Name: ..... ( ) Class: Sec 4A

Queenstown Secondary School

Preliminary Examination 2017
Secondary Four Express
Science (Physics)
5077/01

15 September 2017
Friday

Time: 0930 – 1030h
Duration: 1h

READ THESE INSTRUCTIONS FIRST

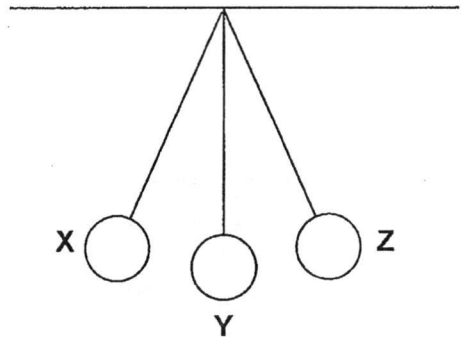
Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and index number on the Answer Sheet in the spaces provided.

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.
The use of an approved scientific calculator is expected, where appropriate.

1 A simple pendulum swings from **X** through **Y** to **Z**. The time to go from **X** to **Z** is 3.0 s. What is the frequency of the pendulum?



A 0.167 Hz **B** 0.333 Hz **C** 3.00 Hz **D** 6.00 Hz

2 Under free-fall, both a book and a leaf would take the same time to fall from the same height to the same horizontal level. Which of the following statements is correct?

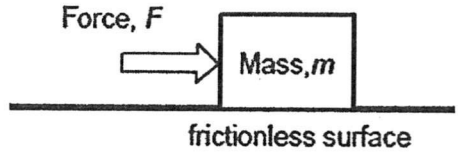
A Both the book and the leaf are of the same mass.
B Both the book and the leaf are of the same volume.
C Both the book and the leaf fall at the same constant speed.
D Both the book and the leaf fall at the same constant acceleration.

3 The acceleration of free fall is 1.6 m/s^2 on the Moon and 10 m/s^2 on Earth. A rock of weight 2 N is brought back from the Moon to Earth.

What is the weight of the rock on Earth?

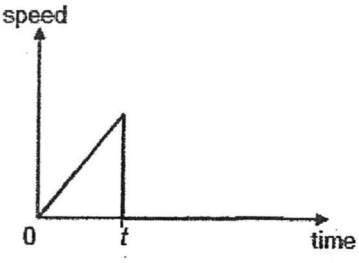
A 1.25 **B** 2 **C** 10 **D** 12.5

4 A mass, ***m***, is being pushed by a force, ***F***, on a frictionless surface as shown in the figure below. The force is being applied for ***t*** s and after which the force is removed.

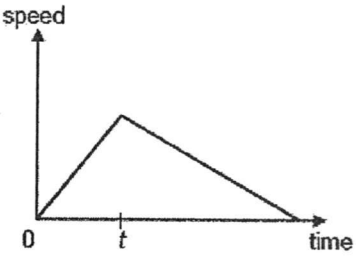


Which of the following speed-time graphs illustrates the motion of the mass for the whole duration?

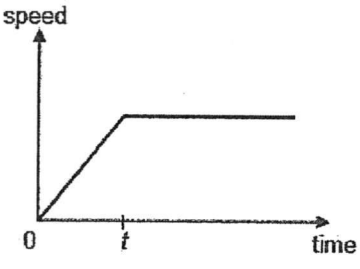
A



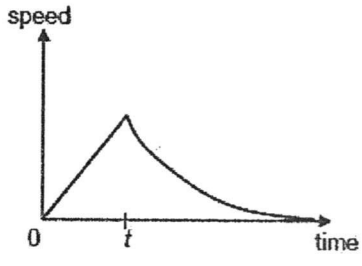
B



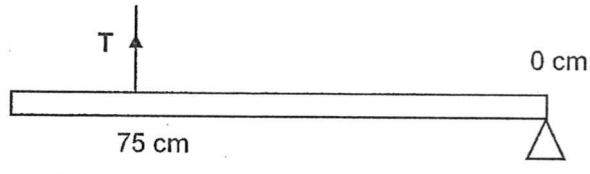
C



D



5 A uniform metre rule of mass 54 g is pivoted at the 0 cm mark and kept horizontal by a string attached at the 75 cm mark.



Calculate the tension **T** in the string.

A 0.18 N **B** 0.36 N **C** 18 N **D** 36 N

6 A crane lifts a load of 500 kg at a constant speed of 5 m/s.
Calculate the power developed by the crane.

A 0 W **B** 2500 W **C** 5000 W **D** 25000 W

7 A block with dimensions 1.6 m x 1.0 m x 0.5 m exerts a maximum pressure of 8 kPa on the floor.

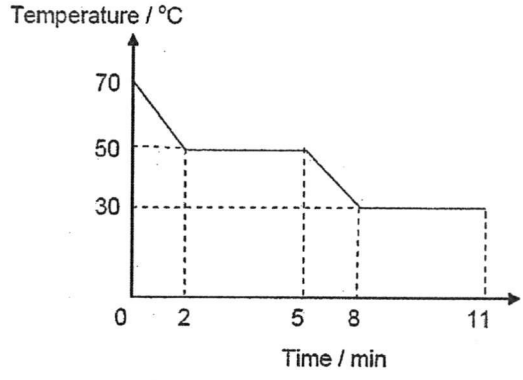
What is the weight of the object?

