and sticks on to a stationary 2 kg car B.

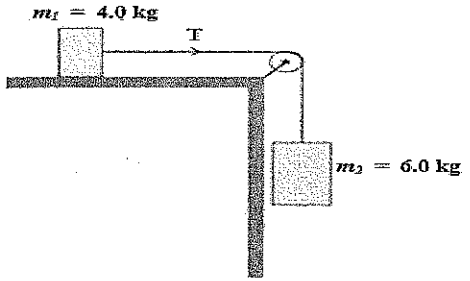


(i) Calculate the momentum of car A before collision. **(1 mark)**

(ii) Calculate the combined velocity after the collision. **(1 mark)**

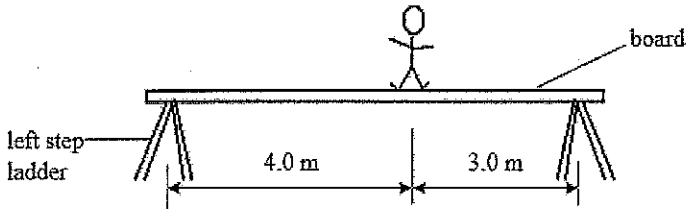
(iii) Calculate the height, h the combined cars will reach after the collision. **(2 marks)**

14. Two masses are connected by a light string over a frictionless massless pulley. Assume mass m_1 is resting on a frictionless horizontal surface.



(i) Draw and label the forces acting on mass m_2. **(1 mark)**
(ii) What is the acceleration of mass m_2? **(2 marks)**
(iii) Determine the tension, T on mass m_1. **(1 mark)**

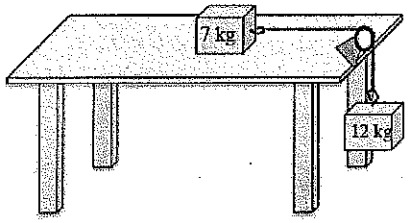
15. An 840 N painter stands on a 7.0 m board of negligible weight. The board is supported by two step-ladders as shown below.



(i) State the principle of moments. **(1 mark)**
(ii)What is the force exerted on the board by the left step-ladder? **(2 marks)**

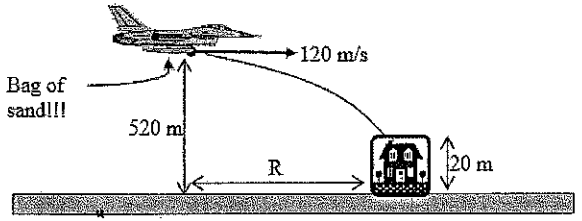
16. A stone of mass 0.15 kg is attached to a string and whirled in a horizontal circle of radius 80 cm. The period of rotation is 0.80 seconds.
(i) Calculate the velocity of the stone. **(1 mark)**
(ii)Determine the tension in the string. **(1 mark)**

17. Two masses are connected on a horizontal table surface by a light inextensible string over a pulley as shown.



Assuming that the horizontal table surface is frictionless, calculate the acceleration of the system. **(2 marks)**

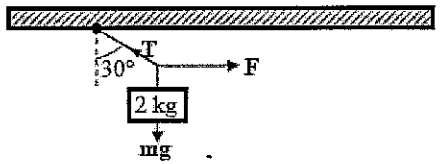
18. A pilot training school is conducting a training exercise for its trainee pilots. As part of the exercise, the trainee pilots are supposed to drop a bag of sand from an altitude of 520 m to hit an empty house which is 20 m high.



(i) Given that the plane is flying horizontally at 120 m/s and the bag of sand is in free fall, calculate the time it takes the bag to hit the top of the house. **(1 mark)**

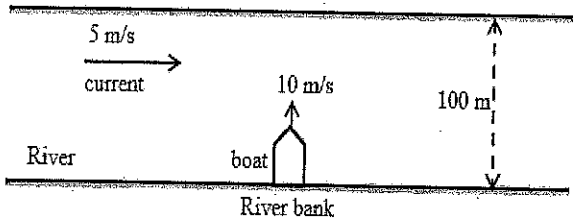
(ii) At what distance, R, should the pilot release the bag of sand in order to hit the house? **(1 mark)**

19. A mass of 2 kg hangs by a light string and is pulled to one side by a force F. The string is at an angle of 30° to the vertical axis.



(i) Determine the weight force, mg. **(1 mark)**
(ii) Calculate the value of the tension, T, of the string. **(2 marks)**

20. A river flows with a current of 5 m/s relative to the river bank and a boat can move 10 m/s relative to the river. The river is 100 m wide.



