PHYSICS
AT WORK
for HKDSE

Progressive Exam Resources

Sample

1 FOUNDATION EXERCISE

- Two types of practices: Exercise and Revision
  - Exercise contains questions in one chapter
  - Revision contains questions in several chapters
- Questions are simple and straightforward to help student grasp basic concepts and problem-solving skills
- **Word files** available on OUP web:

OXFORD
UNIVERSITY PRESS

www.oupchina.com.hk

Contents (sample)

Exercise 2-1 (Book 2 Chapter 1) p.1
Solutions p.3

Exercise 3-4 (Book 3B Chapter 4) p.5
Solutions p.7

Revision 1B (Book 1 Chapters 1–5) p.9
Solutions p.13

Revision 4A (Book 4 Chapters 1–3) p.15
Solutions p.20

Oxford University Press is a department of the University of Oxford.
It furthers the University's objective of excellence in research, scholarship,
and education by publishing worldwide. Oxford is a registered trade mark of
Oxford University Press in the UK and in certain other countries

Published in Hong Kong by
Oxford University Press (China) Limited
39th Floor, One Kowloon, 1 Wang Yuen Street, Kowloon Bay,
Hong Kong

First Edition published in 2023

ISBN: 978-6-31-000985-8

1 3 5 7 9 10 8 6 4 2

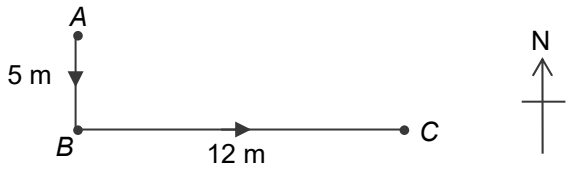
Class: _____ Name: _____( ) Date: _____

Marks: _____ / 15

Exercise 2-1 (Book 2 Chapter 1)

A Multiple-choice questions (6 marks)

(For Q1–2.) Carman skates along path *ABC* as shown below. The whole process takes 15 s.



1 Which of the following statements is/are correct?

(1) The magnitude of her total displacement is $\sqrt{17}$ m.

(2) She travels a total distance of 17 m.

(3) The direction of her total displacement points due east.

A (1) only B (2) only

C (1) and (2) only D (2) and (3) only

2 Carman skates at a constant speed throughout the whole process. Which of the following statements must be correct?

(1) Her average speed over the whole process is 1.13 m s^{-1}.

(2) The magnitude of her instantaneous velocity is 1.13 m s^{-1} at the mid-point of *B* and *C*.

(3) When she skates from *A* to *B*, the magnitude of her average velocity is the same as her average speed.

A (1) only B (1) and (2) only

C (1) and (3) only D (1), (2) and (3)

3 Kenny measures the time taken for a car to travel 100 m with a stop-watch. The time recorded is 6.40 s, with an uncertainty of ±0.4 s. Find the maximum percentage error of this measurement.

A 0.004% B 0.0625%

C 0.4% D 6.25%

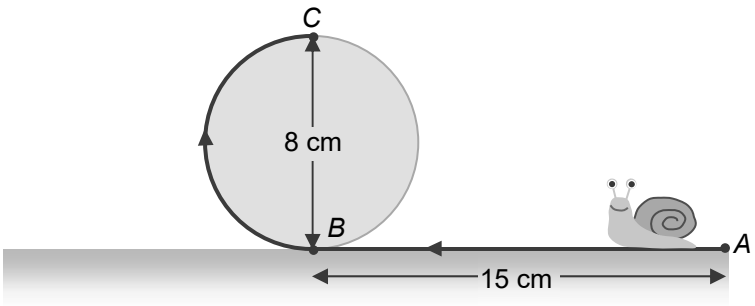
B Short questions (9 marks)

4 A boat sailing at 72 km h^{-1} towards the right comes to rest in 10 s.
(Take the direction towards the right as positive.)

(a) Find the average acceleration of the boat in these 10 s. (3 marks)

(b) Jamie claims that an object with a negative acceleration must be slowing down. Is he correct? Explain your answer. (2 marks)

5 A snail first moves 15 cm from *A* to *B* in 10 s. It takes a rest at *B* for 4 s before climbing up to *C* along a circular path of diameter 8 cm as shown. The climbing process takes 20 s.



(a) Find the total distance travelled by the snail. (2 marks)

(b) Hence find the average speed of the snail in moving from *A* to *C*. (2 marks)

- End -

Solutions

1 B

Magnitude of total displacement $= \sqrt{5^2 + 12^2} = 13$ m

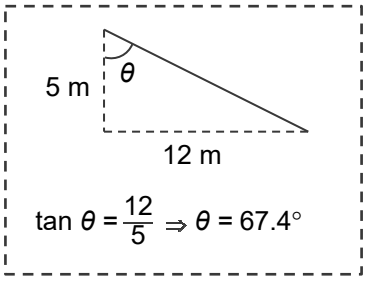
$\therefore$ (1) is incorrect.

