NAME _____ CLASS 2T

Catholic Junior College

JC2 Preliminary Examination

Higher 1

PHYSICS 8867/1

Paper 1 Multiple Choice **12 September 2024**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name and tutorial group on this cover page.
Write and/or shade your name, NRIC / FIN number and HT group on the Answer Sheet (OMR sheet), unless this has been done for you.

There are **thirty** questions on this paper. Answer **all** questions. For each question, there are four possible answers, **A, B, C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet (OMR sheet).

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

Data

speed of light in free space,	c	=	3.00×10^{8} m s^{-1}
elementary charge,	e	=	1.60×10^{-19} C
unified atomic mass constant,	u	=	1.66×10^{-27} kg
rest mass of electron,	m_e	=	9.11×10^{-31} kg
rest mass of proton,	m_p	=	1.67×10^{-27} kg
the Avogadro constant,	N_A	=	6.02×10^{23} mol^{-1}
gravitational constant,	G	=	6.67×10^{-11} N m^2 kg^{-2}
acceleration of free fall,	g	=	9.81 m s^{-2}

Formulae

uniformly accelerated motion,	s	=	$ut + \frac{1}{2}at^2$
	v^2	=	$u^2 + 2as$
resistors in series,	R	=	$R_1 + R_2 + \ldots$
resistors in parallel,	$1/R$	=	$1/R_1 + 1/R_2 + \ldots$

1 Which estimate is **not** realistic?

A The power of a hair dryer is 150 W.

B The kinetic energy of a running man is 2000 J.

C The weight of a can of soft drink is 4 N.

D The density of ice is 900 kg m^{-3}.

2 Prefixes are often used to represent powers of 10 when writing the units of quantities. For example, 6.0 microampere, that is, 6.0×10^{-6} A, is written as 6.0 μA, where μ is the prefix symbol for 10^{-6} A.

Which prefix is not one of the standard symbols?

A g **B** p **C** m **D** T

3 To find the resistivity of a semi-conductor, a student makes the following measurements of a cylindrical rod of a material.

length = (25 ± 1) mm

diameter = (5.0 ± 0.1) mm

resistance = (68 ± 1) Ω

He calculates the resistivity to be (5.34×10^{-2}) Ω m.

How should the uncertainty be included in the student's statement of the resistivity of the semi-conductor?

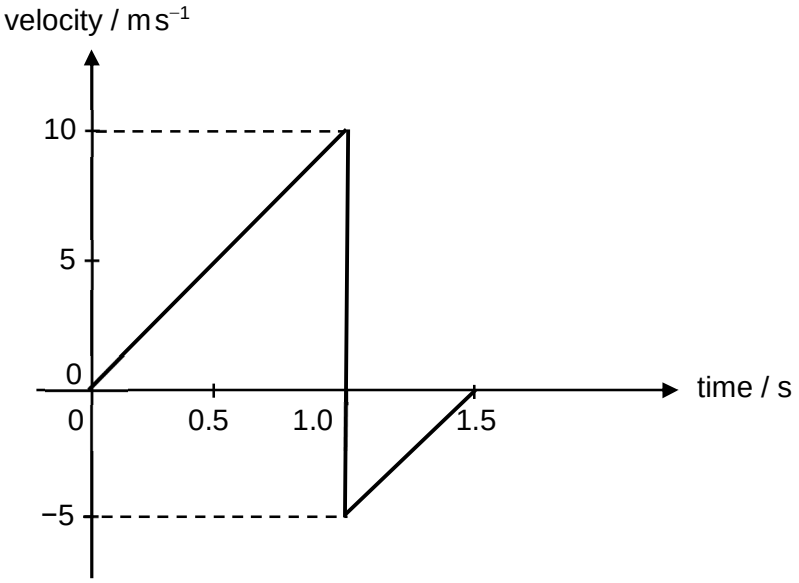
A $(5.34 \pm 0.07) \times 10^{-2}$ Ω m

B $(5.34 \pm 0.05) \times 10^{-2}$ Ω m

C $(5.3 \pm 0.4) \times 10^{-2}$ Ω m

D $(5.3 \pm 0.5) \times 10^{-2}$ Ω m

4 A ball is released from rest at time zero. After 1.0 s, it hits a horizontal surface and rebounds, reaching the top of its first bounce after 1.5 s.



