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- 1 A pendulum clock is swinging too fast.

What has to be done to make the clock move slower?

- A Decrease the amplitude of oscillation.
- B Decrease the length of the pendulum.
- C Increase the amplitude of oscillation.
- D Increase the length of the pendulum.

- 2 Which of the following motion(s) is/are possible?

- 1 moving with constant speed and non-zero acceleration
- 2 moving with zero-velocity initially and non-zero acceleration
- 3 moving with constant velocity and zero acceleration

- A 2 only
- B 1 and 3 only
- C 2 and 3 only
- D 1, 2 and 3

- 3 A stone is thrown upwards.

Which row describes the acceleration and the velocity of the stone when it reaches maximum height?

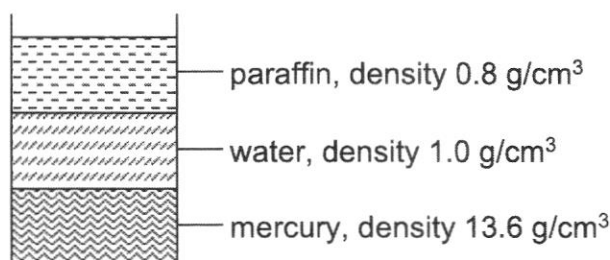
	acceleration / m/s^2	velocity/ m/s
A	0	0
B	0	10
C	10	0
D	10	10

- 4 Only two forces act on an object. If the object is in equilibrium, which of the following conditions are required?

- 1 The two forces have the same magnitude.
- 2 The two forces are opposite in direction.
- 3 The two forces are in the same direction.
- 4 The two forces are of the same type.

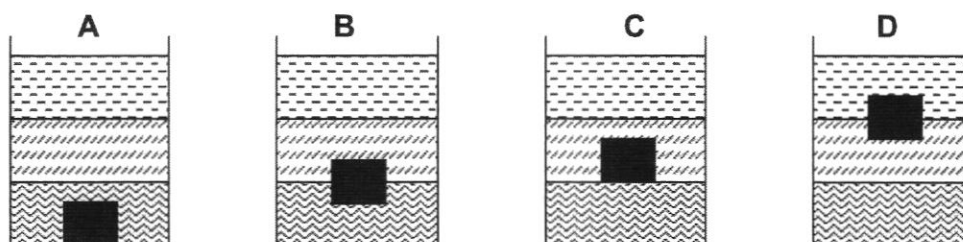
- A 1 and 2 only
- B 1 and 3 only
- C 3 and 4 only
- D 1, 2 and 4 only

- 5 The diagram shows a beaker containing three liquids which do not mix.



An ice cube of density 0.92 g/cm^3 is dropped into the beaker.

Which figure shows the final position of the ice cube?

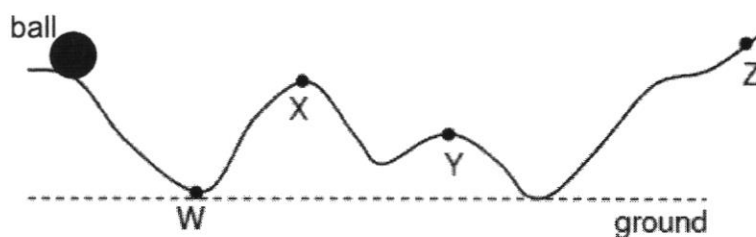


- 6 An object is slightly displaced by an external force. When the external force is removed, the object returns to its original position.

What state of equilibrium is the object in?

- | | |
|------------------|---------------------|
| A neutral | B rotational |
| C stable | D unstable |

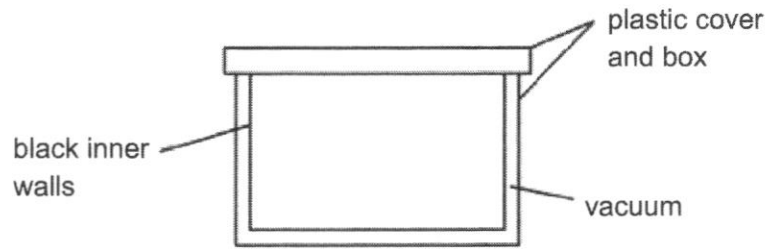
- 7 A ball is released from rest on a smooth surface. Air resistance is negligible.



Which statement is correct?

