Name: ..... Index No.: ..... Class: .....

BUKIT BATOK SECONDARY SCHOOL
GCE 'O' LEVEL PRELIMINARY EXAMINATIONS 2022
SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)

SCIENCE (PHYSICS, CHEMISTRY)

Paper 1 Multiple Choice

5076/01
24 AUGUST 2021
1105 - 1205 h
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

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

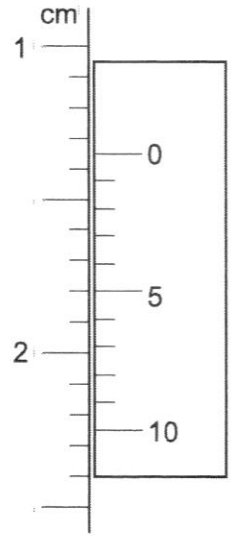
There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A, B, C** and **D.**
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
A copy of the Data Sheet is printed on page XX.
A copy of the Periodic Table is printed on page XX
The use of an approved scientific calculator is expected, where appropriate.

This Question paper consists of **XX** printed pages.

1 The diagram shows part of a vernier scale.



What is the correct reading of the vernier scale?

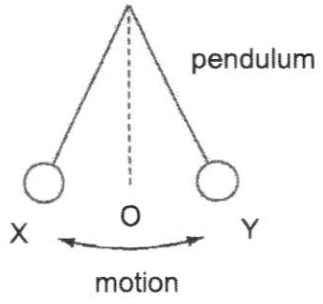
A 1.85 cm

B 1.58 cm

C 1.35 cm

D 1.05 cm

2 The diagram shows a simple pendulum. It swings between X and Y.



Which sequence should be timed to measure the period of the pendulum?

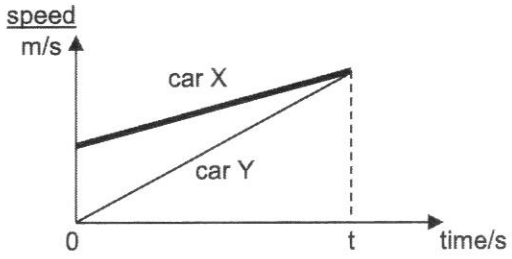
A $Y \rightarrow O$

B $X \rightarrow O \rightarrow Y$

C $O \rightarrow Y \rightarrow O \rightarrow X$

D $O \rightarrow X \rightarrow O \rightarrow Y \rightarrow O$

3 The diagram below shows how speed varies with time for two cars, X and Y.



Which of the following statements is correct?

A Both cars come to a stop at time t.

B Both cars travel at the same speed throughout the journey.

C The acceleration of car Y is greater than the acceleration of car X.

D The distance covered by car X and car Y is the same.

4 On Earth, two different balances show that an object has a mass of 2.0 kg and a weight of 20 N.

The same balances and object are taken to the Moon, where the gravitational field strength is less than on Earth.

Which row shows the weight and mass of the object on the moon as compared to on Earth?

	weight	mass
A	less	same
B	same	same
C	less	less
D	same	less

5 The densities of some liquids at 15 °C are shown below.

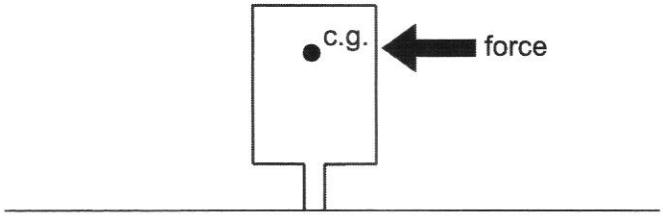
liquid	density kg/m^3
palm oil	914
rosin oil	980
naphtha	665
milk	1020

A solid cube with a mass of 1.3 kg and has sides of length 0.11 m.

What happens to the cube when it is placed in each of the liquids?

	milk	naphtha	palm oil	rosin oil
A	float	float	float	float
B	float	sink	float	float
C	float	sink	sink	float
D	sink	sink	sink	sink

6 The diagram shows an object placed on a level table. The centre of gravity (c.g.) of the object mark is shown on the object.



Why does the object topple easily?

A When tilted slightly left, the vertical line through the centre of gravity lies easily inside the base area and produces a clockwise moment.

B When tilted slightly left, the vertical line through the centre of gravity lies easily inside the base area and produces an anti-clockwise moment.

C When tilted slightly left, the vertical line through the centre of gravity lies easily outside the base area and produces a clockwise moment.

D When tilted slightly left, the vertical line through the centre of gravity lies easily outside the base area and produces an anti-clockwise moment.

7 An electric motor can lift a weight of 2000 N through a height of 10 m in 20 s.

What is the power of the motor?

A 10 W

B 1000 W

C 4000 W

D 400 000 W

8 A house, built in a country with a hot, sunny climate, stays cool during the day.

Which material for the wall and which outside colour keeps the house the coolest?

	wall material	outside colour
A	poor conductor	light
B	poor conductor	dark
C	good conductor	light
D	good conductor	dark

9 Which statement is correct about boiling and evaporation?

A Evaporation occurs throughout the entire liquid but boiling only occurs at the surface.

B Evaporation can only occur when the temperature of the liquid is at boiling point.

C Evaporation causes the temperature of a liquid to drop.

D When a liquid is boiling, its temperature continues to rise.

10 In view of the current Covid-19 situation, Singapore has placed thermal sensors to detect arriving visitors from overseas with high body temperatures.

What type of electromagnetic wave does the thermal sensors detect?

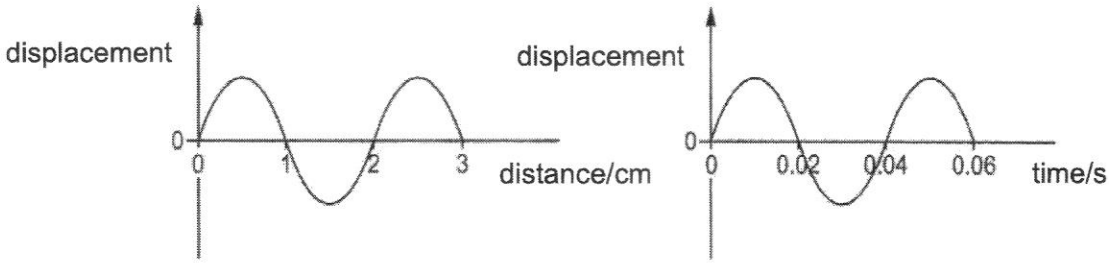
A gamma rays

B infra-red

C ultraviolet rays

D X-rays

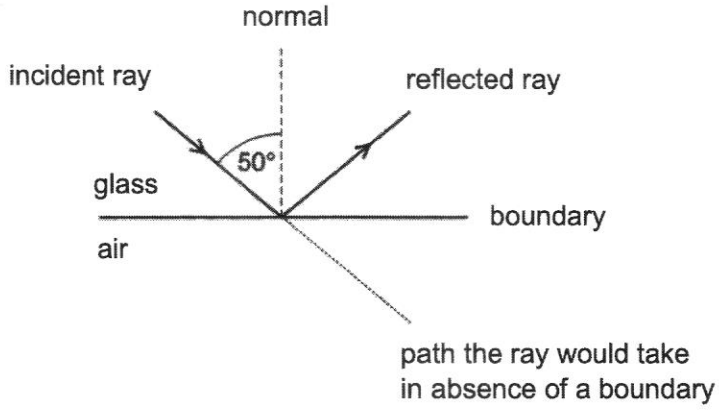
11 The displacement-distance and displacement-time graphs are shown for a water wave in a ripple tank.



What is the speed of the water wave?

A 0.02 cm/s **B** 0.08 cm/s **C** 25 cm/s **D** 50 cm/s

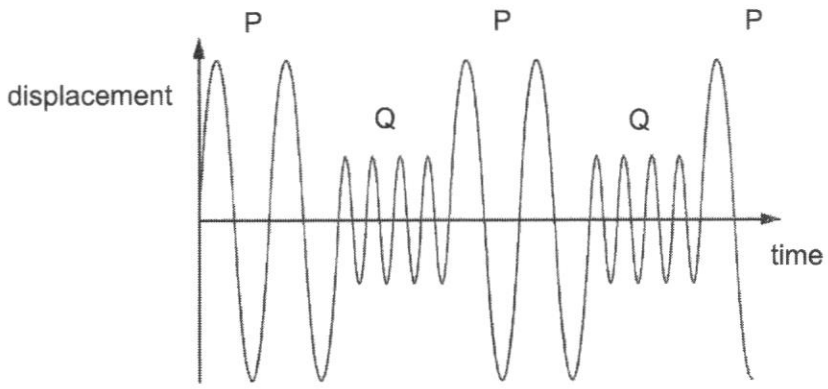
12 A ray of light travelling in a glass block will change direction when it reaches the edge of the block.