What is the displacement of the ball from its original position after 1.5 s?

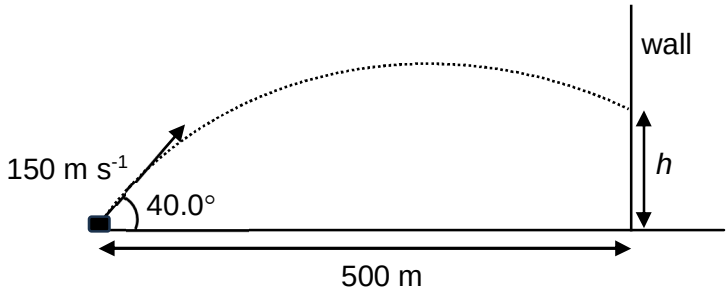
A 1.25 m **B** 3.75 m **C** 5.00 m **D** 6.25 m

5 A car travelling at speed *u* comes to a complete halt after a distance *s* when the driver applies a uniform braking force. A second car, travelling at speed 2*u*, comes to a halt when the driver applies a uniform braking force with twice the magnitude to that of the first car. You may ignore the reaction time of the driver.

What is the distance, in terms of *s* for the second car to come to a halt?

A 0.5*s* **B** 2*s* **C** 3*s* **D** 4*s*

6 A projectile is fired at an angle of 40.0° above the horizontal, and leaves the gun with a speed of 150 m s^{-1}. The projectile strikes a wall, which is 500 m away, at a vertical height of *h*.



Neglecting the effects of air resistance, what is the vertical height *h*?

A 96.4 m **B** 327 m **C** 420 m **D** 512 m

7 Which of the following pairs of forces is **not** an example of Newton's third law of motion?

A the force exerted on a man's feet by the floor and the weight of the man standing on the floor

B the forces of repulsion experienced by each of two parallel wires carrying currents in opposite directions

C the forces of attraction between an electron and a proton in a hydrogen atom

D the force of repulsion between an atom in the surface of a table and an atom in the surface of a book resting on the table

8 What happens to the apparent weight of an object falling freely in an elevator?

A It becomes zero.

B It decreases.

C It increases.

D It remains the same.

9 A football of mass 0.42 kg is travelling towards a player at 3.0 m s^{-1}.

The player kicks the football with an impulse of 6.3 N s, returning it in the direction of approach.

What is the new speed of the football?

A 3.3 m s^{-1} **B** 5.0 m s^{-1} **C** 12 m s^{-1} **D** 18 m s^{-1}

10 Which does **not** involve work being done by a force?

A a bicycle free-wheeling downhill at a constant speed

B the charging of a car battery

C the motion of a spacecraft in deep space

D a man climbing up a flight of stairs

11 A load of 6.0 N is placed on a spring that obeys Hooke's law, causing it to extend 3.0 cm.

What additional elastic potential energy will be stored in the spring if it is extended by a further 10.0 cm?

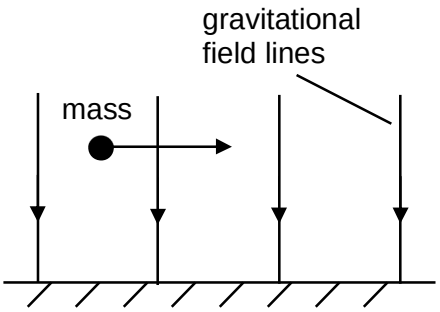
A 0.49 J **B** 0.91 J **C** 1.6 J **D** 1.8 J

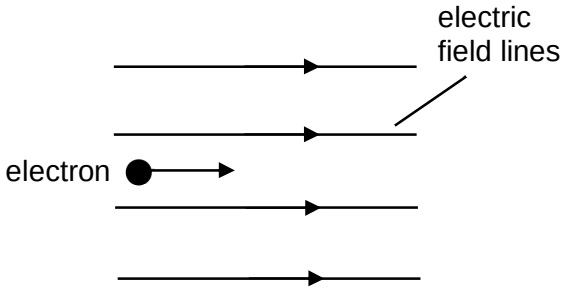
12 A car of mass 1500 kg is accelerated from rest to a speed of 100 km h^{-1} on level ground.

