Register No.	Class

Name ____________________

BENDEMEER SECONDARY SCHOOL
2019 PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS
PHYSICS PAPER 1
6091/01

DATE : 3 Sep 2019
DURATION : 1 hour

READ THESE INSTRUCTIONS FIRST

Write in 2B pencil.
Do not use paper clips, glue or correction fluid.
Write your name, class and register number on the question paper and OTAS sheet in the spaces provided.

There are **forty** 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 **2B pencil** on the OTAS sheet.

Read the instructions on the OTAS 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.

/ 40

This document consists of **17** printed pages.

[Turn over

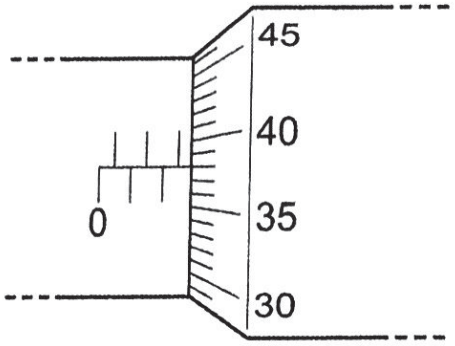
1 A pipe has an approximate length of 60 cm and an approximate internal diameter of 3 cm.

Which instruments are the most suitable for measuring accurately the internal diameter and the length?

A calipers and micrometer
B calipers and rule
C rule and micrometer
D rule and tape

2 A student measures the thickness of 20 sheets of paper with a micrometer.

The diagram shows the reading on the micrometer.



What is the average thickness of one sheet of paper?

A 0.119 mm **B** 0.144 mm **C** 0.169 mm **D** 0.171 mm

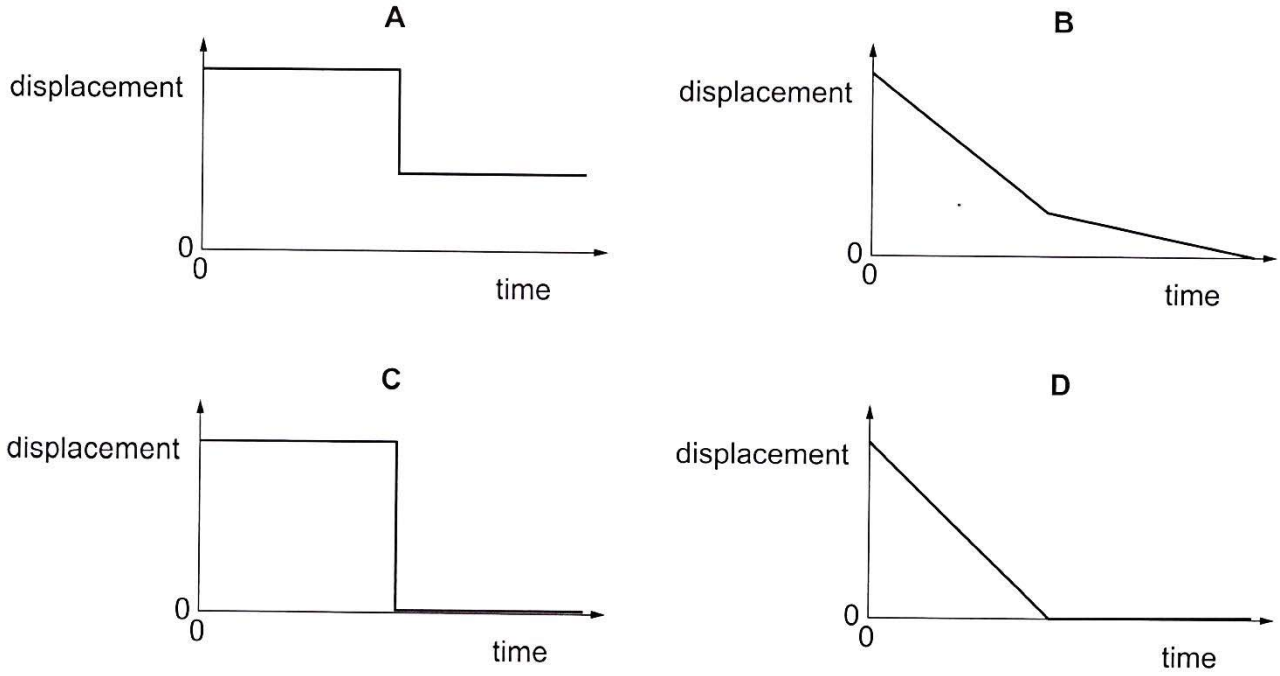
3 A body accelerates from rest at 4 m/s^2 for 5 s.

What is its **average** speed?

A 0.8 m/s **B** 2.0 m/s **C** 10.0 m/s **D** 20.0 m/s

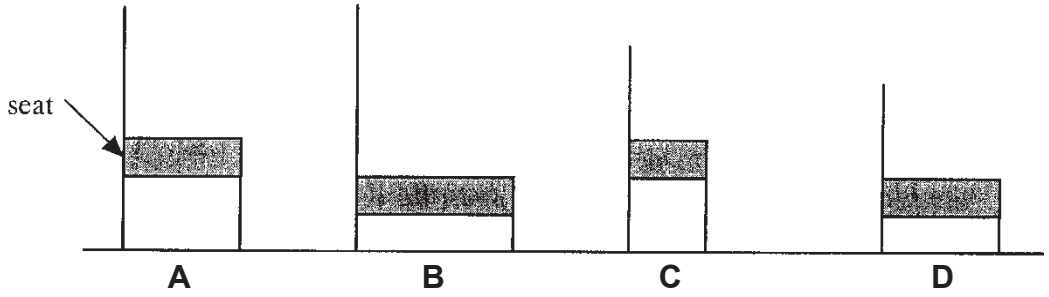
4 A free-fall parachutist falls at a constant speed. He then opens his parachute and continues to fall to Earth at a lower, constant speed.

Which diagram shows how the displacement of the parachutist varies with time?

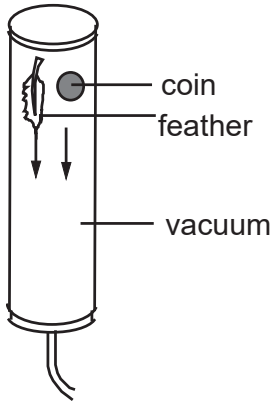


5 The following chairs are drawn to the same scale.

Which one is the most stable?



6 A coin and a feather are released from rest in vacuum as shown in the diagram. It is observed that both the coin and the feather reach the bottom of the cylinder at the same time.



Which of the following is/are correct deduction(s) from this experiment?

I The masses of the coin and the feather are identical in vacuum.
II The coin and the feather fall with the same acceleration in vacuum.
III The gravitational forces acting on the coin and the feather in vacuum are identical.

A I only **B** II only **C** II and III **D** III only

7 Two balls are dropped one after another from the same height. Assuming that the air resistance is negligible, which of the following statements is true?

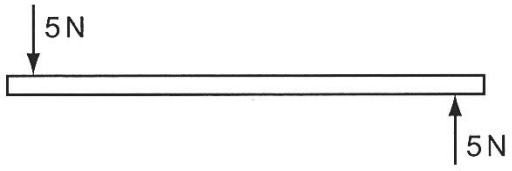
A The two balls drop with a constant distance between them.
B The two balls drop with a constant speed.
C The two balls get closer as they descend.
D The two balls get further away as they descend.

8 5000 kg of iron is melted and mixed with 2.0 m^3 of molten copper.

If the density of molten iron and molten copper are 7500 kg/m^3 and 9000 kg/m^3 respectively, what is the approximate density of the mixture?

A 7.5 g/cm^3 **B** 8.3 kg/m^3 **C** 8300 kg/m^3 **D** 8600 kg/m^3

9 Two forces act on a rod as shown in the diagram.



Which effect will be produced by these two forces?

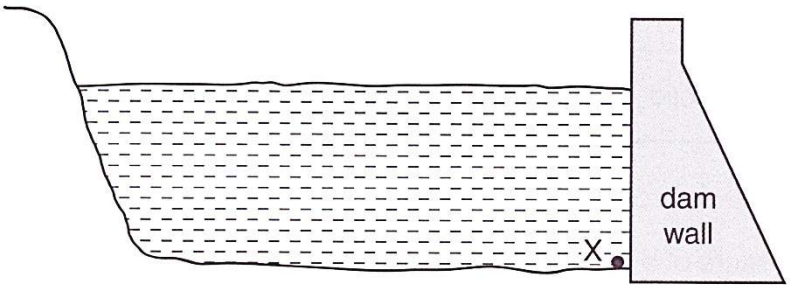
A both rotation and movement in a straight line
B movement in a straight line only
C no effect, because the forces are balanced
D rotation only

10 An object is experiencing a pressure of 800 mmHg.

Express this pressure in Pa, given that the density of mercury is 13,600 kg/m^3.