What is the angle between the reflected ray and the path the ray would take in absence of a boundary?

A 50 ° **B** 80 ° **C** 100 ° **D** 130 °

13 A police car siren emits two different sounds P and Q repeatedly.
The diagram represents the sounds emitted.

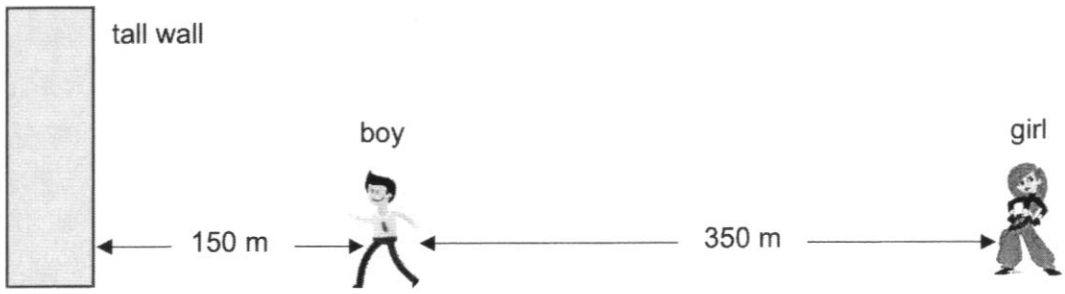


Which sound is louder and which has the lower pitch?

	louder	lower pitch
A	P	P
B	P	Q
C	Q	P
D	Q	Q

14 A boy stands 150 m in front of a tall wall. A girl stands 350 m from the boy.

The boy fires a starting pistol and girl hears two bangs.



Given that the speed of sound is 300 m/s, what is the time interval between the two bangs heard by the girl?

A 0.50 s

B 1.00 s

C 1.17 s

D 1.67 s

15 A small battery, when fully charged, is capable of supplying a current of 400 mA to a circuit for 1.0 hour before fully discharged.

For how long this battery will be able to supply a current of 2.0 A?

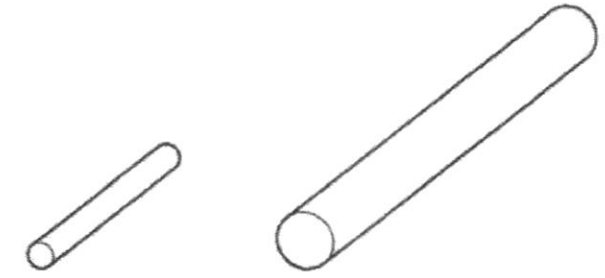
A 720 hours

B 200 hours

C 12 hours

D 0.20 hours

16 The resistance of a cylindrical P is 80 Ω. A second wire Q is made from the same material.
The cross-sectional area of Q is four times that of P.
The length of Q is twice the length of P.



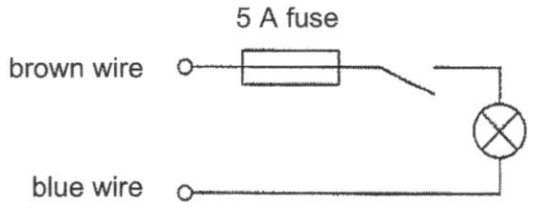
wire P wire Q

What is the resistance of Q?

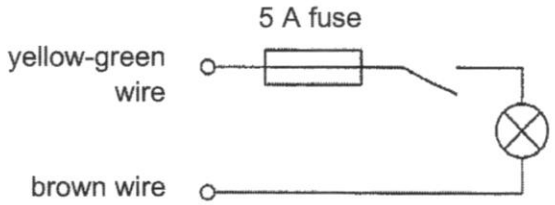
A 10 Ω **B** 40 Ω **C** 160 Ω **D** 640 Ω

17 Which circuit shows the correct colour of wire, position of fuse and fuse rating for an appliance that requires 4.0 A of current?

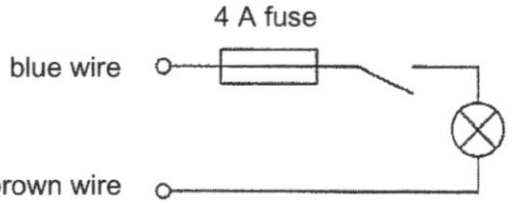
A



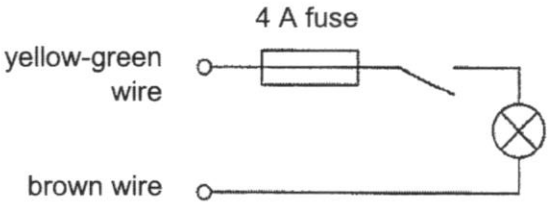
B



C



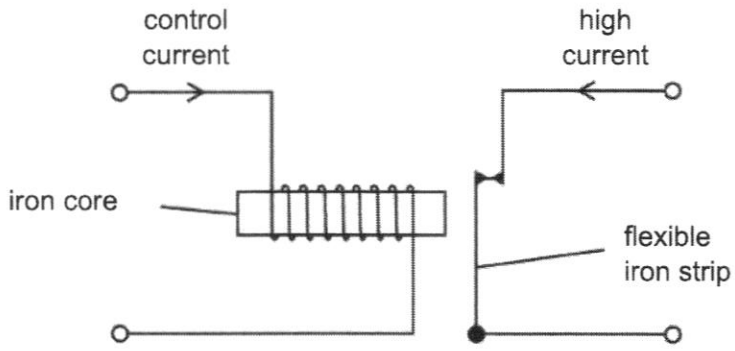
D



18 In which pair are both formulae correct?

A	$E = VIt$	$V = \frac{W}{Q}$
B	$E = VIt$	$V = WQ$
C	$E = \frac{VI}{t}$	$V = WQ$
D	$E = \frac{VI}{t}$	$V = \frac{W}{Q}$

19 A component of a simplified circuit breaker shows a control current is used to switch off a high current.



When the control current is switched on, the high current does not switch off.

Which change might switch off the high current?

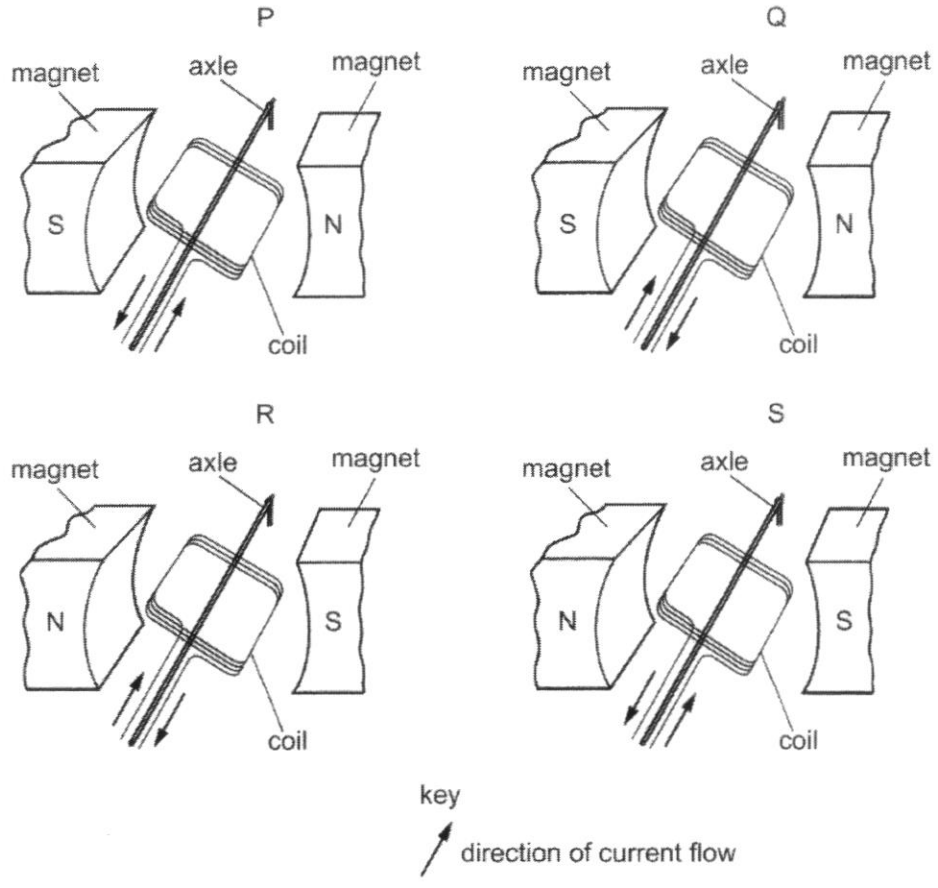
A moving the strip further from the iron core

B reducing the number of turns around the iron core

C replacing the iron core by a steel core

D using a larger control current

20 A current-carrying coil in a magnetic field experiences a turning effect which causes it to rotate.
The diagrams show the possible arrangements of field and current flow around the coil.