A 4000 N **B** 6400 N **C** 12800 N **D** 16000 N

8 Which of the following is true during freezing?

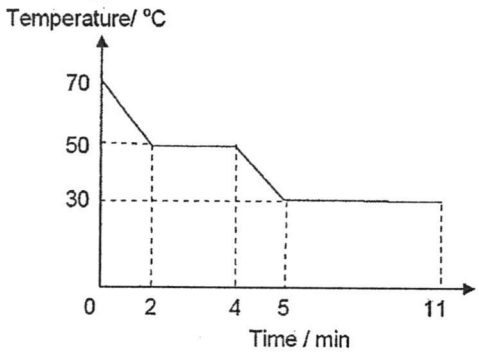
A The intermolecular force weakens and the molecules move slower.
B The intermolecular force weakens and the speed of molecules remains constant.
C The intermolecular force becomes stronger and the molecules move faster.
D The intermolecular force becomes stronger and the speed of molecules remains constant.

9 Roger placed a liquid Q of temperature 70°C in a shiny beaker and plotted a cooling curve as shown in the diagram below.

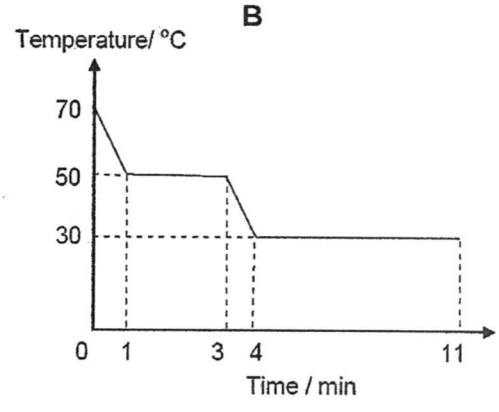


Which of the following cooling curves shows how the liquid Q of temperature 70°C will cool when placed in a dark container?

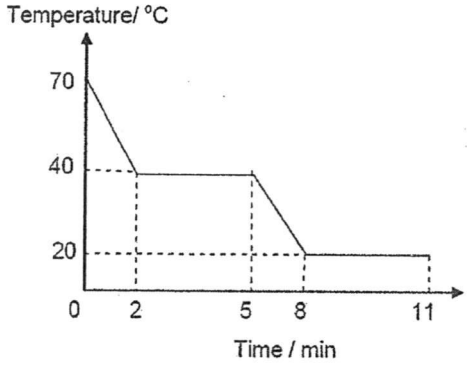
A



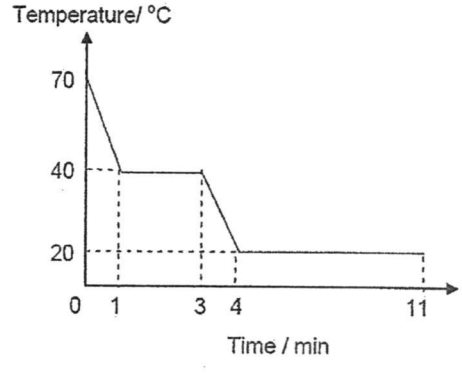
B



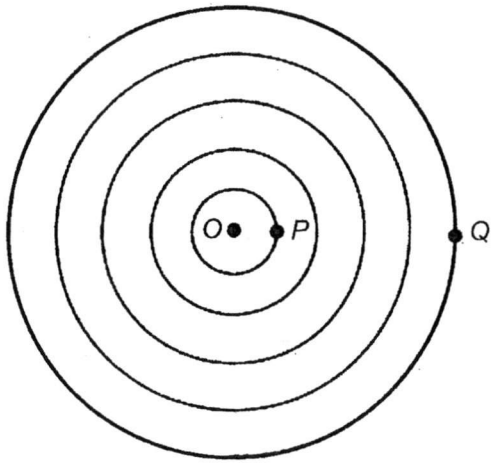
C



D



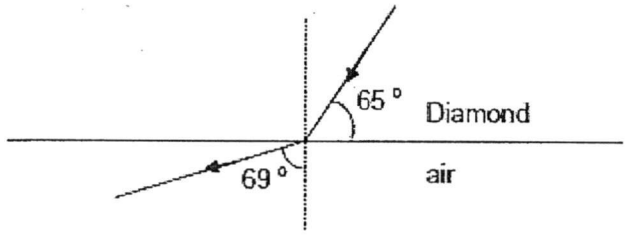
10 The diagram illustrates crests of circular wavefronts moving from a point source *O*.



Given that the time taken for a wavefront to travel from *P* to *Q* is 5 s, and the wavelength of the waves is 2 m. What is the speed of the wave?

A 0.2 m/s **B** 0.8 m/s **C** 1.6 m/s **D** 40 m/s

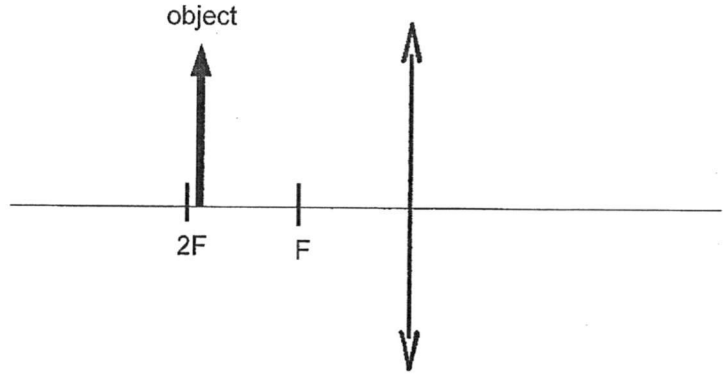
11 The figure shows a ray of light moving from diamond to air.