Total distance travelled = 5 + 12 = 17 m

$\therefore$ (2) is correct.

Direction of total displacement: S67.4°E

$\therefore$ (3) is incorrect.



2 D

$$\text{Average speed} = \frac{\text{total distance travelled}}{\text{time taken}} = \frac{17}{15} = 1.13 \text{ m s}^{-1}$$

$\therefore$ (1) is correct.

Since she skates at a constant speed,

magnitude of instantaneous velocity = instantaneous speed = average speed

$\therefore$ (2) is correct.

When skating from A to B, the magnitude of her displacement = distance travelled

$$\text{Magnitude of average velocity} = \frac{\text{magnitude of displacement}}{\text{time taken}}$$

$$= \frac{\text{distance travelled}}{\text{time taken}}$$

$$= \text{average speed}$$

$\therefore$ (3) is correct.

3 D

$$\text{Maximum percentage error} = \frac{0.4}{6.40} \times 100\% = 6.25\%$$

4

(a) $72 \text{ km h}^{-1} = \frac{72}{3.6} \text{ m s}^{-1} = 20 \text{ m s}^{-1}$ 1M

$$\text{Average acceleration} = \frac{v-u}{t} = \frac{0-20}{10}$$ 1M

$$= -2 \text{ m s}^{-2}$$ 1A

(b) He is incorrect. 1A

If an object is moving in the negative direction, a negative acceleration will result in an increase in speed. 1A

5

(a) Total distance travelled $= 15 + \frac{8\pi}{2}$ 1M

$= 27.57 \text{ cm} \approx 27.6 \text{ cm}$ 1A

(b) Average speed $= \frac{\text{total distance travelled}}{\text{time taken}}$

$= \frac{27.57}{10 + 4 + 20}$ 1M

$= 0.811 \text{ cm s}^{-1}$ 1A

Class: _____ Name: _____( ) Date: _____

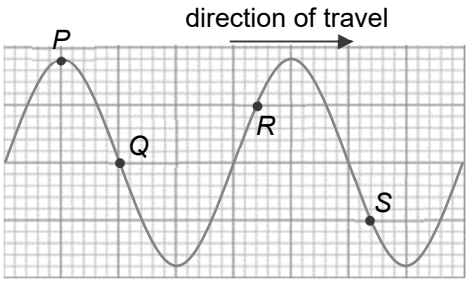
Marks: _____ / 16

Exercise 3-4

(Book 3B Chapter 4)

A Multiple-choice questions (6 marks)

1 The figure shows a wave travelling to the right. *P*, *Q*, *R* and *S* are four particles on the wave.



Which of the following statements is/are correct at the instant shown?

(1) Particle *P* is moving downwards.

(2) Particles *R* and *S* are vibrating in antiphase.

(3) Particle *Q* is moving at the highest speed.

A (1) only B (3) only

C (1) and (2) only D (2) and (3) only

2 Jenny uses a slinky spring to produce a longitudinal wave. Which of the following statements about this wave is **incorrect**?

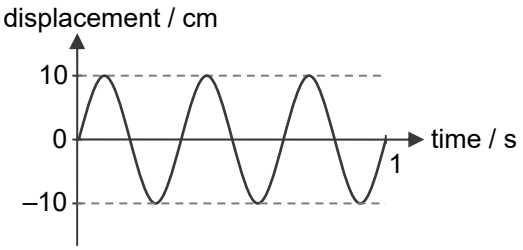
A It is produced by oscillations.

B It transfers energy from one end to another as it propagates.

C It transfers particles from one end to another as it propagates.

D The particles on it vibrate along its direction of travel.

3 The figure shows the displacement–time graph of a particle on a travelling wave. Displacement is measured from its equilibrium position.



Which of the following statements are correct?

(1) The particle is momentarily at rest at time = 1 s.

(2) The amplitude of the wave is 10 cm.

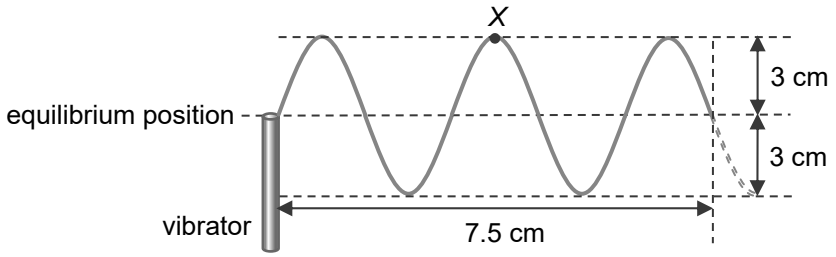
(3) The period of the wave is $\frac{1}{3}$ s.