In which diagrams does the coil rotate in an anti-clockwise direction?

A P and Q

B P and R

C Q and R

D Q and S

Name: ..... Index No.: ..... Class: .....

Bukit Batok Secondary School

GCE 'O' LEVEL PRELIMINARY EXAMINATIONS 2022

SECONDARY 4 EXPRESS / 5 NORMAL (ACADEMIC)

SCIENCE (PHYSICS)

Paper 2

5076 / 02

23 August 2022

1105 – 1220 h

1 hour 15 minutes

Candidates answer on the Question Paper
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, index number and class in the spaces provided at the top of this page.
You may use a pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
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.
Write your answers in the spaces provided on the question paper.

Section B
Answer any **two** questions.
Write your answers in the spaces provided on the question paper.

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

FOR EXAMINER'S USE	
Section A	
Section B	
TOTAL	

This Question Paper consists of 17 printed pages.

Section A [45 marks]

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

1 Two forces of magnitude 10 N and 18 N act on an object, P as shown in Fig. 1.1.

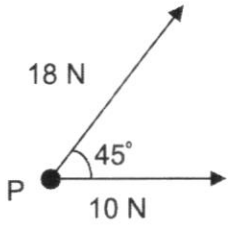


Fig. 1.1

An incomplete vector diagram for these forces is shown in Fig. 1.2.

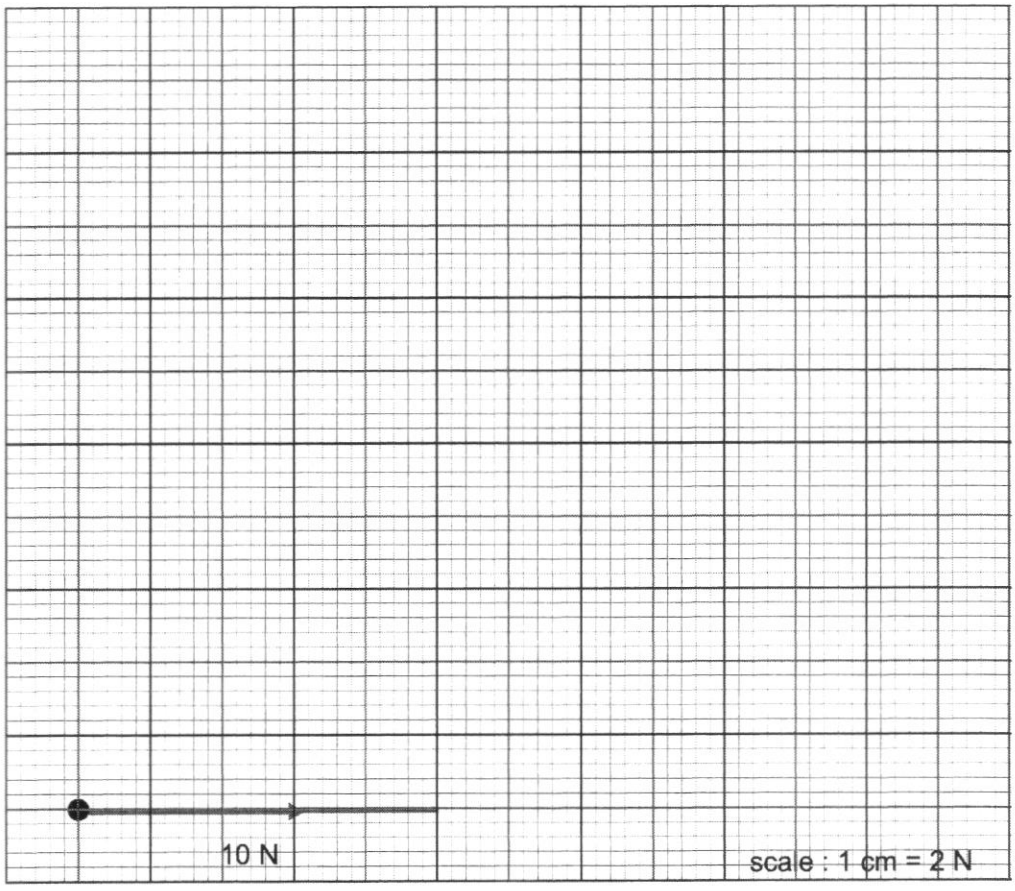


Fig. 2.2

Complete Fig. 1.2, using a scale of 1 cm to represent 2 N, to determine the magnitude of the resultant force and angle between resultant force and 10 N force.

resultant force = ... N

direction = ... [3]

2 A ball bearing is dropped into a long cylinder containing oil as shown in Fig. 2.1.

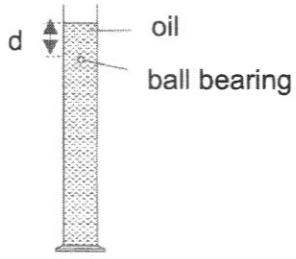


Fig. 2.1

The ball bearing moves down through the oil.
The distance, d, between the oil surface and the ball bearing is measured every second.
The results obtained are shown on Fig. 2.2.

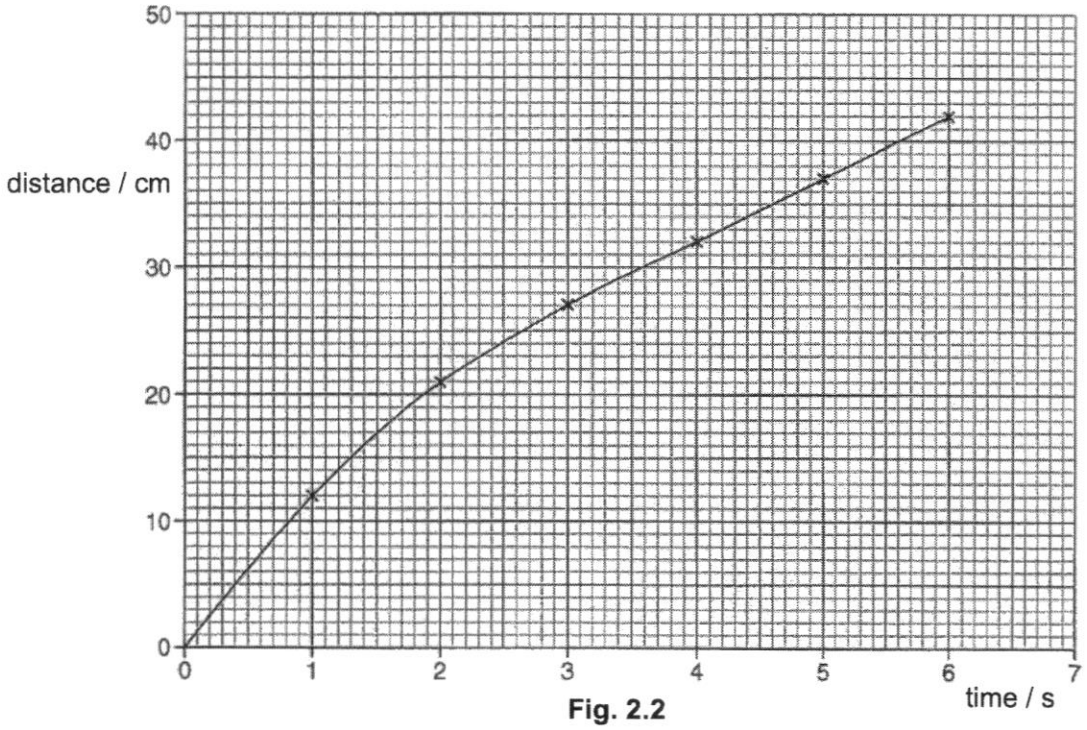


Fig. 2.2

(a) Calculate the speed of the ball bearing from 3.0 to 6.0 seconds.

speed =..... m/s [2]

(b) With reference to forces acting on the ball bearing, explain why the speed is constant between 3.0 to 6.0 seconds.

.....

.....