(i) What would the speed of the boat relative to the river bank be? **(1 mark)**
(ii) How long would the boat take to cross the river? **(1 mark)**
(iii) How far downstream would the boat be taken by the river current? **(1 mark)**

STRAND 2 **ENERGY** **(10 MARKS)**

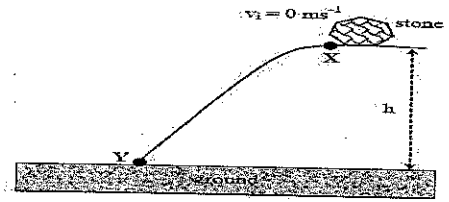
There are **two multiple choice and three short answer** questions and **all** are **compulsory.**

Section A **Multiple Choice** **(2 marks)**

There **are two multiple choice questions** in this section and **all** are **compulsory**. Each question is worth **1 mark.**

1. An example of a renewable energy source is
A. coal
B. sunlight
C. petroleum
D. nuclear power

2. The diagram given below shows a stone at rest on the top of a hill, with two points labelled X and Y.



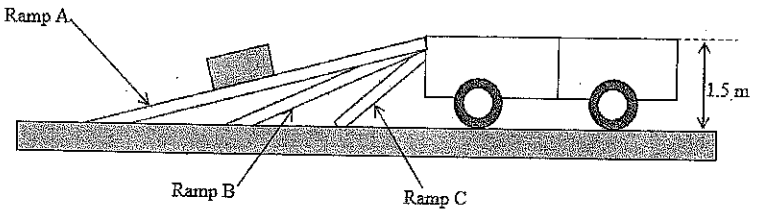
Which of the following best describes the energy transformation if the stone rolls from point X to point Y?

A. Kinetic energy to heat energy
B. Heat energy to potential energy
C. Potential energy to kinetic energy
D. Kinetic energy to potential energy

Section B **Short Answer Questions** **(8 Marks)**

There are **three** questions in this section. **All** questions are **compulsory**.

3. The diagram below shows options for an inclined plane (ramp) to be used to lift a heavy mass onto a truck.



(i) Of the three options, which ramp, A, B or C would use the least amount of force? Give a reason for your answer. **(1 mark)**

(ii) Given that Ramp B has an angle of incline of 30° and the mass to be lifted is 45 kg, disregarding friction, calculate the amount of work done in lifting the mass to the top of the truck. **(1 mark)**

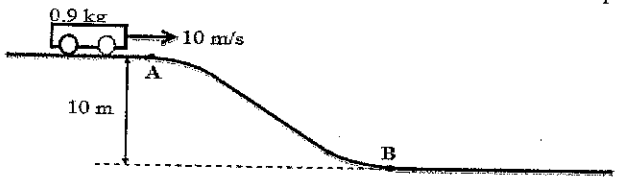
4

A 0.4 kg iron block with specific heat capacity of 450 J kg^{-1} $^{\circ}C^{-1}$ is heated from 22°C to 52°C.

(i) Determine the change in temperature of the iron block. **(2 marks)**

(ii) Calculate the amount of heat absorbed by the iron block. **(2 marks)**

5. A trolley of mass 0.9 kg moves at 10 m/s until it comes to a downward slope.



(i) Calculate the total energy of the trolley at point A. **(1 mark)**
(ii) Calculate the velocity of the trolley at point B. **(1 mark)**

STRAND 3 **FLUIDS** **(8 MARKS)**

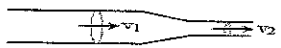
There are **two multiple choice and three short answer** questions and **all** are **compulsory.**

Section A **Multiple Choice** **(2 marks)**

There **are two multiple choice questions** in this section and **all** are **compulsory**. Each question is worth **1 mark.**

1. The lowest possible temperature is known as
   A. Kelvin
   B. Celsius
   C. Fahrenheit
   D. Absolute Zero

2. Refer to the diagram given below which shows a section of a Venturi tube.



Section of a Venturi tube

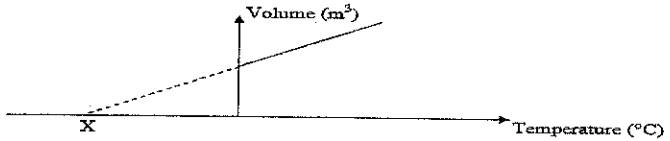
Which of the following is true about velocity of fluid in the Venturi tube?

A. $v_1 = 0$
B. $v_1 < v_2$
C. $v_1 > v_2$
D. $v_1 = v_2$

Section B **Short Answer Questions** **(6 Marks)**

There are **three** questions in this section. **All** questions are **compulsory**.