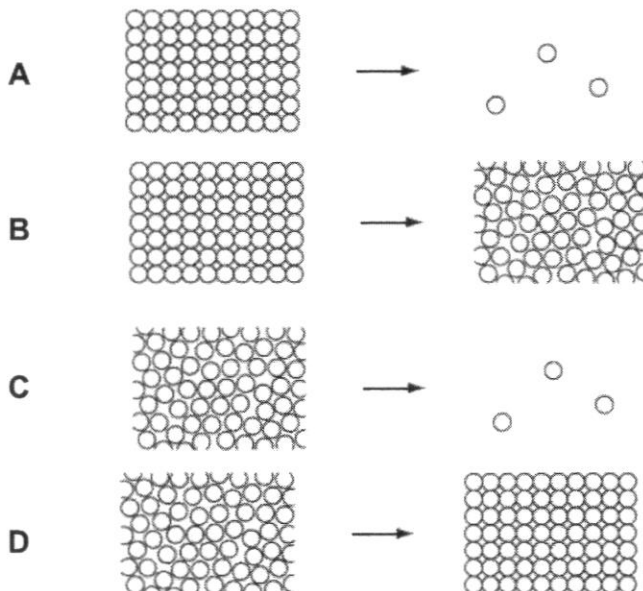
- | |
|--|
| A The ball will move past point Z. |
| B The kinetic energy of the ball at Y is greater than X. |
| C The kinetic energy of the ball at W is the lowest compared to X, Y and Z. |
| D The gravitational potential energy of the ball at X is smaller than Y. |

- 8 The diagram shows a container used to keep food warm for delivery.



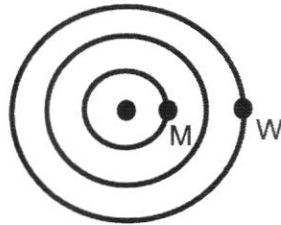
Which of the following explanation is incorrect?

- A** Plastic is a poor conductor of heat, hence heat loss will be reduced through conduction.
- B** Plastic cover reduces the formation of convection current, preventing the cooling of food contents in the container.
- C** Vacuum reduces heat loss due to conduction as it does not have a medium to transfer the heat.
- D** Black inner wall is a poor absorber of infrared radiation, hence does not absorb heat from the food.
- 9 Which diagram represents the change in arrangement of the particles of water when it freezes?

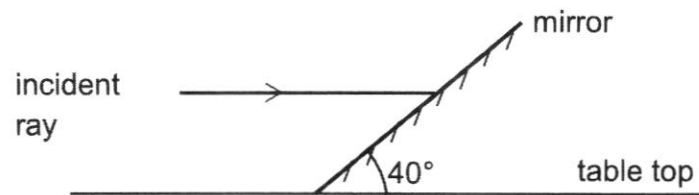


- 10 A pebble is dropped into still water so that the circular wavefronts are seen to travel outwards with a speed of v .

If the wavelength is λ , what is the time taken for the disturbance at M to reach W?

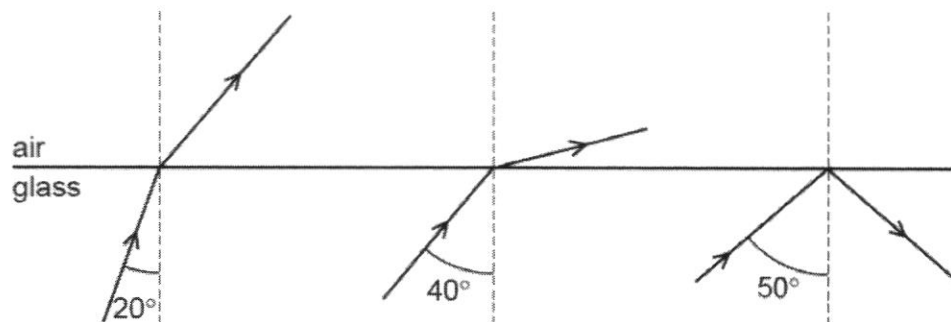


- A** $\lambda / 2v$ **B** λ / v
C $3\lambda / 2v$ **D** $2\lambda / v$
- 11 A plane mirror is inclined at 40° to the table-top. An incident ray parallel to the table-top strikes the mirror and a reflected ray is formed.



What is the angle of reflection?

- A** 20° **B** 40°
C 50° **D** 100°
- 12 Three rays of light are incident between a glass block and air. The diagram is not drawn to scale.



Which of the following is most likely to be the critical angle of the glass?

- A** 25° **B** 35°
C 45° **D** 55°

13 Which of the following is **not** an application of infrared radiation?

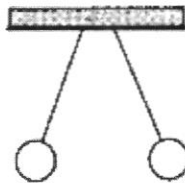
- A ear thermometer
- B night vision goggles
- C remote control
- D sunbeds used for skin tanning

14 A man fired a pistol at the starting line of a race and he heard an echo from the wall 0.5 s later. The speed of sound in air is 330 m/s.