A (1) and (2) only B (1) and (3) only

C (2) and (3) only D (1), (2) and (3)

B Short question (10 marks)

4 A vibrator vibrates vertically to produce a wave on a string. The vibrator moves up and down for 20 times in 2 s. The shape of the string at time $t = 0$ is shown in the figure below. X is a particle on the string.



(a) (i) Find the wavelength of the wave. (2 marks)

(ii) Find the frequency of the wave. (2 marks)

(iii) Find the wave speed. (2 marks)

(b) Sketch the displacement–time graph of particle X from $t = 0$ to $t = 0.2$ s. (3 marks)

(c) Suggest one way to increase the wave speed on a string. (1 mark)

- End -

Solutions

1 D

P is at the crest, so it is momentarily at rest.

∴ (1) is incorrect.

The distance between *R* and *S* is 0.5λ, so they are vibrating in antiphase.

∴ (2) is correct.

Q is at its equilibrium position, so it is moving at the highest speed.

∴ (3) is correct.

2 C

Travelling waves transfer energy from one place to another but do not transfer matter.

3 C

At time = 1 s, the particle is at its equilibrium position. It is moving at the highest speed instead of being momentarily at rest.

∴ (1) is incorrect.

The amplitude of the wave is equal to the amplitude of the particle.

∴ (2) is correct.

The particle vibrates for three cycles in 1 s.

∴ (3) is correct.

4

(a) (i) Wavelength $= \dfrac{7.5}{2.5}$ 1A

$= 3$ cm 1A

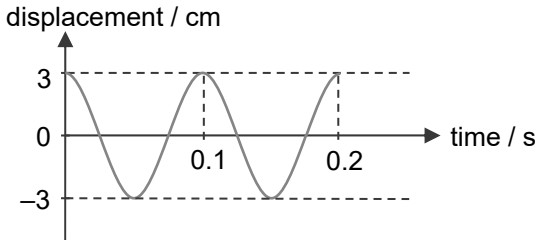
(ii) Frequency $= \dfrac{20}{2}$ 1A

$= 10$ Hz 1A

(iii) Wave speed $= f\lambda = 10 \times 3$ 1M

$= 30$ cm s^{-1} 1A

(b)



	(Correct axes and labels)	1A
	(Correct shape, amplitude and period)	1A
	(X is at crest at $t = 0$)	1A
(c)	Stretch the string more tightly. /	
	Use a string which has lower mass per unit length.	
	(Any one; accept other reasonable answer)	1A

Class: _____ Name: _____( ) Date: _____

Marks: _____ / 27

Revision 1B

(Book 1 Chapters 1–5)

Given: c (water) = 4200 J kg^{-1} °C^{-1}, l_f (ice) = 3.34 × 10^5 J kg^{-1}, l_v (water) = 2.26 × 10^6 J kg^{-1}

Universal gas constant R = 8.31 J mol^{-1} kg^{-1}

A Multiple-choice questions (6 marks)

1 A mixture of ice and water at 0 °C is put in a room at temperature 20 °C. A student keeps stirring the mixture. Before all the ice melts, which of the following statements are correct?

(1) The internal energy of the mixture increases.

(2) The average kinetic energy of the molecules in the mixture increases.

(3) Energy is transferred from the environment to the mixture.

A (1) and (2) only

B (1) and (3) only

C (2) and (3) only

D (1), (2) and (3) ☐

2 On a cold winter day, Alice wears a down jacket to keep herself warm. This jacket

(1) can generate heat.

(2) does not absorbs energy from Alice's body.

(3) traps a layer of air.

A (1) only B (3) only

C (1) and (2) only D (2) and (3) only ☐

3 Bella conducts an experiment on the net rate of evaporation of water under different weather conditions. On which of the following settings will she record the highest rate? The air temperature of the four settings is the same.

