DAMAI SECONDARY SCHOOL
Preliminary Examination 2019

CANDIDATE NAME

CLASS | | | | INDEX NUMBER | | | |

SCIENCE (PHYSICS) 5076/02

Paper 2 **16 September 2019**

Secondary 4 Express/ 5 Normal Academic **1 hour 15 minutes**

Setter: **65 Marks**

Additional Materials: Nil

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagram, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.
The use of an approved scientific calculator is expected, where appropriate.
You may lose marks if you do not show your working or if you do not use appropriate units.

Section A
Answer **all** questions.

Section B
Answer only **two** questions.

The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **18** printed pages including the cover page.

[Turn over

Section A (45 marks)

Answer **all** the questions in the spaces provided.

1 Electronic components can be damaged by overheating. To overcome this problem, the component, such as a computer chip, is fitted with a heat sink as shown in Fig. 1.1.

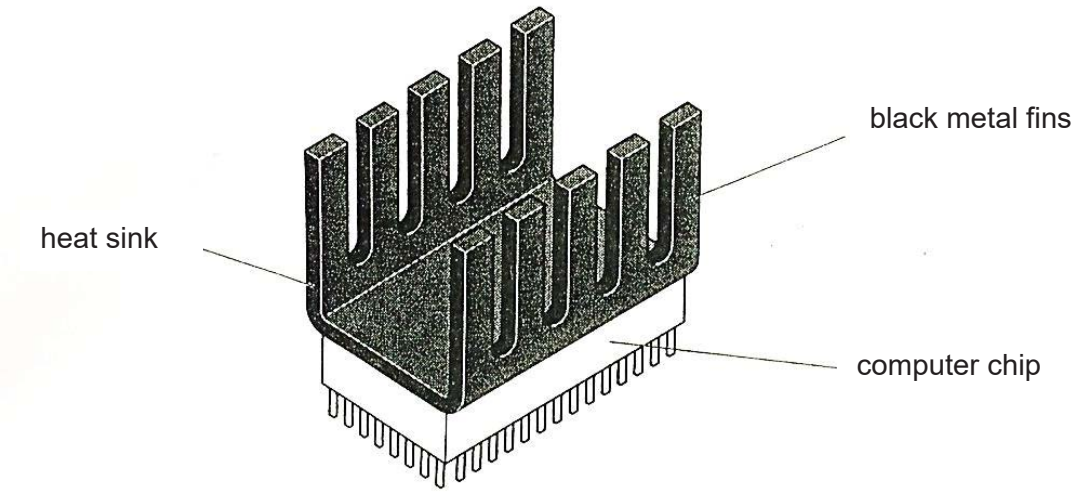


Fig. 1.1

The heat sink keeps the computer chip cool. Explain how the heat sink increases the loss of thermal energy by

(a) conduction ……..

……..……[1]

(b) radiation …….

.....

……..……[1]

2 A heated substance is cooled to the temperature of its surroundings. Fig. 2.1 shows more information about the substance and the process.

initial temperature of heated substance	110 ºC
boiling point of substance	70 ºC
melting point of substance	-10 ºC
temperature of surroundings	- 30 ºC

Fig. 2.1

Describe the changes to

(a) the arrangement of molecules from 110 ºC to – 10 °C,

……..……

……..[1]

(b) the motion of molecules from 80 °C to 60 °C.

……..……

…… [1]

3 A U-tube is first filled with liquid **A** and then with liquid **B** in the right side of the tube as shown in Fig. 3.1.

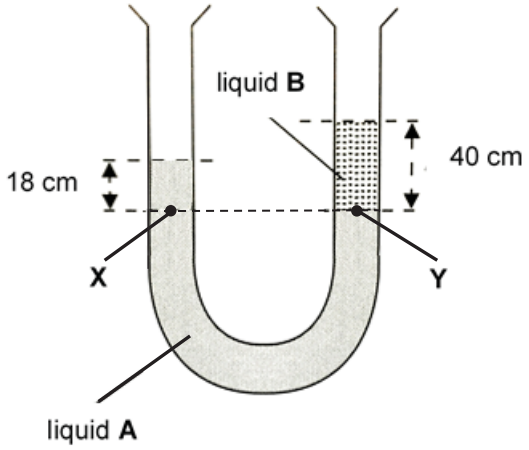


Fig. 3.1

The cross sectional area of the U-tube is 3.0 cm^2. The density of liquid **B** is 1.0 g/cm^3. Point **X** and **Y** are at the same horizontal level.

Take the Earth's gravitational field strength as 10 N/kg.

(a) Calculate the mass of liquid **B** in the U-tube.

mass = ... g [2]

(b) Calculate the pressure at point **Y** due to liquid **B**.

pressure = ... N/m^2 [2]

(c) The pressure at point **X** and point **Y** are the same. Explain whether liquid **A** has a larger or smaller density than liquid **B**.

.....

..... [1]

4 Fig. 4.1. shows a system for raising a heavy piece of metal at position **W** to a vertical position **X**.

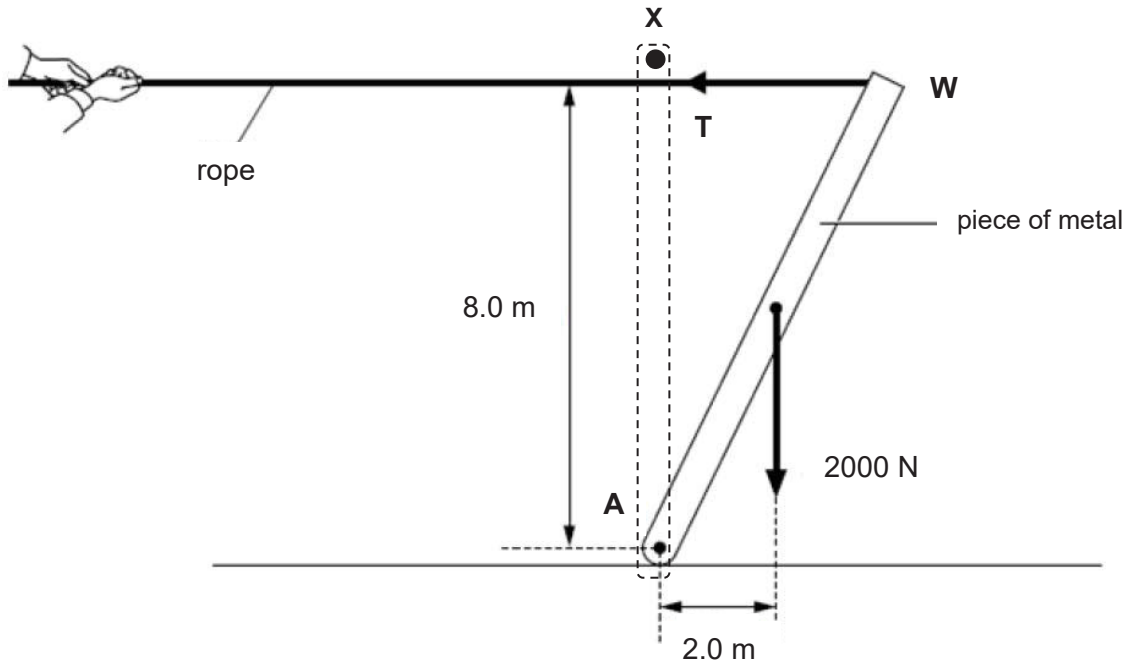


Fig. 4.1

A man pulls on a rope with a horizontal force **T**. The piece of metal has a weight of 2000 N and is freely pivoted at **A**. The system is in equilibrium.

(a) Calculate the moment produced by the metal's weight about pivot **A**.

moment = ……. Nm [1]

(b) Hence, calculate the horizontal force **T**.

force **T** = …….. N [2]

(c) As the piece of metal moves from position **W** to **X** as shown in Fig. 4.1, explain how the moment produced by **T** changes if the magnitude of **T** remains constant.

……...

……..……[2]

5 Fig. 5.1 shows a water ride at a theme park. A man sitting on a float is about to go down the water slide. The combined mass of the man and float is 80.0 kg. The Earth's gravitational field strength is 10 N/kg.