What is the distance between the man and the wall?

- | | |
|----------|---------|
| A 82.5 m | B 165 m |
| C 330 m | D 660 m |

15 Two identical conducting balls are suspended freely and placed close to one another.



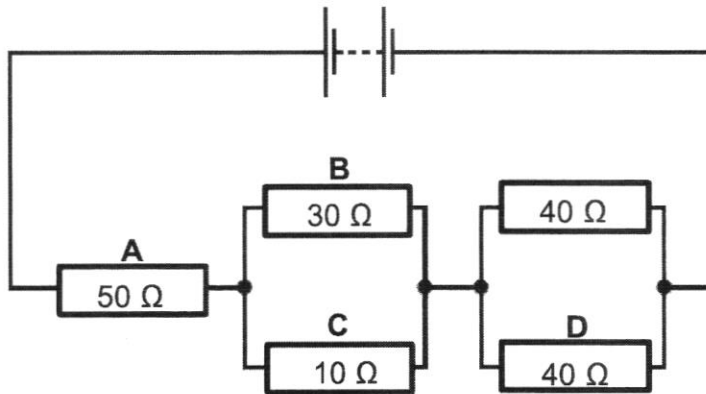
What could be the charge on the conducting balls?

- 1 Both of them have positive charges.
- 2 Both of them have negative charges.
- 3 They have opposite charges.

- A 1 only
- B 1 and 2 only
- C 1 and 3 only
- D 3 only

- 16 The diagram shows a circuit containing five resistors connected to a battery.

In which resistor is the current the smallest?



- 17 A battery drives 30 C of charge round a circuit. The total work done is 600 J.

What is the electromotive force of the battery?

- | | | | |
|----------|--------|----------|-------|
| A | 0.05 V | B | 5 V |
| C | 20 V | D | 300 V |

- 18 When a 9.0 V battery is connected to a filament lamp, the current flowing through it is 3.0 A.

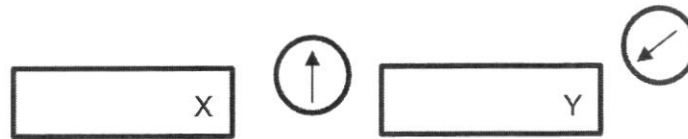
If the filament lamp converts 25% of the electrical energy into light and the rest is lost as heat, what is the amount of heat produced by the lamp in 6.0 minutes?

- | | | | |
|----------|-----------------------------|----------|-----------------------------|
| A | $1.2 \times 10^2\ \text{J}$ | B | $1.6 \times 10^2\ \text{J}$ |
| C | $2.4 \times 10^3\ \text{J}$ | D | $7.3 \times 10^3\ \text{J}$ |

- 19 The best way to demagnetise a magnet is to

- A** throw it on the ground several times.
- B** place it along the E-W axis and hammer it.
- C** place it in a solenoid carrying direct-current and slowly pulling it out.
- D** place it in a solenoid carrying alternating-current and slowly pulling it out.

- 20 The diagram shows the direction of the compass needle when placed near two bar magnets.



What are the likely poles at X and Y?

	pole at X	pole at Y
A	North	South
B	North	North
C	South	North
D	South	South

Section A (45 marks)

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

- 1 (a) The table shows some instruments used in scientific measurements.

Write down the physical quantities measured and their respective SI units.

Instrument	Physical quantity	SI Unit
metre rule	length	metre
spring balance		
electronic balance		
stopwatch		
measuring cylinder		

[4]

- (b) Fig. 1.1 shows a simple pendulum swinging from P to R and back to P repeatedly.

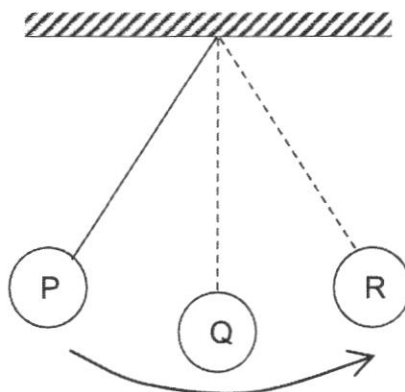


Fig. 1.1

An experiment was done to determine the periodic time of a pendulum. The time taken, t , for the pendulum to complete 20 oscillations are recorded below.

23.75 s , 25.11 s , 24.01 s , 23.13 s

- (i) Determine the periodic time of the pendulum.

period = s [2]

- (ii) What is the time taken for the pendulum to move from P to Q?

time = s [1]

- 2 A uniform beam, with mass 2.0 kg, is supported at 0.20 m from the centre by a pivot P. Two objects, of mass 4.0 kg and 8.0 kg respectively, are balanced on the beam as shown in Fig. 2.1 below.

