PDG

Candidate Name _____ ( )

ANDERSON JUNIOR COLLEGE

2015 JC2 Preliminary Examination

PHYSICS **8866/01**
Higher 1
Paper 1 Multiple Choice **Monday 31 August 2015**
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**, **PDG** and **NRIC/FIN** and shade the **7 digits of your NRIC/FIN** in soft pencil on the Answer Sheet.

There are **thirty** questions in this section.
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.

Read the instructions on the Answer Sheet very carefully.

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 question paper.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **15** printed pages and **1** blank page

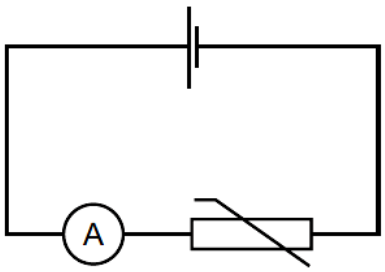
Data

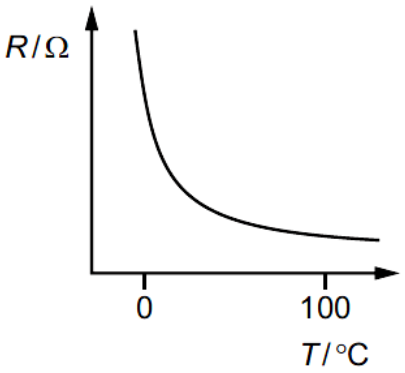
speed of light in free space,	$c = 3.00 \times 10^{8}$ m s^{-1}
elementary charge,	$e = 1.60 \times 10^{-19}$ C
the Planck constant	$h = 6.63 \times 10^{-34}$ J s
unified atomic mass constant	$u = 1.66 \times 10^{-27}$ kg
rest mass of electron,	$m_e = 9.11 \times 10^{-31}$ kg
rest mass of proton,	$m_p = 1.67 \times 10^{-27}$ kg
acceleration of free fall.	$g = 9.81$ m s^{-2}

Formulae

uniformly accelerated motion,	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
work done on/by a gas,	$W = p\Delta V$
hydrostatic pressure,	$p = \rho gh$
resistors in series,	$R = R_1 + R_2 + \ldots$
resistors in parallel.	$1/R = 1/R_1 + 1/R_2 + \ldots$

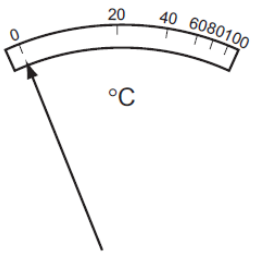
1 In the circuit shown, an analogue ammeter is to be recalibrated as a thermometer. The graph shows how the resistance R of the thermistor changes with temperature T.



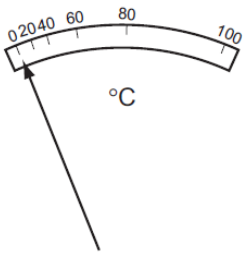


Which diagram could represent the temperature scale on the ammeter?

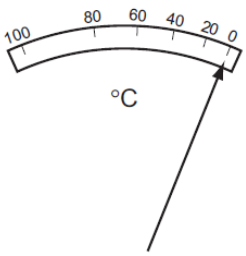
A



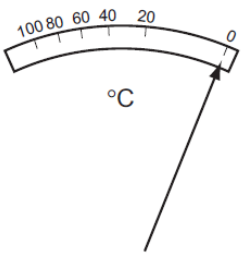
B



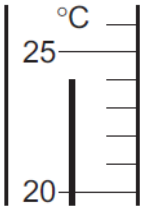
C



D



2 The diagram shows part of a thermometer.

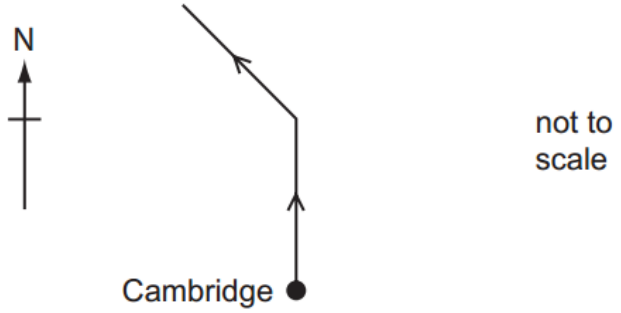


What is the correct reading on the thermometer and the uncertainty in this reading?