What is the critical angle of diamond?

A 21 ° **B** 27 ° **C** 63 ° **D** 76 °

12 The object shown in the diagram below is moved away from the lens.



What happens to the image formed?

A It becomes larger.

B It becomes smaller.

C It becomes real.

D It becomes virtual.

13 A flute is a musical instrument that creates a higher pitched sound than a drum. The two instruments are played at the same time, each making a single sound. The two sounds have the same amplitude.

Which statement below is correct?

A The sound from the drum will travel faster through air.

B The sound from the flute will travel faster through air.

C The two sounds will travel at the same speed through air.

D The two sounds will travel faster through air than through a liquid medium.

14 Radio waves, visible light and X-rays are all part of the electromagnetic spectrum.
What is the correct order of decreasing wavelength?

	longest wavelength ⟶ shortest wavelength		
A	microwaves	visible light	X-rays
B	microwaves	X-rays	radio waves
C	X-rays	radio waves	visible light
D	X-rays	visible light	radio waves

15 A plastic rod is rubbed with a dry piece of cloth and the rod becomes positively charged. What happened to the rod and the cloth?

	the rod	the cloth
A	gained protons	lost protons
B	lost protons	gained electrons
C	gained electrons	lost electrons
D	lost electrons	gained electrons

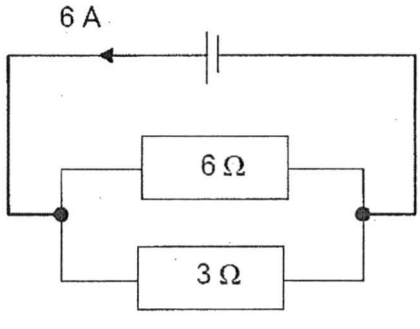
16 Calculate the amount of current flowing through a point in a circuit when 30 mC of charge flows through the point in 0.5 min.

A 0.001 A **B** 0.06 A **C** 1.0 A **D** 60 A

17 A wire of resistance *R* has length *L* and cross-sectional area *A*. The wire is then stretched to twice its length and half its cross-sectional area. What is the resistance of the wire after it is being stretched?

A ¼ *R* **B** R **C** 2R **D** 4R

18 What is the current flowing through the 3 Ω resistor as shown in the figure below?

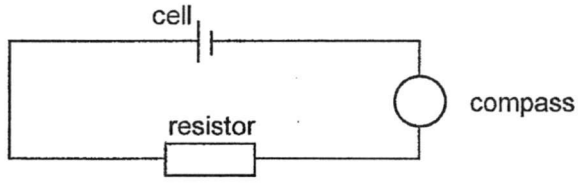


A 1 A **B** 2 A **C** 3 A **D** 4 A

19 The Earth wire is wrongly wired to the live terminal in the 3-pin plug of an electrical appliance with metal casing. Which of the following will happen when the electrical appliance is turned on?

A The electrical appliance will not operate.
B The fuse will blow.
C The circuit breaker will trip.
D The user who touches the metal casing will get an electric shock.

20 The diagram below shows a compass placed above a current carrying wire.



In which direction will the compass point? Ignore effects of the Earth's magnetic field.

A **B** **C** **D**

Name: ..... ( ) Class: Sec 4/5 .....

Queenstown Secondary School

Preliminary Examination 2017
Secondary Four Express / Five Normal (Academic)
Science (Physics)
5076/02 & 5077/02

14 September 2017
Thursday

Time: 0800 – 0915h
Duration: 1h 15min

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Write in dark blue or black pen.
Do not use staples, paper clips, 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 on writing paper provided.

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

Examiner's Use	
Section A	/45
Section B	/20
Q11	
Q12	
Q13	
TOTAL	/65

Section A

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

1. A skydiver, of mass 80 kg, jumps off from an air plane and falls towards the Earth at a constant speed for some time. He opens his parachute only at 12 s.
The speed time graph of the parachutist is shown in **Fig. 1**.

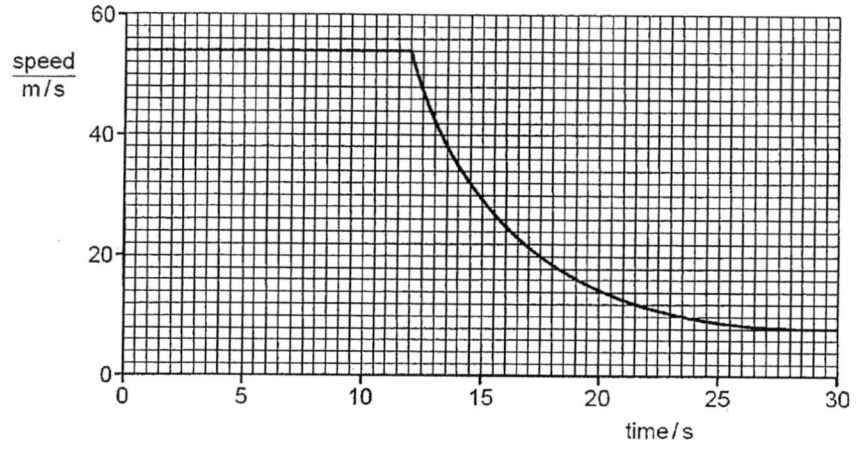


Fig. 1

a) The gravitational field strength g is 10 N/kg. Calculate the weight of the skydiver. [1]

weight = ... N

b) Calculate the height he falls from the plane before he opens his parachute. [2]

height = ... m

c) Determine the air resistance acting on the skydiver for the first 12 seconds. Explain your answer. [2]

.....