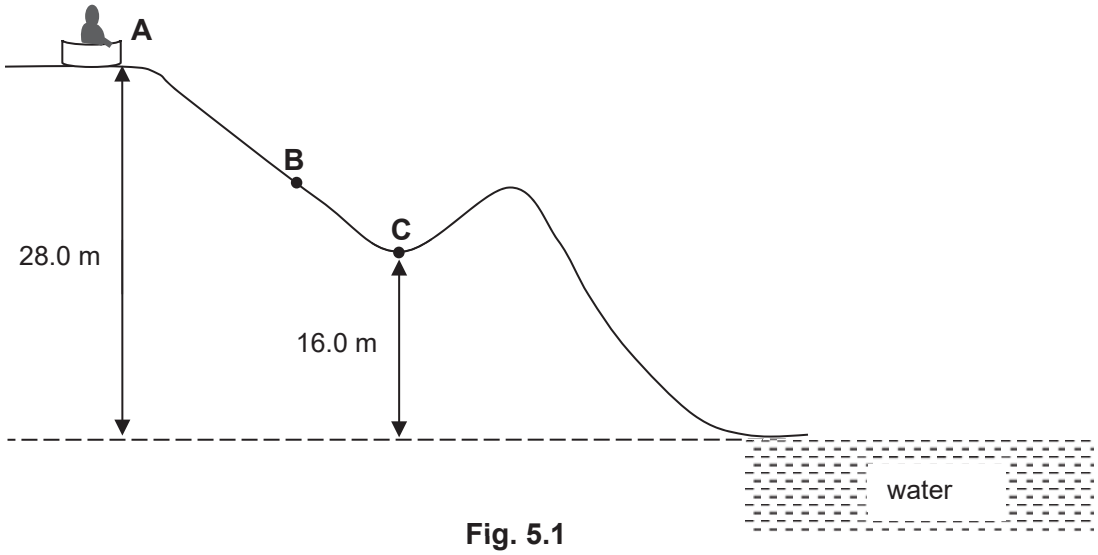


Fig. 5.1

The man slides down from rest from point **A** to point **C**.

(a) Assuming that the slide is frictionless,

(i) calculate the loss in gravitational potential energy,

loss in gravitational potential energy =……. J [2]

(ii) the speed of the man at point **C**.

speed = …….. m/s [2]

(b) In reality, friction is present between the slide and the float. The kinetic energy of the man and the float is 8800 J at point **C** and the length of the slide from **A** to **C** is 56.0 m. By considering the work done against friction, calculate the average frictional force acting on the man from **A** to **C**.

frictional force = …….. N [2]

6 Fig. 6.1 shows a ray of light entering an equilateral glass prism at the point of incidence **A**. The refractive index of the glass prism is 1.50.

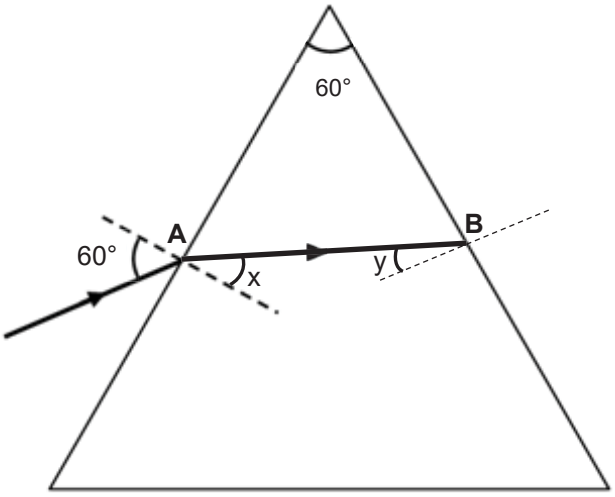


Fig. 6.1

(a) Calculate the angle of refraction at point **A**.

∢x = ... º [2]

(b) Calculate the critical angle of the glass prism.

critical angle = ... º [1]

(c) Calculate the angle of incidence y at point **B**.

∢y = ... º [1]

(d) On Fig. 6.1, draw the path of the light ray after it hits the surface at **B**. [1]

7 A collector views a postage stamp of height 1.0 cm through a lens. The lens is 1.5 cm from the stamp. The height of the image of the stamp seen is 3.5 cm.

The stamp, the image of the stamp and the position of the lens are drawn to scale are shown in Fig. 7.1.

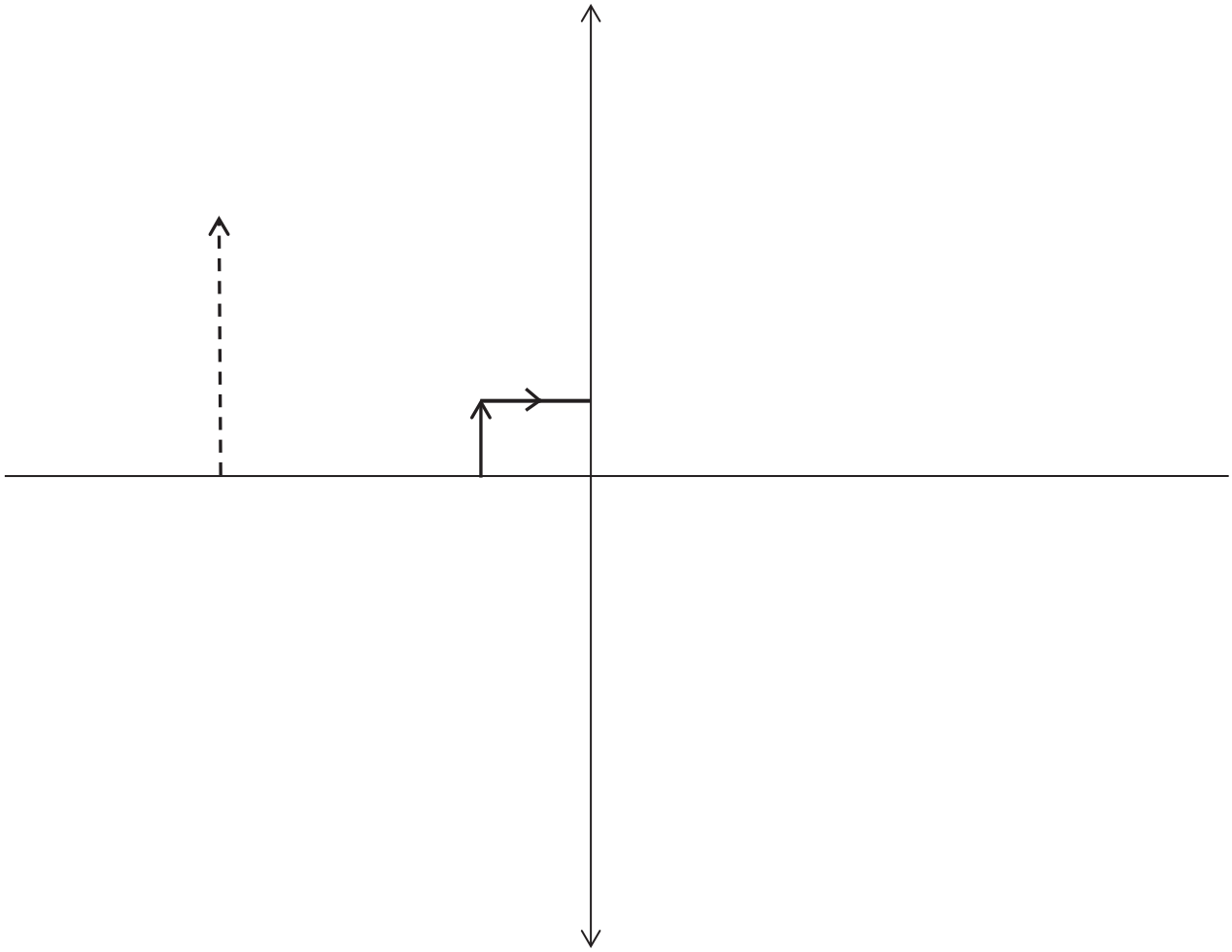


Fig. 7.1

A ray of light from the top of the stamp to the lens is shown in Fig. 7.1.

(a) On Fig. 7.1,

(i) complete the path of the ray from the top of the stamp after it passes through the lens. [1]

(ii) draw another ray from the top of the stamp to show how the image is formed. [1]

(b) From Fig. 7.1, determine the focal length of the lens.

focal length = ……... cm [1]

8 Fig. 8.1 shows a section (**PQ**) of a sea waves approaching a beach at a speed of 1.5 m/s. Two complete waves hit the sand every 10 s.

