1 A ray of light hits and transfers energy to an area. The *intensity* of the light ray is defined as the energy transferred per unit area per unit time. What is the unit of *intensity*?

A $kg\ s^{-2}$ **B** $kg\ s^{-3}$ **C** $kg\ m^2\ s^{-2}$ **D** $kg\ m^2\ s^{-3}$

2 What is equivalent to $0.62\ g\ cm^{-3}$?

A $62\ kg\ m^{-3}$ **B** $6.2 \times 10^2\ kg\ m^{-3}$ **C** $6.2 \times 10^3\ kg\ m^{-3}$ **D** $6.2 \times 10^4\ kg\ m^{-3}$

3 An object X of mass *m* is released from a height *h*. Another object Y of mass *4m* is released from a height *4h* simultaneously. If both objects fall freely, which statement is true?

A The distance between them decreases and Y overtakes X.

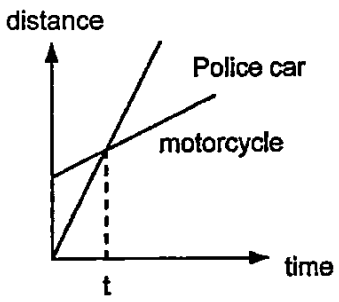
B The distance between them remains constant.

C The distance between them increases as X falls faster.

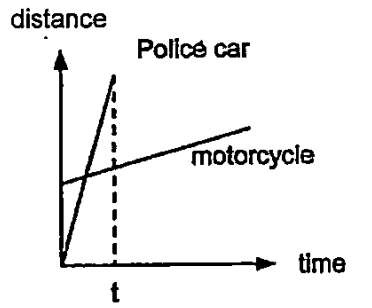
D The velocities of both objects are constant.

4 A police car starts from rest and accelerates to catch up with a speeding motorcycle within *t* minutes. Which graph describes the above scenario?

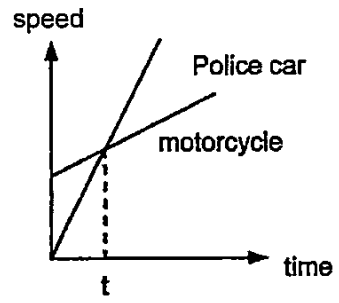
A



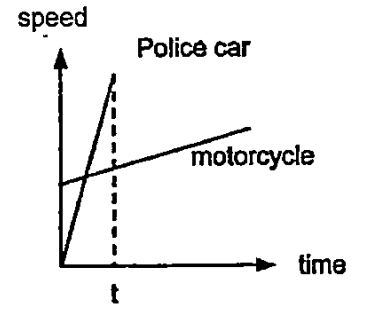
B



C



D



5 Which is a vector quantity?

A energy B speed C temperature D tension

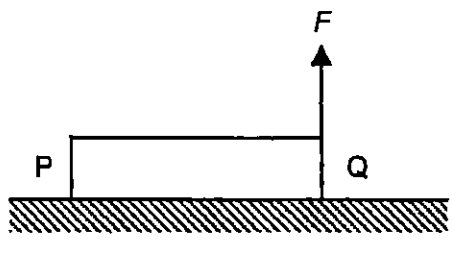
6 A ball bearing is released and sinks into a liquid. It falls vertically until it reaches terminal velocity. In this duration, the resultant force on the ball bearing is

A zero. B decreasing. C constant. D increasing.

7 Ice of mass 10 g, volume 11 cm^3 and temperature -3°C is added with water of mass 20 g, volume 20 cm^3 and temperature 30°C in a cup. The ice melted and all the water returns to 30°C. What is the final density of the water?

A 0.91 g cm^{-3} B 0.95 g cm^{-3} C 0.97 g cm^{-3} D 1.00 g cm^{-3}

8 A uniform bar has mass 25 kg and length 8 m. A man lifts edge Q vertically up with a force *F* such that the bar pivots at edge P. What is the magnitude of force *F* to just lift edge Q off the floor?



A 12.5 N B 62.5 N C 125 N D 250 N

9 Which object is in neutral equilibrium?

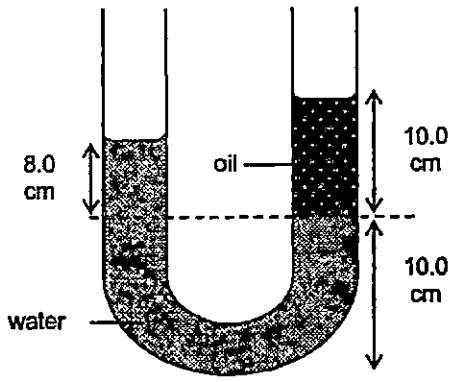
A a pencil balanced on its sharp tip

B a playground swing that is at rest

C a traffic cone that is upright

D an ice cream cone resting on its slant edge

10 An U-tube contains water of density 1.00 g cm^{-3} and oil. What is the density of the oil?



A 0.80 g cm^{-3} B 0.90 g cm^{-3} C 1.11 g cm^{-3} D 1.25 g cm^{-3}

11 When a barometer is taken up in a hot air balloon, the mercury level

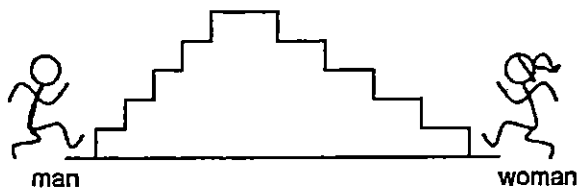
A increases as the atmospheric pressure increases.

B increases as the atmospheric pressure decreases.

C decreases as the atmospheric pressure increases.

D decreases as the atmospheric pressure decreases.

12 A man of mass 67 kg and a woman of mass 48 kg runs up to the same stage via two different flight of steps. If they reach the stage at the same time, which statement is true?



A The man runs faster than the woman.

B The man is more powerful than the woman.

C The man gains more gravitational potental energy than the woman.

D The man gains more kinetic energy than the woman.

13 A car of mass 800 kg brakes and decelerates uniformly from 80 km h^{-1} to rest in 12 s. All the kinetic energy of the car is converted to thermal energy (work done against friction). At what rate must the braking surfaces lose thermal energy to keep their temperatures constant?

A 16.5 kW B 161 kW C 198 kW D 213 kW

14 A motor drives a pump that raises 0.20 m^3 of water up by 5.0 m in 10 minutes. If the efficiency of the pump is 75 %, what is the power generated by the motor? Take density of water to be 1000 kg m^{-3}.

A 12.5 W B 22.2 W C 556 W D 1330 W

15 A gas is heated in a rigid sealed container. Which quantity does **not** change?

A the average speed of the gas particles

B the average force exerted on the walls of the container by the gas particles

C the average distance between the gas particles

D the frequency of collisions on the walls of the container by the gas particles

16 Which substance contracts the most when cooled?

A air B iron C mercury D water

17 A metal ring is cooled from 80°C to 30°C. Which statement is true?

A The external diameter decreases while the internal diameter increases.