	reading / °C	uncertainty in reading / °C
A	24	± 1
B	24	± 0.5
C	24	± 0.2
D	24.0	± 0.5

3 The air-traffic control centre at Cambridge looks after all aircraft within a 250 kilometre radius of Cambridge.

A small aircraft, flying due north at 200 kilometres per hour, passes over Cambridge at 12:00pm. It carries enough fuel for another 350 kilometres of flying. At 12:30pm, air traffic control instructs the pilot to turn through 45° onto a north-westerly bearing. The aircraft continues at 200 kilometres per hour until 1:30pm.



At 1:30pm the aircraft is still 80 kilometres from its destination.

What is the location of the aircraft and which action is required?

	location of aircraft	action required
A	outside Cambridge's air-traffic control space	carry on to destination
B	outside Cambridge's air-traffic control space	make an emergency landing before getting to destination
C	within Cambridge's air-traffic control space	carry on to destination
D	within Cambridge's air-traffic control space	make an emergency landing before getting to destination

4 The acceleration of free fall on the Moon is one-sixth of that on Earth.

On Earth it takes time t for a stone to fall from rest a distance of 2 m.

What is the time taken for a stone to fall from rest a distance of 2 m on the Moon?

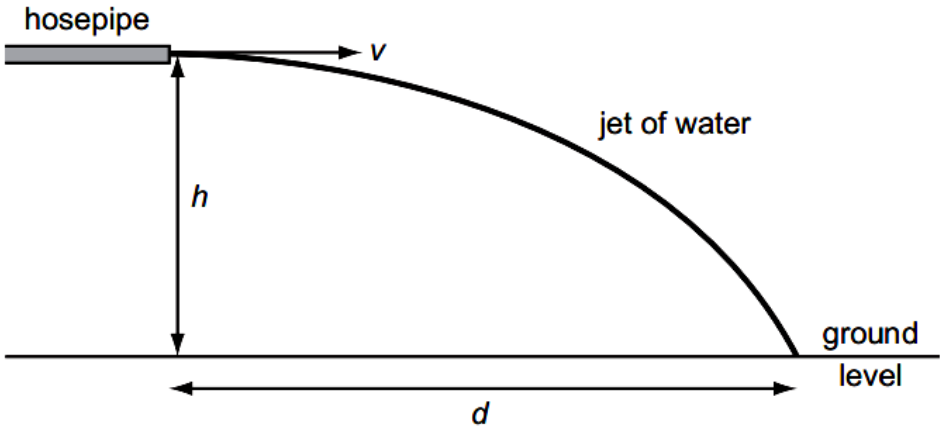
A $6t$ **B** $t\sqrt{6}$ **C** $\frac{t}{\sqrt{6}}$ **D** $\frac{t}{6}$

5 A projectile is launched at 30° to the horizontal with initial kinetic energy E.

Assuming air resistance to be negligible, what will be the kinetic energy of the projectile when it reaches its highest point?

A 0.50 E **B** 0.71 E **C** 0.75 E **D** 0.87 E

6 A hosepipe is fixed as shown.



The jet of water emerges with a horizontal velocity v. The hosepipe is fixed at a height h above the ground. The water jet hits the floor at a horizontal distance d from the nozzle tip. The gravitational field strength is g.

What is the expression for distance d? (Ignore air resistance.)

A $\frac{vg}{2h}$ **B** $\frac{2vh}{g}$ **C** $v\sqrt{\frac{g}{2h}}$ **D** $v\sqrt{\frac{2h}{g}}$

7 Water is pumped through a hosepipe at a rate of 90 kg per minute. It emerges from the hosepipe horizontally with a speed of 20 m s^{-1}.

Which force is required from a person holding the hosepipe to prevent it moving backwards?