..... [2]

3 Water is contained in a syringe that has a cap over its nozzle, as shown in Fig. 3.1.

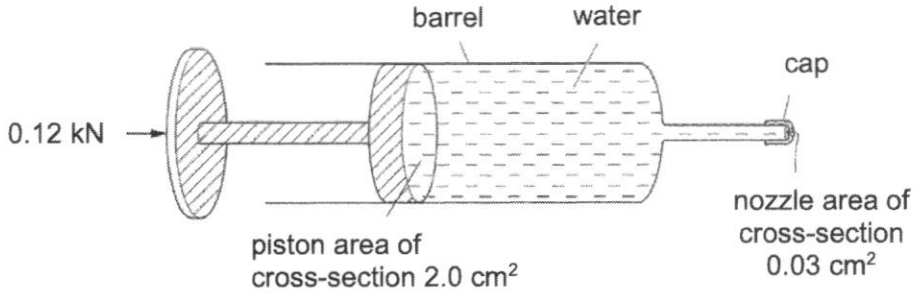


Fig. 3.1

The cross-sectional area of the piston of the syringe is 2.0 cm^2 and the cross-sectional area of the nozzle is 0.03 cm^2. A force of 0.12 kN is applied at the piston, as shown in Fig. 3.1. The pressure in the water is the same throughout the syringe.

(a) Calculate

(i) the pressure of the water in the syringe,

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

(ii) the force on the cap.

force = ... N [1]

(b) The cap is removed from the syringe. As the piston is pushed in the direction shown, water is forced out of the nozzle. The volume of water leaving the barrel of the syringe per second is equal to the volume leaving the nozzle per second.

Suggest why the speed of the water leaving the nozzle is greater than the speed of the water in the barrel.

.....

.....

.....

.....

..... [3]

4 A gaseous substance at a temperature of 100 °C is cooled until it becomes a liquid. The variation with time of the temperature of the substance is shown in Fig. 4.1.

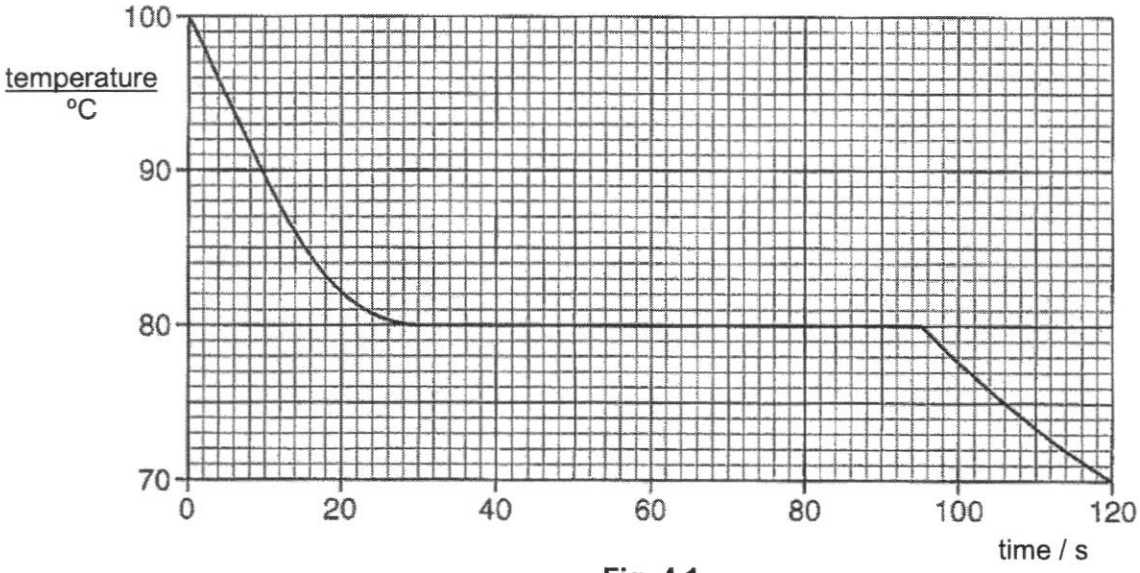


Fig. 4.1

(a) Describe how the motion of the molecules of the substance changes during the first 20 seconds of cooling.

.....

..... [1]

(b) Describe the molecular arrangement of the substance at 100th second.

.....

..... [1]

(c) The temperature of the substance remains constant for a period during cooling.

(i) Determine the duration when the temperature remains constant.

time = ... s [1]

(ii) Explain why the temperature remains constant during this period.

.....

.....

.....

..... [2]

5 Table 5.1 contains statements about electromagnetic waves and sound waves. Some of the statements are true and some are false.

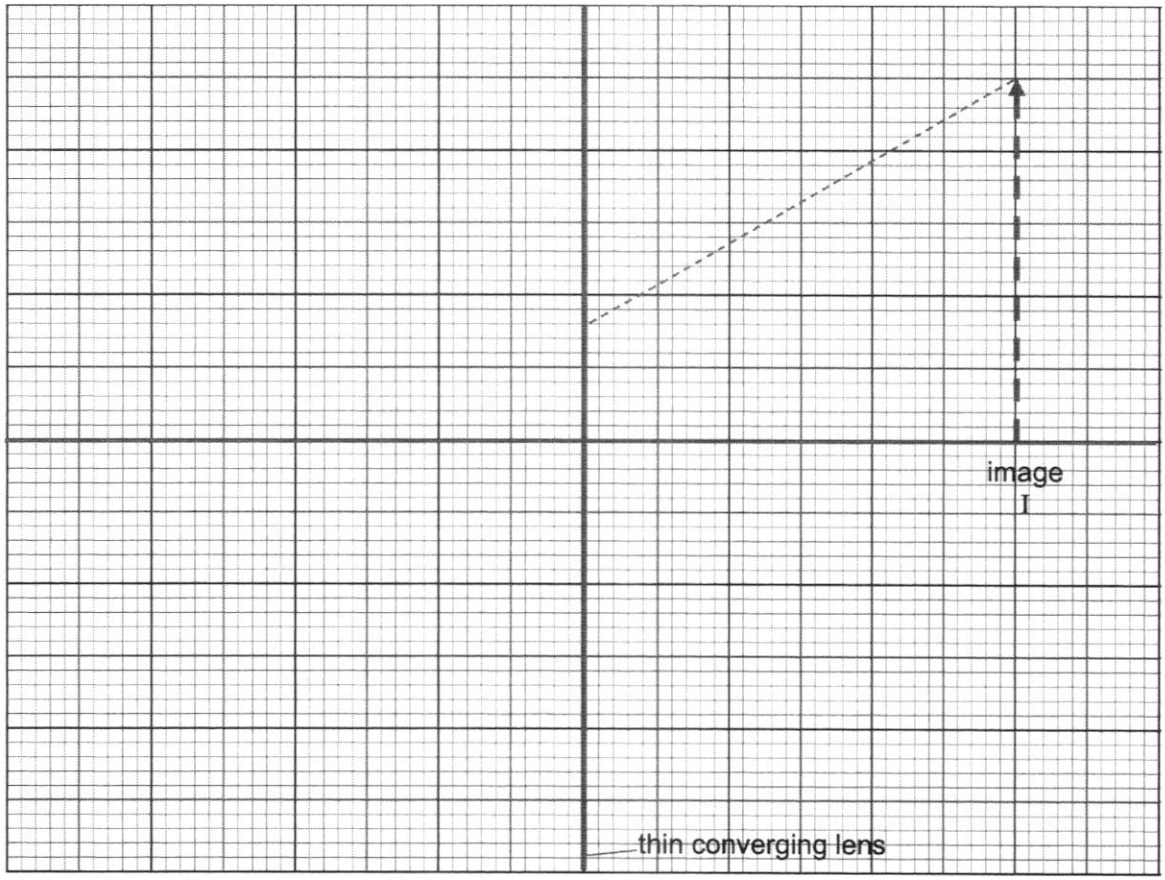
For each statement, state whether true or false.

Table 5.1

statement	true or false
Sound waves travel at the same speed in liquids as they do in solids.	
The speed of sound in a vacuum is approximately 330 m/s.	
Infrared waves travel at a different speed compared to gamma ray in vacuum.	
Light waves are transverse wave.	
Sound waves transfer sound energy, but electromagnetic waves do not transfer energy.	

[3]

6 An image I is formed 30 cm away from a thin converging lens as shown in Fig. 6.1.



Scale: 1 cm represents 5 cm

Fig. 6.1

The object, O, is not shown in Fig. 6.1. The diagram is drawn to a scale in which 1 cm represents 5 cm.

A light ray has been drawn from the top of the image to the lens.

On Fig. 6.1:

(a) Complete the existing ray and add additional ray through the lens to draw the object and label it as O. [2]

(b) Use the rays you have drawn to determine the actual focal length of the lens.

actual focal length = ... cm [2]

7 A student investigates the refraction of light when it travels from glass to air.

Fig. 7.1 shows the arrangement of the apparatus.

