EUNOIA JUNIOR COLLEGE
JC2 Mid Year Examination 2021
General Certificate of Education Advanced Level
Higher 1

PHYSICS

Paper 1 Multiple Choice

8867/01

09 Jul 2021

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use paper clips, glue or correction fluid.
Write your name, civics group and registration number on the Answer Sheet in the spaces provided.

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.

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 booklet.
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	=	3.00×10^{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 formula could be correct for the speed v of ocean waves in terms of the density ρ of sea-water, the acceleration of free fall g, the depth h of the ocean and the wavelength λ?

A $v = \sqrt{g\lambda}$ **B** $v = \sqrt{\frac{g}{h}}$ **C** $v = \sqrt{\rho g h}$ **D** $v = \sqrt{\frac{g}{\rho}}$

2 A specimen of volume V is cut from a length of circular-section metal rod. The length of the specimen is known with an uncertainty of ± 1% and the diameter with an uncertainty of ± 2%.

What will be the uncertainty of V?

A 2% **B** 3% **C** 4% **D** 5%

3 The speed of an aeroplane in still air is 200 km h^{-1}. The wind blows from the west at a speed of 85.0 km h^{-1}.

In which direction must the pilot steer in order to fly due north?

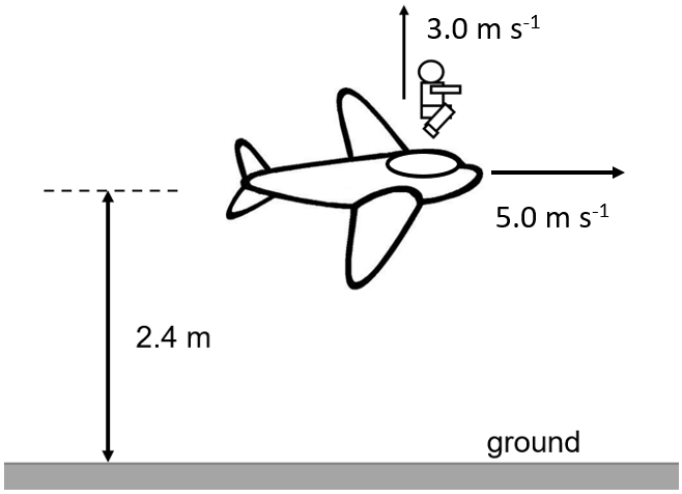
A 23.0° east of north

B 23.0° west of north

C 25.2° east of north

D 25.2° west of north

4 A toy airplane is flying above the ground at a constant horizontal velocity of 5.0 m s^{-1} when the toy pilot is ejected. The airplane propels the toy pilot upward at a height of 2.4 m above the ground and the vertical component of his speed is initially 3.0 m s^{-1}. Ignore the effects of air resistance.



What is the speed of the toy pilot when it hits the ground?

A 3.7 m s^{-1}

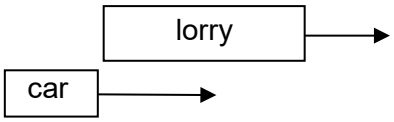
B 5.8 m s^{-1}

C 7.5 m s^{-1}

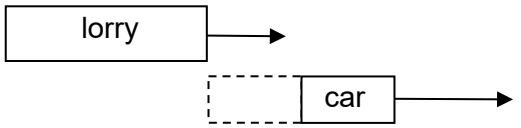
D 9.0 m s^{-1}

5 The minimum time T required for a car to safely overtake a lorry is illustrated in the given figure. It is measured from the time the front of the car is level with the rear of the lorry, until the rear of the passing car is one full car-length ahead of the front of the lorry.