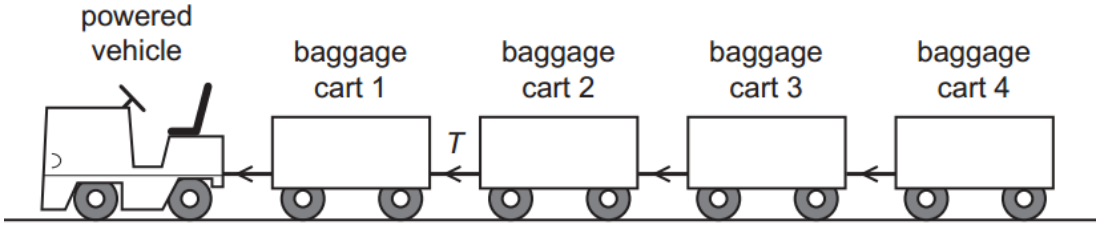
A 30 N **B** 270 N **C** 1800 N **D** 10800 N

8 Two railway trucks of masses m and $3m$ move towards each other in opposite directions with speeds $2v$ and v respectively. These trucks collide and stick together.

What is the speed of the trucks after the collision?

A $\frac{v}{4}$ **B** $\frac{v}{2}$ **C** v **D** $\frac{5v}{4}$

9 A transport system, used to move luggage from the airport terminal to the aircraft, consists of a powered vehicle connected to four baggage carts by a series of connecting bars.



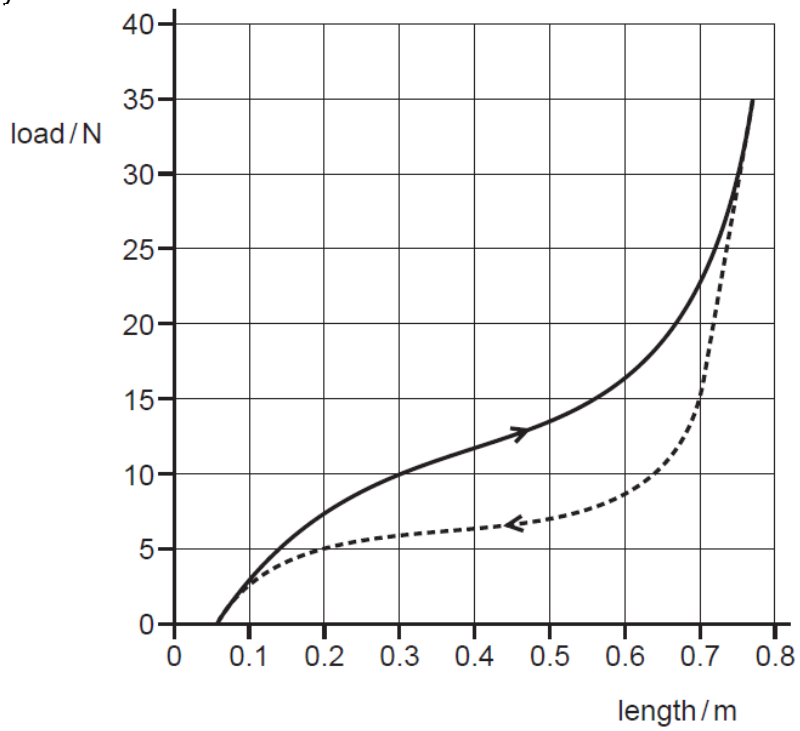
The mass of the powered vehicle is 200 kg and each of the baggage carts has a mass of 400 kg.

The system starts with an acceleration of 2.0 m s^{-2}.

What is the tension *T* in the connecting bar between baggage carts 1 and 2? (Ignore any friction forces on the carts.)

A 800 N **B** 1200 N **C** 2400 N **D** 3600 N

10 The solid line on the graph shows how the length of a rubber band varies when an increasing load is applied. The dotted line shows how the length subsequently varies as the load is gradually decreased.



Which statement is correct?