Take acceleration due to gravity to be 10 m/s^2 .

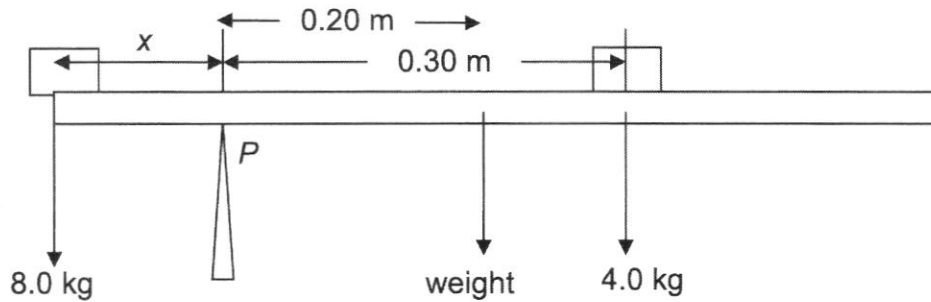


Fig. 2.1

- (a) Calculate the weight of the beam.

weight = N [1]

- (b) Determine the turning effect due to the weight of the beam.

turning effect = Nm [2]

- (c) State the principle of moment.

.....
 [2]

- (d) Find the distance between the 8.0 kg mass and the pivot.

distance = m [2]

- 3 A bullet of mass 2.5 g, travelling at a velocity of 100 m/s is brought to rest in a bag of sand in 0.10 s.

Assuming that the deceleration is uniform, find

- (a) the deceleration of the bullet,

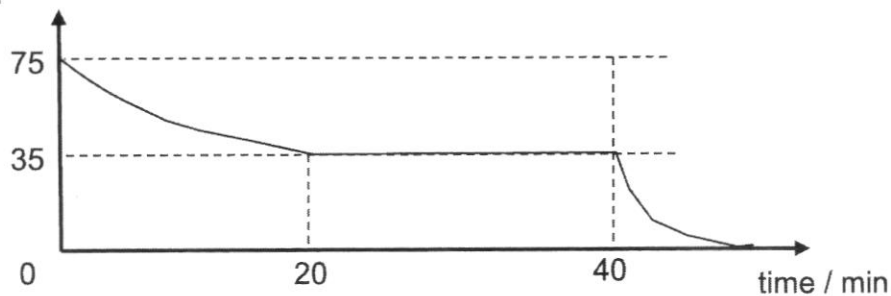
deceleration = m/s² [2]

- (b) the average retarding force.

average retarding force = N [2]

- 4 A substance in the liquid state is cooled down. The graph below shows how the temperature of substance changes with time.

temperature / °C



- (a) Fill in the blank with an appropriate word.

"35 °C is known as the point of the solid." [1]

- (b) From 20th to 40th min, the temperature of the substance did not decrease. Explain why.

.....

..... [2]

5 (a) Using the kinetic theory of matter, discuss why

(i) solids have a fixed volume,

.....
 [2]

(ii) liquids have no fixed shape.

.....

 [1]

(b) Fig. 5.1 shows a metal pot containing water and placed on a hot plate.

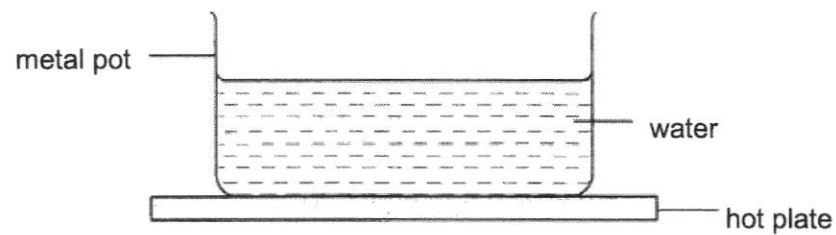


Fig. 5.1

Explain how heat is transmitted from the hot plate to all the water in the pot.

.....

 [3]

- 6 A loudspeaker and its microphone are set up facing each other such that the distance between them is 6.8 m. When the cone of the loudspeaker vibrates at a frequency of 200 Hz, there are exactly 4 complete waves in the air between the loudspeaker and microphone as shown in Fig. 6.1.