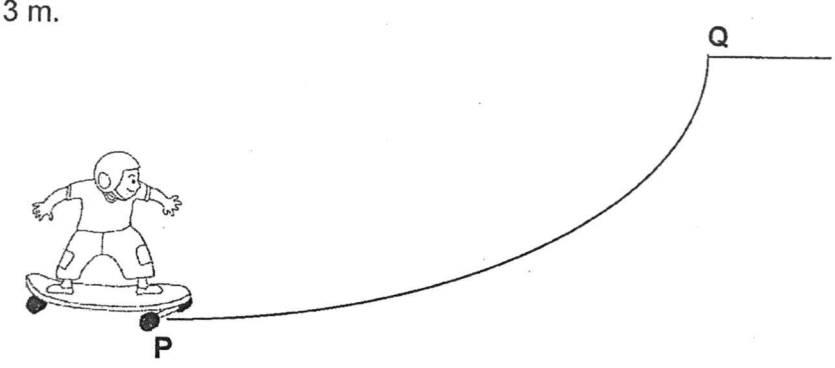
.....

.....

d) Describe his motion after he opens his parachute. [1]

.....

2. A boy on a skateboard has a total mass of 65 kg. He glides up to the top of a slope with a certain amount of kinetic energy at point **P**. The height at the top of the slope, **Q** is 3 m.



Assume air resistance is negligible,

a) Calculate the total gain in potential energy when the boy reached **Q**, the top of the slope. [2]

gain in potential energy = ... J

b) State the kinetic energy of the boy at point **P**. [1]

.....

c) Calculate the speed of the boy at point **P**. [2]

speed = ... m/s

d) In reality, the speed of the boy at point **P** will be higher than the value calculated in part c). Explain why. [1]

.....

.....

3. **Fig. 3** shows a table lamp of weight 20 N. It has a square base of sides 12 cm and a height of 25 cm. It stands on a rough horizontal surface. The centre of gravity of the table is 10 cm above the base.

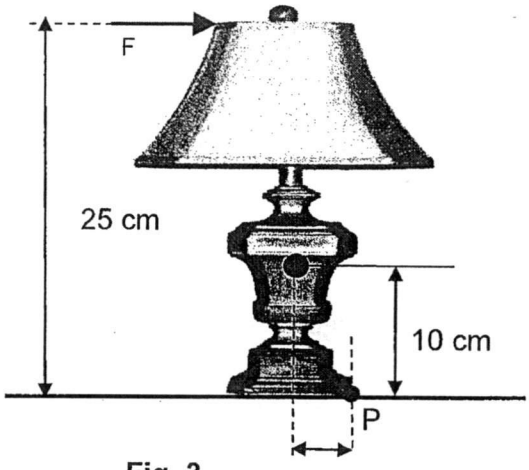


Fig. 3

a) On Fig. 3, draw the direction of the weight acting on the table lamp. [1]

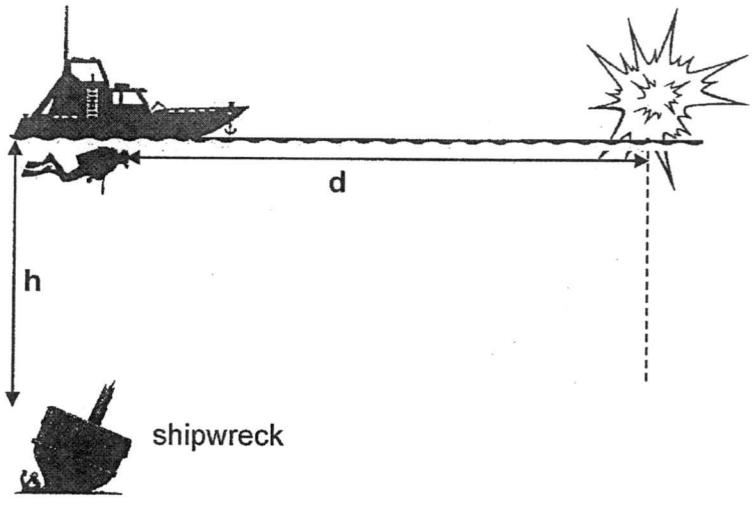
b) Calculate the pressure exerted by the lamp on the horizontal surface. [2]

pressure = ... Pa

c) By using the principle of moments, calculate the force F needed to just tilt the table lamp about P. [2]

force = ... N

4. In a marine rescue, a boat of divers found part of a ship wreck underwater using a sonar. One of them then went underwater to search for survivors in the ship wreck. Assume speed of sound in air to be 330 m/s and speed of sound in water to be 1500 m/s.



a) Calculate the depth **h**, of the ship wreck, if it took 0.08 s for the sonar to receive the reflected pulse from the ship wreck. [2]

depth = ... m

b) When the diver was just underwater, he heard a loud bang from an explosion at the surface of the sea which occurred at a distance **d** away. He reported this to his partner who was staying on board the boat but his partner did not hear the loud bang until 6 seconds later.

i) Explain why there was a time lag between their observations. [1]

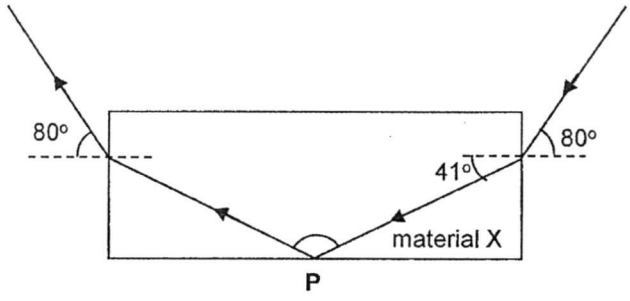
.....