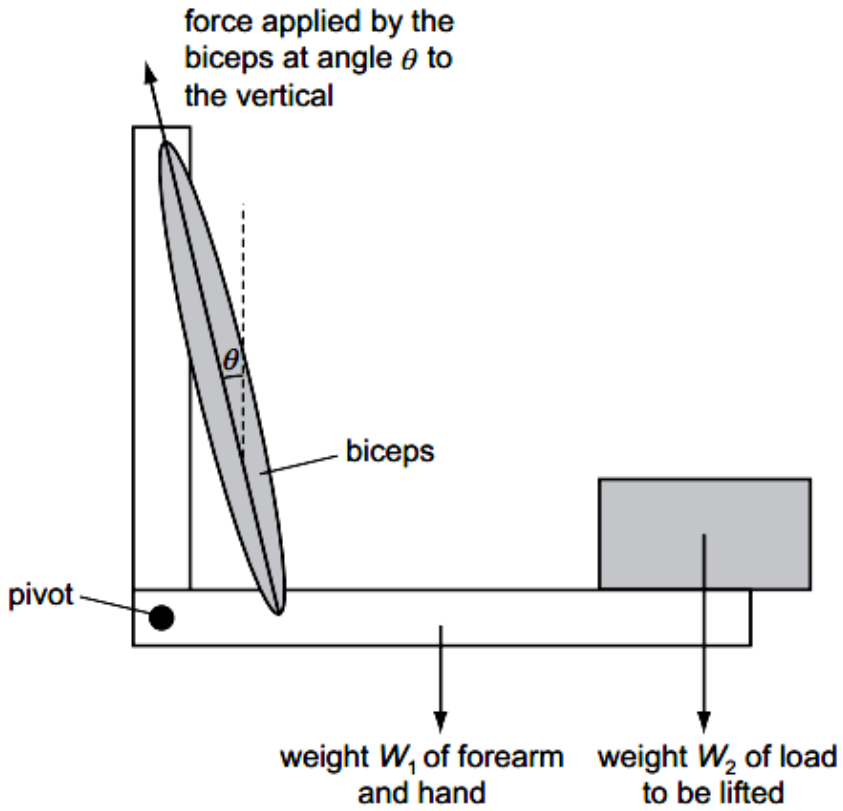
A The energy recovered when the load is removed is about 10 J.

B The energy remaining in the rubber band after one cycle of loading and unloading is about 3 J.

C The total work done on the rubber band during one cycle of loading and unloading is about 14 J.

D The work done in stretching the rubber band is about 5 J.

11 The diagram shows a model of an arm. A force applied by the biceps muscle can hold the arm in equilibrium while it supports a load.



Which statement is correct when the arm is in equilibrium in the position shown?

A The force at the pivot is zero.

B The force from the biceps is bigger when the load is moved nearer to the pivot.

C The force from the biceps is equal to $W_1 + W_2$.

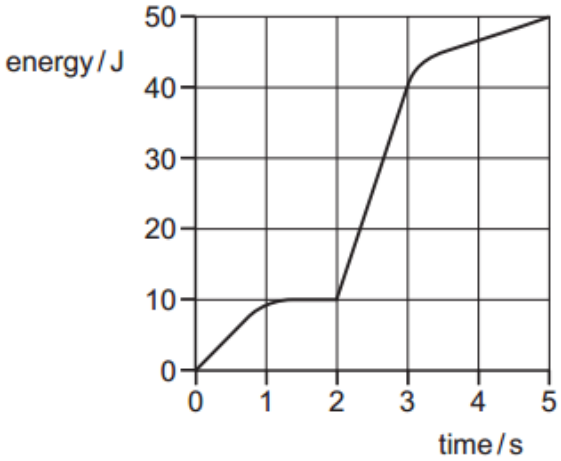
D The resultant force on the biceps is zero.

12 A vehicle is used to explore under the sea. The force due to the water on its horizontal rectangular window, which measures 50.0 cm by 40.0 cm, is 8.24×10^6 N.

At what depth is the window? (Average density of sea water is 1.03×10^3 kg m^{-3}).

A 40.8 m **B** 163 m **C** 4.08×10^3 m **D** 4.00×10^4 m

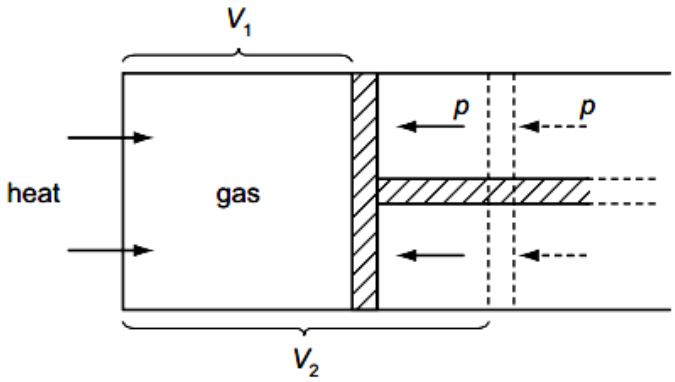
13 An electrical generator is started at time zero. The total electrical energy generated during the first 5 seconds is shown in the graph.



What is the maximum electrical power generated at any instant during these first 5 seconds?