A No direct sunlight and no wind

B No direct sunlight and with wind

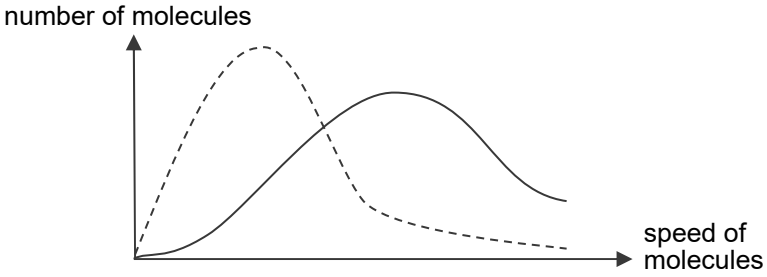
C Under direct sunlight and no wind ☐

D Under direct sunlight and with wind

B Short questions (21 marks)

Ext **4** Nitrogen is usually used to lengthen the shelf life of food. Calvin buys a bag of potato chips. At temperature of 20 °C and pressure of 100 kPa, the volume of the bag is 640 cm^3 and half the volume is occupied by nitrogen. Assume that the nitrogen inside the bag is an ideal gas.
Given: molar mass of nitrogen = 28.0 g mol^{-1}

(a) The following graph shows the distribution of speeds of nitrogen molecules at 20 °C and 40 °C. Label each curve with the gas temperature it represents. (1 mark)



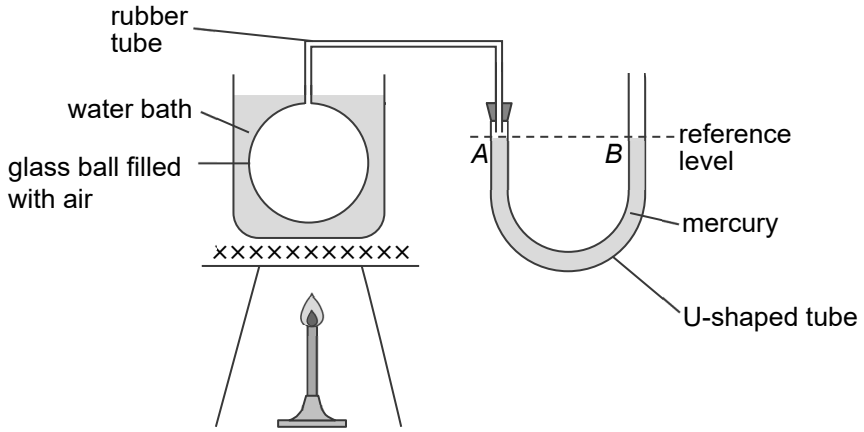
(b) Find the root-mean-square speed of the nitrogen molecules inside the bag. (2 marks)

(c) Calvin cuts a small opening on the bag and presses the bag gently. Some nitrogen leaks out. After he stops pressing, the volume of nitrogen inside the bag decreases by 20%, while the temperature and pressure remain the same as those before cutting the opening.

(i) Find the number of moles of nitrogen inside the bag before the leakage. (2 marks)

(ii) Hence, find the number of moles of nitrogen leaked from the bag. (1 mark)

Ext **5** In the set-up below, a glass ball filled with air is connected to a U-shaped tube via a rubber tube of negligible volume. The glass ball is immersed in a water bath heated by a Bunsen burner. The U-shaped tube contains some mercury. The reference level marks the initial height of the mercury column on sides *A* and *B* before the glass ball is heated.



(a) When the glass ball is heated, will the mercury level at *B* rise above or fall below the reference level? Explain your answer. (3 marks)

(b) Will the mercury level at *B* change after the water bath reaches 100 °C? Explain your answer. (3 marks)

6 Sometimes milk foam is added into coffee to change its texture and favour. Bob uses the steamer on a coffee machine to make milk foam by pumping steam at 100 °C into 600 g of milk until the temperature of the mixture reaches 65 °C.

Given: specific heat capacity of milk = 3930 J kg^{-1} $°C^{-1}$

(a) (i) The milk is initially at 4 °C. Calculate the amount of energy absorbed by the milk. (2 marks)

(ii) Hence, find the mass of steam pumped into the milk. Assume that all the steam condenses and stays in the mixture. (2 marks)

(b) The steamer produces steam at 100 °C by using water at 20 °C. If the power of the steamer is 1500 W, what is the mass of steam it can produce in 1 minute? (3 marks)

(c) Assume that tap water is heated at a constant rate to produce steam over 100 °C. Sketch a graph to show how the temperature of the water/steam changes with time in this process. Label the state(s) exist(s) in each stage. (2 marks)

- End -

Solutions

1 B

The ice absorbs energy from the environment and melts. The molecular potential energy of the ice molecules and hence the internal energy of the mixture increase.

∴ (1) and (3) are correct.

When the ice is changing its state, its temperature and hence the average kinetic energy of the molecules do not change.

∴ (2) is incorrect.

2 B

The jacket keeps Alice warm by reducing heat transfer through it. It does not generate heat.

∴ (1) is incorrect.

The down jacket loses energy to the surroundings. When the down jacket is at a lower temperature than Alice's body, there is energy transferred to it from Alice's body.