B The external diameter increases while the internal diameter decreases.

C Both the external and internal diameters decrease.

D Both the external and internal diameters increase.

18 A boy is wrapping a sweet corn in aluminium foil for a barbeque. Which side should be on the outside and why?

A The shiny side, as it is a better absorber of thermal radiation.

B The shiny side, as it is a better conductor of thermal radiation.

C The dull side, as it is a better absorber of thermal radiation.

D The dull side, as it is a better emitter of thermal radiation.

19 The intellectual beings in M-universe use a different set of units for measurements.

They measure temperature using the Thor, where the melting and boiling points of water are 25 Thor and 75 Thor respectively.

They measure energy using the Hulk, where one Hulk is the amount of thermal energy needed to increase the temperature of one gram of water by one Thor.

What is the specific heat capacity of water in M-universe?

A 1 Hulk per gram per Thor

B 25 Hulk per gram per Thor

C 50 Hulk per gram per Thor

D 75 Hulk per gram per Thor

20 When some ether is spilled onto someone's hand, the hand feels very cold. If water is spilled under the same conditions, the hand will not feel the change in temperature because

A water does not evaporate as quickly as ether.

B water has a higher boiling point.

C water has a higher specific latent heat of vaporisation.

D water has a lower specific heat capacity.

21 A dipper sends ripples across the surface of a water body. The distance between ripples decreases as they travel further away from the dipper as the

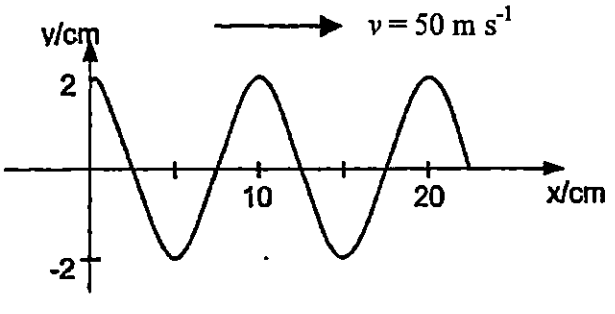
A frequency of the wave decreases.

B frequency of the wave increases.

C speed of the wave decreases.

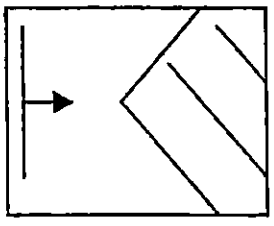
D speed of the wave increases.

22 One end of a rope is vibrated up and down and the rope wave travels from left to right. If the speed of the rope wave is 50 m s^{-1}, what is the period of the rope wave?

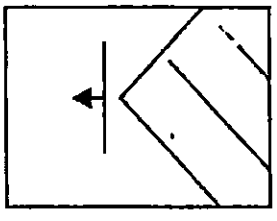


A 1 ms **B** 2 ms **C** 5 ms **D** 10 ms

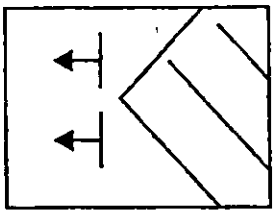
23 A wave approaches a triangular reflecting surface. Which diagram shows the correct reflected wave?



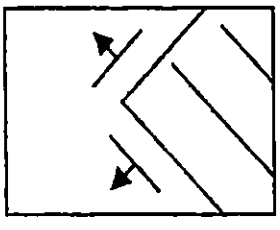
A



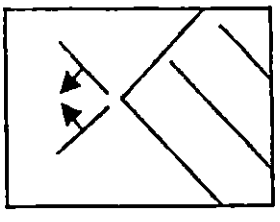
B



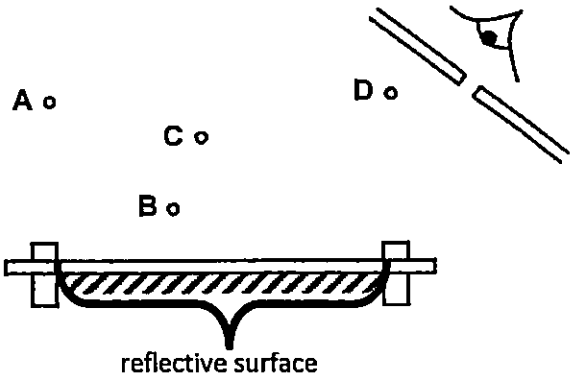
C



D

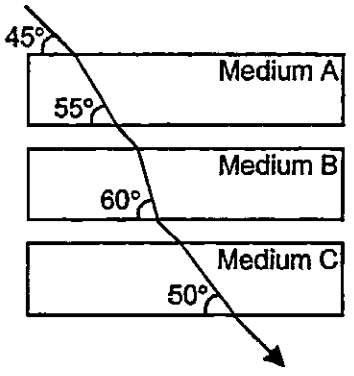


24 A coach tries to observe four dancers through a small glass panel on the door of a dance studio. Whose image in the mirror **cannot** be seen by the coach?



Top View of Dance Studio

25 A ray of light passes three transparent media, A, B and C. Which statement is true?



Not drawn to scale

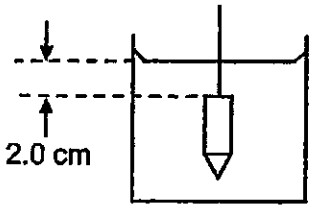
A Medium B has a lower refractive index than medium C.

B Medium B has the smallest refractive index.

C Light travels slower in medium A than in medium C.

D Light travels the fastest in medium A.

26 A pencil is suspended by a string in a tank of liquid such that its round end is 2 cm below the surface of the liquid. When viewed in air from the top of the tank, the pencil appears to be 2 cm long and 1 cm below the surface of the liquid. What is the real distance between the tip of the pencil and the surface of the liquid?



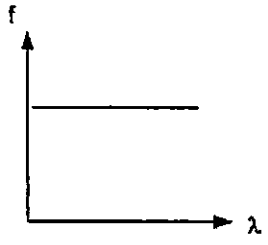
A 3 cm **B** 4 cm **C** 5 cm **D** 6 cm

27 When travelling in air, wave M travels much faster than wave N but also has a much shorter wavelength. What are waves M and N?

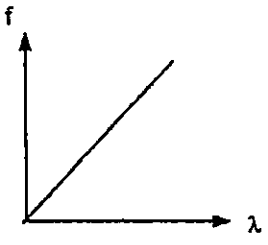
	M	N
A	gamma ray	visible light
B	radio wave	visible light
C	radio wave	sound wave
D	infrared wave	sound wave

28 Which graph shows the correct relationship between the frequency, *f* and the wavelength λ of a wave that is travelling in one particular material?