.....

ii) Find the distance, **d** they are away from the explosion. [2]

distance = ... m

5. The diagram shows a narrow ray of light incident at 80° on a rectangular block made of material **X**.



a) Calculate the refractive index of material **X**. [2]

refractive index = ...

b) Calculate the smallest possible angle of incidence at point P for total internal reflection to take place. Leave your answer to the nearest degree. [2]

degree = ... °

6. **Fig. 6** shows an object and its virtual image formed by a convex lens.

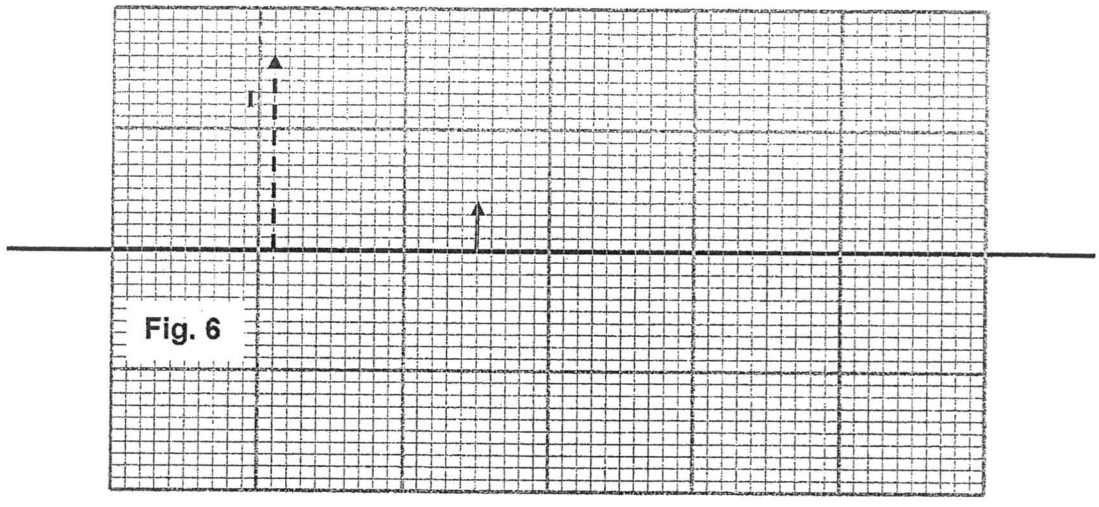


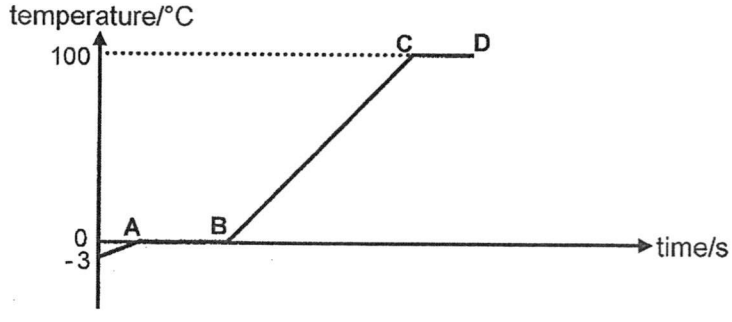
Fig. 6

a) The image in **Fig. 6** is a virtual image. Describe one other characteristic of this image. [1]

.....

b) On **Fig 6**, complete the ray diagram to show the position of the lens and principal focus. Mark the position of the principal focus, F. [2]

7. A small quantity of substance X is heated from a temperature of – 3 °C using a 200 W heater. The graph below shows how the temperature of the substance varies with time.



a) What is the melting point of substance X? [1]

.....

b) Using the Kinetic Theory of Matter, explain why the temperature remains constant during the period AB although substance X is absorbing thermal energy. [2]

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8. Electrostatic charges can be used to paint a metal panel. A paint spray produces positively charged paint droplets and the metal panel is negatively charged, as shown in **Fig. 8**.

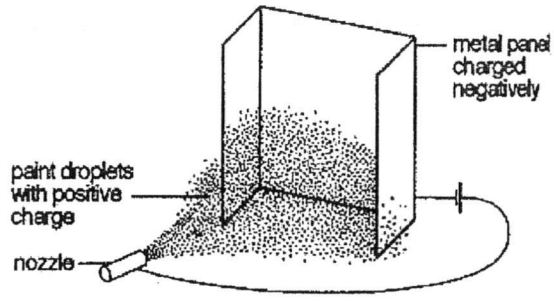


Fig. 8

a) Explain why the droplets spread out as they leave the nozzle. [2]

.....

.....

.....

b) State one advantage of painting the metal this way using electrostatic. [1]

.....

.....