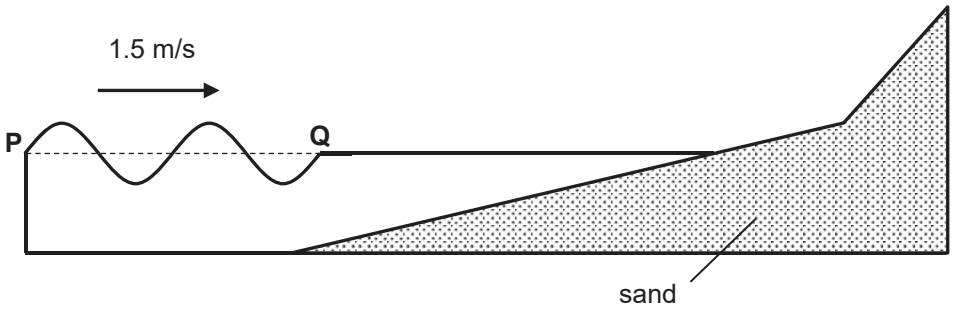


Fig. 8.1

(a) Calculate the wavelength of the wave between **P** and **Q**.

wavelength = …….. m [2]

(b) State the direction of movement of a particle at position **P** at the next instant.

…… [1]

(c) Explain whether the wave shown in Fig. 8.1 is a transverse wave or a longitudinal wave.

……..

……..[2]

9 Electromagnetic (EM) waves have many applications. Complete Fig. 9.1 by identifying the electromagnetic waves used for each of the applications.

application	EM waves
ear thermometer	
Global Positioning System (GPS)	
sterilization of medical equipment	
cancer treatment	

Fig. 9.1

[2]

10 During a thunderstorm, the base of a cloud is negatively charged. Fig.10.1 shows one such cloud above the ground.

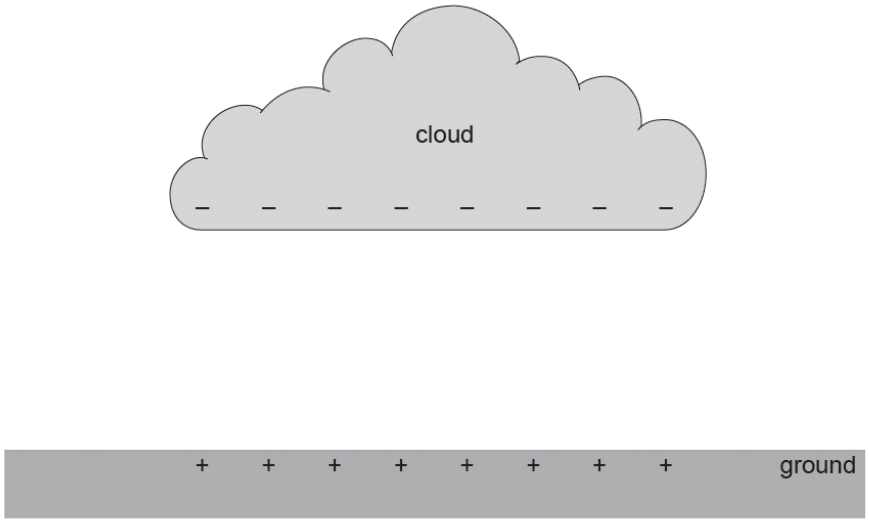


Fig. 10.1

(a) The cloud causes the ground beneath it to become positively charged. Explain, how the ground becomes positively charged.

……..……....

……..[1]

(b) A lightning strike occurs. Within a short duration of 1.5 ms, a charge of 180 C passes between the cloud and the ground.

Calculate the average current in the lightning strike.

current = ……... A [2]

11 Fig. 11.1 shows a simplified household circuit. It consists of an air-conditioner and a lighting unit connected to the mains supply of 230 V.

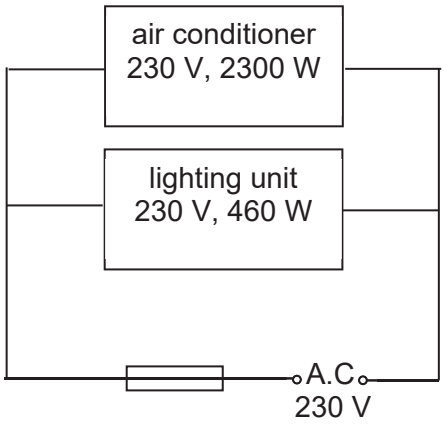


Fig. 11.1

(a) Explain how a fuse works.

……

……[1]

(b) By using suitable calculations, suggest an appropriate rating for the fuse shown in Fig. 11.1.

fuse rating = …….. A [2]

12 Fig. 12.1 shows a light aluminum rod resting between the poles of a magnet. Each end of the aluminum rod rests on a brass strip, which is connected to an electric circuit.

.

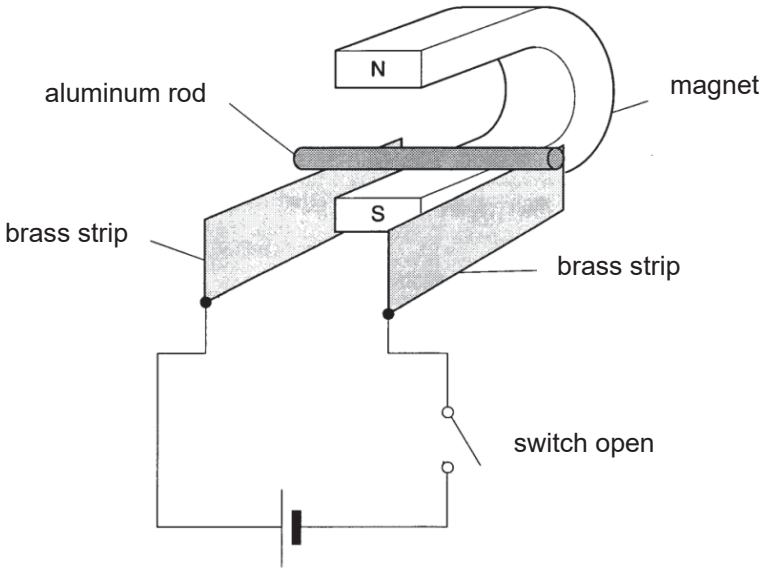


Fig. 12.1

(a) By means of an arrow, indicate on Fig. 12.1 the direction in which the aluminium rod will move when the switch is closed. [1]

(b) Suggest one way to increase the speed of the aluminium rod when it moves.

……

…… [1]

(c) The battery is changed to an a.c. source of frequency of 0.50 Hz. Describe and explain what you will observe about the movement of the aluminium rod.

……

…… [2]

Section B (20 marks)

Answer any **two** questions in this section.

Write your answers in the spaces provided.

13 A motorcycle of mass 180 kg accelerates along a straight section of the racing track from a speed of 40 m/s. Fig. 13.1 shows the speed-time graph of the motorcycle.