∴ (2) is incorrect.

The feathers in the jacket traps air to reduce heat lost to the surroundings.

∴ (3) is correct.

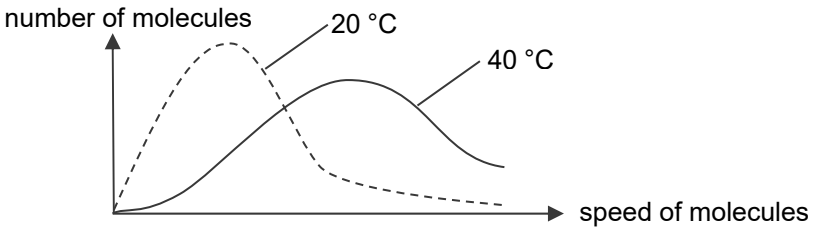
3 D

The temperature of the water is higher under direct sunlight. The water molecules have greater chance to escape from the water surface.

Vapour molecules are brought away by wind and have smaller chance to return to the water.

4

(a)



1A

(b) $\bar{c} = \sqrt{\dfrac{3RT}{mN_A}} = \sqrt{\dfrac{3\times 8.31\times(20+273)}{0.0280}}$ 1M

$= 511 \text{ m s}^{-1}$ 1A

(c) (i) By $pV = nRT$,

number of moles of nitrogen $= \dfrac{pV}{RT} = \dfrac{(100\times10^3)\,(640\times10^{-6}\div 2)}{8.31\,(20+273)}$ 1M

$= 0.01314 \approx 0.0131 \text{ mol}$ 1A

(ii) Number of moles of nitrogen leaked out = $0.01314 \times 20\%$

$= 0.00263$ mol — 1A

5

(a) When the glass ball is heated, the temperature, hence the pressure, of the air inside the ball increase. — 1A

The pressure acting on the mercury at *A* is larger than that at *B*. — 1A

The mercury moves towards *B* and the mercury level at *B* rises above the reference level. — 1A

(b) When the water reaches 100 °C, its temperature remains unchanged, — 1A

and the temperature of the air inside the glass ball also remains unchanged. — 1A

Therefore, the mercury level at *B* remains unchanged. — 1A

6

(a) (i) Energy absorbed by the milk = $m_m c_m \Delta T_m$

$= 0.6 \times 3930 \times (65 - 4)$ — 1M

$= 143\,838 \approx 144\,000$ J — 1A

(ii) Energy lost by the steam/water = energy gained by the milk

$m_w l_v + m_w c_w \Delta T_w = 143\,838$

$m_w \times [2.26 \times 10^6 + 4200 \times (100 - 65)] = 143\,838$ — 1M

$m_w = 0.0598$ kg — 1A

The mass of steam pumped into the milk is 0.0598 kg.

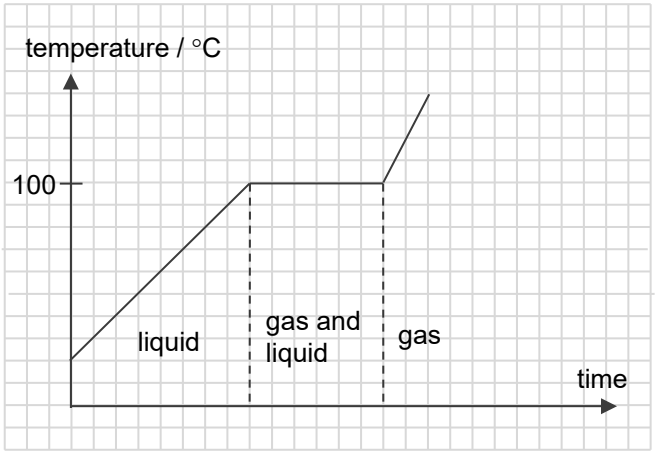
(b) $E = mc\Delta T + ml_v$

$1500 \times 60 = m \times [4200 \times (100 - 20) + 2.26 \times 10^6]$ — 1M+1M

$m = 0.0347$ kg — 1A

The mass of steam produced in 1 minute is 0.0347 kg.