9. **Fig. 9** shows a coil wound around an iron core. It is placed near an iron nail.

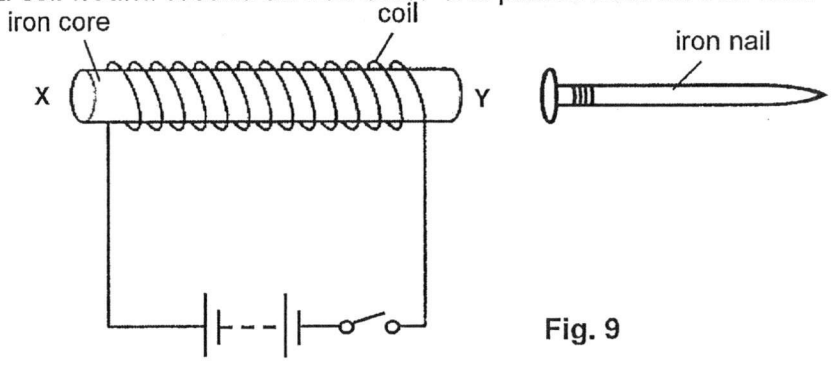


Fig. 9

a) Explain why the iron nail moves towards the coil when the circuit is switched on.[3]

.....

.....

.....

b) Suggest a modification to the setup that may allow the iron nail to be attracted to the iron core if it is now placed further away. [1]

.....

10. **Fig. 10** shows an electrical circuit containing a 12 V power supply and a number of resistors.

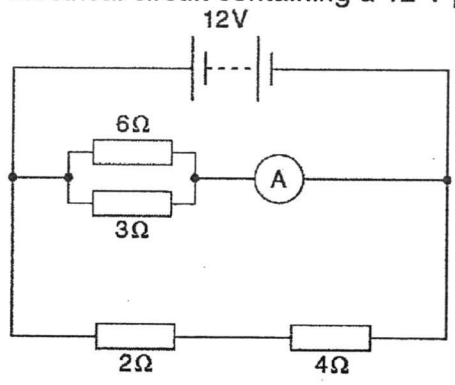


Fig. 10

a) Calculate the combined resistance of the 3 Ω and 6 Ω resistors in parallel. [2]

combined resistance = ... Ω

b) Calculate the reading of the ammeter in **Fig. 10**. [2]

reading = ... A

c) Determine the potential difference across the 4 Ω resistor. [2]

potential difference = ... V

Section B

Answer any **two** questions in this section.
Write your answers on the writing paper provided.

11.

a) **Fig. 11.1** shows a student setting up waves on a long elastic cord.

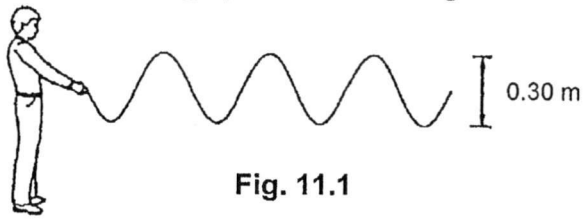


Fig. 11.1

The student's hand makes one complete up-and-down movement in 0.40 s. In each up-and-down movement, the hand moves through a height of 0.30 m. The wavelength of the waves on the string is 0.80 m.

For each wave, determine

i) the amplitude, [1]
ii) the frequency, [2]
iii) the speed. [2]

b) The pressure variations in two sound waves, labelled **A** and **B** are as shown in **Fig. 11.2.**

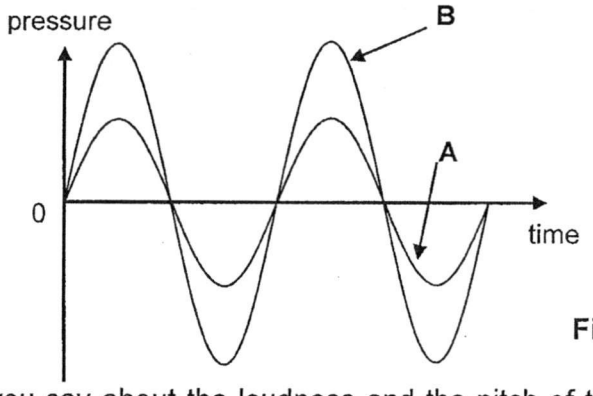


Fig. 11.2

What can you say about the loudness and the pitch of the sound wave labelled **B** as compared to the sound wave labelled **A**? [2]

c) The table shows the components of the electromagnetic spectrum.
Two components **X** and **Y** have not been named.

Radio Waves	Micro-waves	**X**	Visible light	Ultra-violet rays	X-rays	**Y**

i) State the components **X** and **Y**. [2]
ii) Which component is used for satellite television? [1]

12. A heat pipe is a device that transmits thermal energy along its length. **Fig. 12.1** shows a heat pipe attached to black metal fins. The fins absorb energy from the Sun. The sealed pipe transmits this energy along its length into a tank of cold water.