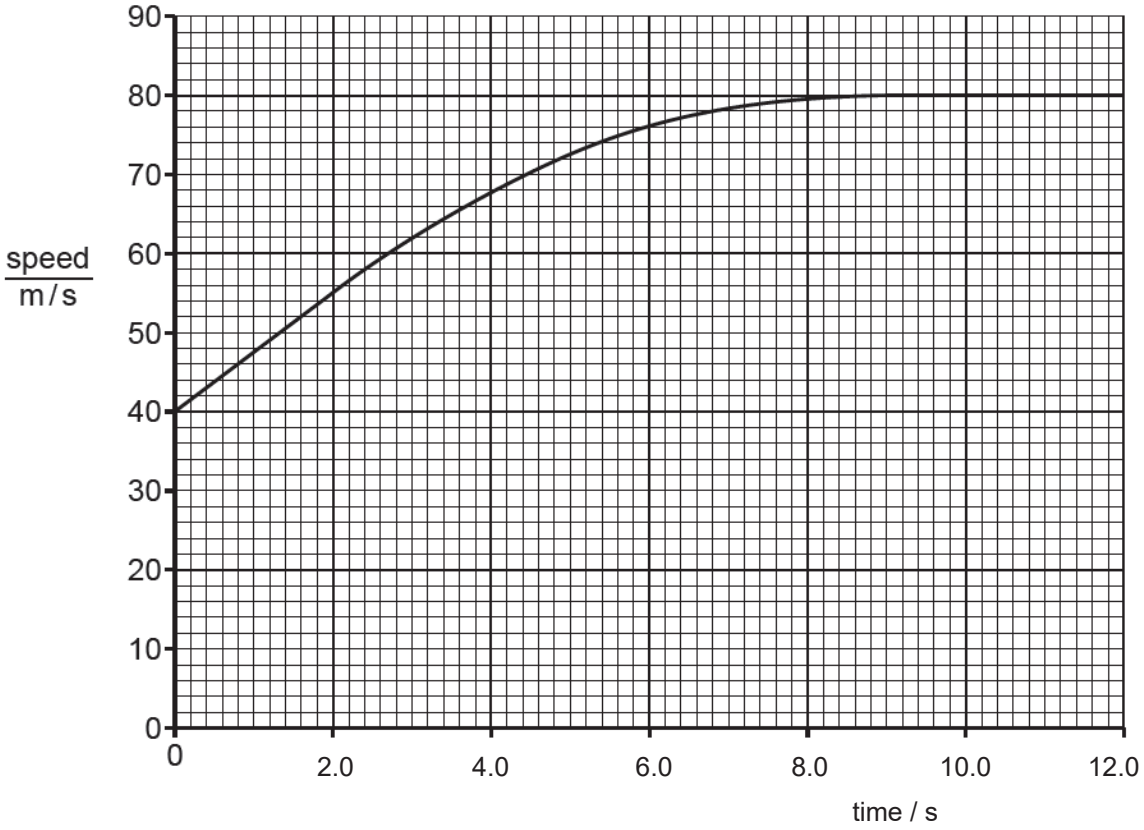


Fig. 13.1

(a) For time = 0 s to 2.0 s, determine

(i) the acceleration of the motorcycle,

acceleration = …….. [2]

(ii) the resultant force acting on the motorcycle.

resultant force = ……. [2]

(b) The driving force acting on the motorcycle remains constant throughout the 12 s spent on the straight section of the track.

(i) Using Fig. 13.1, describe how the acceleration of the motorcycle changes during this time.

..……...

……. [2]

(ii) Explain, in terms of the forces acting on the motorcycle, why the acceleration changes in this way.

..……...

…….……...

……....

…….. [3]

(iii) On Fig. 13.1, sketch a graph to show how its motion may look like if the motorcyclist now travels on a racing track with a rougher surface. [1]

14 A student measures the speed of sound in a laboratory, as shown in Fig. 14.1.

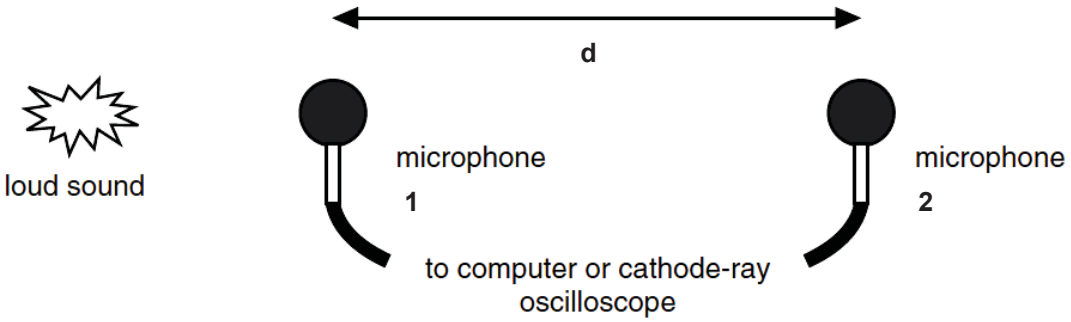


Fig. 14.1

(a) The sound is received by two microphones placed at a distance **d** apart. The time interval t between the sound arriving at the two microphones is recorded.

(i) Explain how sound travels through the air to microphones.

.....

.....

..... [2]

(ii) Explain why microphone **2** detects a softer sound than microphone **1**.

.....

..... [1]

(b) Fig. 14.2 shows the trace observed when the signal from the microphones are fed to the two inputs of a cathode-ray oscilloscope.

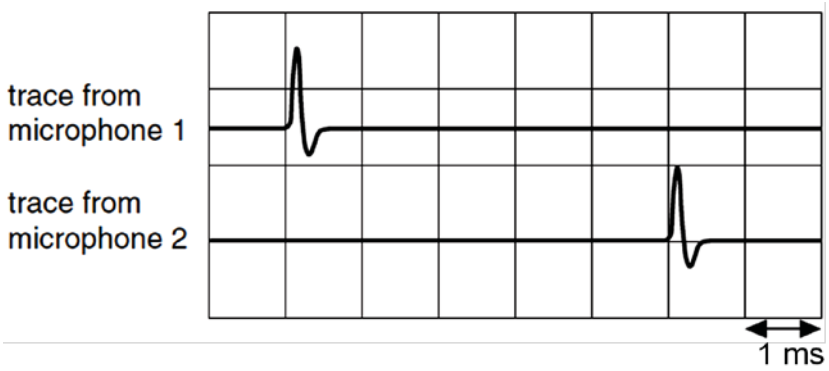


Fig. 14.2

If the speed of sound is 330 m/s, estimate the distance **d** between the two microphones.

distance **d** = …….. [3]

(c) Suggest two reasons why it is difficult to measure the speed of sound inside a building using only a stopwatch and a meter rule.

……..

……..

…… [2]

(d) The experiment is repeated under water when the microphones can still detect the sound. State and explain how the trace in Fig. 14.2 differs.

……

……

…… [2]

15 The resistance of component **X** changes with temperature. It is connected in series with a light bulb of resistance 10 Ω and a 1.5 V battery, as shown in Fig. 15.1.

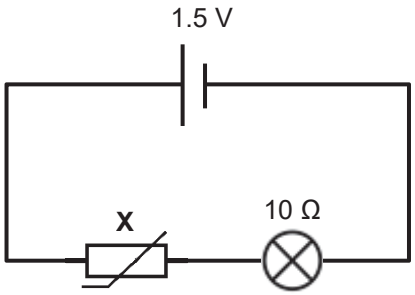


Fig. 15.1

Fig. 15.2 shows the variation in the resistance of **X** with temperature.

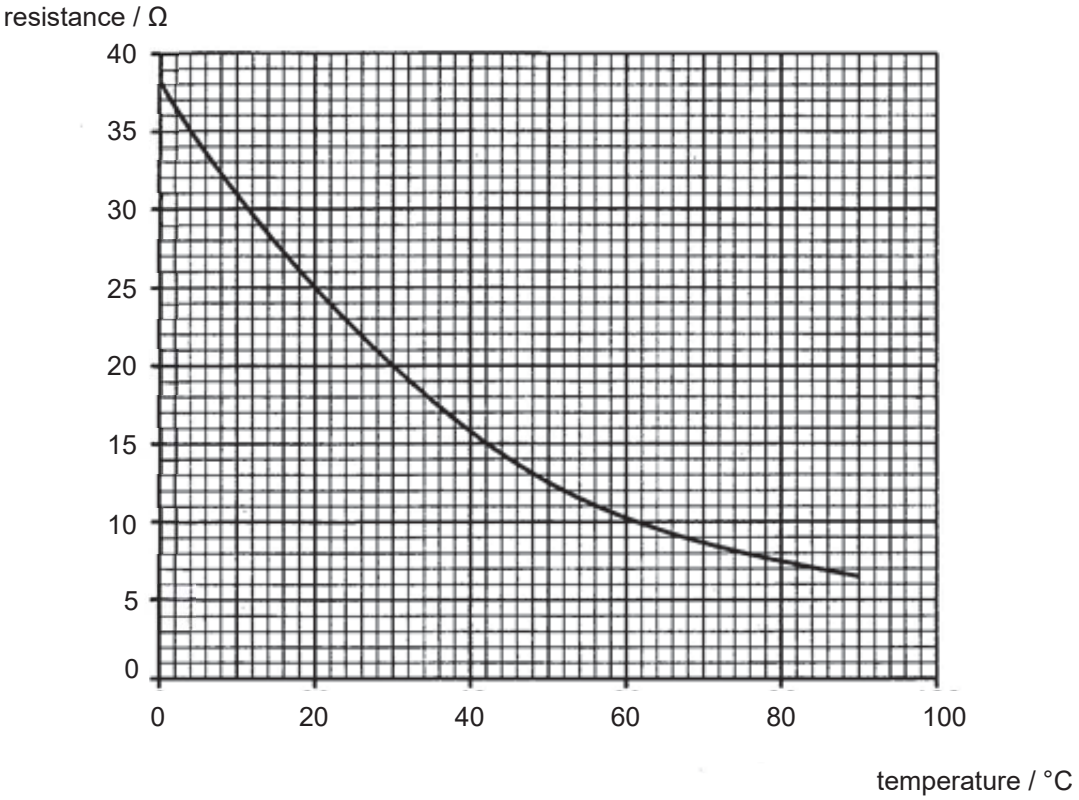


Fig. 15.2

(a) **(i)** Determine the resistance of **X** at 30ºC.

resistance of **X** = …….. [1]

(ii) Hence, calculate the potential difference across **X** at 30ºC.

potential difference across **X** = …….. [2]

(b) Describe and explain how the current in the circuit changes as temperature increases.