Given that the time taken is 12.1 s, what is the maximum power delivered by the engine?

A 1.72 kW **B** 47.8 kW **C** 95.7 kW **D** 620 kW

13 A mass is initially travelling at right angles to the Earth's uniform gravitational field, and an electron is initially travelling parallel to a uniform electric field, as shown.

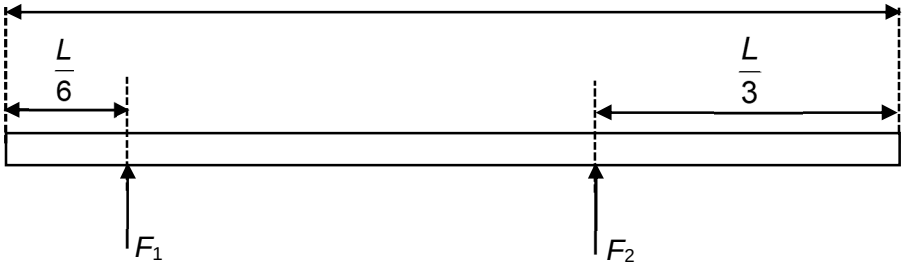




What is the direction of the gravitational force and the electric force experienced by the particles respectively?

	gravitational force on mass	electric force on electron
A	↓	↓
B	→	→
C	↓	→
D	↓	←

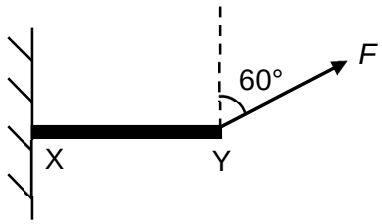
14 A heavy uniform plank of length L is supported by two forces F_1 and F_2 at points of distances $\frac{L}{6}$ and $\frac{L}{3}$ from its ends as shown.



What is the value of $\frac{F_1}{F_2}$?

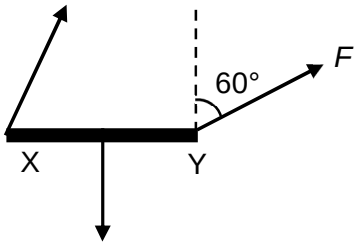
A 0.5 **B** 1.0 **C** 2.0 **D** 4.0

15 A uniform rod XY is freely hinged to a wall at X. It is held horizontally by a force F acting from Y at an angle of 60° to the vertical as shown.

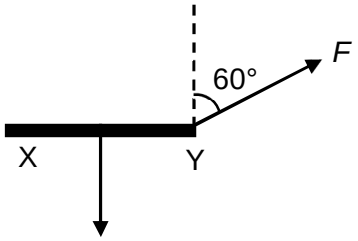


Which of the following best shows the correct free body diagram of all the forces acting on the rod?