A 108,800 Pa
B 170,000 Pa
C 170,000,000 Pa
D 108,800,000 Pa

11 An engineer designs a dam wall for a reservoir.



Which factor determines the pressure at X?

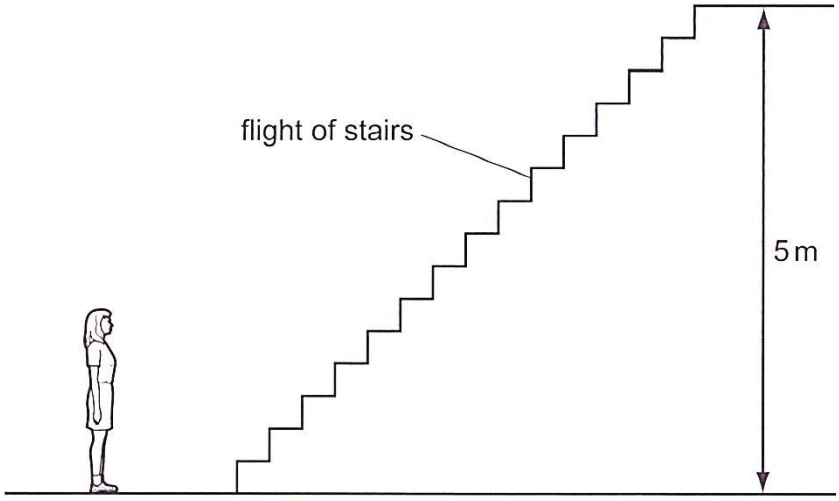
A the depth of the water in the reservoir
B the length of the reservoir
C the surface area of the reservoir
D the thickness of the dam wall

12 A parachutist opens his parachute and falls to Earth at constant speed.

What is the principal energy conversion taking place as he falls?

A kinetic energy ➔ potential energy
B kinetic energy ➔ thermal energy (heat)
C potential energy ➔ kinetic energy
D potential energy ➔ thermal energy (heat)

13 A girl of weight 500 N runs up a flight of stairs in 10 seconds. The vertical height of the stairs is 5 m.



What is the average useful power developed by the girl?

A 50 W **B** 100 W **C** 250 W **D** 1000 W

14 Which change is condensation?

15 A fixed mass of gas is trapped in a cylinder with a movable piston. The piston is pushed inward slowly to decrease the volume and yet maintain a constant temperature in the cylinder.

Which of the following about the gas molecules is correct?

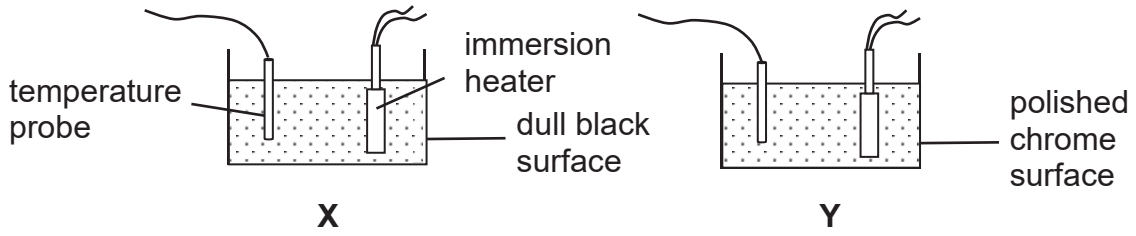
	average speed	average distance apart
A	increase	decrease
B	increase	no change
C	no change	decrease
D	no change	no change

16 How is heat transferred from the Sun to Earth?

I conduction
II convection
III radiation

A I only **B** III only **C** I and II **D** I and III

17 In the diagram, two copper cans **X** and **Y** with outer surface of different colours and textures are filled with the same amount of water at room temperature and heated by heaters of the same power.



Which of the following statements is correct?

A Water in both cans take the same amount of time to boil because the texture of the outer surface will not affect the rate of energy absorbed by the water.
B Water in **X** boils faster because the dull black surface is a good absorber of radiant heat.
C Water in **Y** boils faster because the polished chrome surface is a poor absorber of radiant heat.
D Water in **Y** boils faster because the polished chrome surface is a poor radiator.

18 An electric kettle contains 1500 g of liquid and is powered by a 0.5 kW electric element. If the temperature rises at 5°C every minute, what is the specific heat capacity of the liquid?

A 6.7 μJ/(kg°C) **B** 4 mJ/(kg°C) **C** 4000 J/(kg°C) **D** 4200 J/(kg°C)

19 According to the kinetic theory, matter is made up of very small particles in a constant state of motion.

Which row best describes the particle behaviour in the liquid state?

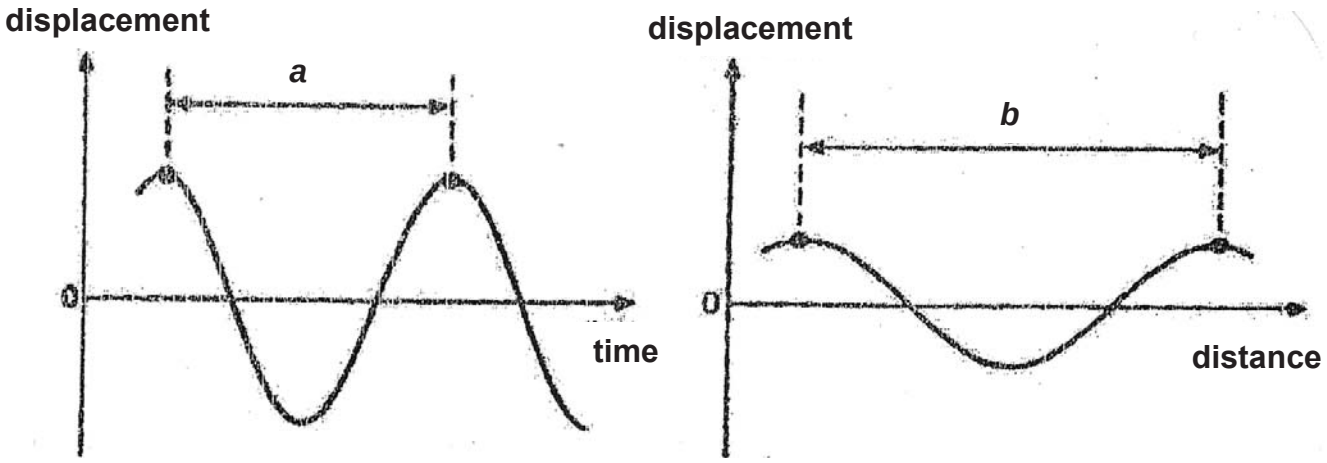
	forces between particles	motion of particles
A	strong	move randomly at high speeds
B	strong	vibrate but can move freely
C	strong	vibrate to and from around a fixed position
D	weak	move randomly at high speed

20 A liquid evaporates rapidly.

Why does this cause it to cool?

A Air molecules remove heat by contact with the liquid surface.
B Energy is lost by convection currents.
C Some of the most energetic molecules leave the liquid.
D The molecules have less room to move around.

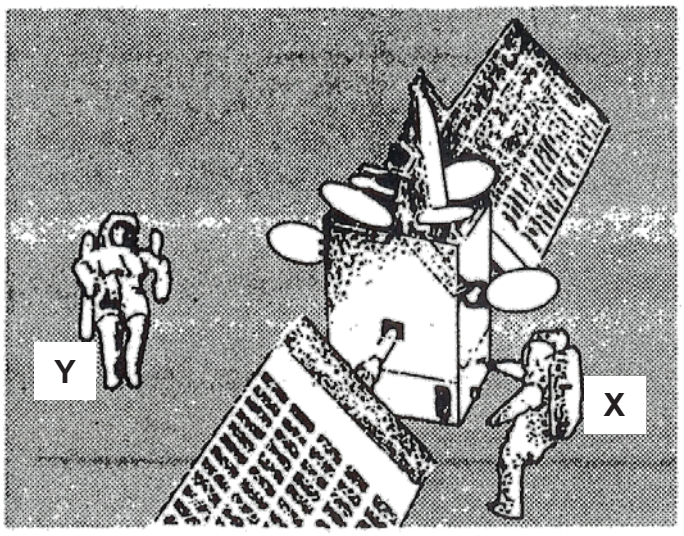
21 The same transverse wave is represented by the following graphs.



Which of the following gives the speed of the wave?