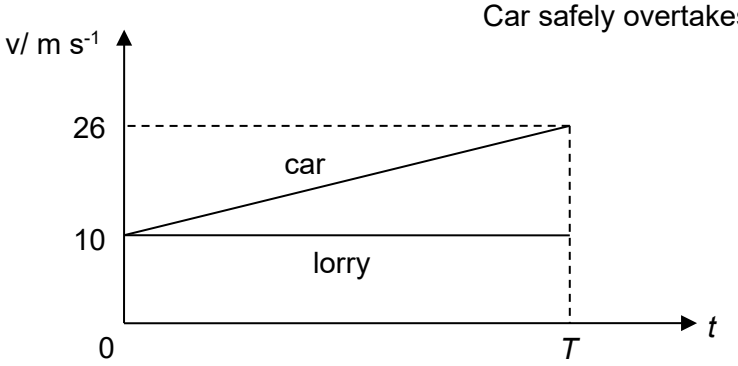
The lorry may be taken to be 17.0 m long and the car 3.5 m long. The given graph shows how the speed v of the car and the lorry vary with time t.



Car begins to overtake: time $t = 0$



Car safely overtakes: time $t = T$



What is the value of T?

A 0.86 s

B 1.2 s

C 2.6 s

D 3.0 s

6 Which equation can be rearranged to give the definition of acceleration?

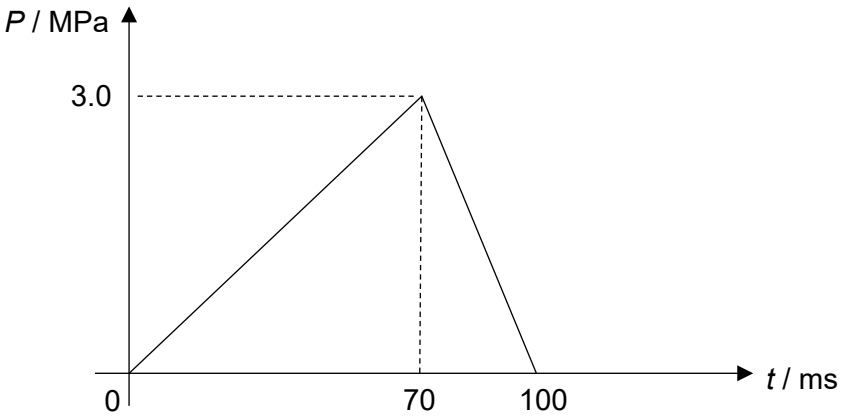
A $F = ma$

B $s = ut + \frac{1}{2} at^2$

C $v = u + at$

D $v^2 = u^2 + 2as$

7 A projectile of mass 3.2×10^{-2} kg is fired from a cylindrical barrel of cross-sectional area 2.8×10^{-4} m^2 by means of compressed gas. The variation with time t of the excess pressure P of the gas in the barrel above atmospheric pressure is shown in the figure.



What is the speed of the projectile as it leaves the barrel?

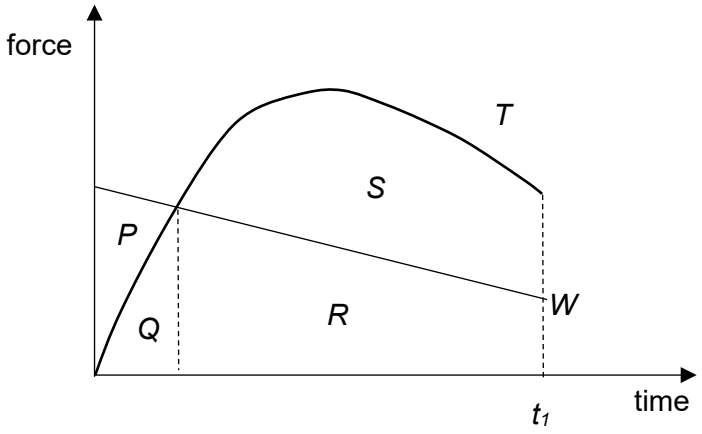
A 42 m s^{-1}

B 1300 m s^{-1}

C 1.5×10^5 m s^{-1}

D 4.7×10^6 m s^{-1}

8 The variation with time of the upward thrust T on the rocket and the total weight W of the rocket are shown in the figure below.



Given that m the mass of rocket at time t_1, which expression gives the speed v of the rocket at time t_1?