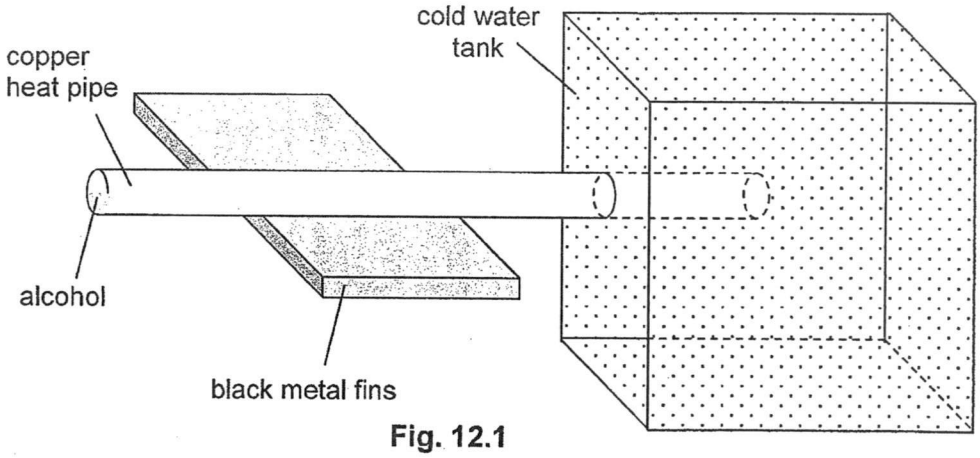


Fig. 12.1

Thermal energy from the fins is conducted through the walls of the copper pipe and causes the alcohol to boil. At the end of the copper pipe which is in contact with cold water, the alcohol condenses. The liquid alcohol runs along the pipe to be boiled again. There is little change in the temperature of the alcohol.

a) Describe how molecules in the copper conduct energy to the alcohol. [1]
b) Explain how boiling and condensation within the heat pipe cause the transfer of energy. [2]
c) Another company has the metal fins painted in silver. Suggest why it is a disadvantage to the device. [1]
d)
   i) Describe how the water in the tank above the heat pipe is heated. [3]
   ii) The temperature of the water in the tank above the heat pipe was measured to be higher than that below the heat pipe. Explain why there is a difference in the temperature. [2]
   iii) State one change that could be made so that the water in the tank could be heated up more efficiently. [1]

13.

a) **Fig. 13.1** shows a household electric circuit, which consists of an air conditioner rated 240 V, 2000 W and a lighting circuit, rated 240 V, 500 W. Both are connected in parallel to the mains supply of 240 V.

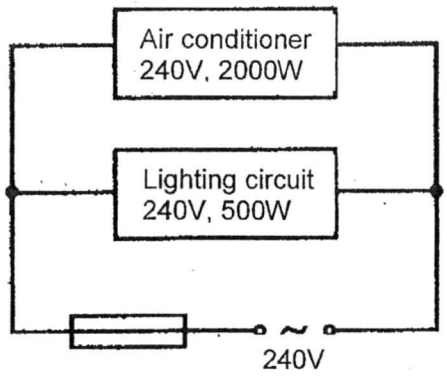


Fig. 13.1

i) Calculate the total current drawn from the mains supply. [2]

ii) Electrical energy costs \$0.50 per kWh. Calculate the cost of switching on the whole system for 1 week if they were turned on together for 8 hours per day. [2]

iii) A student wrongly connected a fuse in the neutral wire as shown in **Fig. 13.2**.

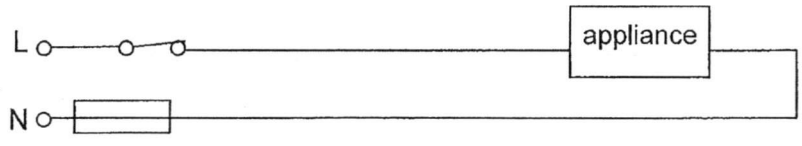


Fig. 13.2

Explain the danger of connecting the fuse in the neutral wire instead of the live wire in the event of a short circuit. [2]

b) **Fig. 13.3** shows a light aluminum rod resting between the poles of a magnet. A current is passed through the rod from two brass strips connected to a power supply.

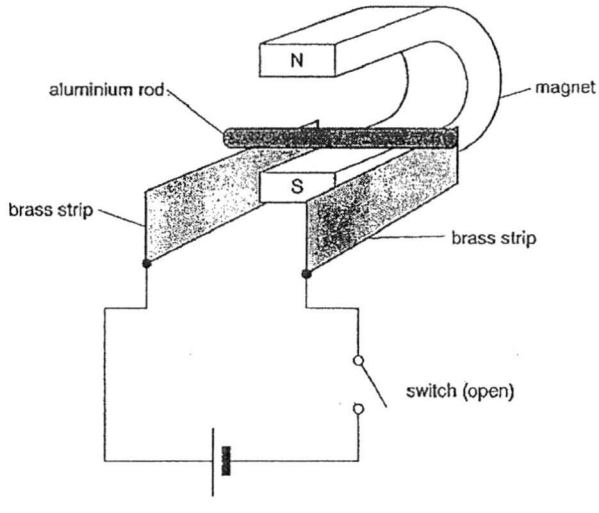


Fig. 13.3

i) State and explain what happens to the rod when the switch is closed. [2]

ii) Suggest a way to increase the speed of movement of the rod. [1]

iii) State the effects on the motion of the rod if the separation between the brass strips is increased. [1]

Answers

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

1. a) W = mg = 80 x 10 = 800 N [1]

   b) Height = area under the graph = 54 x 12[1] = 648 m [1]

   c) Air resistance = 800N. [1]
   Since the speed is constant means the acceleration is zero and the resultant force is zero. So weight acting downwards = air resistance. [1]

   d) The diver experience decreasing deceleration. [1]