A ab **B** $\frac{a}{b}$ **C** $\frac{b}{a}$ **D** $\frac{1}{ab}$

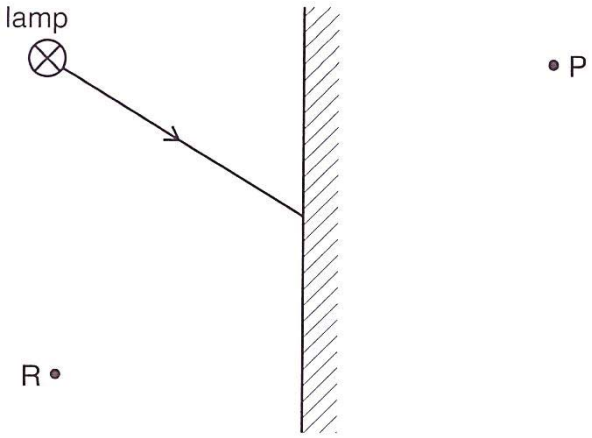
22 Astronaut X is hammering on one side of a satellite.



Astronaut Y on the other side of the satellite will not hear the hammering because

A the satellite is blocking the sound travel.
B the sound is refracted away from him.
C the sound cannot be produced in space.
D the sound cannot travel in space.

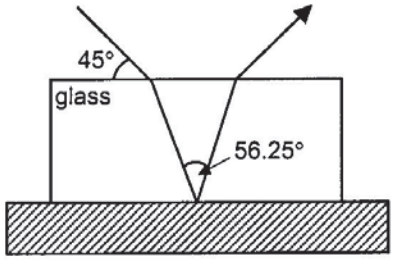
23 The diagram shows a ray of light from one point on a lamp striking a plane mirror.



The image of the point on the lamp formed by the mirror is

A at P and is real.
B at P and is virtual.
C at R and is real.
D at R and is virtual.

24 A piece of glass was placed on top of a polished mirrored surface as shown in the diagram below.



What is the critical angle of the glass?

A 28.1° **B** 41.8° **C** 45.0° **D** 56.3°

25 Which of the following uses microwaves?

I oven
II mobile phone
III metal detector

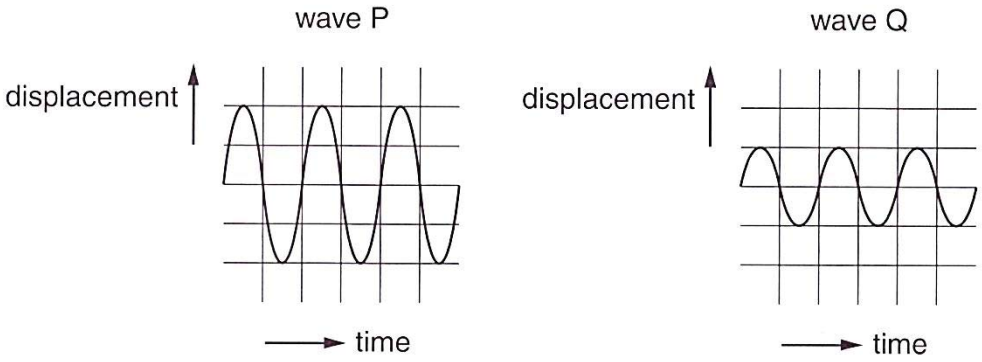
A I and II **B** I and III **C** II and III **D** I, II and III

26 A student stands 50 m from a wall and knocks two wooden blocks together. When the frequency of knocking is 3 knocks per second, the echo of a knock is heard at the instant of the next one.

What is the speed of sound in air?

A 150 m/s **B** 200 m/s **C** 300 m/s **D** 350 m/s

27 The diagrams represent two different sound waves.



How do the frequency and pitch of P compare with the frequency and pitch of Q?

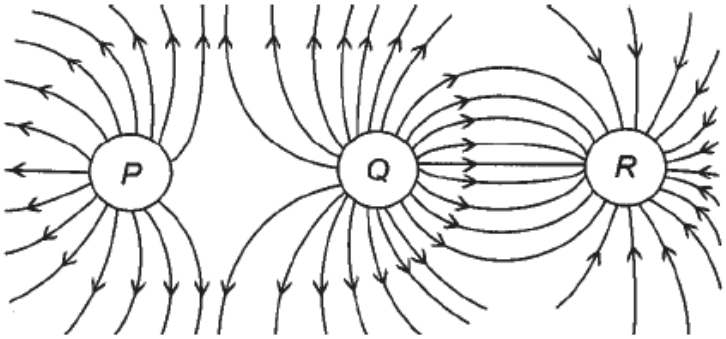
	frequency of P	pitch of P
A	greater than Q	higher than Q
B	greater than Q	same as Q
C	same as Q	higher than Q
D	same as Q	same as Q

28 A piece of polythene is rubbed with a cloth duster. The polythene becomes negatively charged and the cloth becomes positively charged.

What happens to the polythene and to the cloth to cause this?

	polythene	cloth
A	gains electrons	gains protons
B	gains electrons	loses electrons
C	loses protons	gains protons
D	loses protons	loses electrons

29 The diagram below shows the pattern of an electric field produced by three charged spheres.



Which of the following correctly shows the charge on each sphere?

	P	Q	R
A	–	–	+
B	+	–	+
C	–	+	–
D	+	+	–

30 60 C of charge passes through a resistor in 120 seconds.

The energy converted in the resistor is 5 J every second.

What is the potential difference across the resistor?

A 5 V **B** 10 V **C** 12 V **D** 24 V

31 Three wires X, Y and Z are made from the same metal. Their dimensions are listed below.

	length / m	cross-sectional area / mm^2
X	4	2
Y	5	1
Z	8	6

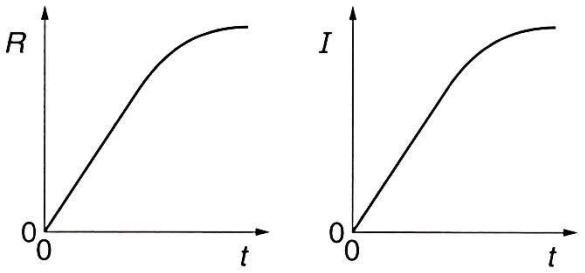
Arrange them in ascending order of their resistances.

A X, Y, Z **B** X, Z, Y **C** Y, X, Z **D** Z, X, Y

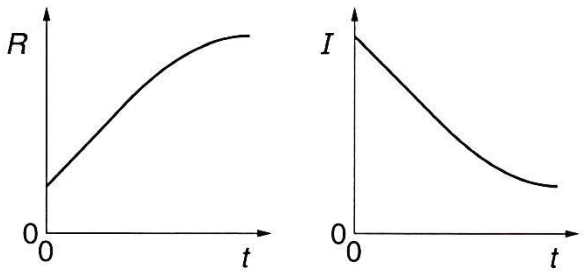
32 When a filament lamp is switched on, there is a current in the lamp. As the temperature of the filament rises, its resistance changes.

Which pair of graphs shows how the resistance *R* of the filament and the current *I* vary with time after the lamp is switched on?

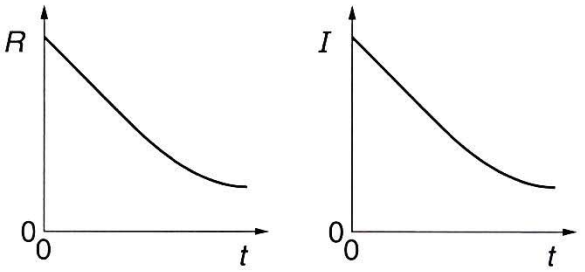
A



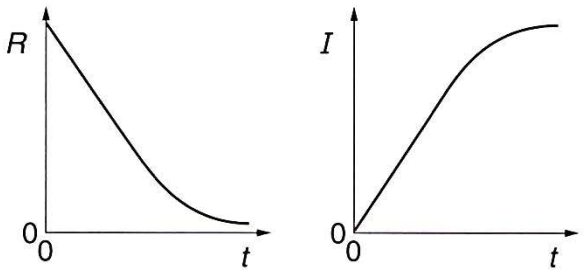
B



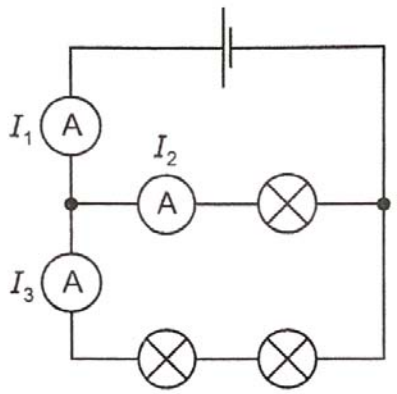
C



D



33 Three identical lamps and three identical ammeters are connected as shown.

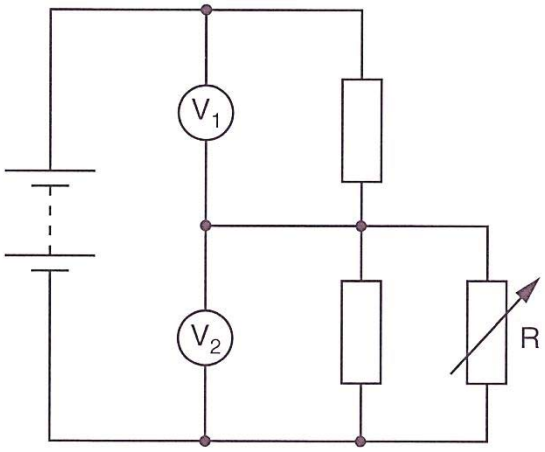


The readings on the ammeters are I_1, I_2 and I_3.