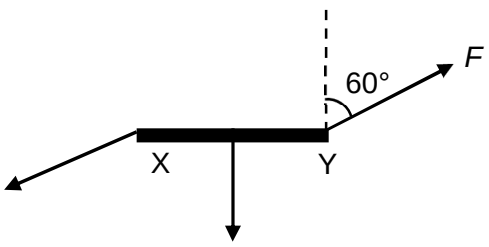
A



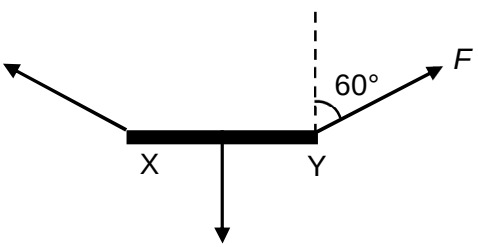
B



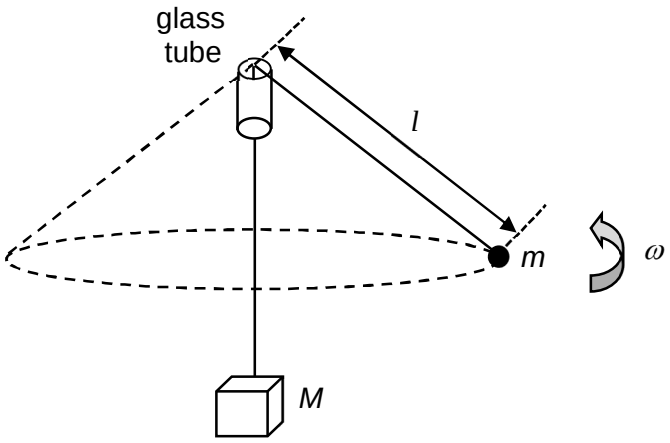
C



D



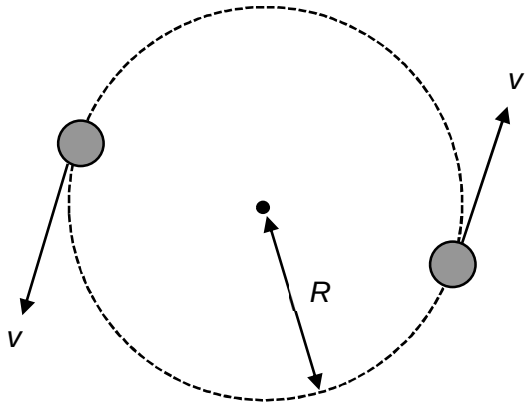
16 A small marble of mass *m* is tied to a rectangular block of mass *M* with an inextensible string as shown in the figure below. The marble is swung in the horizontal plane in circular motion with a constant angular velocity of ω. The string is passed through a smooth vertical glass tube so that the length *l* of the string from the top of the glass tube to the marble can vary freely as the angular velocity changes.



What is the ratio of $\frac{m}{M}$ when mass *M* is stationary?

A $\frac{\omega^2}{gl}$ **B** $\frac{g}{\omega^2 l}$ **C** $g\omega^2 l$ **D** $2g\omega^2 l$

17 Two planets of equal mass *M* are rotating at constant speed *v*, and constant angular velocity ω in a circular orbit. The radius of the orbit is *R* as shown in the diagram below.



Which expression gives the resultant force acting on each planet?

A $\frac{Mv^2}{2GR}$ **B** $\frac{2Mv^2}{GR}$ **C** $\frac{GM^2v^2}{\omega^2}$ **D** $\frac{GM^2\omega^2}{4v^2}$

18 Which of the following quantities is **not** necessarily the same for all geostationary satellites orbiting around the Earth?

A angular velocity

B centripetal acceleration

C kinetic energy

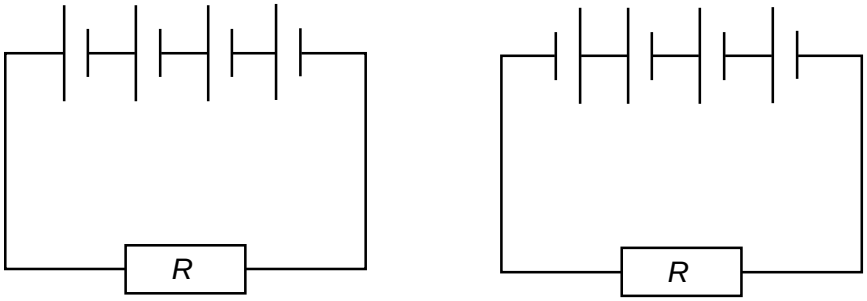
D orbital period

19 The current in a component is reduced uniformly from 100 mA to 20 mA over a period of 8.0 s.

What is the amount of charge that flows during this time?

A 160 mC **B** 320 mC **C** 480 mC **D** 640 mC

20 The given diagrams show two circuits of four identical cells each of e.m.f. 1.5 V and of constant internal resistance 1.0 Ω connected in series with a resistor *R* of resistance 2.0 Ω.



circuit (i) circuit (ii)

Which of the following is the value of $\frac{\text{power in } R \text{ in circuit (i)}}{\text{power in } R \text{ in circuit (ii)}}$?