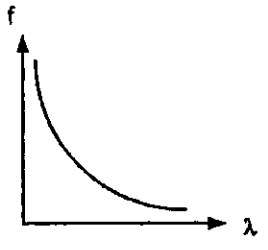
A



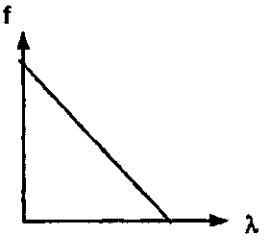
B



C



D



29 The SCDF sounds the "All Clear" siren which produces a note of constant pitch, *P*. An officer walks directly towards to the speaker and then retracts his path at constant speed. What does he hear?

	going towards speaker	going away from speaker
A	a note of constant pitch, P	a note of constant pitch, P
B	a note of increasing pitch from P	a note of decreasing pitch from P
C	a note of constant pitch lower than P	a note of constant pitch higher than P
D	a note of constant pitch higher than P	a note of constant pitch lower than P

30 The speed of sound in air depends on the

A temperature of the air.

B pitch of the sound.

C loudness of the sound.

D distance between the source and receiver of the sound.

31 Which object will **not** attract tiny pieces of paper?

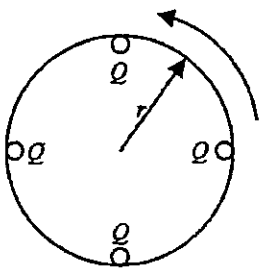
A a metal knife sharpened with a knife sharpener

B a ceramic spoon wiped with a kitchen cloth

C a plastic comb combed through dry hair

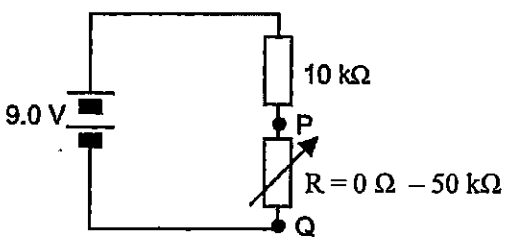
D a wooden pencil rubbed with an eraser

32 Four spheres, each given a charge of Q, are spread apart evenly on the circumference of a round insulating disc. When the disc is rotated about an axle at its centre with a period of T, the electric current at a particular point on the circumference is



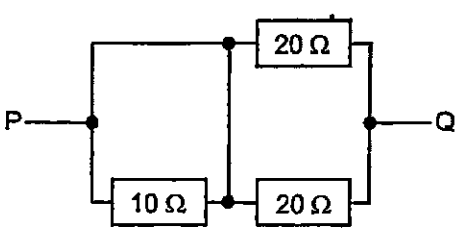
A $\frac{2Q}{\pi r T}$ B $\frac{4Q}{T}$ C $\frac{8\pi r Q}{T}$ D $4QT$

33 What is the possible range of readings on a voltmeter connected across P and Q?



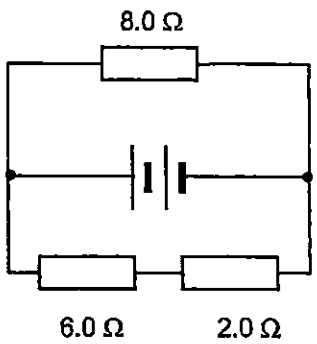
A 0 – 1.5 V B 0 – 7.5 V C 1.5 – 7.5 V D 1.5 – 9.0 V

34 What is the effective resistance between P and Q?



A 10 Ω B 20 Ω C 40 Ω D 50 Ω

35 Given that the current flowing through the 8.0 Ω resistor is 200 mA, what is the voltage across the 6.0 Ω resistor?



A 0.40 V B 1.20 V C 10 V D 30 V

36 Which is a consequence of connecting several electrical appliances to the same power socket?

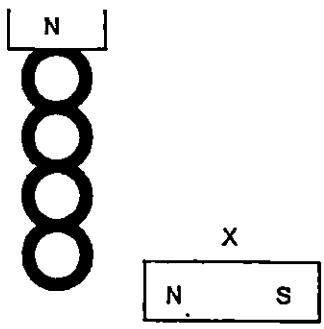
A Current drawn by each appliance is decreased.

B Total energy consumption is decreased.

C Total energy consumption is increased.

D Voltage drawn by each appliance is decreased.

37 A strong permanent magnet attracts a chain of four iron rings. A weaker permanent magnet, X is moved near to the right side of the lowest iron ring. What happens?



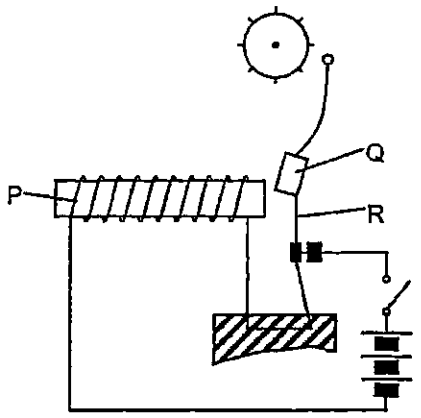
A The chain will bend away from X.

B The chain will bend towards from X.

C The chain will oscillate elliptically in 3-dimensions.

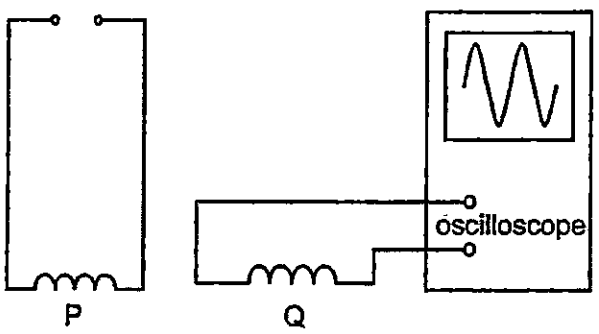
D The chain will swing to-and-fro X in 2-dimensions.

38 In an electric bell, what are parts P, Q and R made of?



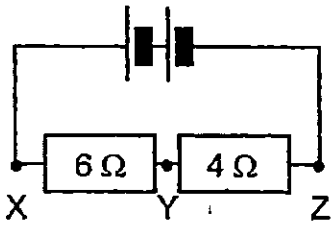
	P	Q	R
A	copper	soft-iron	spring steel
B	copper	steel	spring steel
C	steel	soft-iron	copper
D	steel	steel	copper

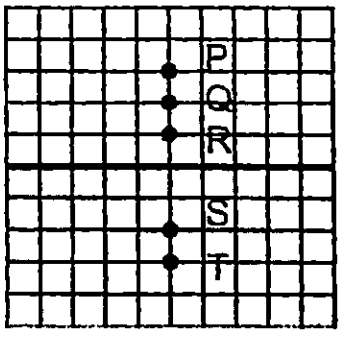
39 An alternating current flows through coil P. Coil Q is connected to a C.R.O. on which a sinusoidal trace appears. What happens to the trace if P and Q are linked by a soft-iron core?



	height	number of cycles
A	remains the same	increases
B	remains the same	remains the same
C	increases	increases
D	increases	remains the same

40 When the two input pins of a C.R.O. is connected to points X and Y of the electric circuit, a bright spot appears on the screen at T. If the input pin at point X is removed and reconnected to point Z of the electric circuit, where will the bright spot move to?