……

……

…… [2]

(c) Component **X** is connected in another circuit as shown in Fig. 15.3.

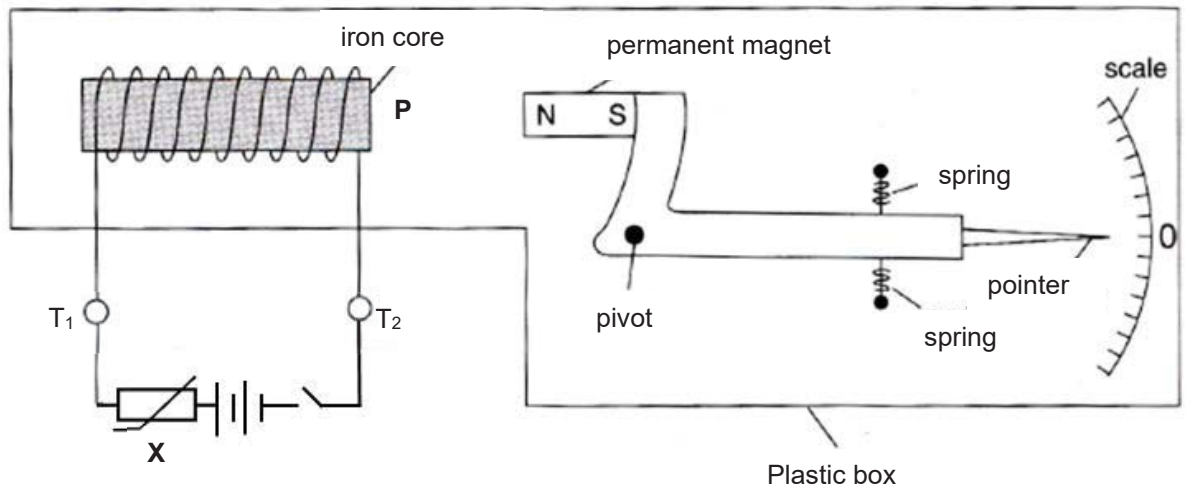


Fig. 15.3

(i) State the polarity of the solenoid induced at end **P** when the switch is closed.

…….... [1]

(ii) Hence, state the direction, clockwise or anticlockwise, in which the pointer will turn when the switch is closed.

…….... [1]

(iii) When the temperature increases, how does it affect the deflection of the pointer? Explain your answer.

…….

…….

…….

…….... [3]

END OF PAPER

DAMAI SECONDARY SCHOOL
Preliminary Examination 2019

CANDIDATE NAME				
CLASS			INDEX NUMBER	

SCIENCE (PHYSICS)

5076/01

Paper 1

17 September 2019

Secondary 4 Express / 5 Normal (Academic)

30 min

Setter:

20 Marks

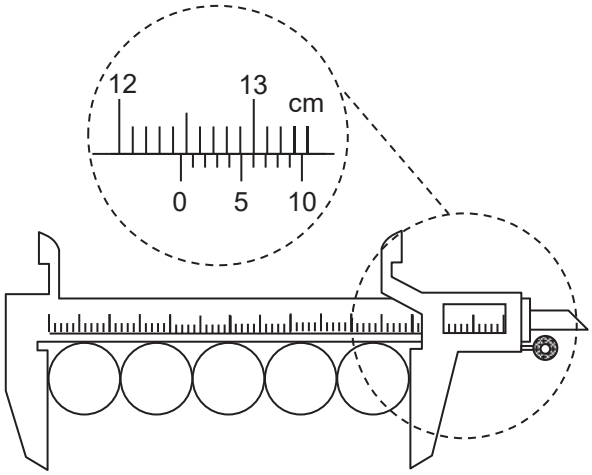
Additional Materials: Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class on the Answer Sheet Provided using a 2B-pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
The use of an approved scientific calculator is expected, where appropriate.

There are **twenty** questions in this booklet. 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 **2B-pencil** on the Answer Sheet.
Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

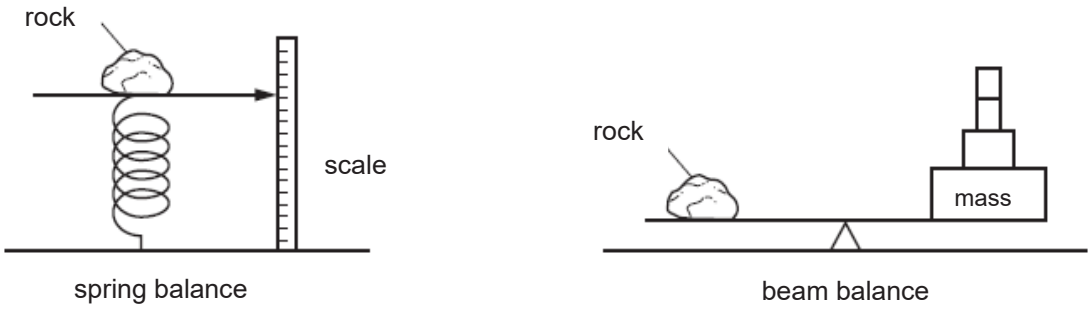
1 A pair of vernier calipers is used to measure the total length of 5 coins placed side by side.



Assuming that there is no zero error, what is the diameter of one coin?

A 2.45 cm **B** 2.49 cm **C** 2.59 cm **D** 2.95 cm

2 A scientist places a rock on a spring balance. She then places the same rock on a beam balance.

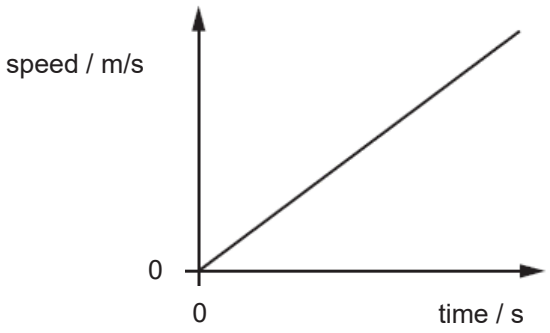


She performs the experiment at the North Pole and at the Equator. At the North pole, gravitational field strength is greater than at the Equator.

How do the readings at the North Pole compare to those at the Equator?

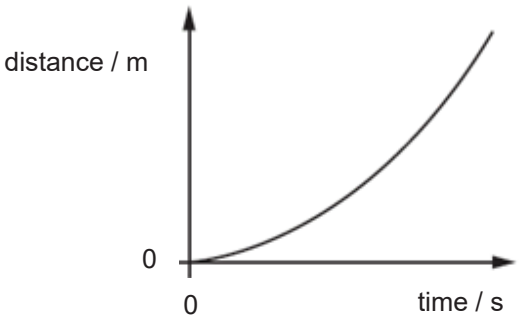
	scale reading on spring balance	masses needed on beam balance
A	different	different
B	different	same
C	same	different
D	same	same

3 The speed-time graph of a short journey is shown below.

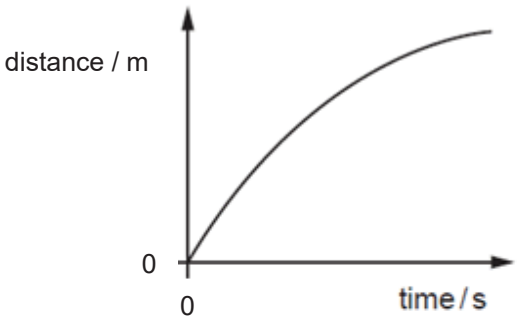


Which distance-time graph represents the same journey?