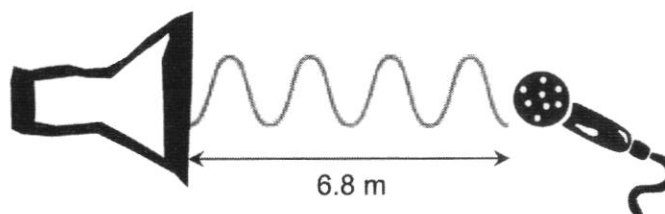


Fig. 6.1

- (a) Calculate the speed of sound as it travels in the air between the loudspeaker and the microphone.

speed of sound = m/s [2]

- (b) Determine the number of waves between the loudspeaker and the microphone when the frequency is 2.5 kHz.

no. of waves = [2]

- 7 (a) Two resistors, $4\ \Omega$ and $12\ \Omega$ are arranged in parallel to a cell of 5 V as shown in Fig. 7.1.

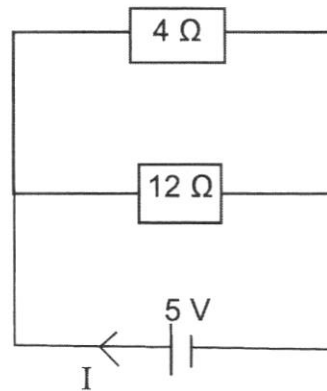


Fig. 7.1

- (i) What is the total resistance of the circuit?

total resistance = Ω [2]

- (ii) What is the total current, I , flowing from the cell?

$I = \dots\dots\dots\text{ A}$ [2]

- (b) Fig. 7.2 shows a coil in a magnetic field. The coil is able to rotate about the axis. The coil is connected to a d.c. power supply.

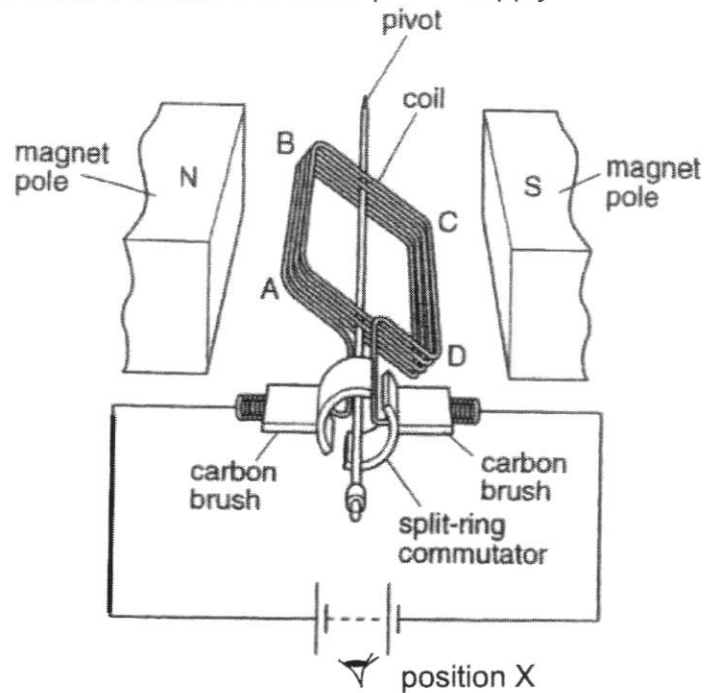


Fig. 7.2

- (i) On Fig. 7.2, indicate the direction of current flow on wire AB. [1]

- (ii) State the direction of rotation of the coil observed from position X.

..... [1]

- 8 The table lamp shown in Fig. 8.1 is made from plastic. It has only two wires in the cable. The lamp has a power rating of 150 W and is used on a 230 V supply.

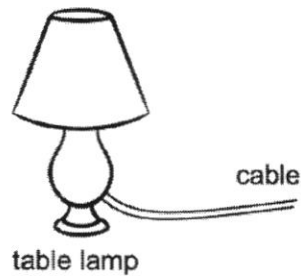


Fig. 8.1

- (a) (i) Identify the two wires in the cable.
-
- [1]
- (ii) Explain why the lamp is safe to use even though it has only two wires.
-
- [1]
- (b) Calculate the current flow through the lamp when it is connected to the 230 V supply.

current = A [2]

- (c) Calculate the electrical energy supplied to the lamp in 4.5 hours.

energy = J [2]

- (d) The lamp is switched on for 4.5 hours each day. Given that the cost of electricity is 23 cents per kWh, calculate the total cost of using the lamp for 30 days.

total cost = \$ [2]

Section B (20 Marks)

Answer any **two** questions in this section in the spaces provided.

- 9 (a) Fig. 9.1 shows a piling hammer used to drive piles into the ground for high rise construction. The hammer is raised to a height of 20.0 m before releasing to drive the pile 2.0 m into the ground.