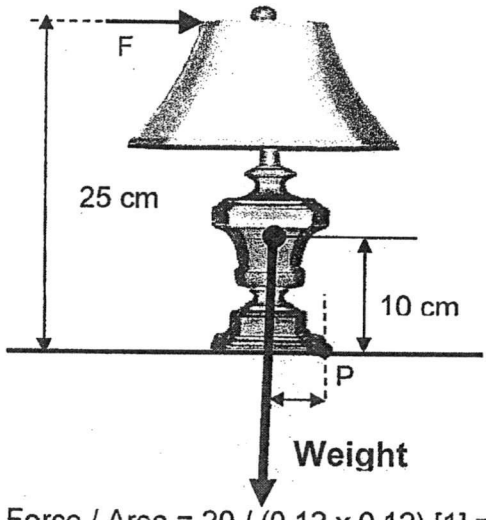
2. a) Gain in PE = mgh = 65 x 10 x 3 [1] = 1950 N

   b) K.E = 1950N

   c) 1950 = ½ (65)v^2 [1] ➔ v = 7.75 m/s [1]

   d) Some K.E is needed to convert to friction with the ground and other wasted energy when moving up the slope. [1]

   3 a)



   b) Pressure = Force / Area = 20 / (0.12 x 0.12) [1] = 1390 Pa [1]

   c) Clockwise moment = antoi clockwise
   F x 0.25 = W x 0.06 [1]
   F = 20 x 0.06 / 0.25 = 4.8 N [1]

   4

   a) v = 2d /t ➔ 1500 = 2h / 0.08 [1] ➔ h = 60m

   b) i) Sound wave travel faster through water and the diver in water will hear the bang first.

   ii) $t_{air} - t_{water}$ = 6 s

   (d / 330) – (d/1500) = 6 s [1] ➔ d (1/330 – 1/1500) = 6 ➔ d = 2540 m [1]

5

a) $n = \sin i / \sin r \rightarrow n = \sin 80° / \sin 41°$ [1] = 1.50 [1]

b) $n = 1/\sin c \rightarrow 1.50 = 1/\sin c \rightarrow c = 41.8°$ [1] Smallest angle = 42° (nearest degree)

6

a) Upright / magnified

7

a) 0

b) The thermal energy absorbed is used to overcome the intermolecular forces between the molecules [1] for the solid to change to liquid state during the process of melting [1].

8

a) The droplets acquired positive charges. Since like charges repel, the droplets will repel from each other and spread out.

b) Since the droplets have same charges, they will not be attracted to the same spot on the metal panel and this will ensure that the paint are evenly distributed [1] on the metal panel.

9

a) When current flows through the coil, the iron core is induced to become a temporary magnet with north pole at the right. [1] Since the iron nail is a magnetic material, it will be induced to become a temporary magnet with south pole nearer the iron core[1]. Since unlike poles attract [1], the iron nail will be attracted and move towards the coil.

b) Increase the number of turns of the coil around the iron core or increase the voltage of the battery [1]

10

a) $1/R = 1/R_1 + 1/R_2 \rightarrow 1/R = 1/3 + 1/6$ [1] $\rightarrow R = 2\ \Omega$

b) $V = IR \rightarrow 12 = I\ (2) \rightarrow I = 6A$

c) $V = IR \rightarrow 12 = I\ (6) \rightarrow I = 2A$ [1]

$V = IR = 2 \times 4 = 8V$ [1]

Section B

11

a) i) 0.15m
ii) $f = 1/T \rightarrow f = 1/0.4 = 2.5$ Hz
iii) $V = f\lambda \rightarrow V = 2.5 \times 0.8 = 2$ m/s

b) Sound is louder than sound A since the amplitude is higher [1]
Sound A and B has the same pitch since the frequency is the same as the period is the same [1]

c) i) X = infra red Y = Gamma Ray
ii) microwave

12

a) The molecules in the copper vibrate about its fixed position [1] and transfer the thermal energy absorb from the metal fins to alcohol as copper is a good conductor of heat.

b) During boiling and condensation, the thermal energy needs to be absorbed or released is used to overcome or form intermolecular [1] bonds which will result in changing of state. These processes will cause transfer of energy to and from the heat pipe.[1]

c) Silver is a poorer radiator or emitter of radiation which will result in slower transfer of heat to the surrounding air.

d) i) Heat pipe will conduct heat to the surrounding water in the tank. Since hot water being less dense will rise [1] and cold water, being denser will sink to take its place around the heat pipe. [1] This set up a convection current which will heat up the water above the tank.[1]

ii) Heat pipe will heat up the water above the pipe through convection and conduction [1]. Heat pipe however can only transfer heat to the bottom through conduction. [1]
The water above the heat pipe will reach a higher temperature faster than the water below the tank.

iii) put heat pipe at the bottom of tank [1]

13 a) i) Current thru aircon + current thru lightning circuit
= (2000 / 240) + (500 / 240) [1]
= 8.333 + 2.083 = 10.4 A [1]

ii) Energy = Power x time = (2 + 0.5)kW x (8 x 7)h
= 140 kWh
Cost = 140 x $0.5 = $70

iii) If too high a current flows through the live wire, the appliance will be exposed to too high a current [1]. This may cause overheating and damaged the appliance [1] before the fuse melts.

b) i) The rod will towards the magnet[1]. Using fleming's left hand rule, when current flows through the rod, the force induced will result in the rod moving inwards.

ii) Increase the current / increase the strength of the magnet

iii) No effect