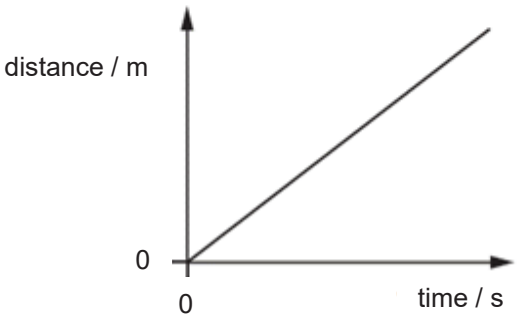
A



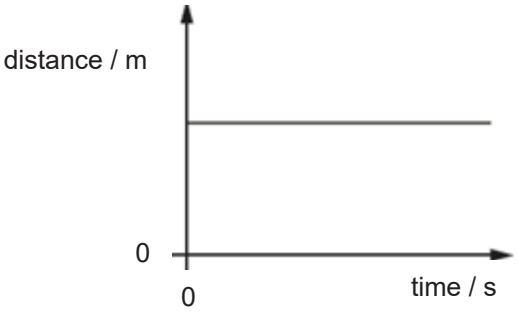
B



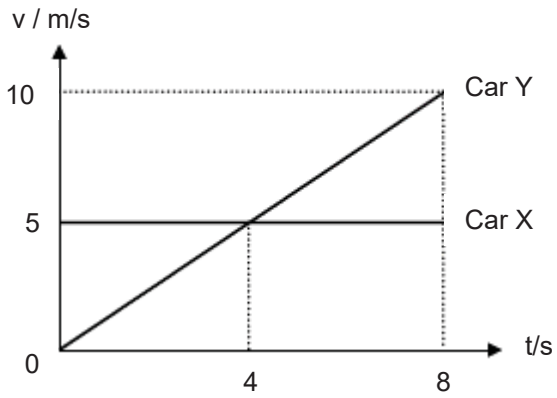
C



D



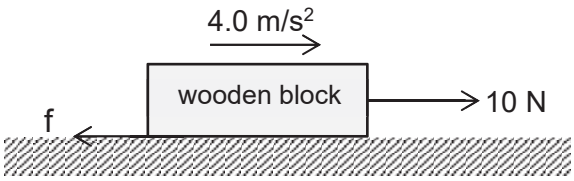
4 The diagram shows the speed-time graphs of cars X and Y. Both cars started moving off from the same position at the same time.



At what time will the two cars meet again?

A 4 s **B** 6 s **C** 8 s **D** 10 s

5 The diagram shows a wooden block of mass 0.80 kg on a rough horizontal surface. A 10 N force is applied to the block and it undergoes a constant acceleration of 4.0 m/s^2.

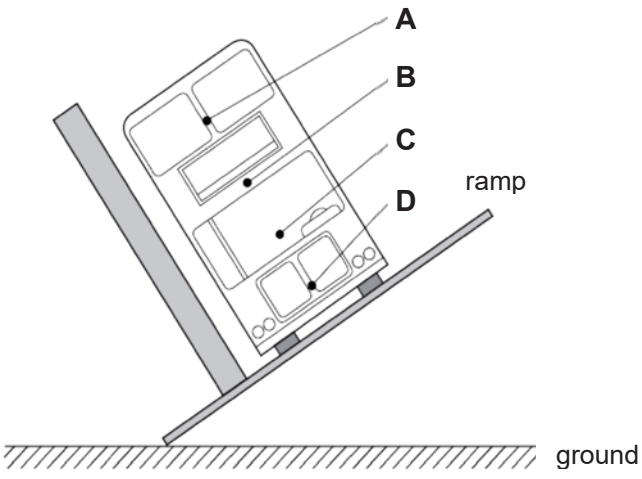


What is the magnitude of the frictional force f?

A 3.2 N **B** 6.8 N **C** 10 N **D** 13.2 N

6 The stability of a bus is tested by tilting it on a ramp. The diagram shows a bus that is just about to topple over.

Where is the centre of gravity of the bus?

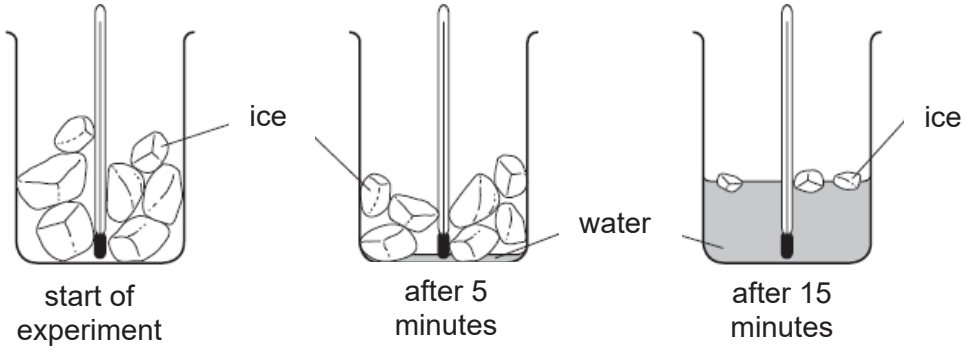


7 A builder carrying a bucket of bricks climbs a 5.0 m tall ladder in 8.0 s. The bucket of bricks has a total mass of 20 kg.

What is the average power in carrying the bucket of bricks to the top of the ladder?

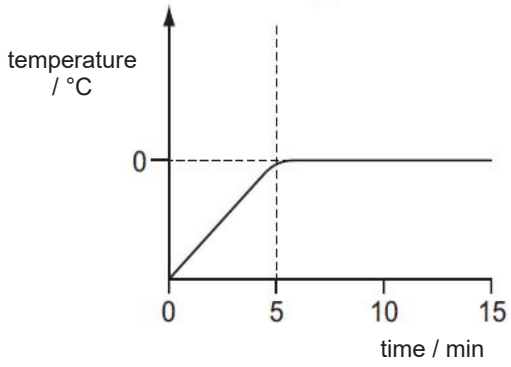
A 4 W **B** 40 W **C** 125 W **D** 1 000 W

8 A beaker containing ice and a thermometer is left in a warm room for 15 minutes. No water is visible in the beaker until 5 minutes have passed. After 15 minutes, some ice is still visible.

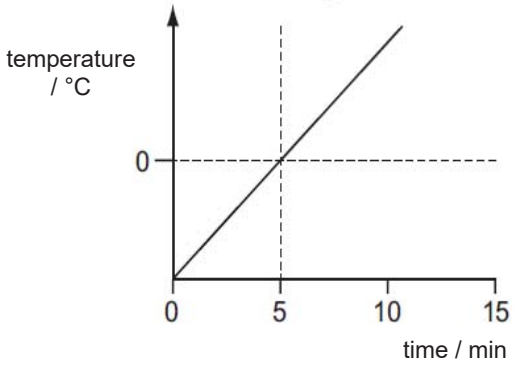


Which graph represents the process described above?

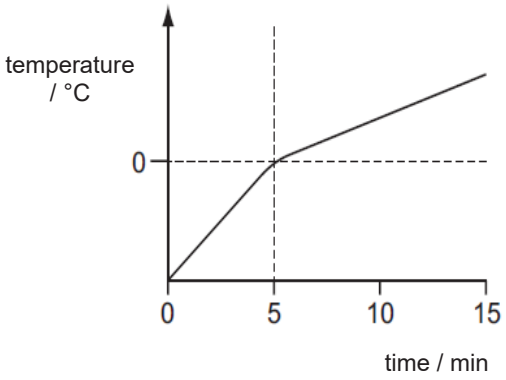
A



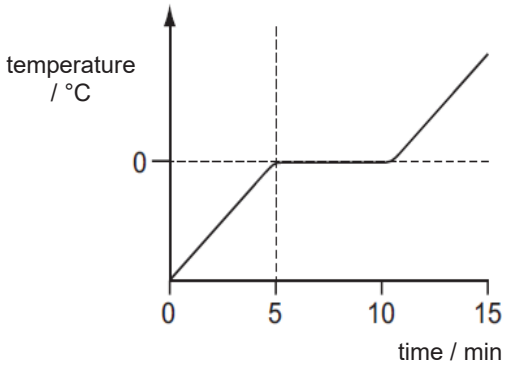
B



C



D



9 Which of the following occurs when a solid expands upon heating?

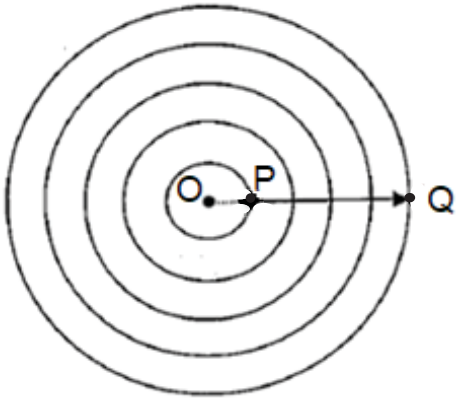
A The particles of the solid increase in number.