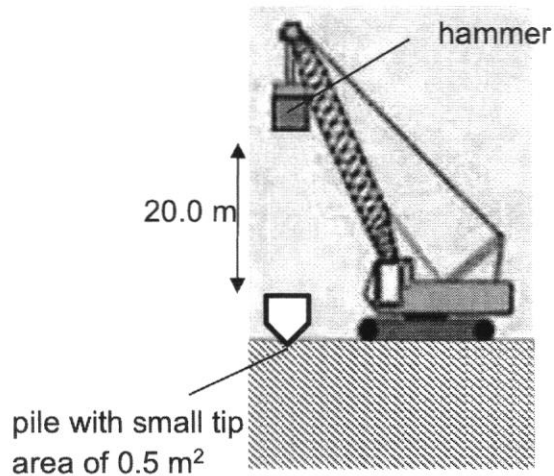


Fig. 9.1

- (i) What is the pressure that the pile is acting on the ground, given that the mass of hammer is 250 kg?

pressure = [2]

- (ii) Calculate the kinetic energy of the hammer just before it hits the pile.

kinetic energy = [2]

- (iii) Given that the energy transferred to the pile is 40 kJ, calculate how much energy is transferred into other forms.

energy = [1]

- (iv) State the form(s) of energy calculated in (iii).

.....

..... [1]

- (b) The hammer is held in equilibrium by 2 strings as shown in Fig. 9.2 (not drawn to scale) when it is not in use. The forces exerted by the 2 strings are T N and 1800 N respectively.

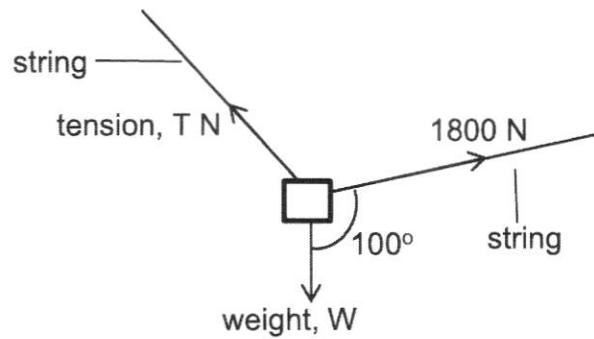
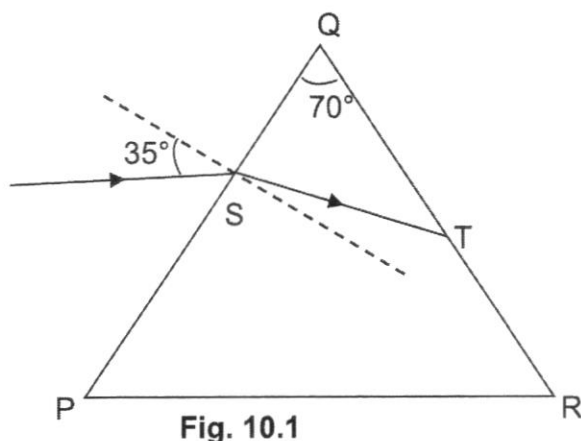


Fig. 9.2

By using a suitable scale diagram, determine the tension, T of the string.

tension, $T = \dots\dots\dots$ [4]

- 10 (a) A ray of light is passed through a regular triangular glass block, PQR with a refractive index of 1.5. The ray strikes the surface PQ at S at an angle of 35° and gets refracted as shown in Fig. 10.1.



- (i) Calculate the critical angle of this medium.

critical angle = [2]

- (ii) Calculate the angle of refraction at S.

angle of refraction at S = [2]

- (iii) Calculate the angle of incidence at T.

angle of incidence at T = [1]

- (iv) On Fig. 10.1, draw the path of the light ray right after it strikes the surface QR. [1]

- (b) Fig. 10.2 shows the position of an object O and image I after light rays from the object pass through a thin converging lens.

On Fig. 10.2,

- (i) complete the ray diagram to show how the image is formed, [2]
- (ii) mark out the position of the lens, [1]
- (iii) mark out the focal point of the lens. [1]



Fig. 10.2

(b) Suggest **two** changes that can be made to the set-up to produce a louder ringing sound.

Change 1:

.....
.....

Change 2:

.....
.....

[2]

(c) What are the poles of the 2 iron cores at X and Y when the switch is closed?

X:

Y:

[1]

(d) Explain how the following changes will affect the use of this doorbell.

Replace the iron core with

(i) a steel core,

.....
.....

(ii) a copper core.

.....
.....