How are the readings related?

A $I_1 = I_2 = I_3$
B $I_1 > I_2$ and $I_2 = I_3$
C $I_1 > I_3 > I_2$
D $I_1 > I_2 > I_3$

34 The circuit diagram shows a variable resistor R connected in parallel to the lower half of a potential divider.



The resistance of R increases.

What happens to the voltmeter readings?

	reading on V_1	reading on V_2
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

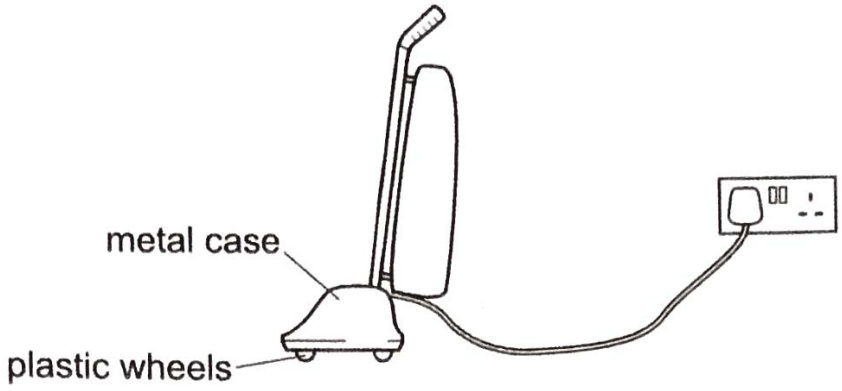
35 The table below shows the typical daily electrical usage in an office.

Appliance	Quantity	Number of hours used per day
40 W lamp	10	15
3 kW air-conditioner	2	12

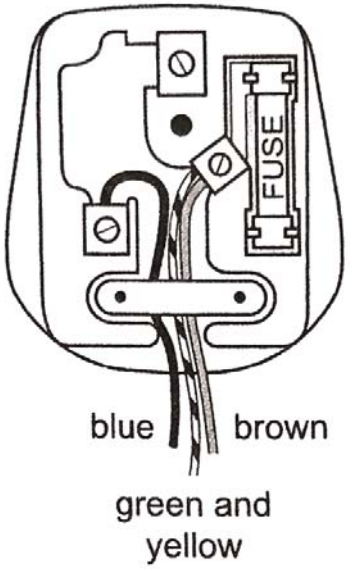
If the cost of electricity is $0.20 per kWh, calculate the total electrical bill per day.

A $12.14 **B** $15.60 **C** $1214.40 **D** $15 600

36 The diagram shows an old vacuum cleaner with plastic wheels and a metal case.



The plug of the vacuum cleaner is wrongly wired as shown.



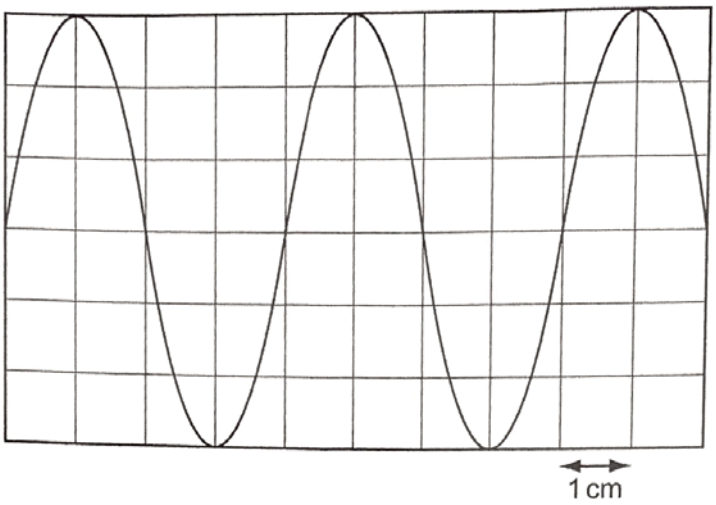
What is the effect of using the plug wired this way?

A The fuse in the plug blows.
B The metal case becomes live.
C The vacuum cleaner catches fire.
D The vacuum cleaner does not work.

37 Which material is used for the needle of a plotting compass?

A aluminium **B** brass **C** iron **D** steel

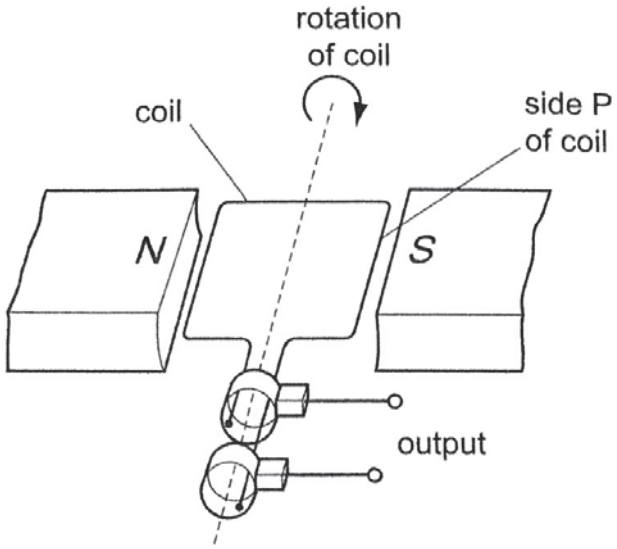
38 An alternating supply with a period of 0.020 s is connected to a cathode-ray oscilloscope (c.r.o.).



What is the time-base setting of the c.r.o.?

A 0.2 ms/cm **B** 0.5 ms/cm **C** 2 ms/cm **D** 5 ms/cm

39 An output voltage is produced as the coil in the diagram rotates.



One side of the coil is labelled P.

During the rotation, when is the output voltage zero?

	orientation of coil	position of P
A	horizontal	near the N-pole only
B	horizontal	near the N-pole or near the S-pole
C	vertical	at the top only
D	vertical	at the top or bottom

40 Which statement about a transformer is correct?

A The core of the transformer is made of iron because iron is a good electrical conductor.
B The direction of the induced e.m.f. in the secondary coil opposes the change that produces it.
C The transformer converts alternating current to direct current.
D The transformer converts direct current to alternating current.

END OF PAPER

Register No.	Class

Name ____________________

BENDEMEER SECONDARY SCHOOL
2019 PRELIMINARY EXAMINATION
SECONDARY 4 EXPRESS
PHYSICS PAPER 2
6091/02

DATE : **2 Sep 2019**
DURATION : **1 hour 45 minutes**

READ THESE INSTRUCTIONS FIRST

Write your name, class and register number on the work you hand in.
Write in dark blue or black pen.
You may use a 2B pencil for any diagrams or graphs.
Do not use paper clips, glue or correction fluid.

Section A
Answer **all** questions.

Section B
Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

/ 80

Section A

Answer **all** the questions in this section.

1 The contractor of the school's upgrading project often uses a crane to lift construction materials from the ground to a higher-level floor.

On one occasion, the crane is used to lift a long and heavy metal bar. Fig. 1.1 shows part of the lifting mechanism comprising a main cable **AB**, two other cables **BC** and **BD**, and the metal bar. **BC** and **BD** make an angle of 100°.

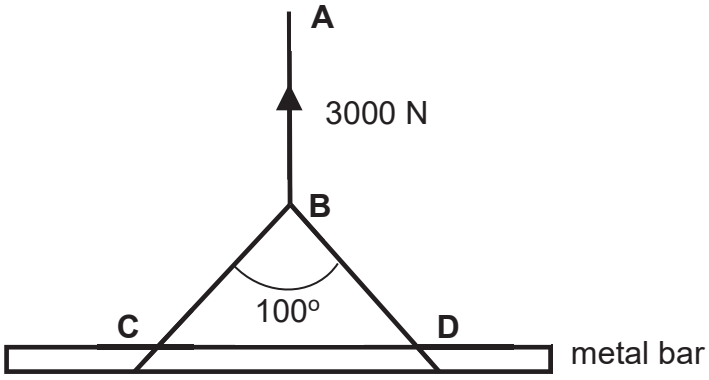


Fig. 1.1

When the metal bar is being lifted vertically at a constant speed, the tension in the main cable **AB** is 3000 N. Take gravitational field strength *g* to be 10 N/kg.