A T → P B T → Q C T → R D T → S

**********End of Paper**********

Section A

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

For Examiner's Use

1 The roof of a bungalow is constructed using ceramic tiles. One tile of mass 300 g starts to slide down the roof from rest. It experiences a constant frictional force of 0.40 N and slides for 3.5 m before reaching and falling off the edge of the roof.

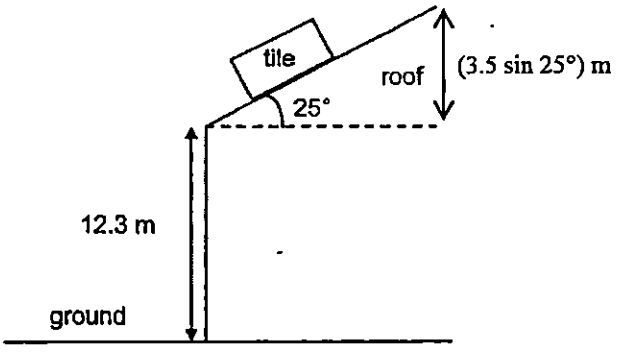


Fig. 1.1

(a) Find the speed of the tile just before it falls off the edge of the roof.

speed = ... [3]

(b) Find the time taken for the tile to hit the ground after falling off the edge of the roof. Hint: Speed in **(a)** is not vertical.

For Examiner's Use

time taken = ... [4]

[Total: 7]

2 Pure gold is usually mixed with copper so that the harder alloy can be used to make jewellery with better form. Auntie Leticia bought a gold necklace which the jeweller claimed was rated 22 karats (91.7% pure). She doubted the claim as the necklace was relatively cheap, so she used some kitchen equipment and found that the mass and volume of the necklace were 88 g and 6.0 cm^3 respectively.

Given that the densities of pure gold and pure copper are 19.3 g cm^{-3} and 8.92 g cm^{-3} respectively, find the percentage of pure gold in Auntie Leticia's necklace.

percentage = ... [4]

[Total: 4]

3 **(a)** The atmospheric pressure at sea level is 101 kPa. An aeroplane takes off from sea level and travels a vertical height of 6.0 km. The average density of air between sea level and that altitude is 1.1 kg m^{-3}. Find the atmospheric pressure at an altitude of 6.0 km.

For Examiner's Use

atmospheric pressure = ... [3]

(b) The aeroplane ascends further to an altitude of 11 km where the atmospheric pressure is 22.5 kPa. The cabin pressure is maintain at 78 kPa. Given that each passenger window on the aeroplane has an area of 0.050 m^2 and is secured by 14 screws, find the tensional force in each screw.

tensional force = ... [2]

[Total: 5]

4 Electronic components are easily overheated and damaged. They are thus usually attached to heat sinks which will transfer thermal energy from the electronic components to the surroundings.

For Examiner's Use

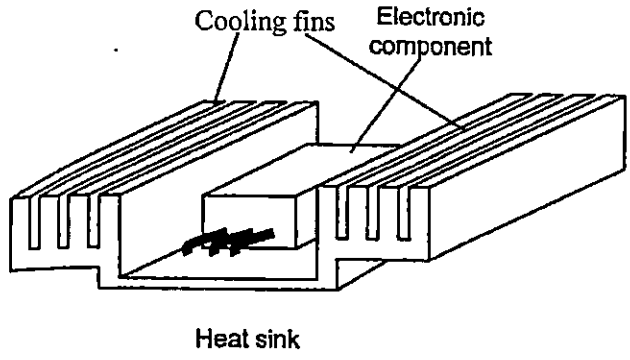


Fig. 4.1

(a) **(i)** Suggest a material for the heat sink and explain why.

.....

..... [2]

(ii) Suggest a colour for the heat sink and explain why.

.....

..... [2]

(b) Heat sinks are characterised by their *thermal resistances*. The heat sink shown in Fig. 4.1 has a *thermal resistance* of 2 °C W^{-1}. This means its temperature will rise by 2 °C when the electronic component dissipates 1 J of thermal energy per second.

(i) Find the temperature rise of the heat sink when the electronic component dissipates a thermal power of 10 W.

temperature rise = ... [2]

(ii) The electronic component continues to dissipate heat. Suggest a reason why the temperature of the heat sink will be constant after some time.

.....

..... [1]

[Total: 7]

5 Fig. 5.1 shows particles in a medium. A wave moves from the left to the right.

For Examiner's Use

Fig. 5.1

(a) Describe the movement of the particles if the wave is a transverse wave.

.....

..... [1]

(b) Draw a full-scale graph of the transverse wave of amplitude 20 mm and wavelength 50 mm. Draw at least two waves and label the graph appropriately. [2]

(c) Find the speed of the transverse wave if its period is 400 ms.

speed = ... [2]

[Total: 5]

6 (a) White light from a lamp is viewed through a piece of green glass. State and explain the difference, if any, in the brightness of the light.

For Examiner's Use

....

....

.... [2]

(b) Another lamp is put inside an opaque box with a hole on one side. A thin vertical wire spans across the hole. Light from the lamp exits the box via the hole, passes through a converging lens and falls onto a plane mirror.

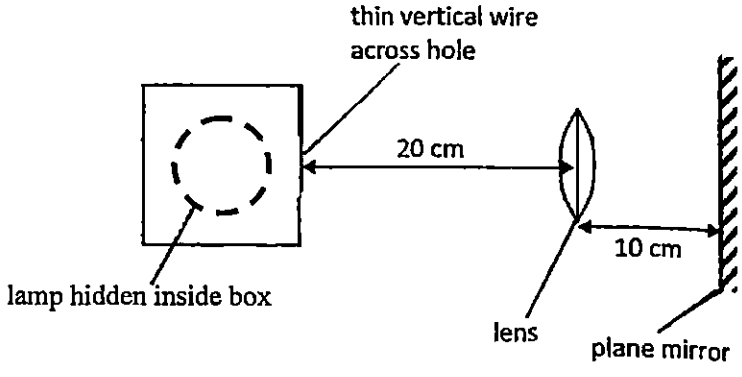


Fig. 6.1

(i) When the distance between the wire and the lens is 20 cm and the distance between the lens and the mirror is 10 cm, a sharp image of the wire is formed on a screen on the same plane as the hole. What is the focal length of the lens?

focal length = ... [1]

(ii) The distance between the wire and the lens is kept at 20 cm but the distance between the lens and the mirror is changed to 15 cm. State and explain the difference, if any, in sharpness of the image of the wire.