3. The graph below illustrates Charles' Law for a fixed mass of gas.



(i) Rewrite Charles' Law in words, stating clearly any necessary conditions. **(1 mark)**

(ii) What is the significance of point X marked above? **(1 mark)**

4. A car tyre, of volume 250 cm^3 is filled to an absolute pressure of 280 kPa at 27 °C. After driving some distance, the temperature of the air inside the tyre rises to 57 °C. Assume that the pressure inside the tyre remains the same. What will be the new volume of the tyre? **(2 marks)**

5. (i) Snow has a high albedo and forests have a low albedo.
   Define **albedo.** **(1 mark)**

   (ii) State **Bernoulli's Principle.** **(1 mark)**

STRAND 4 **GEOMETRICAL OPTICS AND WAVE MOTION** **(10 MARKS)**

There are **two multiple choice and three short answer** questions and **all** are **compulsory.**

Section A **Multiple Choice** **(2 marks)**

There **are two multiple choice questions** in this section and **all** are **compulsory**. Each question is worth **1 mark.**

1. Light, when it hits a plane mirror can be reflected. One of the 'Laws of Reflection' states that the angle of incidence is
   A. equal to the angle of reflection
   B. less than the angle of reflection
   C. greater than the angle of reflection
   D. not equal to the angle of reflection

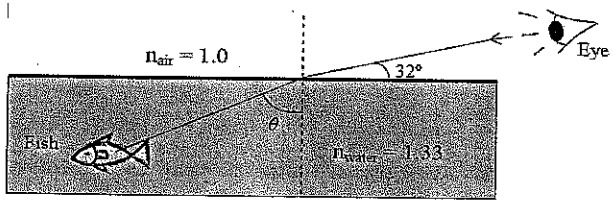
2. Which natural phenomena given below can be attributed to dispersion?

   A. Thunder
   B. Rainbow
   C. Lightning
   D. Lunar eclipse

Section B **Short Answer Questions** **(8 Marks)**

There are **three** questions in this section. **All** questions are **compulsory**.

3. A fisherman notices a fish at the bottom of a lake. Refer to the diagram below to answer the question that follows.



Calculate the size of the angle of refraction, θ. (Express your final answer to three significant figures). **(1 mark)**

4. The interference fringe pattern formed on a screen in a Young's Double Slit experiment is shown in the figure below.

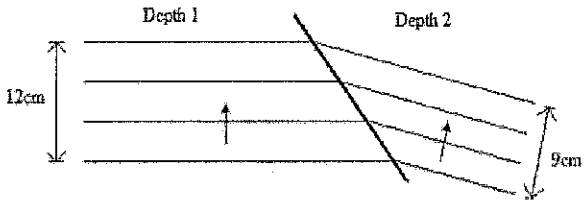
The screen is located 2.0 m from the double slit. The slits are separated by a distance of 1.0 mm.

(i) Calculate the wavelength of the light. **(2 marks)**

(ii) What would happen to the interference fringe pattern if the slits were moved closer to the screen? **(1 mark)**

(iii) Why does this experiment support the wave model of light rather than the particle model? **(1 mark)**

5. Plane waves of frequency 5 Hz in a ripple tank pass from one depth of water into another across a boundary.



(i) Label Depth 1 and Depth 2 as shallow or deep region. **(1 mark)**

(ii) What is the wavelength of waves in Depth 1? **(1 mark)**

(iii) Calculate the speed of waves in Depth 1. **(1 mark)**

STRAND 5 **ELECTRICITY** **(14 MARKS)**

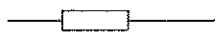
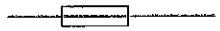
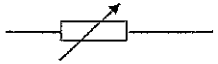
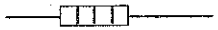
There are **three multiple choice and five short answer** questions and **all** are **compulsory.**

Section A **Multiple Choice** **(3 marks)**

There **are three multiple choice questions** in this section and **all** are **compulsory**. Each question is worth **1 mark.**

1. Which mathematical relationship below represents Ohm's Law?
   A. $Q = It$
   B. $F = BIl$
   C. $V = Bvl$
   D. $V = IR$

2. Which of the electrical symbols given below is for a fuse?

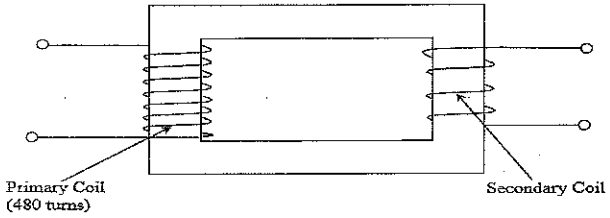
A. 
B. 
C. 
D. 