(a) Given that the tension of cables **BC** and **BD** are equal, use a scaled drawing to determine the tension in each of these two cables.

Scale: ……

tension = …….. [4]

(b) Calculate the total mass of the three cables and metal bar.

total mass = …….. [2]

2 An MRT train took 7 minutes to travel from Sembawang station to Admiralty station. During this time, the train was travelling in a straight line and it reached a top speed of 80 km/h.

Fig 2.1 shows the velocity-time graph of the train.

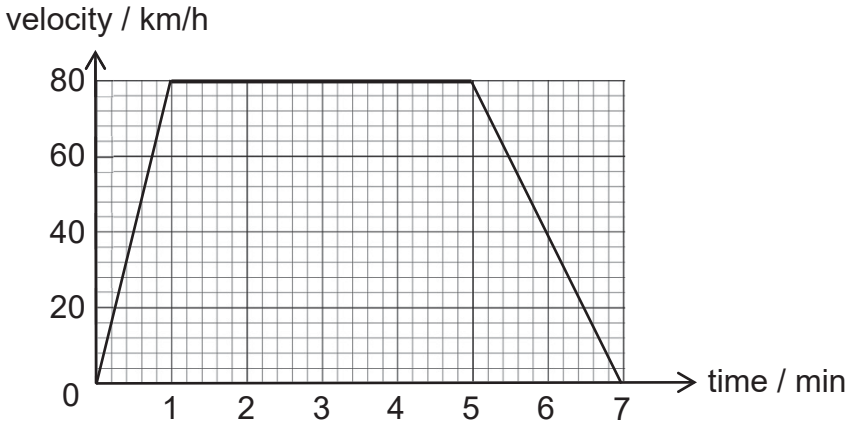


Fig. 2.1

(a) Calculate the average speed of the train (in km/h) from 0 to 7 minutes.

average speed = …… km/h [2]

(b) Calculate the deceleration of the train (in km/h^2) from 5 to 7 minutes.

deceleration = ... km/h^2 [2]

(c) During the time interval of 1 to 5 minutes, a passenger in the train stood without holding onto the rails or leaning on anything.

What are the forces acting on the passenger during this time interval?

.....

.....

..... [2]

3 Fig. 3.1 shows an optical fibre cable probe used in medical procedures.

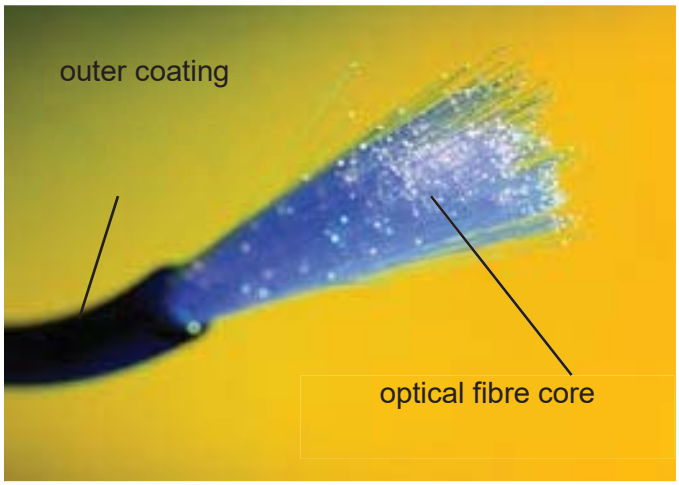


Fig. 3.1

Fig. 3.2 shows the cross-section of one part of the cable probe with a ray of light entering the fibre core at point **X**.

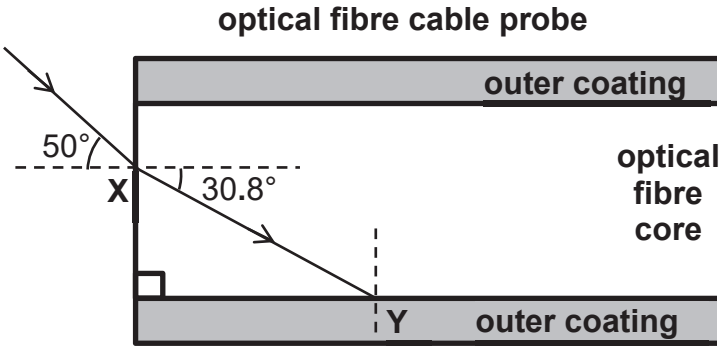


Fig. 3.2

(a) Calculate the refractive index of the optical fibre.

refractive index = ... [2]

(b) Calculate the critical angle *c* for this optical fibre.

critical angle *c* = ... [2]

(c) State and explain what will happen to the ray at point **Y**.

.....

.....

..... [2]

4 Fig. 4.1 shows an incorrect electromagnetic spectrum drawn by a student. The parts of the spectrum and the wavelengths are in the wrong order. The values of the wavelengths do not match the correct parts of the spectrum.

short wavelength						long wavelength
microwaves	radio waves	ultraviolet	infra-red	gamma rays	X-rays	visible
10^{3} m	10^{-14} m	10^{-10} m	10^{-8} m	10^{-2} m	10^{-6} m	10^{-5} m

Fig. 4.1

(a) On Fig. 4.2, complete the table of the electromagnetic spectrum. Radio waves and their correct wavelength have been inserted for you.

short wavelength						long wavelength
						radio waves
						10^{3} m

Fig. 4.2

[3]

(b) State the speed of all electromagnetic waves in vacuum.

…… [1]

(c) State two uses of infra-red radiation.

1. ……

2. …… [2]

5 Fig. 5.1 shows a student touching the metal dome of a Van de Graaff generator. When the generator is switched on, the metal dome becomes negatively charged.

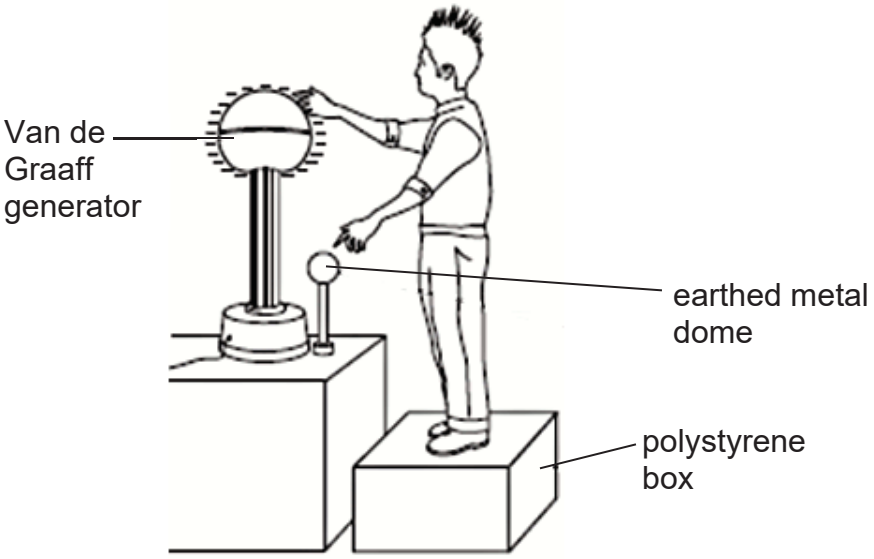


Fig. 5.1

(a) Explain why the student's hair stands on end when the generator is switched on.

……

……

…… [2]

(b) **(i)** When the potential difference between the student and a nearby earthed metal dome reaches 15 kV, a spark jumps between the student and the earthed dome. The spark transforms 0.3 J of energy into heat, light and sound.

Calculate the charge carried by the spark.

charge = …….. [2]

(ii) State the physical quantity that represents the rate of transfer of charge.

…… [1]

6 Fig. 6.1 shows a piece of video tape passing under the recording head of a video recorder. An alternating current is passed through the coil. The video tape is coated with a magnetic material which becomes magnetised.

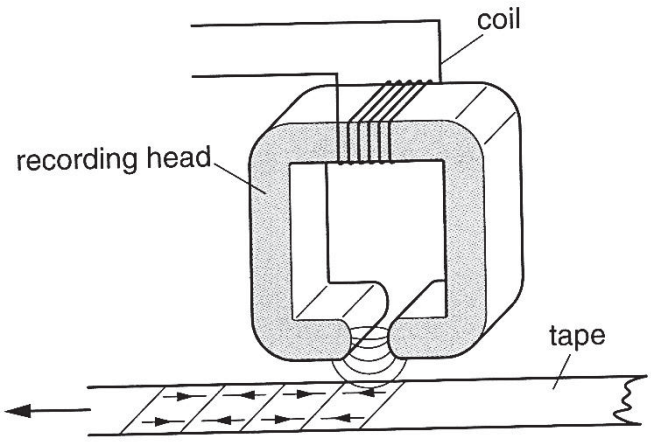


Fig. 6.1

(a) **(i)** Explain why the tape becomes magnetised.