(c)



(Correct horizontal line when the water is changing state) — 1A

(Correct labels of states) — 1A

Class: _____ Name: _____( ) Date: _____

Marks: _____ / 35

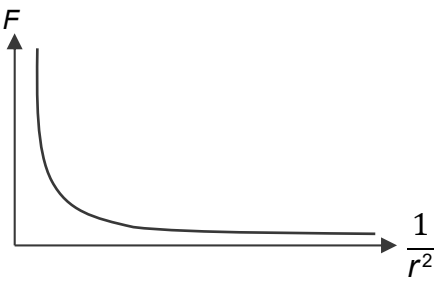
Revision 4A

(Book 4 Chapters 1–4)

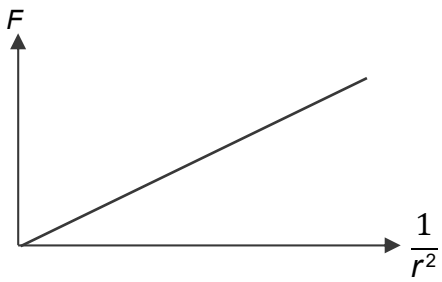
A Multiple-choice questions (10 marks)

1 X and Y are two point charges separated by a distance r. Which of the following graph best shows how the magnitude F of the electrostatic force acting on Y by X changes with $\frac{1}{r^2}$?

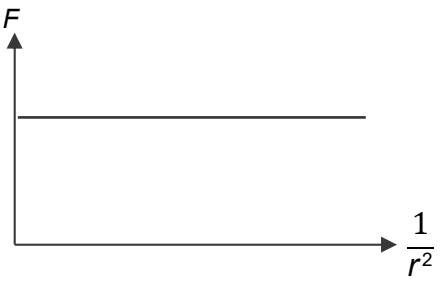
A



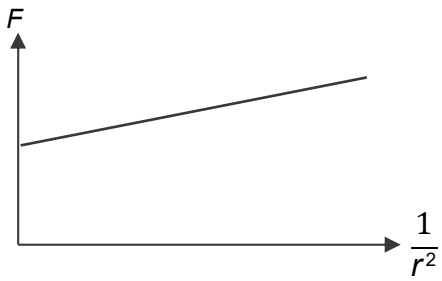
B



C

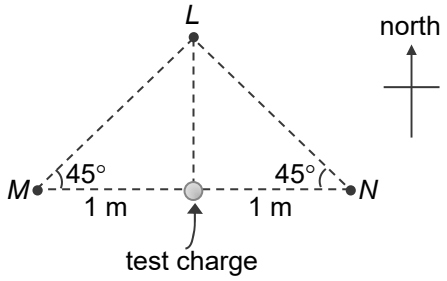


D



☐

2 Three point charges L, M and N carrying the same charge of $-Q$ are placed at the vertices of an isosceles triangle as shown. A test charge of $+q$ is placed at mid-point between M and N. Find the direction of the resultant electrostatic force acting on the test charge.



A Towards the east

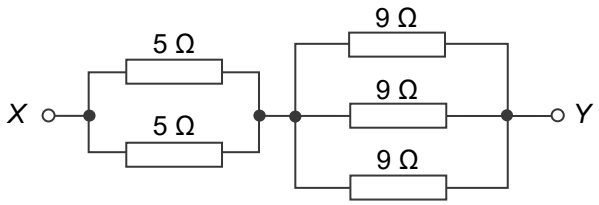
B Towards the south

C Towards the west

D Towards the north

☐

3 The network below consists of two 5-Ω resistors and three 9-Ω resistors. Find the equivalent resistance across *X* and *Y*.



A 3.2 Ω

B 5.5 Ω

C 14 Ω

D 37 Ω

4 A long cylindrical conductor has a radius of 0.24 mm and a length of 0.2 m. It is made of copper, which has a resistivity of 1.7×10^{-8} Ω m. If the potential difference across the conductor is 20 mV, what is the current flowing through the conductor?

A 0.27 A

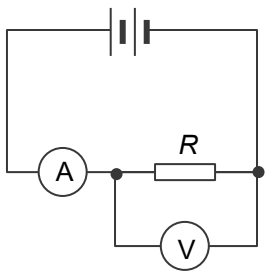
B 0.43 A

C 0.87 A

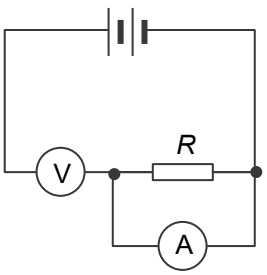
D 1.06 A

5 An ammeter of resistance 1 Ω and a voltmeter of resistance 1000 Ω are used to measure the resistance of a resistor *R*. Which of the following circuits gives the most accurate result if *R* is larger than 500 Ω?