[3]

End of Paper

2022 MSS Sec 4E5N Sci(Physics) Prelim P1

[20 marks]

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

2022 MSS Sec 4E5N Sci(Physics) Prelim P2

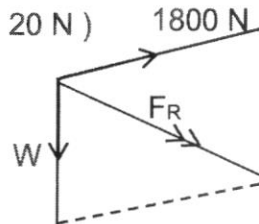
Section A [45 marks]

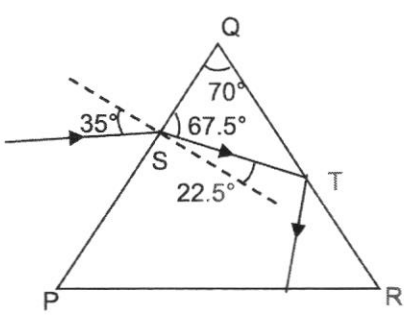
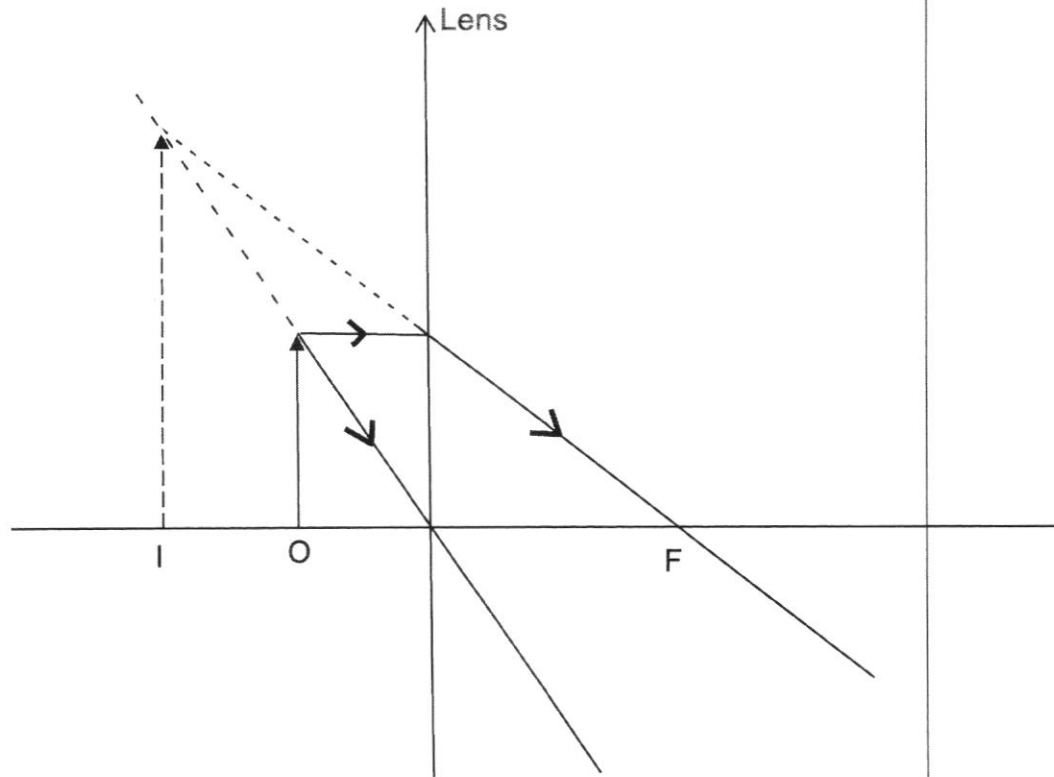
1	a	Instrument	Physical quantity	SI Unit	
		Metre rule	Length	Metre	
		Spring balance	Force/ Weight	Newton	[1]
		Electronic balance	Mass	kilogram	[1]
		Stopwatch	Time	Second	[1]
		Measuring cylinder	Volume	Cubic metre	[1]
	b	(i) $(23.75 + 25.11 + 24.01 + 23.13)/4 = 24 \text{ s}$			[1]
		$24/20 = 1.2 \text{ s}$			[1]
	b	(ii) $1.2/4 = 0.3 \text{ s}$			[1]
2	a	$W = mg = 20 \text{ N}$			[1]
	b	Moment = $F \times d$ $= 20 \times 0.20$ $= 4 \text{ Nm}$			[1]
	c	When an object is balanced , the sum of clockwise moments about a pivot is equal to the sum of anticlockwise moments about the same pivot.			[1]
	d	by POM, $80 \times x = 40 \times 0.3 + 4$ $x = 0.20 \text{ m}$			[1]
3	a	Deceleration = $(100-0)/0.1$ $= 1000 \text{ m/s}^2$			[1]
	b	$F = ma$ $= 0.0025 \times 1000 = 2.5 \text{ N}$			[1]
4	a	Melting/freezing			[1]
	b	The liquid particles are losing potential energy (energy is given out) to settle down in a regular arrangement (to strengthen forces of attraction)			[1]
5	ai	Solids have a fixed volume because the molecules are closely packed with negligible space in between, Not possible to compress any further.			[1]
	ii	However, because the molecules within a liquid can slide over one another throughout the liquid , liquids have no fixed shape.			[1]
	b	Water at the bottom of the pot gets heated up first, expands and becomes less dense and rises. (compare density,) Cooler, denser water at the top sinks to take its place to get heated up and rise. (rise/sink) Convection currents are set up to heat up all the water.			[1]
6	a	$v = f\lambda$ $= 200 \times \frac{6.8}{4}$ $= 340 \text{ m/s}$			[1]
	b	$\lambda = \frac{v}{f}$ $= \frac{340}{2500}$ $= 0.136 \text{ m}$ $\text{no. of waves} = \frac{6.8}{0.136} = 50$			[1]