……

……

…… [1]

(ii) Fig. 6.1 shows that the sections of the video tape are magnetised in opposite directions. Explain the cause of this occurrence.

……

…… [1]

(iii) The tape is moved faster past the recording head. State how this changes the pattern on the tape.

……

…… [1]

(b) **(i)** Explain why the coating must be of a permanent magnetic material.

……

…… [1]

(ii) State the name of a permanent magnetic material.

..... [1]

7 Fig. 7.1 shows a circuit in which all switches S1, S2 and S3 are open.

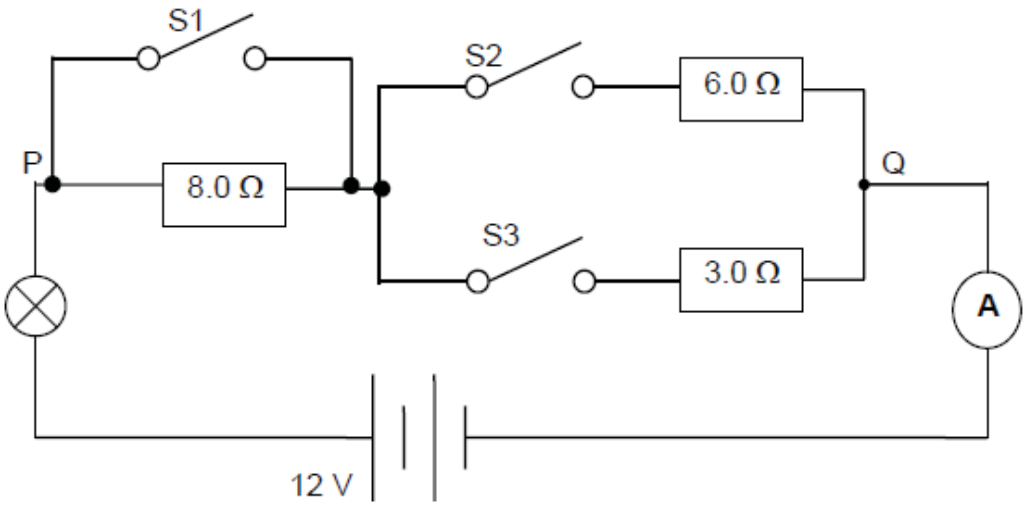


Fig. 7.1

(a) Calculate the effective resistance between points P and Q when S1, S2 and S3 are closed.

effective resistance = ... [2]

(b) Calculate the resistance of the lamp when S1, S2 and S3 are closed and the ammeter reads 2.0 A

resistance = ... [2]

(c) Calculate the energy dissipated by the lamp in 2 min when S1, S2 and S3 are closed.

energy dissipated = …….. [2]

8 Fig. 8.1 shows two coils wound on an iron ring. One coil is connected in series to a switch and a d.c. supply, and the other is connected to a very sensitive centre-zero voltmeter.

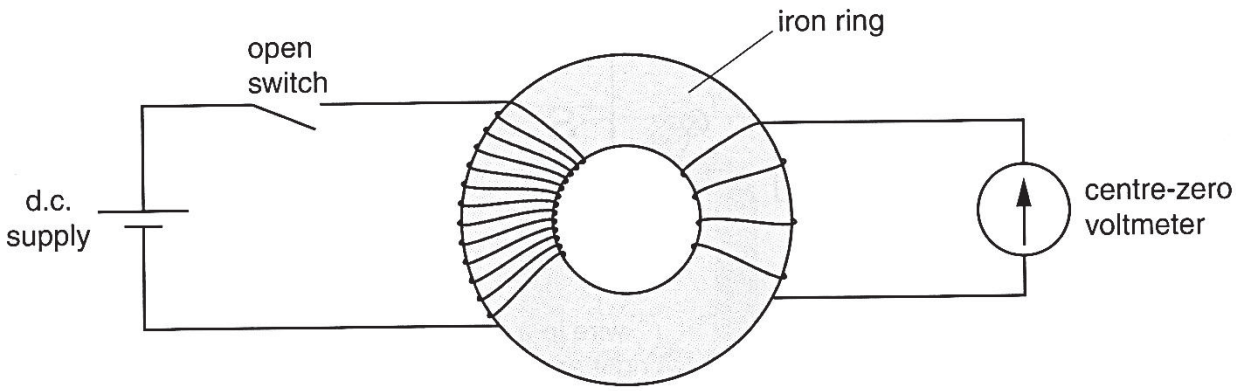


Fig. 8.1

At first the switch is open, as shown in Fig. 8.1.

(a) The following actions are taken in turn.

Describe and explain what happens to the reading on the voltmeter in each case.

(i) The switch is closed.

……

……

……

…… [4]

(ii) The switch is left closed for a long time.

……

…… [1]

(iii) The switch is opened.

……

……

…… [2]

(b) State why an a.c. supply, rather than a d.c. supply, is used for a transformer.

……

…… [1]

(c) State two ways how the turning effect on a current-carrying coil in a d.c. motor can be increased.

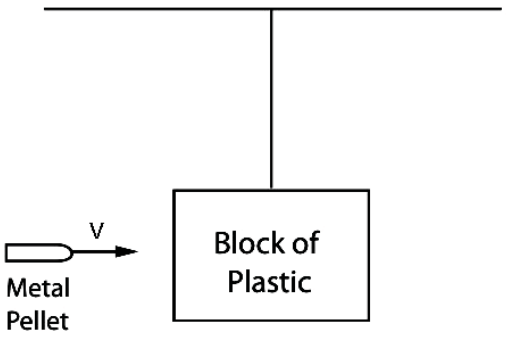
1. ……

2. …… [2]

Section B

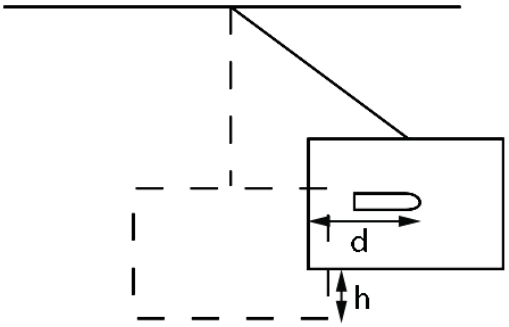
Answer **all** the questions from this section.
Answer only one of the two alternative questions in **Question 11**.

9 In an experiment, different sized metal pellets are fired from an air rifle towards an 8.0 kg block of plastic suspended from the top of a ceiling. The initial position of the block is shown in Fig. 9.1, and when the pellet hits the plastic block, the block is displaced as shown in Fig. 9.2.



BEFORE

Fig. 9.1



AFTER

Fig. 9.2

The information obtained from the experiment is shown in Fig. 9.3.

mass of pellet, m	speed of pellet just before it hits plastic block, v	depth of penetration by pellet, d	time taken for pellet to come to a stop, t	maximum increase in height of plastic block, h
0.050 kg	40 m/s	0.15 m	0.025 s	0.348 m
0.025 kg	56 m/s	0.12 m	0.020 s	0.292 m
0.020 kg	62 m/s	0.11 m	0.018 s	0.274 m

Fig. 9.3

(a) Calculate the kinetic energy of the 0.025 kg pellet just before it hits the block of plastic.

kinetic energy = ... [2]

(b) Calculate the deceleration and hence the resistive force acting on the 0.025 kg pellet.

deceleration = …….. [2]

resistive force = …….. [2]

(c) Calculate the work done by the 0.025 kg pellet against friction.

work done = …….. [2]

(d) Show that there is a discrepancy between the experimental and theoretical values for the increase in height of the plastic block.

[2]

10 Fig. 10.1 shows a refrigerator. The refrigerator walls are made of smooth white metal with a layer of polystyrene foam between the inside and outside walls.