A 1.0 **B** 2.0 **C** 3.0 **D** 4.0

21 The resistance of a piece of pure silicon falls rapidly as the temperature rises because

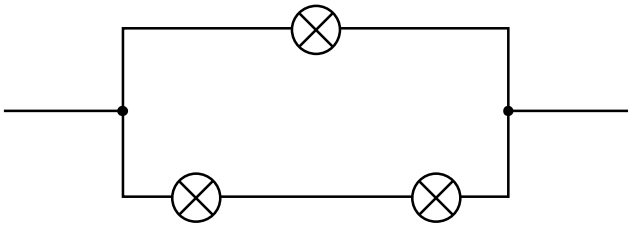
A the total number of charge carriers increases with temperature.

B the ratio of positive to negative charge carriers increases.

C the ratio of positive to negative charge carriers decreases.

D the charge carriers can move more easily at higher temperatures.

22 In the diagram below, three identical bulbs are connected to form a circuit. The maximum power produced by a single bulb is 10 W.

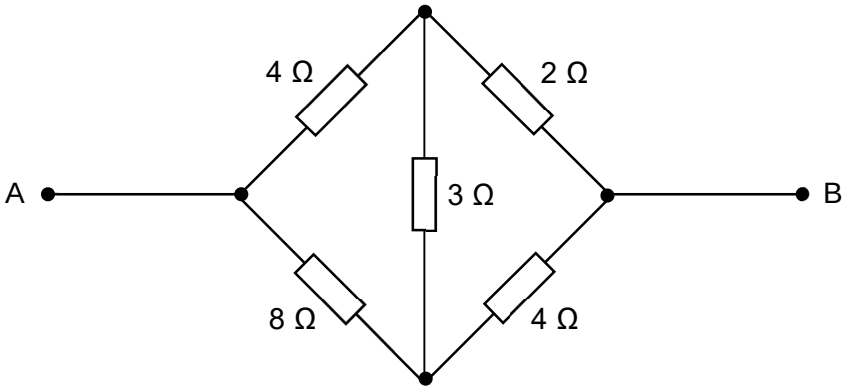


Assume that the resistance of the bulbs remains constant when lighted up.

What is the total maximum power that can be attained in this circuit such that all bulbs are lighted up?

A 10 W **B** 15 W **C** 20 W **D** 30 W

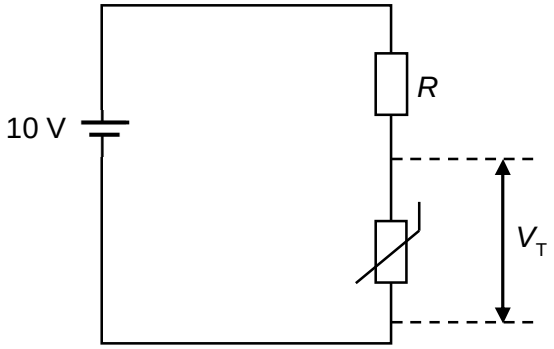
23 The diagram below shows the arrangement of five resistors.



What is the effective resistance between the two points A and B?

A 1.7 Ω **B** 2.6 Ω **C** 4.0 Ω **D** 7.0 Ω

24 A thermistor is connected in series with a fixed resistor of resistance *R* and a cell of e.m.f. 10 V, as shown in the diagram below.

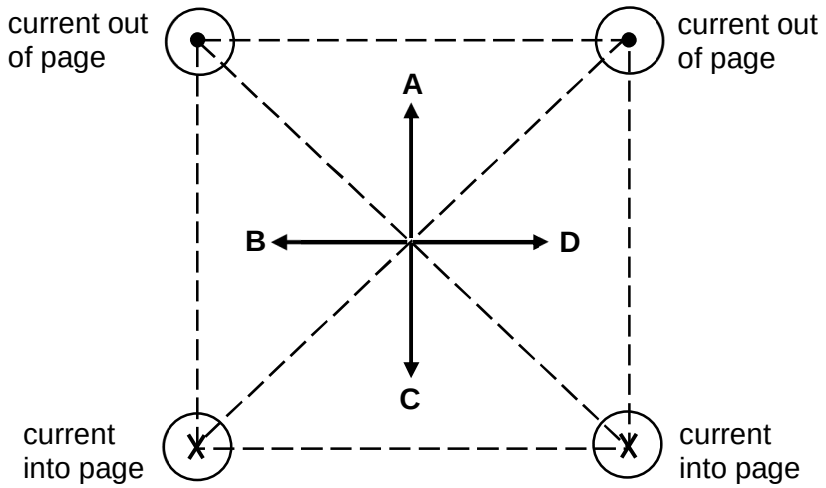


When the temperature of the thermistor is 20 °C, its resistance is 5.3 Ω and the potential difference V_T across it is 4.5 V.