A $v = \dfrac{\text{area P + area Q + area R + area S}}{m}$

B $v = \dfrac{\text{area Q + area R + area S}}{m}$

C $v = \dfrac{\text{area R + area S}}{m}$

D $v = \dfrac{\text{area S}}{m}$

9 A train consisting of six wagons each of mass 6.0×10^4 kg is pulled at a constant speed by a locomotive along a straight horizontal track. The horizontal force resisting the motion of each wagon is 4000 N.

The train now accelerates at 0.15 m s^{-2}.

What is the tension in the coupling between wagons 1 and 2?

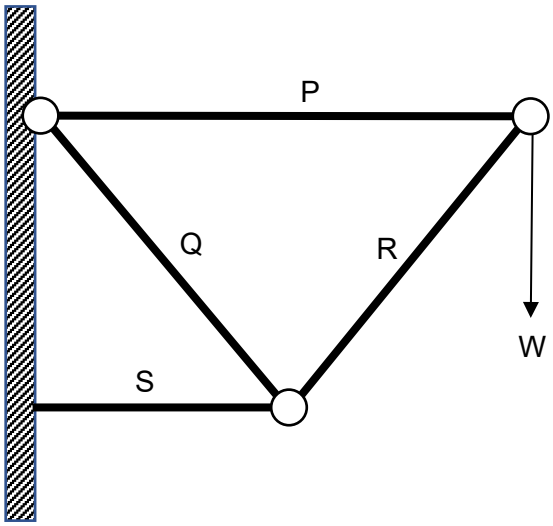
A 26 kN **B** 40 kN **C** 52 kN **D** 65 kN

10 A body, initially at rest, explodes into two fragments, one having three times the mass of the other.

What is the value of the ratio $\frac{\text{speed of the more massive fragment}}{\text{speed of the less massive fragment}}$?

A 0.33
B 0.58
C 1.73
D 3.00

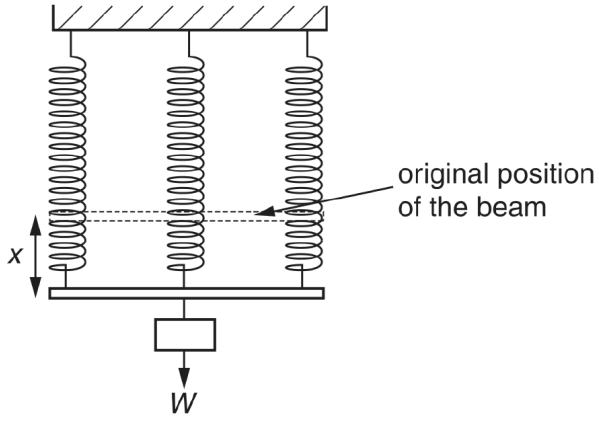
11 The given diagram shows a load W supported by four hinged rods P, Q, R and S, connected and mounted in a vertical plane.



Which row correctly shows the rods in compression and the rods in tension?

	In compression	In tension
A	P	Q, R, S
B	P, Q	R, S
C	Q, R	P, S
D	R, S	P, Q

12 A beam, the weight of which may be neglected, is supported by three identical springs. When a weight W is hung from the middle of the beam, the extension of each spring is x.



The middle spring and the weight are removed.

What is the extension when a weight of $3W$ is hung from the middle of the beam?

A $\frac{2x}{9}$ **B** $\frac{9x}{2}$ **C** x **D** $3x$

13 A car of mass 1000 kg travels up a hill at a constant speed. It gains 87 m in height travelling a distance of 500 m. The total frictional force is 580 N.

What is the work done by the driving force?