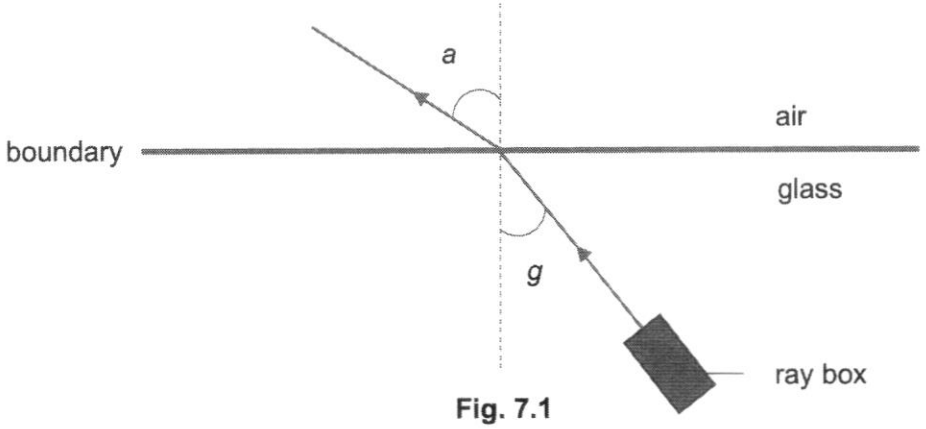


Fig. 7.1

The student measures the angle *a* in air and angle *g* in glass. She then changes the direction of light ray at the boundary and measures the new angle *g* in the glass.
Table 7.2 shows the result.

Table 7.2

angle *a* in the air	angle *g* in the glass
45 °	26 °
35 °	

(a) Use the data in Table 7.2, show that the refractive index of glass is 1.6 and hence calculate the missing value for the angle *g* in the glass.

angle *g* = ... ° [2]

(b) The critical angle for light at the glass air boundary is 39 °.

Describe how the direction of light at the boundary changes as the students increases angle *g* from 30 ° to 50 °.

.....

.....

.....

.....

.....

..... [4]

8 Fig. 8.1 shows the electric field lines between a positively charged strip and negatively charged strip placed close together.

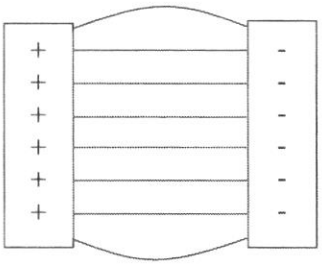


Fig. 8.1

(a) Draw an arrow on each field line to show the direction of the electric field. [1]

(b) State what is meant by electric field.

.....

.....

..... [1]

(c) Fig. 8.2 shows an unknown charged sphere, initially at rest, swings to the right when place near to the positively charged strip.

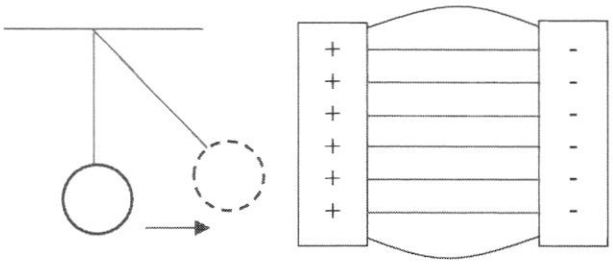


Fig. 8.2

State the charge of the sphere and the reason it swings to the right.

charge of sphere: ..... [1]

reason: .....

..... [1]

9 Four resistors W, X, Y and Z are connected to a battery, as shown in Fig. 9.1.

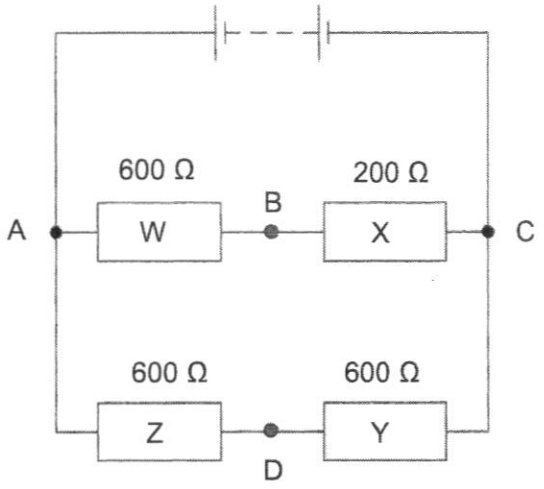


Fig. 9.1

(a) Calculate the effective resistance of the whole circuit.

effective resistance =..... Ω [2]

(b) The current in resistor W is 8.0 mA.

(i) Calculate the potential difference (p.d.) between points A and B.

p.d. =..... V [2]

(ii) Determine the p.d. between points B and D.

p.d. = ... V [2]

10 Fig. 10.1 shows four metal bars A, B, C and D.
The ends of the bars are labelled 1, 2, 3, 4, 5, 6, 7 and 8.

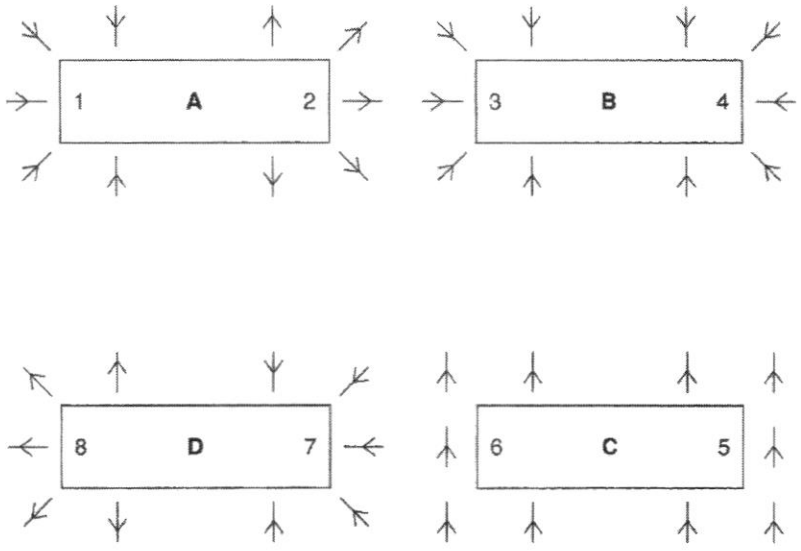


Fig. 10.1

A compass needle is placed at different positions near the end of each metal bar.
The directions in which the compass needle is pointing is shown in Fig. 10.1.

(a) State,

(i) which metal bar may be made of copper, ... [1]

(ii) **one** pair of labelled ends that will repel each other. ..... [1]

(b) Describe an electrical method to demagnetise a bar magnet.
You may include a diagram in your answer.

.....

.....

.....

..... [2]

Section B [20 marks]

Answer any **two** questions.

Write your answers in the spaces provided.

11 Fig. 11.1 shows a gymnast on a trampoline. At position A in Fig. 11.1a, the gymnast starts to rise. She passes through B in Fig. 11.1b and reaches her maximum height at C.

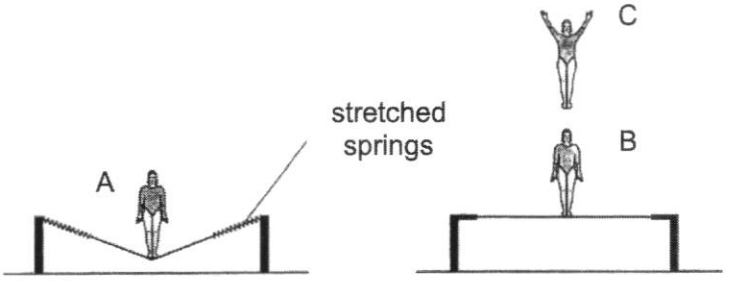


Fig. 11.1a

Fig. 11.1b

(a) State the form of energy stored in the stretched springs shown in Fig. 11.1a.

..... [1]

(b) When the gymnast is at B, her kinetic energy is 1.9 kJ, its maximum value. The mass of the gymnast is 45 kg.

(i) Calculate the speed of the gymnast at B.

speed = ... [2]

(ii) Ignoring the effects of any friction, calculate the maximum height that the gymnast can rise to from B to C.
The gravitational field strength *g* is 10 N/kg.

height = ... m [2]

(c) A second gymnast weigh 600 N walks up a plank from point C to D in Fig. 11.2. The weight of the diving board is 300 N. This force acts at the centre of gravity C of the diving board, which is 0.90 m from P. The diving board is attached to the fixed base. The fixed base exerts a downwards force *F* on the diving board.