7	ai	$\frac{1}{R} = \frac{1}{4} + \frac{1}{12}$ $R = 3 \Omega$	[1] [1]
	aii	$I = \frac{V}{R}$ $= 1.67 \text{ A}$	[1] [1]
	b	(i) A to B	[1]
		(ii) anticlockwise	[1]
8	ai	Live and Neutral wires in the cable.	[1]
	ii	Double insulation (or plastic casing) of lamp prevents the user from electric shock and is safe to use.	[1]
	b	$P = IV$ $150 = 230 I$ $I = 0.652 \text{ A}$	[1] [1]
	c	$E = Pt$ $= (150 \text{ W}) (4.5 \times 60 \times 60 \text{ s})$ $= 2.43 \times 10^6 \text{ J} \quad (2.43 \text{ MJ})$	[1] [1]
	d	Cost = energy (kWh) x unit cost of electricity $= (0.150 \text{ kW}) (4.5 \text{ h} \times 30) (\$0.23)$ $= \$4.6575 = \4.66	[1] [1]

Section B [20 out of 30 marks]

9	ai	Pressure = Force / area $= (250 \times 10) / 0.5$ $= 5000 \text{ Pa}$	[1] [1]
	aii	Using the conservation of energy, Gain in KE = loss in PE $= mgh$ $= 250 \times 10 \times 20$ $= 50000 \text{ J}$	[1] [1]
	iii	Energy transferred to other forms = $50000 - 40000$ $= 10000 \text{ J}$	[1]
	iv	Thermal and sound energy	[1]
	b	Scale: 1 cm rep. 200 N (at least) diagram with arrows correct magnitude of T $(2234 \pm 20 \text{ N})$	[1] [1] [1] [1]



10	ai	$n = \frac{1}{\sin C}$ $1.5 = \frac{1}{\sin C}$ $C = \sin^{-1}\left(\frac{1}{1.5}\right)$ $C = 41.8^\circ$	[1]
	aiaii	$n = \frac{\sin i}{\sin r}$ $1.5 = \frac{\sin 35}{\sin r}$ $r = \sin^{-1}\left(\frac{\sin 35}{1.5}\right)$ $r = 22.5^\circ$	[1] [1]
	aiaiii	angle STQ = 42.5° angle of incidence at T = 47.5°	[1]
	aiv		[1] total internal reflection. if $i < C$, then refraction accepted (ECF)
	b	(i) The position of the lens (ii) The focal point of the lens (iii) Complete the ray diagram to show how the image is formed.	[1] [1] [2]
			

11	a	When switch is closed, the current in the solenoid causes the iron cores to become a strong electromagnet. [1] The iron cores (electromagnet) cause the soft iron armature to become an induced magnet [1] and is attracted towards the iron cores. [1] When the armature turns clockwise about pivot P and the hammer hits the gong, a sound is produced. [1] The circuit is now opened, iron cores lose magnetism and spring returns the armature to original position to get magnetised. The process repeated and the hammer repeatedly hits the gong creating a ringing sound. [1]	
	b	Use a power supply with a higher e.m.f. // more turns on the solenoid/ Place iron core + solenoid nearer to metal rod./Move pivot P nearer to the top of the metal rod that hits the bell. [1] [1]	
	c	X: S Y: N [1]	
	d	(i) Steel core remains magnetised, armature will not return to original position. Gong will only have one ding sound [1] [1] (ii) There will be no sound as copper is not a magnetic material, cannot attract the armature. [1]	