A 0.85×10^6 J

B 1.14×10^6 J

C 4.90×10^6 J

D 5.19×10^6 J

14 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

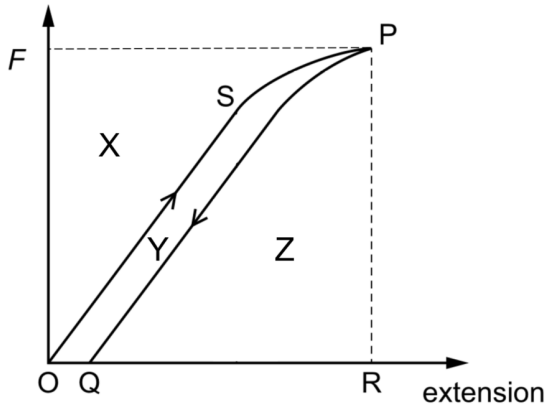
C the motion of a spacecraft in deep space at a constant speed

D the release of compressed air from a cylinder into the atmosphere

15 A massless spring is attached to a mass. The system is lying horizontally on a smooth table. The tension *F* in the spring is as shown in the figure below.

A force that matches *F* is applied, causing the spring to extend. This is shown on the graph by the line OSP.

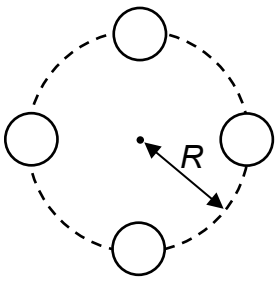
The applied force on the mass-spring system is then released and the spring contracts. This is shown on the graph by the line PQ.



Which of the following correctly represents the energies involved in the process?

	work done to extend the spring	heat loss	kinetic energy of mass just before spring returns to Q
A	Y + Z	Y	Z
B	Y + Z	Y	Z - Y
C	Z	Y	Y + Z
D	X	Z - Y	Z

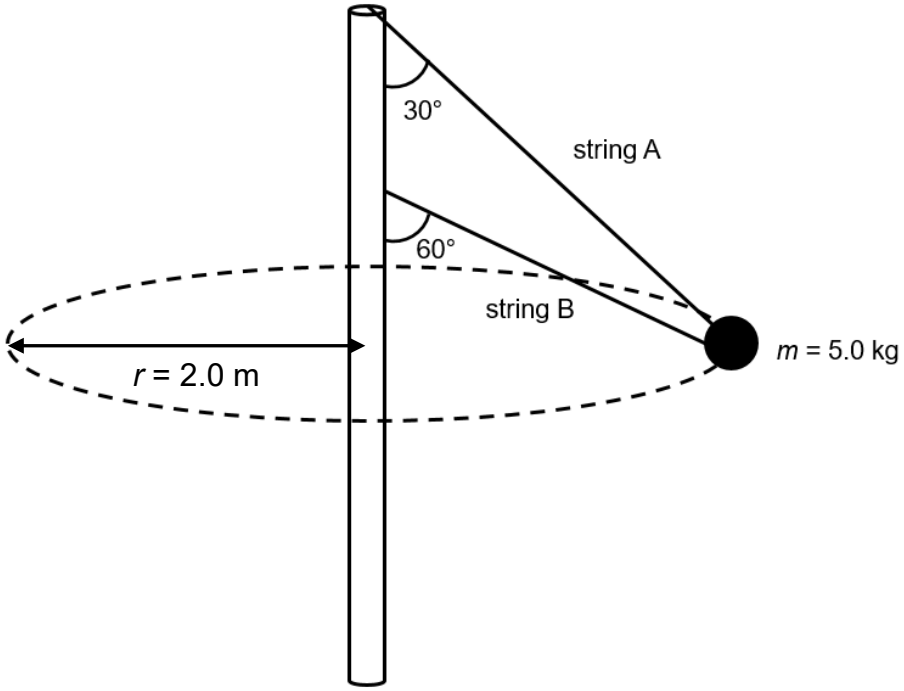
16 Four bodies of equal mass *M* are equally spaced in a circle of radius *R*.



What is the net gravitational force on each body?

A $\frac{0.25GM^2}{R^2}$ **B** $\frac{0.96GM^2}{R^2}$ **C** $\frac{1.3GM^2}{R^2}$ **D** $\frac{1.7GM^2}{R^2}$

17 A mass *m* of 5.0 kg is undergoing uniform circular motion around a pole as shown in the figure below at an angular speed of 2.0 rad s^{-1}. Strings A and B that support the mass make angles of 30° and 60° with the pole respectively.