What is the value of V_T if the temperature of the thermistor increases to 60 °C and the resistance drops to 3.1 Ω?

A 1.5 V **B** 2.6 V **C** 3.2 V **D** 3.5 V

25 The figure below shows four parallel conductors arranged at the vertices of a square. Each conductor carries equal current in the directions as indicated.



Conductor Z which is parallel to the other four conductors, is placed at the centre of the square.

If conductor Z carries current flowing into the page, which of the arrows **A**, **B**, **C** or **D** indicates the direction of the force experienced by conductor Z?

26 An electron is moving along the axis of a solenoid carrying a current.

Which of the following is a correct statement about the electromagnetic force acting on the electron?

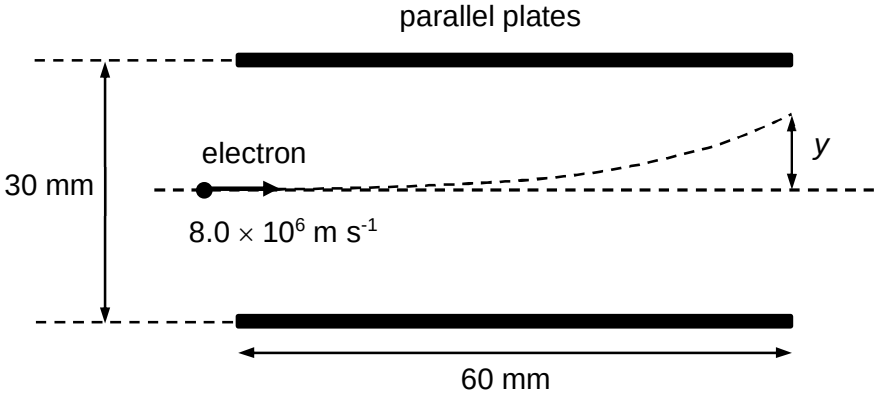
A The force acts radially inwards.

B The force acts radially outwards.

C The force acts in the direction of motion.

D No force acts.

27 A uniform electric field is set up between two parallel plates of length 60 mm and spaced 30 mm apart. A potential difference V is applied between the two plates. An electron is projected horizontally into the electric field with a speed of 8.0×10^6 m s^{-1}. The vertical displacement y of the electron when it exits the parallel plates is 7.6 mm.



What is the potential difference V which is applied between the two plates?

A 10 V **B** 18 V **C** 32 V **D** 46 V

28 A parent nucleus, initially at rest, decays into two particles of masses m_1 and m_2, moving away from each other in opposite directions.

If E is the total energy of the two particles, what is the energy associated with the particle of mass m_1?

A $\left(\frac{m_1}{m_2}\right)E$ **B** $\left(\frac{m_2}{m_1}\right)E$ **C** $\left(\frac{m_1}{m_1+m_2}\right)E$ **D** $\left(\frac{m_2}{m_1+m_2}\right)E$

29 $^{232}_{90}Th$ decays via a series of α, β, and γ decays to the stable isotope $^{208}_{82}Pb$.

Which row describes what can be deduced about the numbers of each decay type?

	number of α decays	number of β decays	number of γ decays
A	6	4	cannot tell
B	6	cannot tell	4
C	cannot tell	6	6
D	cannot tell	cannot tell	cannot tell

30 A radioactive isotope has a half life of 8 hours. A detector placed near the radioactive isotope records a count-rate of 500 counts per minute. The average background count-rate is 35 per minute.

What will be the reading recorded by the detector after one day has passed?

A 58.1 **B** 93.1 **C** 150 **D** 250

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