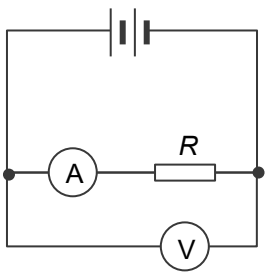
A



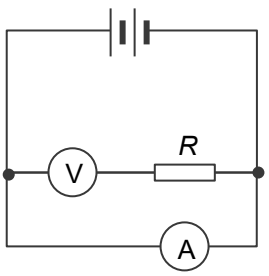
B



C

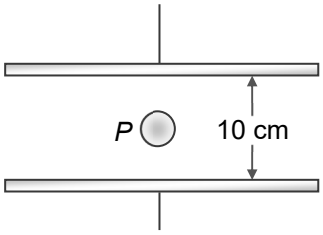


D



B Short questions (25 marks)

6 A positively charged particle *P* remains stationary in the middle between two horizontal plates as shown. The two plates are separated by 10 cm and a voltage of 300 V is applied across them.

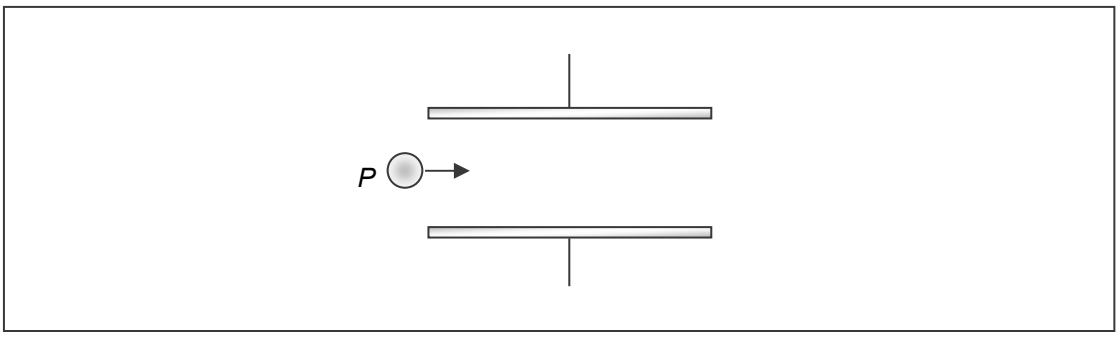


(a) What is the net force acting on *P*? Explain your answer. (2 marks)

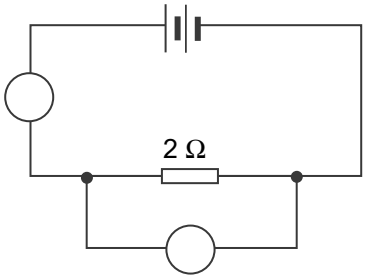
Ext **(b)** Find the direction and magnitude of the electric field strength between the plates. (3 marks)

(c) Matthew claims that if *P* is placed slightly above its original position, it will not remain stationary. Comment on his statement. (2 marks)

Ext **(d)** *P* is moved to the position as shown below and projected horizontally to the right. Sketch the path of *P* in the figure. (1 mark)



7 Catherine sets up the circuit as shown with a battery, an ammeter, a voltmeter and a 2-Ω metal conductor. The ammeter measures the current through the metal conductor and it reads 1.31 A. Suppose the voltmeter and ammeter are ideal.



(a) In the figure, use appropriate symbols to indicate the ammeter and the voltmeter. (1 mark)

(b) The e.m.f. of the battery is 3 V.

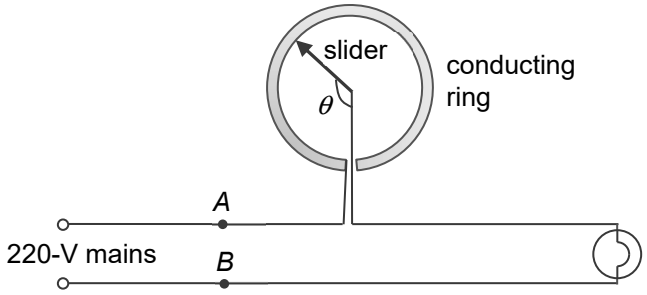
(i) By taking the internal resistance of the battery into account, find the equivalent resistance of the whole circuit. (2 marks)

(ii) Find the internal resistance of the battery and the power dissipated by it. (3 marks)

(c) (i) State the property of an ohmic conductor. (1 mark)

(ii) The metal conductor is an ohmic conductor. Sketch a graph to show how the voltage V across the conductor varies with the current I through it. Assume the temperature of the conductor remains unchanged. (1 mark)

8 Edward designs the circuit as shown to control the brightness of a filament bulb. The uniform conducting ring has a total resistance of 1800 Ω. It has a very small gap and one of its ends is connected to the 220-V mains. A slider is in contact with the conducting ring and is connected to the mains via the bulb. The resistance of the bulb is 1000 Ω. Its brightness can be changed by rotating the slider.