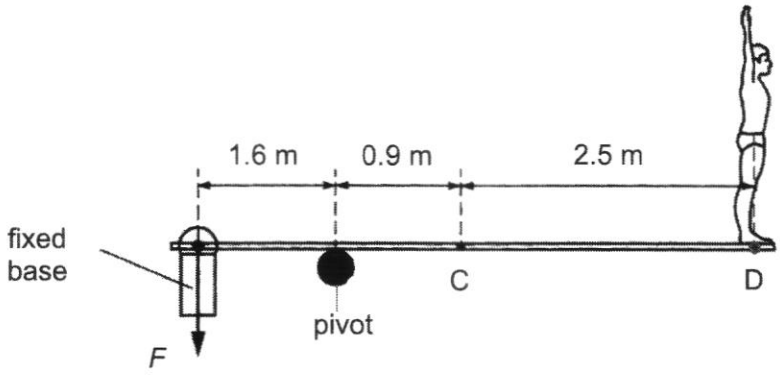


Fig. 11.2

(i) Calculate force F when the gymnast is at point D.

F = ... N [2]

(ii) The gymnast was not ready for his act and walks down the plank from point D to C.

Explain the effect, if any, to force *F*.

.....

.....

.....

.....

.....

.....

..... [3]

12 Typhoons create waves on the surface of the ocean.
Table 12.1 gives data on the speed and wavelength of some water waves.
The waves travel in deep water of depth 4000 m or in shallow water of depth 10 m.

Table 12.1

depth 4000 m	wavelength / m	10	40	100	200	300	400	500	600
	speed / m/s	4.0	7.9	12.5	17.7	21.6	25.0	27.9	30.6

depth 10 m	wavelength / m	10	40	100	200	300	400	500	600
	speed / m/s	4.0	7.6	9.3	9.7	9.8	9.9	9.9	9.9

(a) For the range of wavelengths in Table 12.1, state a difference between the speed of water waves in deep and shallow water.

.....

.....

..... [1]

(b) A typhoon 2000 km away from a stationary ship, forms quickly. It generates water waves for a short period of time.
The waves, with wavelengths between 10 m and 600 m, travels across an ocean of depth 4000 m to the ship.

(i) Calculate the time taken for the **first** wave to reach the ship.

time = ... s [2]

(ii) Calculate the frequency of the **first** wave to reach the ship.

frequency = ... Hz [2]

(iii) Determine, to the nearest 100 m, the wavelength of the wave that arrives 4 hours **after** the first wave.

wavelength = ... m [3]

(c) The stationary ship sounded its siren to alert a fisherman on a fishing boat nearby.

Describe how the sound of siren travels through the air to the fisherman.

.....

.....

.....

..... [2]

13 Water in a swimming pool is heated by solar powered pool heater panels.
Fig. 13.1a and Fig.13.1b show panel design A and panel design B respectively.

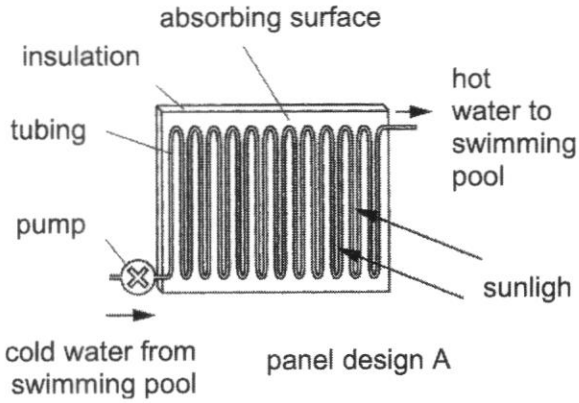


Fig. 13.1a

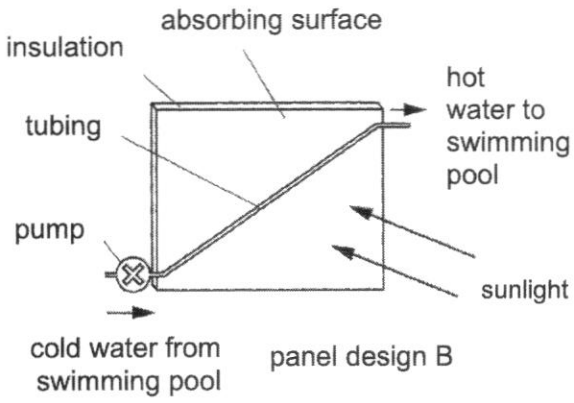


Fig. 13.1b

(a) Name the method of thermal energy transfer that takes place between the sun and the panel.

..... [1]

(b) Explain why panel design A is used rather than panel design B.

.....

.....

..... [2]

(c) Fig. 13.2 shows the side view of the swimming pool with four possible inlet pipe positions K, L, M and N.

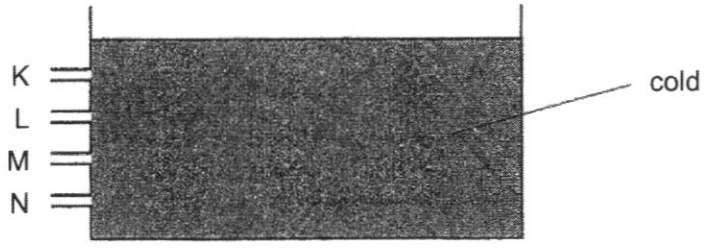


Fig. 13.2

The hot water pipe leaving the heater panels can be attached to any of the inlet pipe.

State and describe which inlet pipe would be the best choice to heat the water in the swimming pool evenly.

.....

.....

.....

..... [3]

(d) Fig 13.3 shows a typical hot-water tank connected to a 240 V mains supply to heat up the water in the pool. The immersion heater has a power of 1.8 kW.

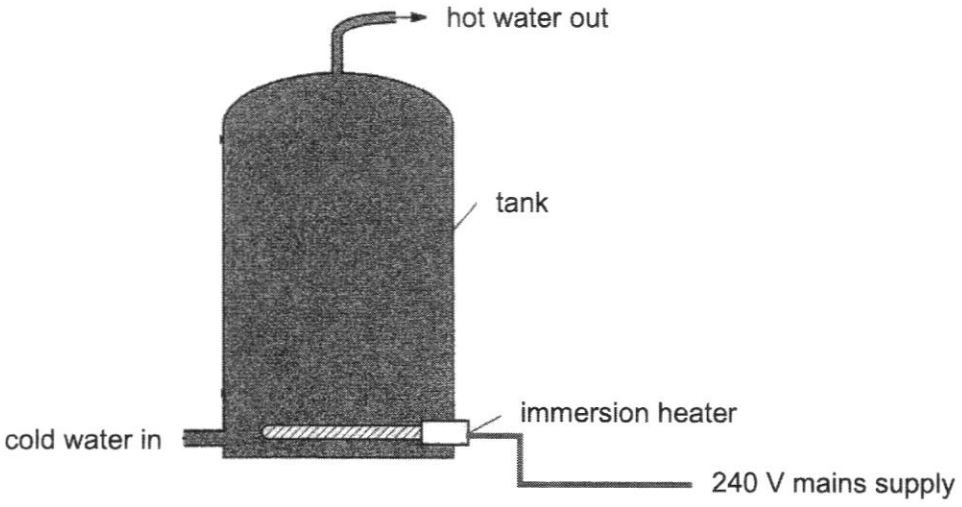


Fig. 13.3

Calculate

(i) the current through the immersion heater,

current = ... A [2]

(ii) the cost of using the hot water tank for 4 hours daily in one week.
The cost for 1.0 kWh is 25 cents.

cost = $ ..... [2]

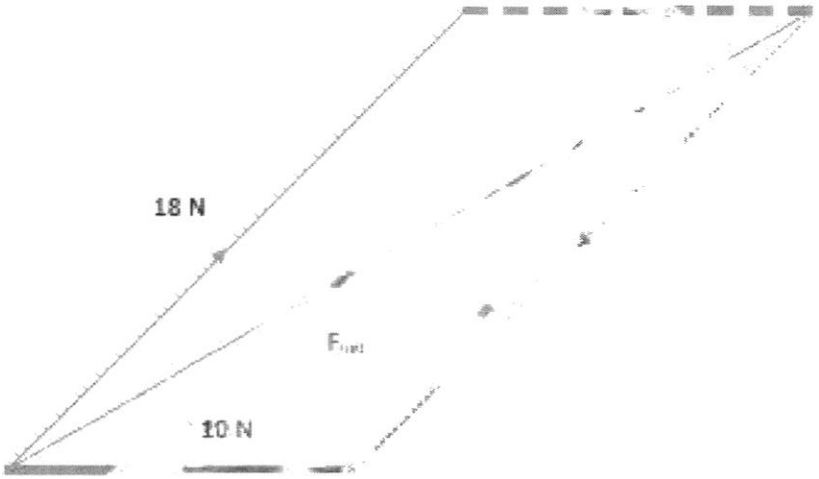
End of Paper

Marking Scheme BBSS Prelims 2022 Paper 1 and Paper 2

Paper 1

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

Marking Scheme BBSS Prelims 2022 Paper 2 with Marker's Report

Qns	Suggested Answer
1	 [1] correct **shape** and **drawing** (solid/dotted lines) of either tip to tail method or parallelogram + **correct** direction of arrows of 10 N, 18 N and F_{net} following 1cm: 2N scale [1] F_{net} = (25.8 – 26.6) N [1] direction : 30° +-1° from 10 N *Markers' comments:* *Majority of students have difficulty in stating the direction which is the angle between resultant force and 10 N*