.....

.....

..... [2]

(iii) The mirror is replaced with another screen. The distance between the wire and the lens and the distance between the lens and the screen are both adjusted until a sharp image of the wire is formed on the screen. The image is inverted and of the same size as the wire. State the distance between the wire and the lens.

distance = ... [1]

[Total: 6]

7 Fig. 7.1 shows a metal can connected to a galvanometer.

For Examiner's Use

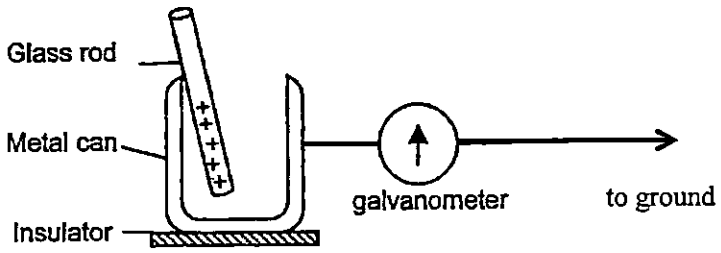


Fig. 7.1

(a) When a positively-charged glass rod is lowered into the metal can, the galvanometer shows a deflection but returns to zero soon after. Explain what has happened.

.....

.....

.....

.....

..... [2]

(b) State one way to

(i) increase the deflection of the galvanometer and

.....

..... [1]

(ii) change the direction of the deflection of the galvanometer.

.....

..... [1]

(c) A student holds a copper rod, tries to charge it and then lowers it into the metal can. State and explain what happens.

.....

.....

..... [2]

[Total: 6]

For Examiner's Use

8 **(a)** In the evacuated glass tube of a cathode-ray oscilloscope, the current between the cathode and the anode is 135 μA.

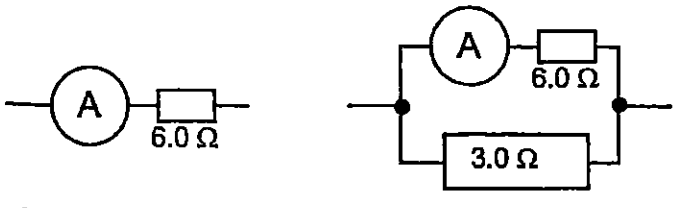
(i) Find the time taken for a charge of 0.54 C to reach the anode.

time taken = ... [2]

(ii) Find the number of electrons emitted by the cathode in one second. Charge of one electron is -1.6×10^{-19} C.

no.of electrons = ... [2]

(b) Fig. 8.1 shows that an ammeter with a range of 0 A to 3.0 A has an internal resistance of 6.0 Ω. In order to increase the range of the ammeter, a technician connected another 3.0 Ω resistor in parallel to the original circuit.



Original ammeter Modified ammeter

Fig. 8.1

(i) State the new range of the modified ammeter.

new range = ... [1]

(ii) State one disadvantage of the using the modified ammeter.

.....

..... [1]

[Total: 6]

9 Fig. 9.1 shows a piece of permanent magnet being released from rest to fall through a copper cylinder.

For Examiner's Use

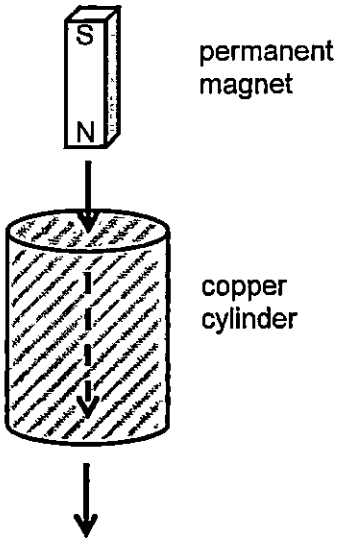


Fig. 9.1

(a) State if copper is a magnetic material.

..... [1]

(b) Using principles in electromagnetic induction, describe and explain the movement of the permanent magnet from the time it is released to the time it totally enters the copper cylinder.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 4]

Section B

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 12.**

For Examiner's Use

10 The Super Power Group (SPG) is a leading energy utility company in the Acia Pasific. It owns and operates the electricity network on Leo Island. Over two million consumers (households, commercial, industries) benefit from SPG's world-class electricity transmission and distribution systems and enjoy more reliable electricity supply than consumers in other global cities.

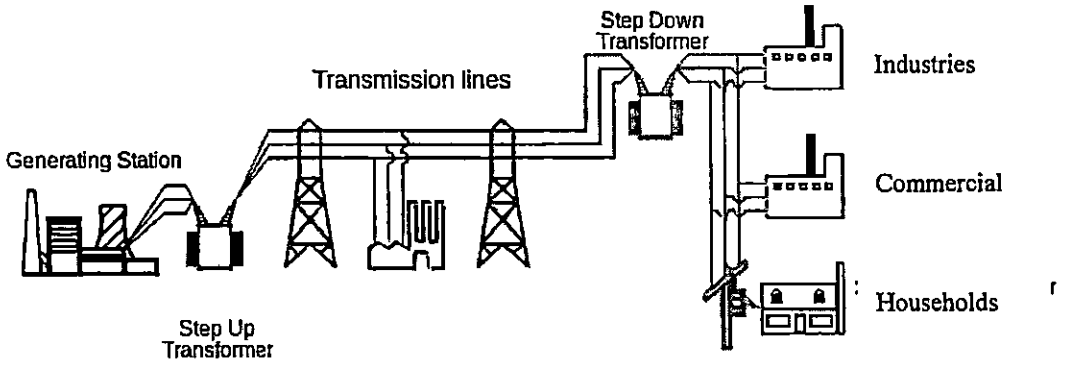


Fig. 10.1

As one of Leo Island's largest corporations, SPG achieved revenue of $4.8 billion and managed $17 billion of assets in 2014.

Its assets include underground electrical cables and substations in service.

- Total cable length in service: 25,000 km
- Cable diameters of 2 cm, 4 cm and 5 cm
- No. of 400 kV substations: 3
- No. of 230 kV substations: 18
- No. of 66 kV substations: 88
- No. of 22 kV substations: 5,590
- No. of 6.6 kV substations: 4,877

It is planning to build a new network branch, to provide electricity from Rurong town to Ris Pasir estate. To increase its revenue yet still maintain the company's competitive edge, it needs to reduce power loss during transmission.

(a) Suggest the type of substation to construct in Rurong and explain why.

.....

.....

..... [2]

(b) Suggest the type of cable to use as transmission lines and explain why.

.....

.....