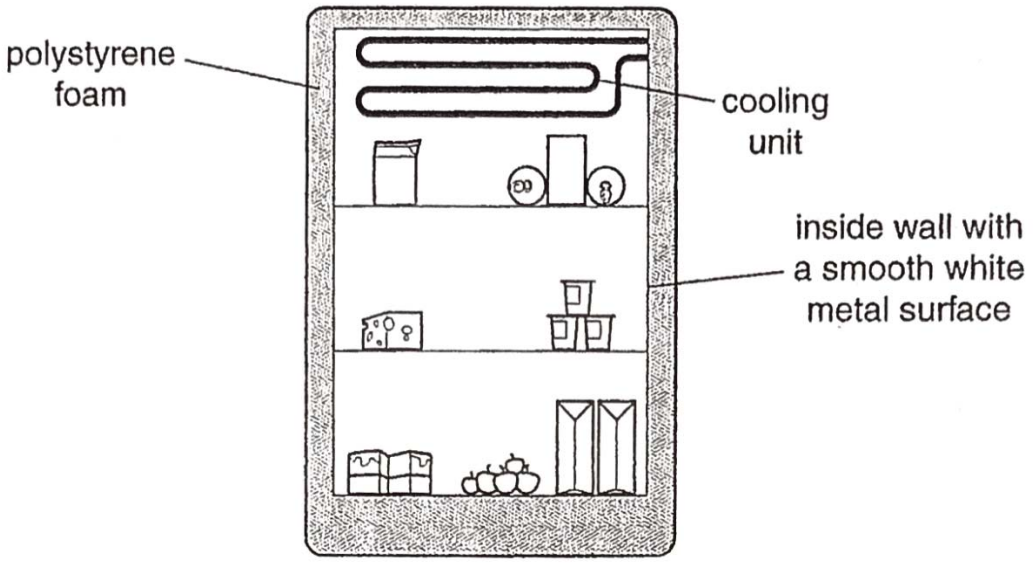


Fig. 10.1

(a) **(i)** Describe how the polystyrene foam insulates the refrigerator.

.....

.....

.....

..... [2]

(ii) Explain how the cooling unit at the top cools all the contents of the refrigerator.

.....

.....

.....

.....

.....

..... [2]

(iii) The inside wall radiates a small amount of thermal energy (infra-red radiation). State how the colours of the surface affects the amount of energy radiated.

……

…… [1]

(b) A beaker contains 100 g of water at temperature of 50°C. An ice cube is removed from a refrigerator and dropped into the water. The ice cube is initially all solid at 0°C and has a mass of 3.0 g.

When the ice has melted, the water is stirred and has a temperature of 46°C.

The specific heat capacity of water is 4.2 J/(g°C).

In this question, ignore heat loss to the beaker and surroundings.

(i) Calculate the energy lost by the water as it cools from 50°C to 46°C.

energy = …….. [2]

(ii) The melted ice (water) from the ice cube gains energy as it warms from 0°C to 46°C. Calculate the thermal energy needed for this rise in temperature.

energy = …….. [1]

(iii) Use your answers to **(i)** and **(ii)** to determine the latent heat needed to melt the ice cube.

energy = …….. [1]

(iv) Determine the specific latent heat of fusion of water.

specific latent heat of fusion = …….. [1]

11 EITHER

Fig. 11.1 shows a man using an exercise machine.

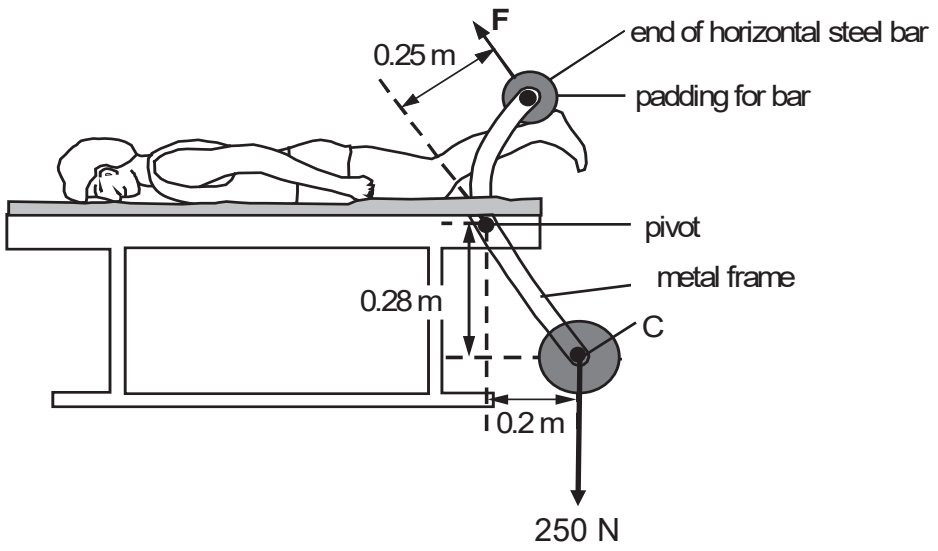


Fig. 11.1

(a) State the *Principle of Moments*.

……

……

……

…… [2]

(b) Define the *moment* of a force and state its SI unit.

……

……

……

…… [2]

(c) The heels press against the pad with a force **F** and cause a turning effect about the pivot. The weight of the 250 N weights acts through the centre of gravity C.

Calculate the

(i) number of weights supported at C if each piece has a mass of 5 kg;

number of weights = …….. [2]

(ii) moment due to the 250 N weights about the pivot;

moment = …….. [2]

(iii) force **F**.

F = …….. [2]

OR

An appliance is connected to the live, neutral and earth conductors of the mains supply.

The current in the circuit is 4.0 A and the rating of the fuse is 5 A.

(a) Explain what is meant by

(i) *live*;

……

…… [1]

(ii) *neutral*.

……

…… [1]

(b) When a fault occurs in the appliance, no damage or injury is caused provided that the correct fuse is used and the metal case is connected to earth.

(i) The 5 A fuse is replaced by a 30 A fuse.

Explain why this presents a risk of damage or injury.

……

……

……

……

…… [2]

(ii) The earth conductor is **not** connected to the metal case.

Explain why this presents a risk of damage or injury.

……

……

……

……

…… [2]

(c) State one advantage of using a circuit breaker rather than a fuse to protect the appliance.

……

…… [1]

(d) Fig. 11.2 shows a circuit connected to a mains voltage of 220 V.

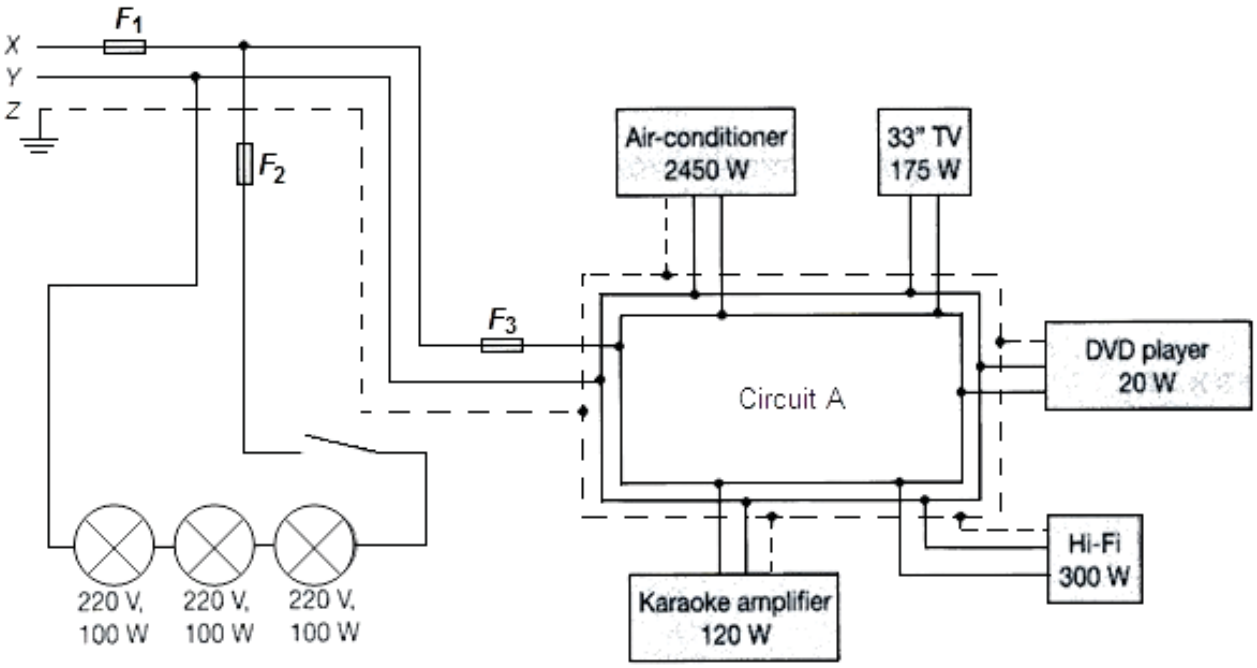


Fig. 11.2

Name the wires *X*, *Y*, and *Z*.

Wire *X* .....

Wire *Y* .....