B The particles of the solid vibrate faster.

C The particles of the solid expand.

D The particles of the solid move further apart.

10 The diagram illustrates circular wavefronts radiating from a point source O.



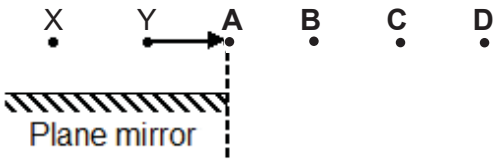
The time taken for the wave to travel from P to Q is 10 s, and the wavelength of the wave is 200 cm.

What is the speed of the wave?

A 20 cm/s **B** 80 cm/s **C** 100 cm/s **D** 2 000 cm/s

11 Two people are standing at points X and Y in front of a plane mirror as shown in the diagram. They see each other through reflection in the mirror.

If the person at Y walks away from X in the direction of the arrow shown, which is the furthest position he can walk to so that the two people will still be able see each other's reflection in the mirror?



12 If the image formed by a converging lens is real, magnified and inverted, the object must be at

A a distance equal to twice the focal length.

B a distance greater than the focal length but less than twice the focal length.

C a distance greater than twice the focal length.

D the principal focus.

13 A student stands at a distance *d* from the base of a tall cliff. He claps together two pieces of wood and measures the time that elapses before he hears the echo. He conducts the experiment five times and obtains these results.

0.72 s 0.80 s 0.71 s 0.81 s 0.71 s

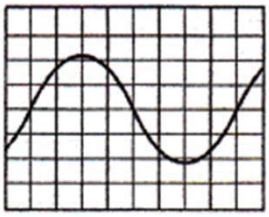
The speed of sound is 320 m/s. What is the distance *d*?

A 120 m **B** 240 m **C** 480 m **D** 600 m

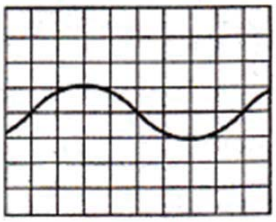
14 The diagrams show traces of sound waves picked up by microphones displayed on an oscilloscope. The oscilloscope controls are set in the same position for all the traces.

Which trace shows a sound that is the loudest but of lowest pitch?

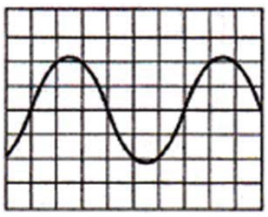
A



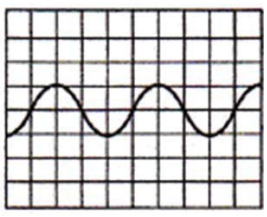
B



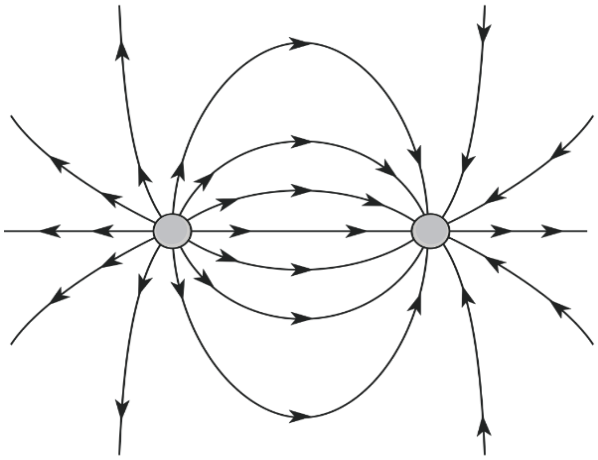
C



D



15 Two isolated point charges produce an electric field pattern as shown in the diagram.



Which pair of charges produce this pattern?

A

B

C

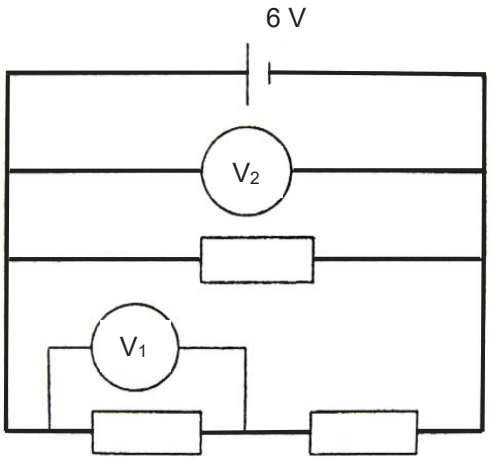
D

16 The potential difference across a light bulb is 3.0 V.

How much energy is required to move 42 C of charge across the light bulb?

A 0.071 J **B** 3.0 J **C** 14 J **D** 126 J

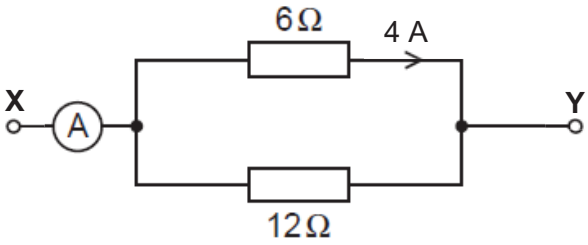
17 The diagram shows three identical resistors connected to a 6.0 V cell.



What would be the readings on voltmeters V_1 and V_2?

	V_1/V	V_2/V
A	2.0	2.0
B	3.0	6.0
C	6.0	3.0
D	6.0	6.0

18 Two resistors of 6 Ω and 12 Ω are arranged in parallel. The current through the 6 Ω resistor is 4 A.



What is the current shown on the ammeter?

A 2 A **B** 6 A **C** 8 A **D** 12 A

19 A metal bar PQ hangs from a thin thread and always comes to rest with end P pointing north. Another bar XY of the same metal settles in no definite direction.

What happens if the two bars are brought near one another?

A Both ends P and Q attract end X.

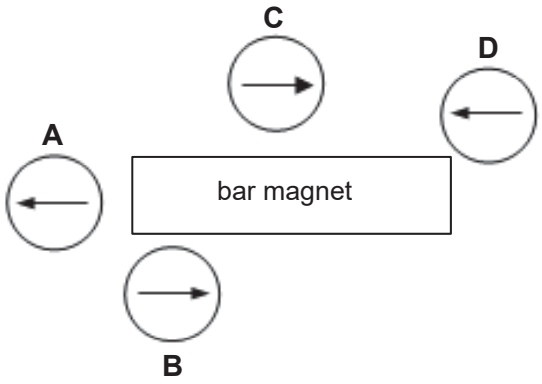
B End P attracts end X but repels end Y.

C End P neither attracts nor repels end X.

D End P repels end X but attracts end Y.

20 Four magnetic compasses are placed near a bar magnet as shown.

Which compass is faulty?