A 10 W **B** 13 W **C** 30 W **D** 50 W

14 A gas is enclosed inside a cylinder which is fitted with a frictionless piston.

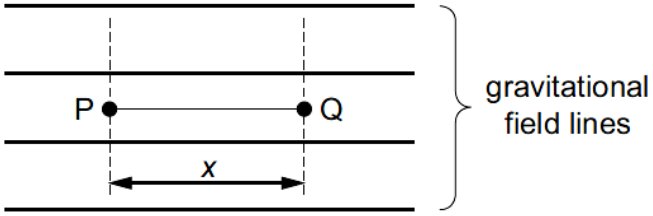


Initially, the gas has a volume V_1 and is in equilibrium with an external pressure p. The gas is then heated slowly so that it expands, pushing the piston back until the volume of the gas has increased to V_2.

How much work is done by the gas during this expansion?

A $p(V_2 - V_1)$ **B** $\frac{1}{2}p(V_2 - V_1)$ **C** $p(V_2 + V_1)$ **D** $\frac{1}{2}p(V_2 + V_1)$

15 A mass m is situated in a uniform gravitational field.



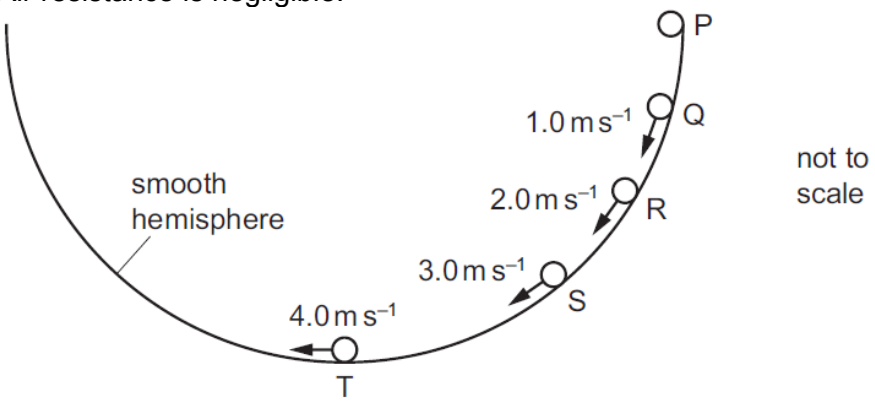
When the mass moves through a displacement x, from P to Q, it loses an amount of potential energy E.

Which row correctly specifies the magnitude and the direction of the acceleration due to gravity in this field?

	magnitude	direction
A	$\frac{E}{mx}$	→
B	$\frac{E}{mx}$	←
C	$\frac{E}{x}$	→
D	$\frac{E}{x}$	←

16 A small mass is placed at point P on the inside surface of a smooth hemisphere. It is then released from rest. When it reaches the lowest point T, its speed is 4.0 m s^{-1}.

The diagram (not to scale) shows the speed of the mass at other points Q, R and S as it slides down. Air resistance is negligible.



The mass loses potential energy E in falling from P to T.

At which point has the mass lost potential energy $\frac{E}{4}$?

A Q

B R

C S

D None of these

17 Which statement describes a situation when polarisation could **not** occur?

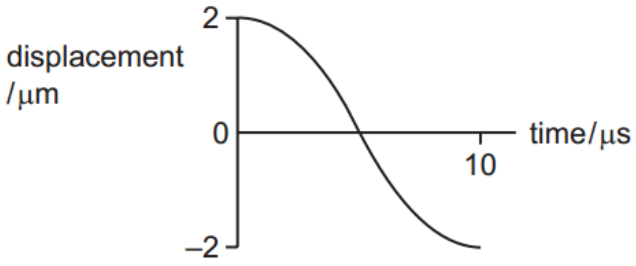
A Light waves are reflected.

B Light waves are scattered.

C Microwaves pass through a metal grid.

D Sound waves pass through a metal grid.