(a) Explain why the brightness of the bulb increases when θ decreases. (3 marks)

Ext **(b)** Find the root-mean-square current flowing through the bulb when $\theta = 120°$. (2 marks)

(c) It is found that the electric potential at point *A* is 0 V. Should a fuse be installed at point *A* or point *B*? (1 mark)

(d) Is a 0.2-A fuse suitable for this circuit? Explain briefly. (3 marks)

- End -

Solutions

1 B

As $F = \frac{Q_X Q_Y}{4\pi\varepsilon_0}\frac{1}{r^2}$, F is directly proportional to $\frac{1}{r^2}$. The graph of F against $\frac{1}{r^2}$ should be a straight line passing through the origin with positive slope.

2 D

The electrostatic forces exerted by M and N on the test charge are along the horizontal direction and cancel out each other. L exerts an attractive force on the test charge and, therefore, the resultant electrostatic force points towards the north.

3 B

$$R_{eq} = \left(\frac{1}{5}+\frac{1}{5}\right)^{-1} + \left(\frac{1}{9}+\frac{1}{9}+\frac{1}{9}\right)^{-1} = 5.5\ \Omega$$

4 D

$$\text{Resistance } R \text{ of the conductor} = \rho\frac{l}{A} = (1.7\times10^{-8})\times\frac{0.2}{\pi(0.24\times10^{-3})^2} = 0.01879\ \Omega$$

$$\text{Current } I \text{ flowing through the conductor} = \frac{V}{R} = \frac{20\times10^{-3}}{0.01879} = 1.06\ \text{A}$$

5 C

The ammeter should measure the current through R while the voltmeter should measure the voltage across R.

The ammeter must be connected in series to R.

$\therefore$ B and D are incorrect.

In A, since the resistance of R is comparable to that of the voltmeter, the current through the voltmeter will be comparable to that through R and the ammeter will have a large error.

In C, since the resistance of R is much larger than that of the ammeter, the voltmeter will have a small error only. Also, the ammeter gives the true value. As a result, this circuit gives a very accurate value.

6

(a) Since P is stationary, by Newton's first law, — 1A

the net force is zero. — 1A

(b) $E = \frac{V}{d} = \frac{300}{0.1}$ — 1M

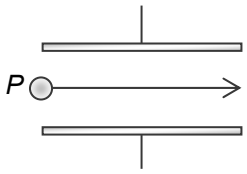
$= 3000\ \text{N C}^{-1}$ (upwards) — 1A + 1A

(c) He is not correct. 1A

The electric field strength between the plates is uniform and P will experience the same electrostatic force at different positions between the plates. 1A

As a result, P will remain stationary.

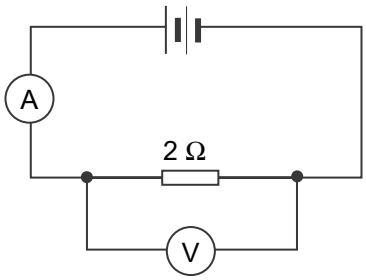
(d)



1A

7

(a)



1A

(b) (i) Equivalent resistance $= \frac{V}{I}$

$= \frac{3}{1.31}$ 1M

$= 2.29\ \Omega$ 1A

(ii) Internal resistance of battery = 2.29 – 2 = 0.29 Ω 1A

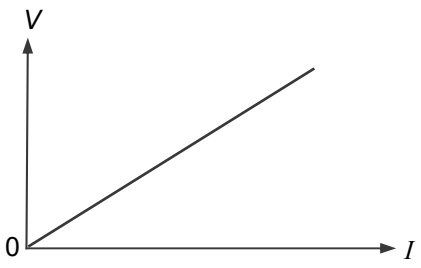
Power dissipated by the internal resistance = I^2R

$= 1.31^2 \times 0.29$ 1M

$= 0.498$ W 1A

(c) (i) The potential difference across an ohmic conductor is directly proportional to the current flowing through it, provided that other physical conditions are unchanged. 1A

(ii)



1A

8

(a) When θ decreases, the resistance of the circuit decreases. 1A

By $I = \frac{V}{R}$ with the voltage unchanged, 1A

the current flowing through the bulb increases. 1A

As a result, the brightness of the bulb increases.

(b) When $\theta = 120°$,

total resistance of circuit $= \frac{120°}{360°} \times 1800 + 1000 = 1600\ \Omega$ 1M

$I_{rms} = \frac{V_{rms}}{R} = \frac{220}{1600} = 0.138$ A 1A

(c) Point B 1A

(d) The current is maximum when resistance of the ring is 0.

Maximum current = $\frac{220}{1000} = 0.22$ A 1A

The fuse should have a rating larger than the maximum current, 1A

so a 0.2-A fuse is not suitable. 1A