..... [2]

(c)

Fixed specifications:
Power at substation in Rurong is 800 MW
Electrical resistivity of copper is 1.68×10^{-8} Ωm
Distance between substations in Rurong and Ris Pasir is 38 km
Consumers in Ris Pasir to receive voltages at 240 V

Given the information above, find the percentage of power loss during transmission.

For Examiner's Use

percentage of power loss = ... [6]

[Total: 10]

For Examiner's Use

11 In the construction industry, cranes are used to lift girders. A crane is made up of two parts, a cab (the body) and a jib (the hand).

The weight of the cab acts through its midpoint F and is 200 kN. The weight of the jib acts through its midpoint E and is 25 kN.

Cables AB and AC are disjoint. The weights of the cables and hooks are negligible.

Each girder weighs 5 kN.

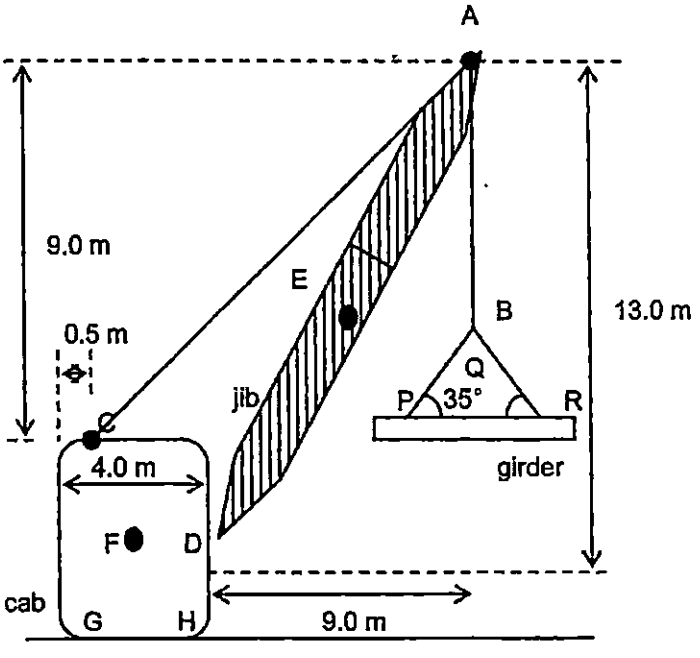


Fig. 11.1

(a) (i) The crane is lifting one girder up at constant speed. State the tension in cable AB. Explain how you arrived at your answer.

tension in AB = ... [1]

Explanation:

.....

..... [1]

(ii) Hence, find the tension in cable PQ.

tension in PQ = ... [2]

(b) (i) On Fig. 11.2 below, draw and label the external forces acting on the crane. [2]

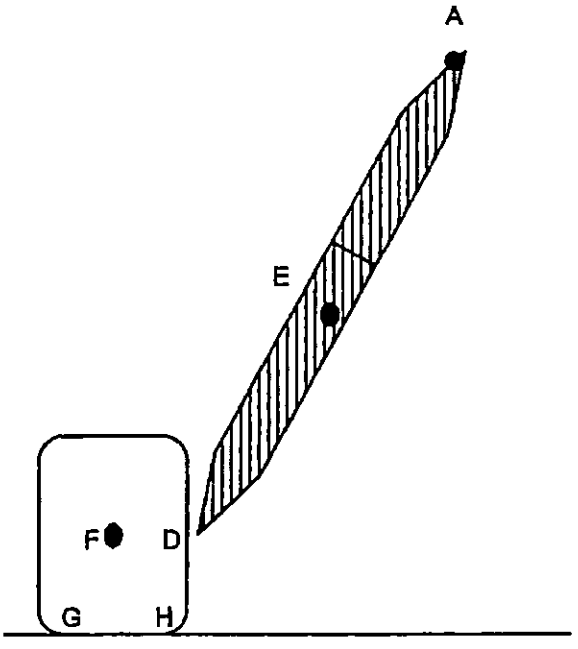


Fig. 11.2

(ii) State which one of the external forces will **not** produce a turning effect when the crane is just about to topple about point H.

..... [1]

(iii) Hence, find the maximum tension cable AB can withstand when the crane is just about to topple about point H.

maximum tension = ... [2]

(iv) Hence, find the maximum number of girders the crane can lift at any one time.

no. of girders = ... [1]

[Total: 10]

12 EITHER

For Examiner's Use

In an experiment, a coil of wire of resistance 28.0 Ω, is submerged in a beaker of water. When current is passed through the wire, the water heats up. Student P uses a current of 2.5 A while student Q uses a current of 2 0 A. They plot the increase in temperature of the water, θ against time taken, t.

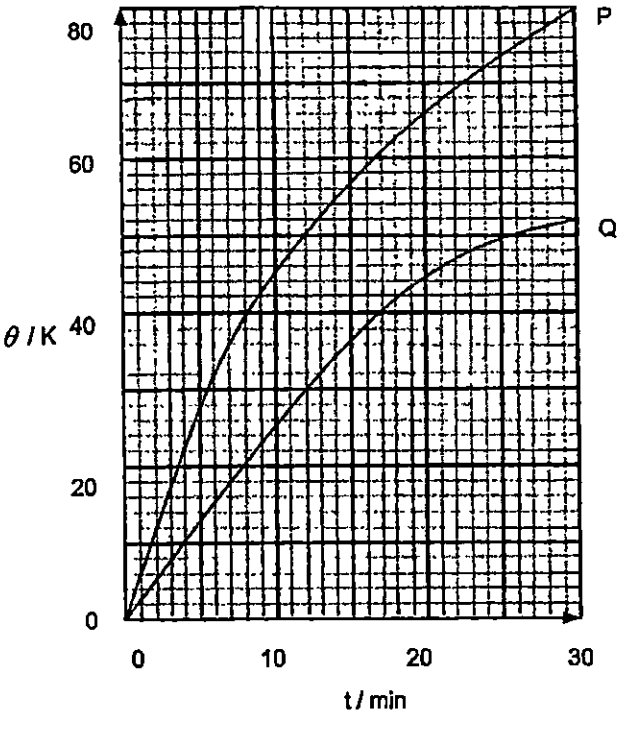


Fig. 12.1

(a) (i) Find the power input in each of the two experiments.

power input in P = ... [1]

power input in Q = ... [1]

(ii) Hence, state and explain the difference between graph P and graph Q.

.....

.....

.....

..... [2]

(b) State and explain the relationship between the increase in temperature of the water, θ and time taken, t.

.....

.....

.....

.....

..... [3]

(c) **(i)** Derive a formula to calculate power P, in terms of mass of water m, increase in temperature of the water θ, specific heat capacity of water c and time taken t.

formula: ..... [1]

(ii) Hence, find the mass of water m, used in experiment P if the gradient of graph P at t = 0 min is 12 K min^{-1}. Specific heat capacity of water is 4.2 J g^{-1} K^{-1}.

mass of water: ..... [2]

[Total: 10]

12 OR

For Examiner's Use

To investigate the make-up of the underground, an explosion is created on the Earth's surface and the sound is picked up by a detector. Fig. 12.2 shows four possible paths of the sound waves.