2a	**Concept** statement: **speed** from 3 to 6 seconds = **gradient of distance - time graph** $v = \frac{0.42-0.27}{6-3}$ (substitution) v = 0.050 m/s (2.s.f) (-1 m if student forget to convert distance from m to cm and ans as 5.0 m/s) *Markers' comments:* *Weaker students fail to convert cm to m.* *Insist student to write down the concept statement.*
2b	At 3 to 6 seconds, the resistance due to liquid on the ball bearing is equal in magnitude but opposite in direction to the weight of the ball bearing. Hence it will have zero resultant force, zero acceleration thus moving at constant speed. *Markers' comments:* *Students are not able to mention that weight of ball and the resistance the ball is facing due to the liquid is acting in opposite direction.*

	Students are not able to link the 3 concepts of, *$F_{resultant}$ = 0 N: acceleration = 0 m/s^2 : speed is constant* *Weaker students have misconceptopn and relates the concepts of energy, KE and GPE, in explaining the constant speed.*
3ai	**Conversion:** F = 0.12 kN = 120 N **Formula:** P = F / A P = F / A P = 120 / 2.0 P = 60 N/cm^2 *Markers' comments:* *Weaker students fail to convert 0.12 kN to 120* *Encourage students to write physics concept statement/formula before starting the calculation.*
3aii	**Concept statement:** Since pressure in the water is the same throughout the syringe, then: Pressure on cap = 60 N/cm^2 **Formula:** F = P x A Force on cap, F = pressure on cap × area of cap Force on cap, F = 60 x 0.03 Force on cap, F = = 1.8 N *Markers' comments:* *Generally well done*
3b	• Since Volume = cross section area x length. The cross-section area of nozzle is smaller than cross section area of piston. • Length of water column move in nozzle is more than length of water column move in barrel. • Since speed = length/ time, length of water column travelling past the nozzle per second is more than the length of water column travelling past the barrel per second hence higher speed at nozzle. *Markers' comments:* *No marks for contradiction.* *Majority of students compare and relates the cross sectional area to pressure at piston and nozzle - contradict* *Misconception 1: since P = F/A, and F is constant, small area at nozzle will lead to high pressure hence faster speed of water.* *Big area at piston will lead to low pressure hence low speed of water* *Misconception 2: high pressure relates to high speed*

4a	The gas molecules that initially move at high speed and at random, move at lower speed / less energetically / less vigorous *Markers' comments:* *Generally well done*
4b	The molecules of the substance are • **randomly arranged** and • **closely packed but not as closely packed as solid** *Markers' comments:* *Some students did not write down 1 of the 2 key phrases.* *Weaker students explain the motion rather than arrangements.* *Comparison to solid was commonly missing.*
4ci	Time = 95 – 30 = 65 s *Markers' comments:* *Students must show that they have read the final reading (to half of the smallest division) as 95 s.* *Importance of showing working: Give student benefit of doubt and accept answer, only if students show working: 95 – 28 = 67 s*
4cii	• During this period, internal potential energy decreases, forming of **stronger intermolecular forces of attraction** and thermal energy released to the surrounding • The **internal kinetic energy remains constant** hence the **temperature remains constant**. *Markers' comments:* *Many candidates could not give sufficient points to gain credit.*

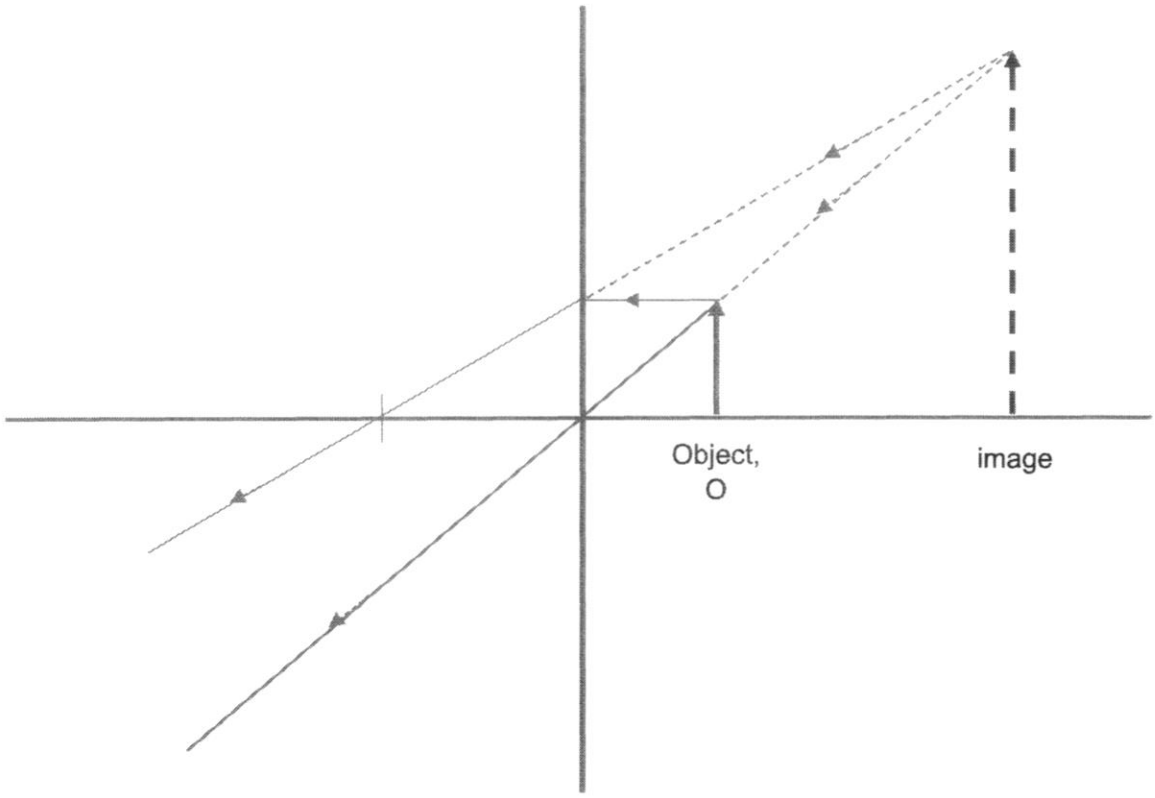
5	

statement	true or false
Sound waves travel at the same speed in liquids as they do in solids.	**false**
The speed of sound in a vacuum is approximately 330 m/s.	**false**
Infrared waves travel at a same speed compared to gamma ray in vacuum.	**true**
Light waves are transverse wave	**true**
Sound waves transfer sound energy, but electromagnetic waves do not transfer energy.	**false**

5 correct [3 marks]

	3 - 4 correct [2 marks] 2 correct [1 mark] 0 - 1 correct [0 mark] *Markers' comments:* *Students assume 330 m/s is correct but fail to see the word vacuum. There is no sound in vacuum hence 0 m/s.* *Students may have misconception that all EM wave travel in different speed.*

6a



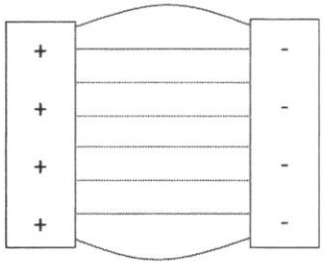
Correct dotted and solid lines with arrows [1]
Correct positioning of object with arrow head and label [1]

Markers' comments:
Poorly done.
Many candidates did not realise that the dotted image refers to a virtual image.
Many candidates tried to draw rays unsuccessfully.

6b 2.8 cm x 5 = 14 cm [2]
(allow e.c.f if they have drawn wrongly but understand the concept of focal length
(deduct 1 mark for those who put 2.4 x 5 = 12 cm)

Markers' comments:
Poorly done. Due to no diagram drawn.