Which of the following options gives the magnitude of the tensions in the strings respectively?

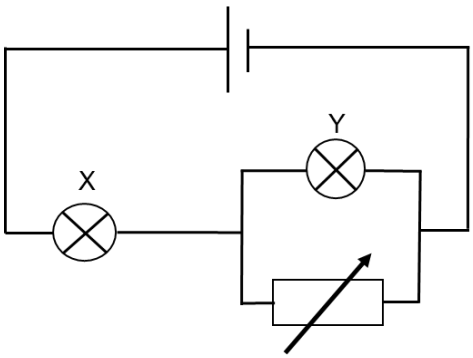
	tension in string A / N	tension in string B / N
A	45.0	20.2
B	62.5	10.1
C	65.0	14.4
D	125.0	118.3

18 An astronaut in a space capsule orbiting the Earth appears to float inside the capsule.

Which statement explains this?

A The astronaut has zero weight.
B The centripetal acceleration of the astronaut and the capsule are the same.
C The centripetal force on the astronaut and the capsule are the same.
D The force of gravity on the astronaut is zero.

19 A circuit contains a battery, two identical lamps X and Y, and a variable resistor.

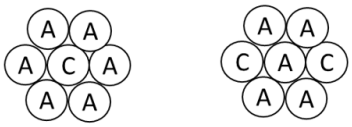


The resistance of the variable resistor is decreased.

What will happen to the brightness of the lamp?

	lamp X	lamp Y
A	brighter	brighter
B	brighter	less bright
C	less bright	brighter
D	less bright	less bright

20 Wire X and wire Y are each 0.6 m long. The wires are formed by seven smaller wires of different materials each with a cross-sectional area 2.8 mm^2. The figure below shows the cross-sections of wires X and Y. The resistivities of copper and aluminium are 1.7×10^{-8} Ω m and 2.7×10^{-8} Ω m respectively.



Wire X Wire Y

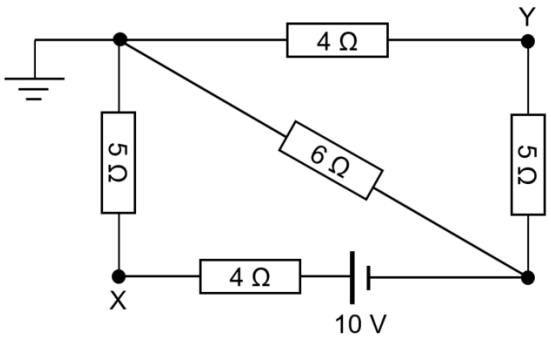
A = Aluminium
C = Copper

A 1.2 m long wire is formed by joining wire X and wire Y together.

Determine the resistance of the long wire.

A 3.7×10^{-4} Ω **B** 7.6×10^{-4} Ω **C** 1.1×10^{-3} Ω **D** 1.5×10^{-3} Ω

21 A circuit is arranged using a 10 V cell and 5 different resistors as illustrated in the diagram below.

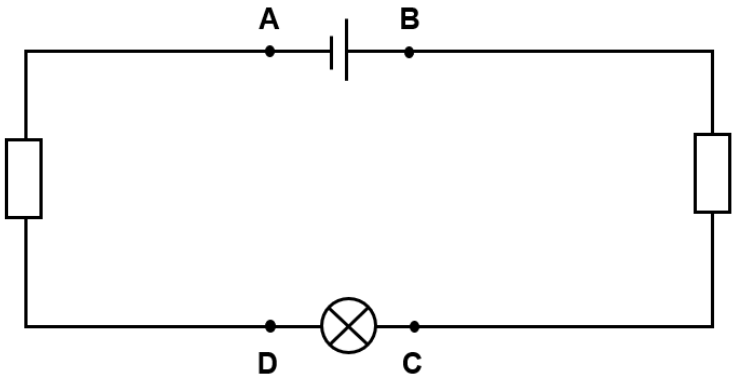


What are the electric potential at point X and Y respectively?