END OF PAPER

DSS Prelim 2019 Sc(Phy) Sec 4 E/5 N 5076

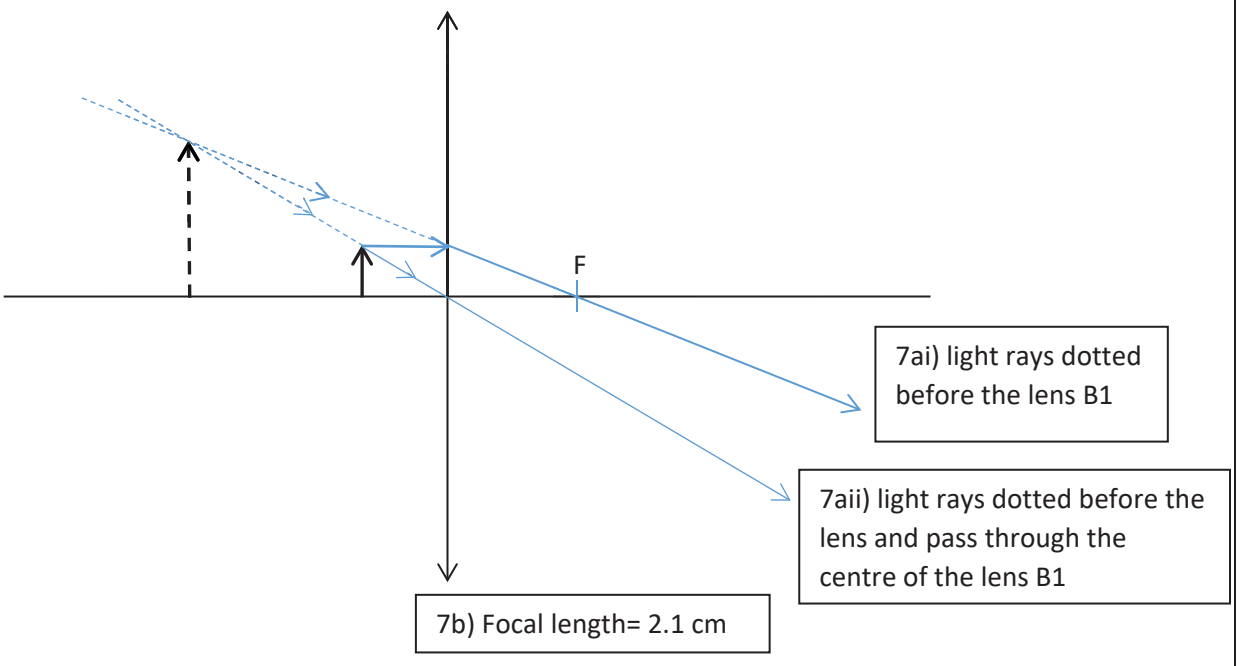
Section A MCQ

1	2	3	4	5	6	7	8	9	10
B	B	A	C	B	C	C	A	D	B
11	12	13	14	15	16	17	18	19	20
C	B	A	A	D	D	B	B	A	D

Section B

No.	Answer	Marks
1a	The heat sink is made up of metal, which is a good conductor of heat.	B1
1b	- The fins are black in colour, which is a good emitter of infrared radiation/radiant heat. *(*Zero marks if student also mentions good absorber of radiation too)* ***Or*** - The fins create a larger surface area for increased rate of emission of radiation.	B1
2a	Far apart to closely packed or Random to orderly/regular	B1
2b	move randomly at very high speeds to sliding past one another.	B1
3a	Mass of B = ρV = 1 x (3.0 x 40) = 120 g	 M1 A1
3b	Weight of B = 120/1000 x 10 = 1.2 N Pressure = 1.2/(3.0x0.0001) *(ecf)* = 4000 N/m^2	M1 A1
3c	The density of liquid A is higher than B. The pressure is the same at X and Y, hence mass of liquid A and B above points X and Y are equal. But volume of liquid A is smaller than B.	A1 M0
4a	2000 x 2.0 = 4000 Nm	 A1
4b	T = 4000/8.0 (ecf) = 500 N	M1 A1
4c	The moment increases. The perpendicular distance from the line of action of T to the pivot increases,	A1 M1

5ai	Loss in GPE = mgΔh = 80 x 10 x (28-16) = 9600 J	 M1 A1
5aii	Gain in KE = loss in GPE ½ x 80 x v^2 = 9600 v = 15.5 m/s	 M1 A1
5b	Ecf from 5a: Work done against friction = 9600-8800 = 800 J Friction x 56 = 800 Friction = 14.3 N	 M1 A1
6a	Sin 60/sin x = 1. 50 x = 35.3° (1 d.p.)	M1 A1
6b	Sin C = 1/n = 1/1.5 C = 41.8°	M0 A1
6c	y = 360-60-60-90-90-35.3 = 24.7° (1 d.p.) M0 A1	M0 A1
6d	Draw ray refracted away from the normal. (ecf from 5c)	B1
7ai aii	See diagram below. Award the marks even without arrows drawn. Dotted lines must be drawn to show virtual light rays.	B1 B1



7b	Accept 2.0 cm to 2.2 cm (2.1cm)	B1
8a	V = wavelength / Period Wavelength = V x Period = 1.5 x 5 = 7.5 m	 M1 A1
8b	Particle at P move down	B1
8c	Wave shown is a transverse wave because the particles of the wave moves in a direction perpendicular to the direction of the wave motion.	A1 A1
9a-d	Infrared radiation; Microwave Ultraviolet radiation Gamma rays	B1 (1 wrong) 0m (2 wrong)
10a	The negative charges at the bottom/ base of the cloud repels away the electrons in the ground, leaving excess positive charges. This is because like charges repel.	B1
10b	I = Q/t = 180/0.0015 = 120 000A	M1 A1
11a	When current exceeds the fuse rating flows through the fuse, the wire inside gets heated up and melts/fuse blows. This breaks the circuit.	B1
11b	Total power = 2300 + 460 = 2760 W Total I = P/V = 2760/230 = 12 A Or $I=I_1+I_2$ $= \frac{2300}{230} + \frac{460}{230} = 12\ A$ Fuse rating = 13 A	 A1 A1
12a	Arrow pointing towards the inside of the magnet.	B1
12b	increase the current *reject: Add more batteries. Use stronger magnet / use a stronger magnetic field strength	Any – 1
12c	The rod will oscillate forward and backward with a frequency of 0.5 Hz. The current direction alternates, causing the direction of the force to alternate too.	B1 B1
13ai	a = (55-40)/2 = 7.5 m/s^2	M1 A1

13aii	F = ma = 180 x 7.5 (ecf : 1m) = 1350 N	M1 A1
13bi	0 to 2.0 s : constant acceleration / accelerating at constant rate. 2.0 s to 8.4 s : decreasing acceleration / accelerate at a decreasing rate. 8.4 s to 12 s : no acceleration / constant speed First two points correct – 1m Last point correct – 1m	 B1 B1
13bii	As the motorcycle accelerates, it experiences more air resistance. This decreases the resultant force and since resultant force = mass x acceleration, acceleration decreases. The total resistive force eventually equal to the driving force, causing resultant force to be zero and hence acceleration will also be zero.	B1 B1 B1
13biii	Draw a graph with a smaller gradient, reaching a lower top speed.	B1
14ai	Sound travels through a series of compressions and rarefactions of particles. Particles vibrate parallel to the direction of wave propagation.	B1 B1
14aii	Some of the sound energy is lost to the surroundings /converted to thermal energy as it travels further to microphone 2.	B1
14b	Time = 5 intervals x 1 ms = 0.005 s d = speed x time = 330 x 0.005 = 1.65 m *penalise 1 m for not converting time to seconds	M1 M1 A1
14c	• There may be multiple echoes due to the surrounding walls. • When using the stopwatch to measure time, there could be a human reaction time error incurred. • When measuring the distance between the microphones, it is difficult to measure length of more than 1 meter accurately using a metre rule.	Any 2 - B2
14d	The traces from microphone 1 and 2 will be closer to each other. Sound travels faster in water than in air. / Smaller amplitude because some energy maybe absorbed by the water particles.	B1 B1
15ai	20 Ω	A1
15aii	Total R = 20 + 10 = 30 Ω Total I = 1.5/30 = 0.05 A Potential difference = 0.05 x 20 = 1.0 V OR Total R= 20 + 10 = 30 Ω p.d. = 20/30 x 1.5 = 1 V	 M1 A1 or M1 A1
15b	As temperature increases, the resistance of X decreases. Since emf remains constant and V = RI, the current will increase.	B1 B1

15ci	South	B1
15cii	Anticlockwise	B1
15ciii	- As the current increases, the solenoid will be magnetised more strongly / strength of induced magnetism at P increases. - The permanent magnet will be attracted more strongly / This increases the forces of attraction, - Thus pointer deflect in the anticlockwise moment about the pivot. (This causes the pointer to deflect on the scale above zero mark.)	B1 B1 B1