7a	**Formula:** $n = \frac{\sin i \ (angle\ in\ optically\ less\ dense\ medium)}{\sin r \ (angle\ in\ optically\ denser\ medium)}$ $n = \frac{\sin 45}{\sin 26}$ n = 1.6 (shown) *(formula + substitution + final ans in 2.s.f) [1]* $\sin g = \frac{\sin i \ (angle\ in\ optically\ less\ dense\ medium)}{n}$ $g = \sin^{-1} [\frac{\sin i \ (angle\ in\ optically\ less\ dense\ medium)}{n}]$ $g = \sin^{-1} [\frac{\sin 35}{1.6}]$ g = 21 ° *(formula + substitution + final ans in 2.s.f) [1]* *Markers' comments:* *New trend of Qns (proving)* *Some students fail to show the working that the refractive index is 1.6.* *Weaker students reverse the value to be substituted in, n = sin i / sin r (typical mistake when light ray moves from optically denser to optically less dense medium)*
7b	1. When angle g **increases from 30 ° to below 39 °**, the light ray is refracted out of the glass-air boundary with an **increasing value of angle a**. 2. When **angle g = 39 °**, the light ray emerges at glass-air boundary as **angle a = 90 °** 3. When angle g **increases from above 39 ° to 50 °**, it undergoes total internal reflection 4. where **angle g = angle of reflection** *Markers' comments:* *Some students could not properly explain the segregation of the 3 different range of values clearly.* *1) At 30° ≤ g < 39°,* *2) At g = 39°,* *3) At 39° < g < 50°* *Students did not gain credits due to missing key phrases like refracted ray, refracted angle, total internal reflection*

8a	 Direction of arrow: positive to negative Arrow must be at the line *Markers' comments:* *Generally ok.*

8b	An electric field is a region in which an electric charge experiences an electric force/electrostatic force. *Markers' comments:* *Generally ok.* *Weaker students, have missing keywords or wrong keywords*
8c	• negative. • As unlike charges attracts *Markers' comments:* *Generally ok.* *Weaker students mention wrong keywords : unlike poles repel instead of unlike charges repel*
9a	resistance W and X in series = 600 + 200 = 800 Ω resistance Z and Y in series = 600 + 600 = 1200 Ω effective resistance = $[\frac{1}{800} + \frac{1}{1200}]^{-1}$ = 480 Ω *Markers' comments:* *Generally ok.* *Weaker students did not show the correct technique of calculation*
9bi	**Conversion:** 8.0 mA = 8.0×10^{-3} **Formula:** V = RI V = 600 x 8.0 x 10^{-3} [1] for conversion V = 4.8 V *(formula + substitution + final ans in 2.s.f) [1]* *Markers' comments:* *Generally ok.* *Weaker students did not get the formula right*
9bii	V_{batt} = (600 + 200) x 8.0 x 10^{-3} V_{batt} = 6.4 V $V_{batt} = V_{ADC}$ V_{AD} = 6.4 / 2 = 3.2 V $V_{BD} = V_{AB} - V_{AD}$ V_B *Markers' comments:* *Poorly done.* *Students are not sure of how to interpret the diagram*
10ai	C *Markers' comments:* *Generally ok*

10aii	1 and 7 or 2 and 8 *Markers' comments:* *Generally ok* *Some students did not answer to the question requirement* *(a pair must have two entities)*
10b	Place a magnet inside a solenoid in the east - west direction Connect the solenoid to an alternating current Withdraw the magnet with the alternating current still flowing in the solenoid, until it is some distance away. *Markers' comments:* *Moderately done* *Missing keywords 'east-west' direction.* *Some students have a misconception; DC supply drawn/explain rather AC supply.*

Section B

Qns	Answer
11a	Elastic Potential Energy due to stretched springs *Markers' comments:* *Well done*
11bi	**Conversion:** 1.9 kJ = 1900 J *(1 mark conversion)* **Formula:** $KE = ½ \times m \times v^2$ $1900 = ½ \times 45 \times v^2$ v = 9.2 m/s *(final ans + 2 or 3 sf) [1]* *Markers' comments:* *Generally Well done.* *Weaker students have issues with conversion and/or mathematical manipulation.* *Many candidates forgot to write the units, losing marks.*
11bi	**Concept statement:** Loss in KE = Gain in GPE *(concept statement)* 1900 = m x g x h 1900 = 45 x 10 x h *(formula + substitution) [1]* h = 4.22 m *(final ans + 2 or 3 sf) [1]* *Markers' comments:* *Wrong / no concept statement (-1 mark)* *Some candidates wrote KE = GPE which is not acceptable conceptually.* *Students are supposed to write loss in KE = Gain in GPE.* *Weaker students did not understand the concept that 1.9kJ of energy of KE is converted to GPE, hence are unable to start on the question*

11ci	**Concept statement:** Applying principle of moment about pivot, sum of anticlockwise M = sum of clockwise M (concept statement) F x 1.6 = (300 x 0.9) + [600 x (0.9 + 2.5)] *(substitution) [1]* F = 1443.75 F = 1440 N *(final ans + 2 or 3 sf) [1]* *Markers' comments:* *Poorly done* *students have issues with the summation of clockwise moment and/or mathematical manipulation.*
11cii	As the gymnast walks from D to C, the **perpendicular distance from line of action of his weight to pivot decreases**. Hence **decreasing the total clockwise moment**. For sum of clockwise moment to equal sum of anticlockwise moment, the **sum of anticlockwise moment can be decreased** by **decreasing the force F, f**or the same fixed distance of 1.6 m, *Markers' comments:* *Poorly done* *students understood that force F will decrease but could not use the appropriate keywords using the concepts of POM to explain the effect of the change.*

12	*Markers' comments:* *Fewer candidates chose this question.* *Perhaps due to the overwhelming data / comprehending the data*
12a	• The speed of waves in deep water continues to increase when wavelength increases from 400m to 600m. • Whereas in shallow water, the speed of the waves remains constant when wavelength increases from 400m to 600m.
12bi	For first wave to reach the ship, the first wave's speed must be the highest (i.e., 30.6m/s) **Formula:** time taken = distance / speed time taken = 2000×10^3 m / $30.6 ms^{-1}$ time taken = 6.54×10^4 s *Markers' comments:* *Candidates must be able to comprehend the data and apply it to new situations*
12bii	**Formula:** Since v = $f\lambda$, f = v/λ f = 30.6/600 (formula + Substitution) [1] f = 0.051 Hz (final ans + 2 s.f + unit) [1]

12biii	4 hours = (4 x 60 x 60)s = 14400 s Total time elapsed = 4 hours + time for first wave to reach ship (i.e., answer to (b)(i)) = (14400 + 6.54 x 10^4)s = 79 800 s Speed = distance / time = 2 000 000m / 79 800s = 25.1 m/s Approximate wavelength = 400 m (check with respect to data) *Markers' comments:* *Candidates must be able to cross reference their answer to the data given. Similar type of question O level Nov 2014 Paper 2 Q10*
12c	• **air molecules vibrate parallel to the direction of travel of the sound wave**, from the ship to the fisherman **causing regions of compression** (where the molecules are closely packed) and **regions of rarefaction** (where the molecules are spaced out). • These **vibrations pass sound energy from molecule to molecule** without transferring the air molecule *Markers' comments:* *Many candidates could not give sufficient points to gain credit.*

13a	Radiation (due to travelling through space where there are no particles)
13b	• Panel design A make use of **more absorbing surface, hence higher rate of thermal absorption,** as compared to panel design b. • The longer tubing in A allows the water to be **heated up longer and reach a higher temperature** compared to B *Markers' comments:* *Many candidates could not give sufficient points to gain credit. 2nd point was often missing in the explanation.*
13c	Inlet pipe N. Entering from pipe N, the bulk of hotter water having a **lower density** than cold water will **rise**. The bulk of **cold water which is denser, sinks and will displace the hot water**. This sets up a convection current and the cycle continues until it reaches thermal equilibrium. *Markers' comments:* *Many candidates could not give sufficient points to gain credit.* *Some candidates are not careful with their keywords and went on to mention that water molecules will expand. Some candidates forget to mention that the cycle repeats/continues to reach thermal equilibrium*

13di	**Conversion:** P = 1.8 kW = 1800 W **Formula:** I = P/V I = 1800 / 240 I = 7.5 A *Markers' comments:* *Generally Well done.*
13dii	**Formula:** E = P x t E = 1.8 x 4 x 7 E = 50.4 kWh (final ans + 2 s.f + unit) [1] Cost = E x rate Cost = 50.4 x 25 cents Cost = 1260 cents or $12.60 *Markers' comments:* *Generally Well done.* *Emphasise that time is in hours rather than seconds when involving calculation of electrical bills.*