	Potential at X / V	Potential at Y / V
A	4.0	- 1.3
B	4.0	- 2.9
C	5.3	- 1.3
D	5.3	- 2.9

22 An electron travels around the circuit as shown in the diagram. The cell has negligible internal resistance.

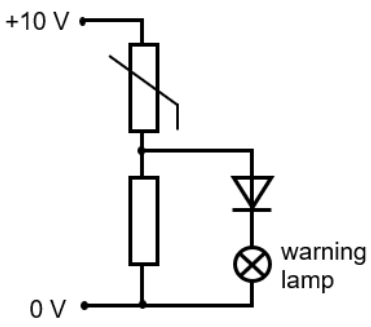
At which point in the circuit does the electron have its maximum electrical potential energy?



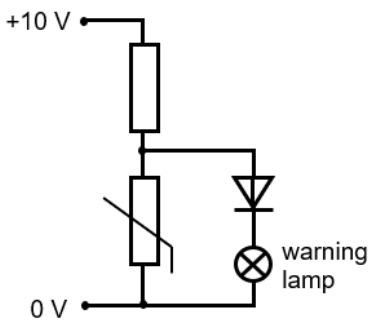
23 A circuit is needed to switch on a warning lamp when the temperature of a thermistor is too high.

Which circuit is suitable?

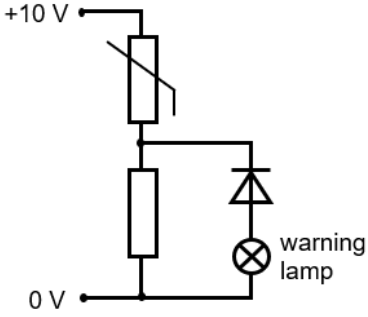
A



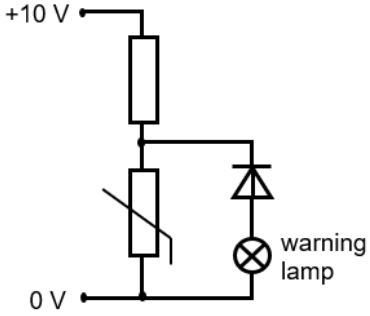
B



C

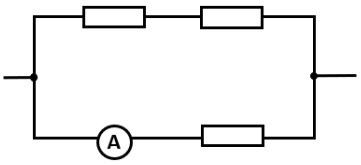


D

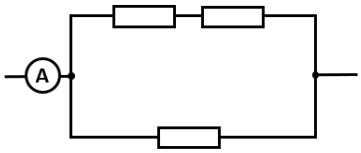


24 Four different arrangements of identical resistors are connected to the same constant voltage power supply. An ammeter of negligible resistance is connected in each arrangement.

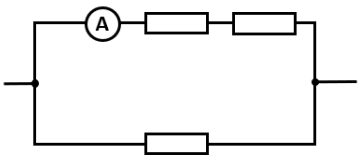
P



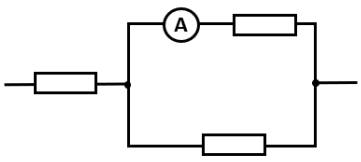
Q



R



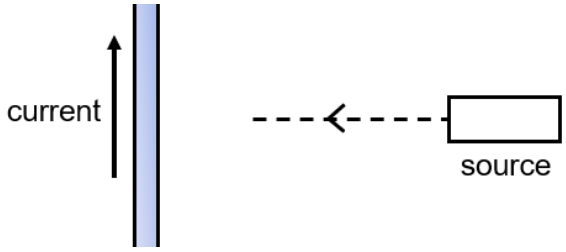
S



In which arrangement will the ammeter show the maximum reading and in which will it show the minimum reading?

	maximum ammeter reading	minimum ammeter reading
A	P	R
B	P	S
C	Q	R
D	Q	S

25 The diagram shows a long vertical wire carrying a steady current. A source fires a horizontal beam of positively-charged particles towards the wires.