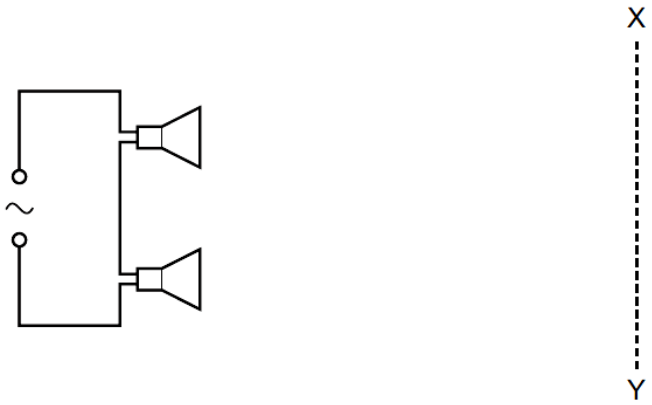
18 The graph shows the variation in the displacement of a particle in a progressive wave with respect to time.



Which row gives the correct values of the frequency and amplitude of the vibration of the particle?

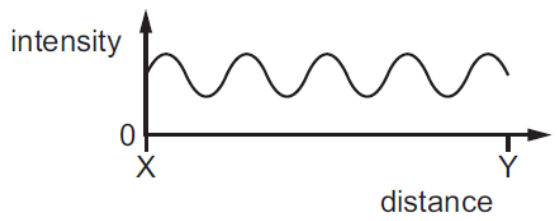
	frequency / kHz	amplitude / μm
A	25	2.0
B	25	4.0
C	50	2.0
D	50	4.0

19 Two identical loudspeakers are connected in series to an a.c. supply, as shown.

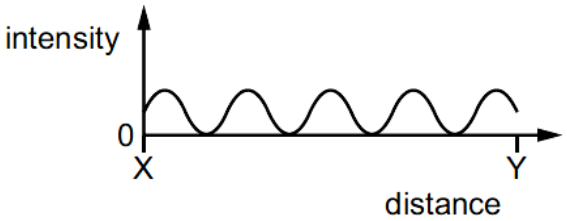


Which graph best shows the variation of the intensity of the sound with distance along the line XY?

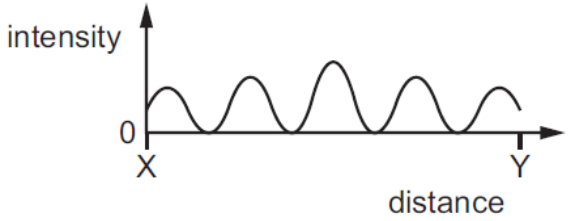
A



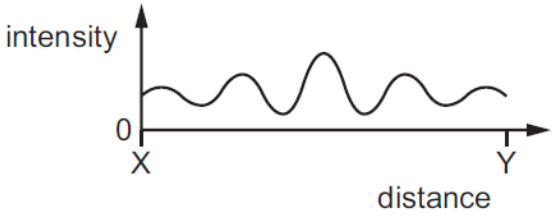
B



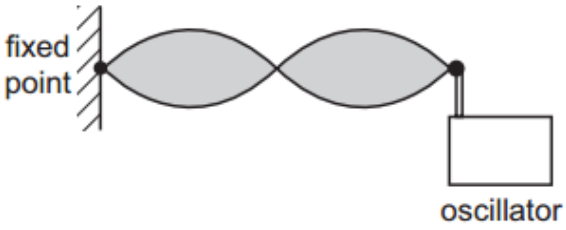
C



D



20 The speed of a transverse wave on a stretched string can be changed by adjusting the tension of the string. A stationary wave pattern is set up on a stretched string using an oscillator set at a frequency of 650 Hz.



How must the wave be changed to maintain the same stationary wave pattern if the applied frequency is increased to 750 Hz?

A Decrease the wavelength of the wave on the string.

B Increase the wavelength of the wave on the string.

C Decrease the speed of the wave on the string.

D Increase the speed of the wave on the string.

21 The Large Hadron Collider is designed to accelerate groups of protons around a large circular ring.

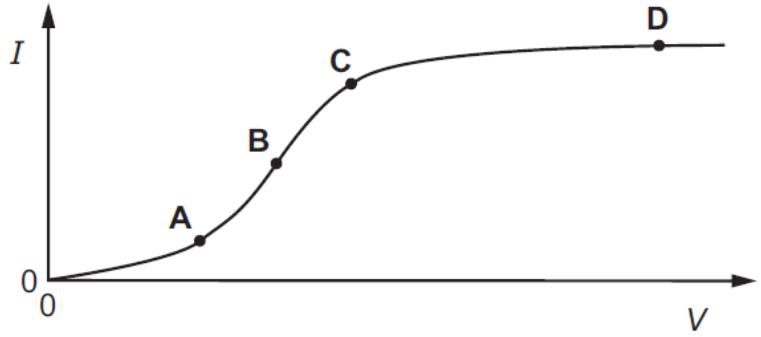
At any moment, there will be 3000 groups in the ring and each group will contain about 10^{11} protons. All the protons go around the ring 10^4 times per second.