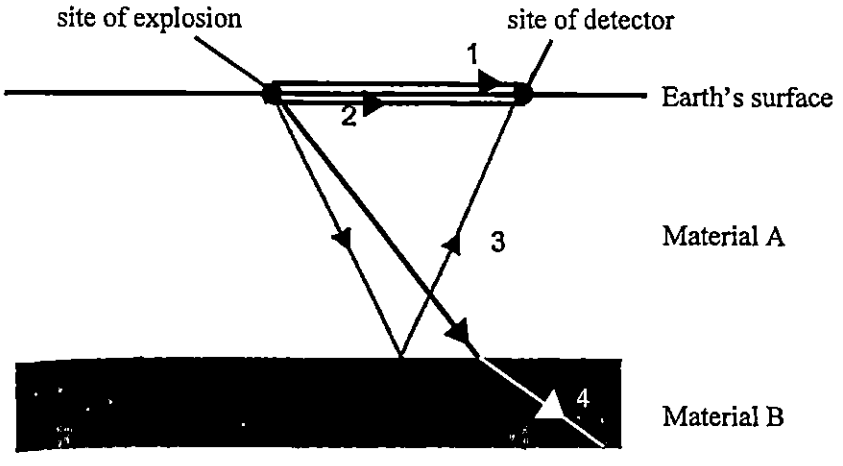


Fig. 12.2

Table 12.1 shows the timings taken for the sounds to be detected.

Path	1 (in air)	2 (through material A)	3 (reflected by material B)	4 (refracted into material B)
Time taken for sound to be detected / s	0.60	0.15	1.75	not detected

Table 12.1

(a) Using principles in particulate theory, explain why sound travels faster along path 2 than path 1.

.....

.....

..... [2]

(b) (i) Find the distance between the site of the explosion and the detector. Speed of sound in air is 330 m s^{-1}.

distance = ... [2]

(ii) Hence, find the speed of sound in material A.

For Examiner's Use

speed in material A = ... [2]

(c) Path 3 and path 4 shows that sound waves can be both reflected and refracted.

(i) State the Laws of Reflection.

.....

.....

.....

..... [2]

(ii) State and explain if sound travels faster in material A or material B.

.....

.....

.....

..... [2]

[Total: 10]

**********End of Paper**********

5059 Physics (SPA) Marking Scheme
Xinmin Sec 4E Preliminary Examination 2015

Paper 1

Qn	1	2	3	4	5	6	7	8	9	10
Ans	B	B	B	D	D	B	D	C	D	A

Qn	1	2	3	4	5	6	7	8	9	10
Ans	D	C	A	B	C	A	C	C	A	A

Qn	1	2	3	4	5	6	7	8	9	10
Ans	C	B	C	D	C	D	D	C	D	A

Qn	1	2	3	4	5	6	7	8	9	10
Ans	A	B	B	A	B	C	A	A	D	B

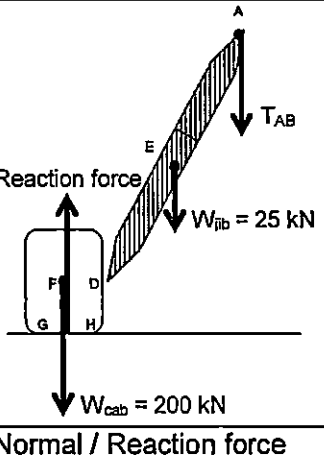
Paper 2 Section A

Qns	Answers	Remarks
1a	Loss in GPE = Gain in KE + WD against friction $mgh = \frac{1}{2}mv^2 + Fd$ $(0.300)(10)(3.5 \times \sin 25°) = (\frac{1}{2})(0.300)(v^2) + (0.40)(3.5)$ $v = 4.499... = 4.50\ m\ s^{-1}$	[1] calculates GPE [1] calculates WD [1] ans
1b	Vertical component of v = $(\sin 25°)(4.50\ m\ s^{-1}) = 1.901... = 1.90\ m\ s^{-1}$ Distance = Area under v-t graph = ½ x base x sum of parallel sides $12.3 = (\frac{1}{2})(t)(1.9 + v_f)$ --- eqn 1 Acceleration = Gradient of v-t graph $10 = (v_f - 1.9)/t$ $v_f = 10t + 1.9$ --- eqn 2 Sub eqn 2 into eqn 1 and solve for t: t = 1.389... = 1.39 s	[1] vertical component [1] any one of the 2 eqns [1] working [1] ans
		Total 7m
2	$m_g + m_c = 88$ $m_c = 88 - m_g$ --- eqn 1 $V_g + V_c = 6.0$ $(m_g/19.3) + (m_c/8.92) = 6.0$ --- eqn 2 Sub eqn 1 into eqn 2 and solve for m_g: $m_g = 64.11... = 64.1\ g$ percentage purity = 64.1/88 x 100% = 72.85... = 72.9%	[1] eqn 1 [1] eqn 2 [1] working [1] ans
		Total 4m
3a	Pressure due to 6 km column of air $= \rho gh = (1.1)(10)(6.0 \times 10^3) = 66\ kPa$ Atmospheric pressure at altitude 6 km = Atmospheric pressure at sea level – Pressure due to 6 km cloumn = 101 – 66 = 35 kPa	[1] column [1] subtraction [1] ans

3b	Resultant pressure = 78 – 22.5 = 55.5 kPa Resultant force on each window = pA = $(55.5 \times 10^3)(0.050)$ = 2775 N Tensional force in each screw = 2775/14 = 198.2... = 198 N	 [1] working [1] ans
		Total 5m
4ai	Material: Any type of metal, eg. aluminium Explanation: Metals are <u>better conductors</u> of thermal energy <u>than non-metals</u>.	[1] [1] [-1] if not conductor but absorber or emitter [-½] if not compared to non-metals
4aii	Colour: Any dark colours, eg black Explanation: Dark colours are <u>better emitters</u> of thermal energy <u>than light colours</u>.	[1] [1] [-1] if not emitter but conductor or absorber [-½] if not compared to light colours, unless student wrote "darker"
4bi	Temperature rise = $(2°C\ W^{-1})(10\ W)$ = 20°C	[1] working, [1] ans
4bii	Rate of conduction of thermal energy from electronic component = rate of emission of thermal thermal energy to surroundings	[1]
		Total 7m
5a	Up and down	[1]
5b	Vertical axis labelled "amplitude/mm" or "displacement/mm" Horizontal axis labelled "distance/mm" Amplitude 20 mm Wavelength 50 mm	[½] [½] [½] [½] [-½] if not full-scale [-½] if less than 2 waves
5c	Speed = $\lambda/T = (50 \times 10^{-3})/(400 \times 10^{-3}) = 0.125\ m\ s^{-1}$	[1] working, [1] ans
		Total 5m
6a	Difference: Light is less bright. Explanation: Only green light is allowed to pass through; light of other colours are absorbed by the green glass.	[1] [1]
6bi	20 cm *p.s. To get a sharp image, the light rays from the lens must be parallel to one another. Thus u = f.*	[1]
6bii	Difference: Image is still/equally sharp. No difference. Explanation: As the object distance is unchanged/still equals to focal length, light rays from the lens are parallel to one another/angle of incidence (and angle of reflection) is zero on the mirror.	[1] [1]