3. The main function of a step - up transformer is to increase the
   A. voltage in the primary coil
   B. voltage in the secondary coil
   C. number of turns of wire in the primary coil
   D. number of turns of wire in the secondary coil

Section B **Short Answer Questions** **(11 Marks)**

There are **five** questions in this section. **All** questions are **compulsory**.

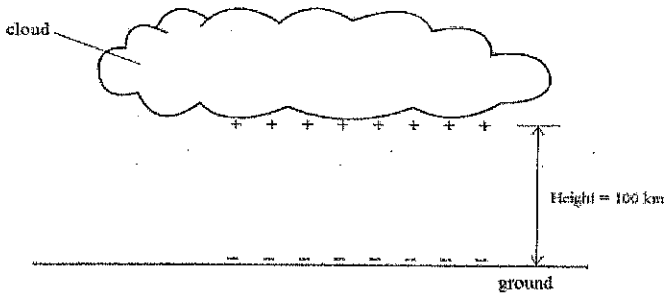
4. The transformer shown below is used to convert 240 V AC to 6 V AC.



(i) What name is given to this type of transformer? **(1 mark)**

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

5. A thunder cloud at 100 km above the ground contains positive charges. The potential difference between the cloud and the ground is 1000 V.

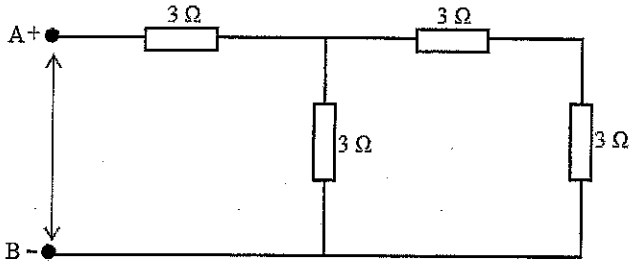


(i) Draw the uniform electric field lines between the cloud and the ground. **(1 mark)**

(ii) Calculate the uniform electric field strength between the cloud and the ground. **(1 mark)**

(iii) If an electron moves from the ground towards the cloud, calculate the work done by the electric field on the electron. (Neglect the effect of gravity on the electron) **(1 mark)**

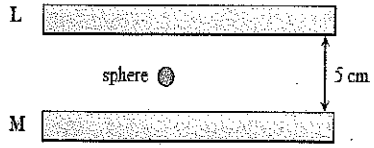
6. Refer to the diagram below and answer the questions that follow.



(i) Calculate the total resistance between points A and B. **(1 mark)**

(ii) Find the voltage drop across AB if the current in the circuit is 4 mA. **(1 mark)**

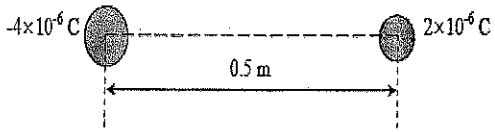
7. A tiny sphere is balanced between two horizontally charged plates; L and M, which are 5 cm apart. The gravitational force on the sphere is 5.2×10^{-14} N. The charge on the sphere is -3.2×10^{-19} C.



(i) Calculate the size and direction of the electrical force on the sphere. **(1 mark)**

(ii) Determine the value of electric field strength between the plates. **(1 mark)**

8. An object with a charge of 2×10^{-6} C is separated from the second object with a charge of -4×10^{-6} C by a distance of 0.5 m experiences an electric force between them.



(i) Calculate the force between the two objects. **(1 mark)**

(ii) State whether the force is attractive or repulsive. **(1 mark)**

STRAND 6 **ELECTROMAGNETISM** **(10 MARKS)**

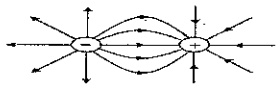
There are **two multiple choice and three short answer** questions and **all** are **compulsory.**

Section A **Multiple Choice** **(2 marks)**

There **are two multiple choice questions** in this section and **all** are **compulsory**. Each question is worth **1 mark.**

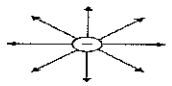
1. Which of the following electric field line patterns is correct?

A.

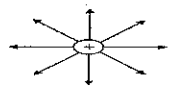


B.

C.



D.



2. A magnetic field is best described as a region in space where a magnetic pole experiences a

A. force
B. current
C. velocity
D. resistance

Section B **Short Answer Questions** **(8 Marks)**

There are **three** questions in this section. **All** questions are **compulsory**.