What is the best estimate of the current in the ring?

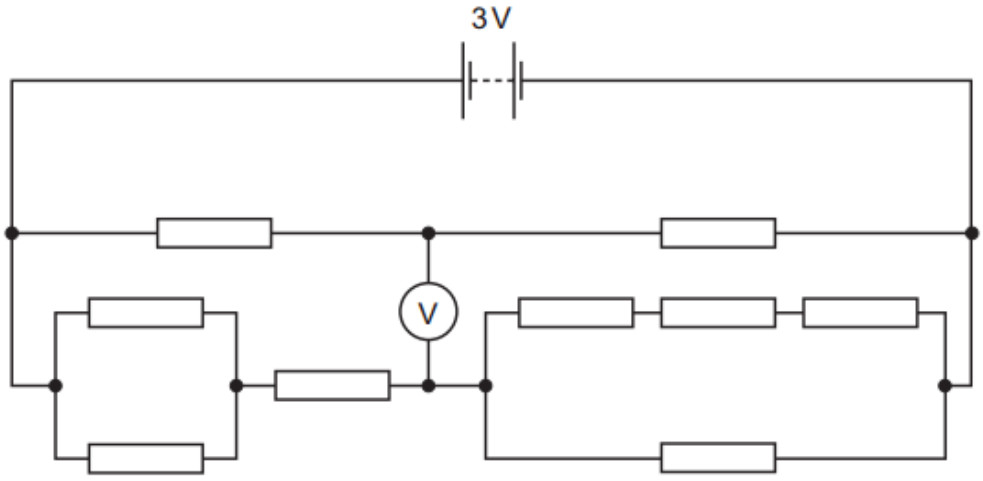
A 50 μA **B** 160 μA **C** 500 mA **D** 160 A

22 The graph shows how the electric current *I* through a conducting liquid varies with the potential difference *V* across it.

At which point on the graph does the liquid have the smallest resistance?



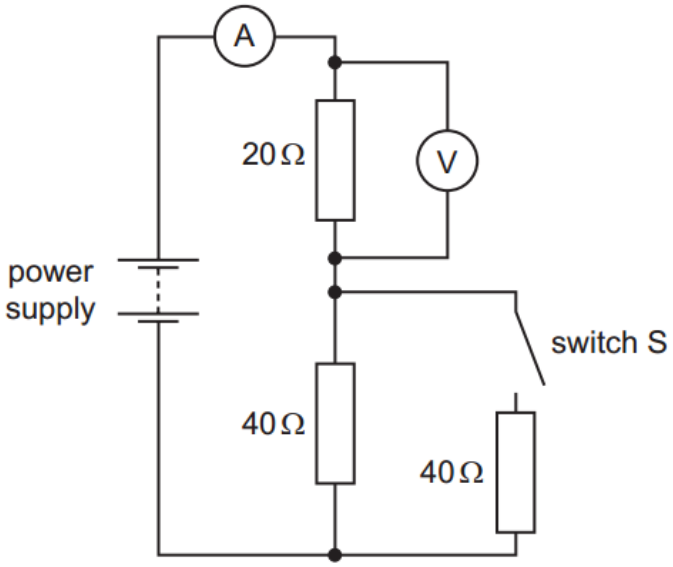
23 A circuit is set up as shown, supplied by a 3 V battery. All resistances are 1 kΩ.



What will be the reading on the voltmeter?

A 0 **B** 0.5 V **C** 1.0 V **D** 1.5 V

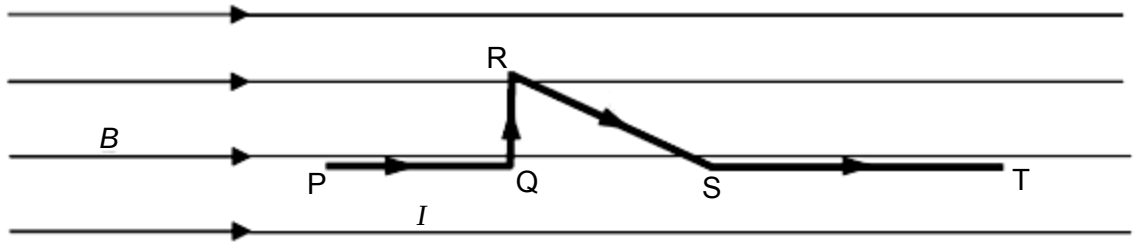
24 A circuit is connected as shown.