As they approach the wire, the particles experience an electromagnetic force from the field of the current.

What is the direction of the force?

A in a direction parallel to the wire

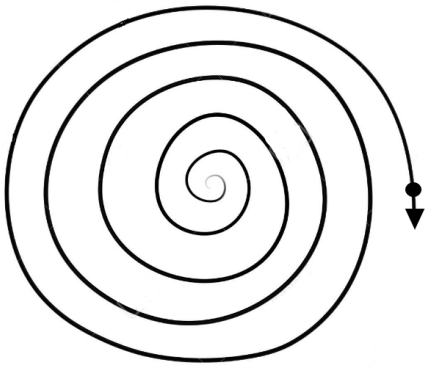
B in a horizontal direction at 90° to the original path

C in a horizontal direction towards the wire

D in a horizontal direction at 180° to the original path

26 A proton (of mass 1.67×10^{-27} kg) is accelerated from rest in a particle accelerator (cyclotron).

It arrives in a very circular path whose diameter very gradually increases over many revolutions to a final value of 1.2 m when the proton reaches a kinetic energy of 5.0×10^{-13} J.



What is the centripetal acceleration of the proton in its final circular orbit?

A 1.25×10^{14} m s^{-2}

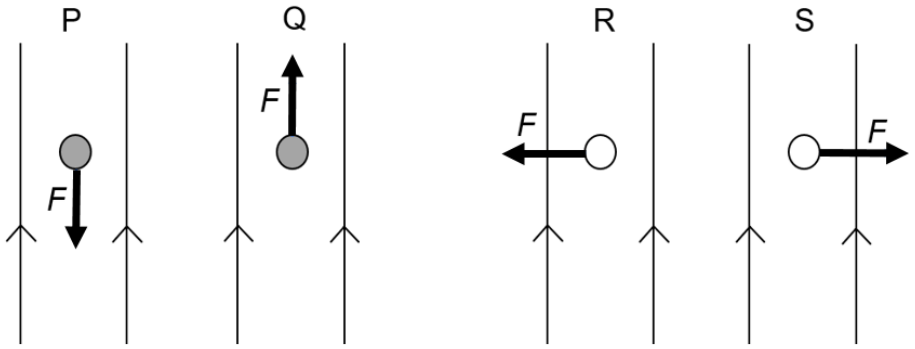
B 2.50×10^{14} m s^{-2}

C 5.00×10^{14} m s^{-2}

D 9.98×10^{14} m s^{-2}

27 Charged particles experience forces in an electric field. Current-carrying wires can experience force in a magnetic field.

Sketches P and Q show the forces *F* acting on charged particles in an electric field.
Sketches R and S show the forces *F* acting on current-carrying wires in a magnetic field.



Which row in the table correctly identifies the charged particles and direction of the currents in the wires?

	charge on P	charge on Q	current in R	current in S
A	positive	negative	into the page	out of the page
B	positive	negative	out of the page	into the page
C	negative	positive	into the page	out of the page
D	negative	positive	out of the page	into the page

28 Three different radioactive nuclides P, Q and R each decay by three different successive emissions.

P emits α, α, β

Q emits α, β, β

R emits β, β, β

Which nuclide produces a final nucleus that has the same proton number as its starting nucleus and which the same nucleon number as its starting nucleus?

	same proton number	same nucleon number
A	P	Q
B	P	R
C	Q	P
D	Q	R

29 Only four stable nuclei contain an odd number of protons and an odd number of neutrons.

Which of these nuclei is one of these four?

A $^{14}_{7}N$

B $^{17}_{9}F$

C $^{11}_{5}B$

D $^{13}_{6}C$

30 Today, the activity of a sample of caesium-137 is 4.0×10^5 Bq. The half-life of caesium-137 is 33 years.

What is the best estimate of the number of caesium-137 nuclei that will decay in the next two days?

A 5.0×10^8

B 1.2×10^9

C 6.9×10^{10}

D 9.5×10^{12}

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