6biii	40 cm *p.s. The descriptions of the image suggest that u = 2f.*	[1]
		Total 6m
7a	Unlike charges attract. Electrons from the outer layer of the can are attracted to the inner layer by the positively-charged glass rod. Electrons from the ground are attracted to the outer layer of the can. The electron flow causes a deflection. Once the charges are balanced, there is no more electron flow and the deflection is zero.	[½] [½] [½] [½]
7bi	Increase the charge of the positively-charged (glass) rod. ~~OR~~ ~~Increase the speed at which the positively-charged (glass) rod is lowered.~~	[1]
7bii	Use a negatively-charged (glass) rod. OR Withdraw positively-charged (glass) rod.	[1]
7c	Nothing happens. No deflection on the galvanometer. A copper rod cannot be charged when the student is holding it as the rod is earthed.	[1] [1]
		Total 6m
8ai	Time = Q/I = 0.54/(135 x 10^{-6}) = 4000 s	[1] working, [1] ans
8aii	No. of electrons = 0.54/(1.6 x 10^{-19}) = 3.375 x 10^{18} = 3.38 x 10^{18} e^-	[1] working, [1] ans
8bi	0 A – 9.0 A *p.s. Since max 3 A flows through 6 Ω, then max 6 A can flow through 3 Ω (same p.d. and bigger R ⇔ smaller I)*	[1]
8bii	The ammeter is less sensitive; increase in current in less visible on ammeter.	[1]
		Total 6m
9a	No	[1]
9b	As the N-pole of the magnet approaches the top of the cylinder, the <u>change in magnetic flux linkage</u> between the magnetic field from the magnet and the cylinder <u>induces a current in the cylinder</u> (Faraday's Law). The induced current in the cylinder flows in a <u>direction</u> that produces a magnetic field and hence a magnetic force that <u>opposes</u> the fall of the magnet (Lenz's Law). Hence, the magnet <u>falls with an acceleration of less than 10 m s^{-2}</u>.	[1] [1] [1]
		Total 4m

Paper 2 Section B

Qns	Answers	Remarks
10a	Type of substation: 400 kV substation Explanation: Electricity should be transmitted at <u>high voltages</u> (low current) to <u>reduce power loss</u>.	[1] [1]
10b	Type of cable: Cable of diameter 5 cm Explanation: The bigger the cross-sectional area of a wire/cable, the <u>smaller its resistance</u>, hence <u>reducing power loss</u>.	[1] [1]
10c	Current in cable = P/V = $(800 \times 10^6)/(400 \times 10^3)$ = 2000 A Resistance of cable = $\rho l/A = (1.68 \times 10^{-8})(38 \times 10^3)/(\pi)(2.5 \times 10^{-2})^2$ = 0.3251... = 0.325 Ω Power loss = $I^2R = (2000)^2(0.325)$ = 1 300 537... = 1.30 MW Percentage of power loss = $(1.30 \times 10^6)/(800 \times 10^6) \times 100\%$ = 0.16256... = 0.163%	[1] ; allow ecf from 10a [1] [1] ; allow ecf from 10b [1] [1] [1]
		Total 10m
11ai	Tension in AB = 5 kN Explanation. Since the girder is lifted at constant speed (zero acceleration), the <u>resultant force</u> on it must be <u>zero</u>. Thus tension in AB is equal to weight of girder.	[1] [1]
11aii	Tension in PQ = Tension in QR = 2.5 kN T_{PQ} = 2.5/(sin 35°) = 4.358... = 4.36 kN	[1] [1]
11bi		[½] for each force *Reaction force by cab on jib = Reaction force by jib on cab (CANCELLED)* *Tension by C on A = Tension by A on C (CANCELLED)*
11bii	Normal / Reaction force	[1]
11biii	By the Principle of Moments, to have rotational equilibrium, taking moments about pivot H, Sum of Anti-clockwise Moments = Sum of Clockwise Moments $(200)(2.0) = (25)(4.5) + (T_{max})(9.0)$ T_{max} = 31.94... = 31.9 kN	[1] working [1] ans
11biv	Max no. of girders = 31.9/5 = 6.3... = 6 girders	[1]
		Total 10m

EITHER		
12ai	Power in P = $I^2R = (2.5^2)(28.0) = 175$ W Power in Q = $I^2R = (2.0^2)(28\ 0) = 112$ W	[1] [1]
12aii	Difference between P & Q: The rate of temperature rise in P is greater than the rate of temperature rise in Q. Explanation: The rate of input of thermal energy in P is greater than the rate of input of thermal energy in Q.	[1] [1]
12b	Relationship between θ and t: (In both P & Q) As t increases, θ increases at a decreasing rate. Explanation: - As t increases, temperature of water increases. The temperature difference between the water and the surroundings increases. - The rate of heat loss to the surroundings increases, so temperature rise decreases.	[1] [1] [1]
12ci	$Q = mc\theta \rightarrow Q/t = mc\theta/t \rightarrow P = mc\theta/t$	[1]
12cii	θ/t is gradient of graph Power in P = mc(θ/t) = mc(gradient) 175 = (m)(4.2)(12 K min^{-1}) = (m)(4.2)(0.2 K s^{-1}) m = 0.2083... = 0.208 g	 [1] working [1] ans
		Total 10m
OR		
12a	Sound travels in a solid along path 2 while sound travels in a gas along path 1. As particles in a solid are closely packed together, sound energy can be transferred from particle to particle at a higher speed than in a gas, where particles are far apart from one another.	[1] [1]
12bi	Distance = vt = 330 x 0.60 = 198 m	[1] working [1] ans
12bii	Speed in material A = d/t = 198/0.15 = 1320 m s^{-1}	[1] working [1] ans
12ci	Law #1: Angle of incidence *i* is equal to angle of reflection *r*. Law #2: The incident ray, the reflected ray and the normal all lies in the same plane.	[1] [1]
12cii	Sound travels faster in material B. Explanation: The sound wave bends away from the normal when it travels from material A to material B.	[1] [1]
		Total 10m