What will happen to the readings on the voltmeter and ammeter when switch S is closed?

	voltmeter reading	ammeter reading
A	decrease	decrease
B	decrease	increase
C	increase	increase
D	no change	increase

25 A bent wire PQRST carrying a current I is placed in a magnetic field of flux density B as shown. QR is the shortest and ST is the longest. PQ and RS are equal in length and both are longer than QR.



The forces acting on PQ, QR, RS and ST are given by F_{PQ}, F_{QR}, F_{RS} and F_{ST} respectively.

Which of the following is true?

A $F_{QR} \neq F_{RS}$ and $F_{PQ} < F_{ST}$

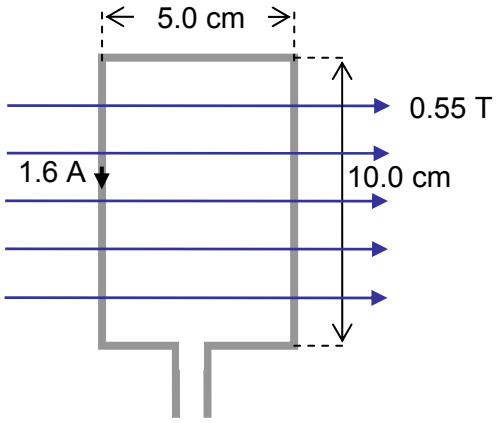
B $F_{QR} = F_{RS}$ and $F_{PQ} = F_{ST}$

C $F_{QR} > F_{RS}$ and $F_{PQ} < F_{ST}$

D $F_{QR} < F_{RS}$ and $F_{PQ} = F_{ST}$

26 A rectangular coil with 100 turns has dimensions 5.0 cm by 10.0 cm. It is placed in a magnetic field of flux density 0.55 T and a current of 1.6 A passes through the coil. The magnetic field lines lie in the plane of the rectangular coil.

What is the magnitude and direction of the maximum torque?



A 0.44 N m with right edge moving into plane of paper

B 0.22 N m with right edge moving into plane of paper

C 0.44 N m with the left edge moving into plane of paper

D 0.22 N m with left edge moving into plane of paper

27 In 2010 the Japanese launched the world's first interplanetary solar sail spacecraft, called IKAROS. This works because photons reflected from the sail, of area A, undergo a change of momentum and, by Newton's third Law, exert a forward force on the sail.

A beam of light of intensity I is reflected at right angles to a solar sail.

The momentum of a photon is given by the expression $\frac{hf}{c}$, where f is the frequency of the light, h is the Planck constant and c is the speed of light.

What is the force exerted on the sail?

A $\frac{2IA}{c}$ **B** $\frac{2hf}{c}$ **C** $\frac{IA}{hf}$ **D** $\frac{I}{c}$

28 Two phenomena P and Q are described.

P When ultraviolet light shines on zinc, electrons are emitted from the surface.

Q When electrons are passed through graphite, a pattern of rings may be observed on a screen.

Which different models are used to explain the phenomena?

	P	Q
A	particle	particle
B	particle	wave
C	wave	particle
D	wave	wave

29 Monochromatic light of wavelength 650 nm is incident on a clean potassium surface.

The work function of potassium is 1.81 eV.

What is the maximum velocity of the electrons emitted?

A 1.3×10^5 m s^{-1}

B 1.9×10^5 m s^{-1}

C 5.2×10^5 m s^{-1}

D 8.2×10^5 m s^{-1}

30 Transitions between three energy levels in a particular atom give rise to three spectral lines. The shortest and the longest wavelengths of these spectral lines are λ_1 and λ_2 respectively. The wavelength of the other spectral line is

A $\lambda_2 - \lambda_1$ **B** $\frac{\lambda_2 - \lambda_1}{2}$ **C** $\frac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$ **D** $\frac{\lambda_1 \lambda_2}{\lambda_2 - \lambda_1}$