3. The table given below shows the region of the electromagnetic spectrum.

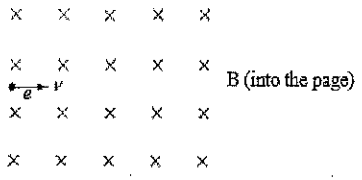
Radio waves	Microwaves	Infrared light	A	Ultraviolet light	B	Gamma rays

(i) Write down the names of regions **A** and **B**. **(2 marks)**

(ii) Which electromagnetic spectrum has the longest frequency? **(1 mark)**

(iii) Which electromagnetic spectrum has the highest energy? **(1 mark)**

4. An electron enters a magnetic field with a velocity, v.
[Charge of electron = 1.6×10^{-19} C ; Mass of electron = 9.1×10^{-31} kg]

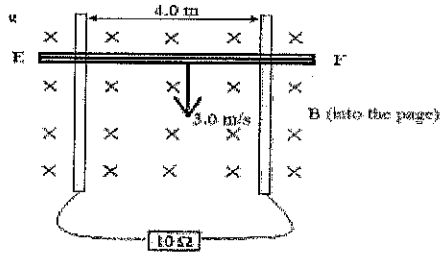


(i) On the diagram in the Answer Book, indicate with an arrow the direction of the force on the electron due to the magnetic field. **(1 mark)**

(ii) The strength of the magnetic field is B = 0.001T and the electron's velocity is $v = 2 \times 10^6$ m/s. Calculate the magnitude of the magnetic force on the electron. **(1 mark)**

(iii) Calculate the radius of the circular path followed by the electron within the magnetic field. **(1 mark)**

5. The diagram below shows a thick copper rod EF moving down at a uniform velocity of 3.0 m/s along two conducting rails, 4.0 m apart, that are connected to a 10 Ω resistor. The set-up is inside a magnetic field of strength 0.8 T that is perpendicular to the plane of the rails.



Calculate the voltage across the rod EF. **(1 mark)**

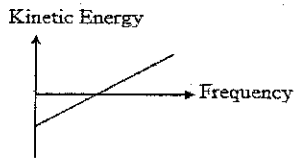
STRAND 7 **ATOMIC PHYSICS** **(8 MARKS)**

There are **two multiple choice and three short answer** questions and **all** are **compulsory.**

Section A **Multiple Choice** **(2 marks)**

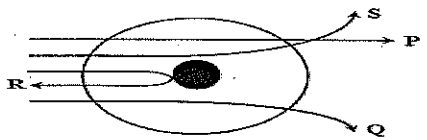
There **are two multiple choice questions** in this section and **all** are **compulsory**. Each question is worth **1 mark.**

1. In a photoelectric effect experiment, the graph of the kinetic energy of ejected electrons is plotted against the frequency of the light.



Which of the following best represents the y-intercept of the graph?
A. Frequency
B. Wavelength
C. Work function
D. Planck's constant

2. Which one of the following labelled paths shows that an atom is mostly an empty space?

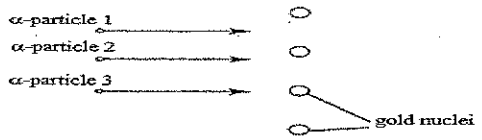


A. P B. Q C. R D. S

Section B **Short Answer Questions** **(6 Marks)**

There are **three** questions in this section. **All** questions are **compulsory.**

3. The diagram below represents a well known Rutherford scattering experiment which involves directing fast moving alpha particles towards a sheet of gold foil. The diagram shows part of the path of three alpha particles as they approach the gold nuclei.



(i) If α-particle 1 is observed to pass through the gold nuclei undeviated, what conclusion can be made about the structure of the gold atom? **(1 mark)**

(ii) If α-particle 3 is observed to bounce backwards from the gold nuclei, what conclusion can be made about the structure of the gold atom? **(1 mark)**

(iii) State one defect of the Rutherford model of an atom. **(1 mark)**

4. A radioactive source has half-life of 60 hours. How many hours will it take to decay to quarter of its original amount? **(1 mark)**

5. Electrons are emitted when a green photon of wavelength 500 nm is incident on the surface of a potassium metal. The emitted electrons have a kinetic energy of 7.2×10^{-20} J.

(i) What is the frequency of the green photon? **(1 mark)**
[Speed of light is 3×10^8 m/s]

(ii) Calculate the energy of the green photon. **(1 mark)**

THE END

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. $E_s(\text{elastic}) = \frac{1}{2}kx^2$
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. $W = Eqd = Vq$
5. $I = \frac{q}{t}$
6. $V = \frac{W}{q}$
7. $R_{\text{Series}} = R_1 + R_2 + R_3 + \ldots$
8. $\frac{1}{R_{\text{Parallel}}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots$
9. $V = IR$
10. $P = VI = I^2R = \frac{V^2}{R}$

Constants

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