Wire *Z* ..... [3]

END OF PAPER

Answer Key

2019 Prelim Examination
Sec 4 Express
Physics
Paper 1

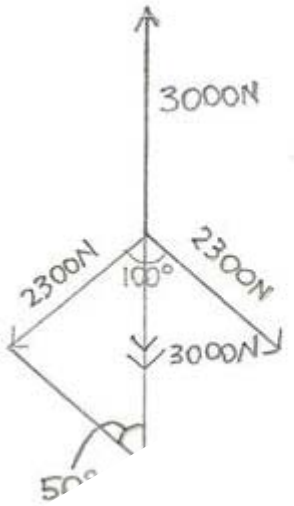
1	**B**	**11**	**A**	**21**	**C**	**31**	**D**
2	**B**	**12**	**D**	**22**	**D**	**32**	**B**
3	**C**	**13**	**C**	**23**	**B**	**33**	**D**
4	**B**	**14**	**D**	**24**	**B**	**34**	**B**
5	**B**	**15**	**C**	**25**	**A**	**35**	**B**
6	**B**	**16**	**B**	**26**	**C**	**36**	**B**
7	**D**	**17**	**D**	**27**	**D**	**37**	**D**
8	**D**	**18**	**C**	**28**	**B**	**38**	**D**
9	**D**	**19**	**B**	**29**	**D**	**39**	**D**
10	**A**	**20**	**C**	**30**	**B**	**40**	**B**

Answer Key

2019 Preliminary Examination
Sec 4 Express
Physics
Paper 2

Section A

1 (a)



[1] for scale (1 cm : 1000 N)
[1] for correct drawing of forces
[1] for correct labelling
[1] Tension – accept 2200 N to 2400 N

(b) W = mg
3000 = m x 10 [1]
m = 300 kg [1]

2 (a) Total distance = area under speed-time graph
= 0.5 x (7+4) x 80 / 60
= 7.333 km [1]
average speed = 7.333 / (7/60)
= 62.9 km/h [1]

(b) a = (v – u)/t
= (0 – 80) / (2/60) [1]
= –2400 km/h^2

Deceleration = 2400 km/h^2 [1]

(c) Weight and [1]
normal reaction force / contact force [1]

3 (a) $\eta = \frac{\sin i}{\sin r}$

$= \frac{\sin 50°}{\sin 30.8°}$ [1]

= 1.50 (3sf) [1]

(b) $\eta = \frac{1}{\sin c}$

$\sin c = \frac{1}{1.50}$ [1]

c = 41.8° (3sf) [1]

(c) Total internal reflection will take place at point Y. [1]

Angle of incidence at point Y = 180° – 90° – 30.8° = 59.2°

Explanation: angle of incidence at point Y is greater than the critical angle [1]

4 (a) correct order of powers of ten [1]
correct order of spectrum [2]
(exchanging two parts or moving one part produces correct order [1])

short wavelength						long wavelength
gamma rays	X-rays	ultraviolet	visible	infra-red	microwaves	radio waves
10^{-14} m	10^{-10} m	10^{-8} m	10^{-6} m	10^{-5} m	10^{-2} m	10^{3} m

(b) 3 x 10^8 m/s [1]

(c) any TWO from cooking, intruder (accept burglar, motion, security) alarms, [2]
any **specific** sensor or medical use, remote controls, night vision, heating (e.g. just heating or heating a greenhouse, heating a solar panel),
detect temp., see in fog,
detect hot bodies, IR astronomy, distance measurement

5 (a) Excess electrons from the negatively charged Van de Graaff generator flows to the student, causing his whole body to be negatively charged. [1]
As his hair strands attain a negative charge, they are repelled from the body as like charges repel, thus making the hair stand on ends. [1]

(b) (i) $V = W / Q$
$15{,}000 = 0.3 / Q$ [1]
$Q = 2 \times 10^{-5}$ C [1]

(ii) Current [1]

6 (a) (i) When current is flowing in the coil, it generates a magnetic field in and around the coil.
Hence the recording head is magnetised as an electromagnet, which in turn magnetises the tape. [1]

(ii) magnetism / magnetic field or current or poles on head reverses / changes direction [1]

(iii) each direction / one cycle longer (on tape) [1]

(b) (i) need to keep record / tape stored [1]

(ii) steel etc. [1]

7 (a) $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

$= \frac{1}{6} + \frac{1}{3}$ [1]

R = 2 Ω [1]

(b) V = IR
12 = 2 x R
Total R = 6 Ω [1]

Resistance of lamp = 6 – 2 = 4 Ω [1]

(c) $E = Pt = I^2R \times t$
$= 2^2 \times 4 \times (2 \times 60)$ [1]
= 1920 J [1]

8	(a)	(i)	meter deflects one way then returns to zero	[1]
			(current in left coil creates a) magnetic field	[1]
			magnetic field / flux cuts right-hand coil or changes (and induces a voltage)	[1]
			meter returns to zero because no more change in flux	[1]
		(ii)	meter remains at / returns to zero **and** no change in flux / no flux cuts coil	[1]
		(iii)	meter deflects in opposite direction	[1]
			field change in opposite direction **or** field / flux cuts in opposite direction	[1]
	(b)		direction of current / magnetic field constantly changes	[1]
	(c)		inserting a soft iron core into the coil	any
			increasing the number of turns in the coil	two
			increasing the current in the coil	[2]

Section B

9	(a)	$KE = ½ mv^2$	
		$= 0.5 \times 0.025 \times 56^2$	[1]
		$= 39.2$ J	[1]
	(b)	$a = (v-u)/t$	
		$= (0 – 56)/0.02$	[1]
		$= –2800$ m/s^2	
		Deceleration $= 2800$ m/s^2	[1]
		$F = ma$	
		$= 0.025 \times 2800$	[1]
		$= 70$ N	[1]
	(c)	work done = F x d	
		$= 70 \times 0.12$	[1]
		$= 8.4$ J	[1]
	(d)	By the Principle of Conservation of Energy	
		KE = W + GPE	
		39.2 = 8.4 + GPE	[1]
		GPE = 30.8 J = mgh	
		h = (30.8) / (0.025+8.0)(10)	
		= 0.384 m (theoretical value)	[1]

10 (a) (i) The polystyrene foam which traps air is a good heat insulator. [1]
It is a good insulator and it prevents heat conduction. [1]

(ii) The cooling unit cools the air at the top.
As the cool air contracts and sinks, the warm air rises. [1]
This movement of air sets up a convention current.
This convection current cools all the contents of the refrigerator. [1]

(iii) Shiny and smooth surfaces are poorer emitters compared to black and dull surfaces.
Hence only a small amount of energy is radiated by the inside wall. [1]

(b) (i) $E = mc\Delta\theta$
$= 100 \times 4.2 \times (50 - 46)$ [1]
$= 1680$ J [1]

(ii) $E = mc\Delta\theta$
$= 3.0 \times 4.2 \times (46 - 0)$
$= 580$ J (3sf) [1]

(iii) Latent heat required $= 1680 - 580$
$= 1100$ J [1]

(iv) specific latent heat of fusion $l_f = L_f / m$
$= 1100 / 3.0$
$= 367$ J/g [1]

EITHER

11 (a) The Principle of Moments states that when a body is in equilibrium, the sum of the clockwise moments about a pivot is equal to the sum of the anticlockwise moments about the same pivot. [1] [1]

(b) The moment of a force is the product of the force and the perpendicular distance from the pivot to the line of action of the force. [1]

SI unit: Nm [1]

(c) (i) Weight of each piece $W = m \times g$
$= 5 \times 10$
$= 50$ N [1]

No. of weights at C $= 250 / 50$
$= 5$ [1]

(ii) moment = F x d
= 250 x 0.2 [1]
= 50 Nm [1]

(iii) By the Principle of Moments
sum of clockwise moments = sum of the anticlockwise moments
50 = F x 0.25 [1]
F = 200 N [1]

OR

11 (a) (i) Live conductors allow current to flow through and reach the appliance. [1]

(ii) Neutral conductors allow the current to flow back to the source and hence complete the circuit. [1]

(b) (i) The fuse rating is much higher than the amount of current flowing through the circuit. [1]
When excessive current flows through the appliance, the fuse may not melt and disconnect the circuit. As a result, it may cause harm to the user or damage to the appliance. [1]

(ii) The metal case becomes live when the live wire is damaged and [1]
touches the metal case. [1]
As a result it may cause harm to the user or damage to the appliance.

(c) The circuit breaker works faster in disconnecting all the switches in the house. Any one
The circuit breaker only needs to be reset after activated whereas the fuse needs to be replaced after melting. [1]

(d) Wire X: Live [1]

Wire Y: Neutral [1]

Wire Z: Earth [1]