SECTION A [50 marks]
Answer **ALL** questions from this section.

1 Fig 1.1 shows the side view of a stationary ladder leaning against a smooth wall and making an angle of 30° with the ground at point A.

The resultant force (**R**) of the weight of the ladder and the force acting on the ladder due to the wall is 1000 N.

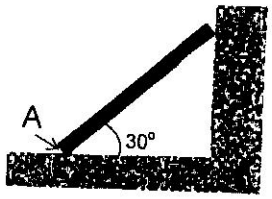


Fig 1.1

For Examiner's User

(a) On Fig 1.1, draw and label the force acting on the ladder due to the wall. [1]

(b) Using the concept of moment, explain why the line of action of the resultant force **R** passes through the point **A**.

_____

_____

_____

_____ [2]

(c) By using a suitable scale, construct a vector diagram to determine the magnitude of the force acting on the ladder due to the wall.

Force = _____ [2]

2 Fig 2.1 shows a hand catapult with an unstretched rubber band. A stone with a mass of 10.0 g is then placed at the centre of the rubber band and the stone is pulled backward with a force **F**. The temperature of the rubber band increases slightly. Fig 2.2 shows the stone on the stretched rubber band.

For Examiner's User

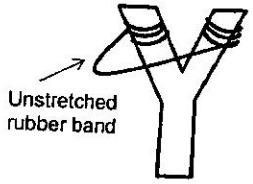


Fig 2.1

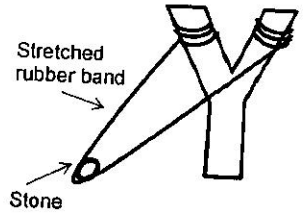


Fig 2.2

(a) Explain how the principle of conservation of energy applies in this case.

_____

_____

_____

_____

_____

_____

_____ [3]

(b) The stone is then released. The speed of the stone at the time of release is 16.0 ms^{-1}. Calculate the kinetic energy of the stone at the time of release.

Kinetic Energy = _____ [2]

(c) The kinetic energy calculated in **(b)** is 90.0% of the work done by force **F**. The mass of the rubber band is 2.00 g and the specific heat capacity of the rubber is 1.25 J g^{-1} $°C^{-1}$. Calculate

For Examiner's User

(i) the thermal energy gained by the rubber band, and

Thermal energy gained = _____[1]

(ii) the increase in the temperature of the rubber band.

Increase in temperature= _____[2]

3 Fig 3.1 shows a light pole with one end inserted into the pole holder that is mounted to the wall. The blanket is placed on the light pole.

For Examiner's User

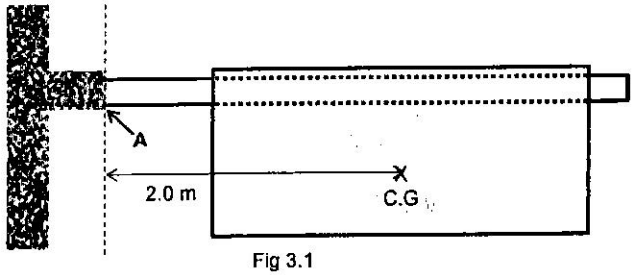


Fig 3.1

The centre of gravity (C.G) for the blanket is 2.0 m from the vertical line passing through point A and the mass of blanket is 3.0 kg.

(a) Define *centre of gravity*.

_____

_____[1]

(b) Calculate the moment due to the weight of blanket about point **A**. State the direction of this moment.

Moment = _____[1]

Direction = _____[1]

(c) The pole will break when the moment about point **A** is greater than 100 Nm. Assume that the blanket is able to absorb all the water that falls on it and the water is uniformly distributed throughout the blanket, calculate the volume of water that is absorbed by the blanket just before the pole breaks. Take the density of the rain water to be 1.02 gcm^{-3}.

Volume = _____[2]

4 (a) Fig 4.1 shows a manometer containing 2 different liquids and connected to two gas supplies. Pressure of gas 1 is 200 kPa. The density of liquid **X** is 5000 kgm^{-3}.

For Examiner's User

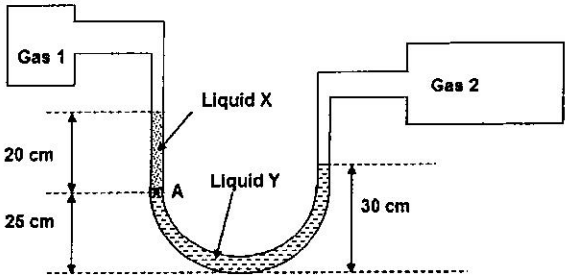


Fig 4.1

(i) Determine the pressure at point **A**.

Pressure at Point A = _____[2]

(ii) Describe, with appropriate equations, how you would calculate the pressure of gas 2.

_____

_____

_____

_____[2]

(b) Mercury, with a density of 13600 kgm^{-3} is usually used in a barometer. Explain why another liquid with a density of 2000 kgm^{-3} is not suitable to be used in a barometer.

_____

_____

_____

_____

_____[2]

5 (a) Fig 5.1 shows a soft hard-boiled egg being trapped in an inverted bottle. The top part of the inverted bottle is subjected to an external heat. The egg is observed to slip out of the mouth piece of the bottle.

For Examiner's User

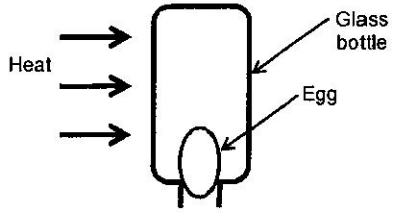


Fig 5.1

Using kinetic model of matter, explain why supplying heat to the gas will cause the egg to slip out of the mouth piece of the bottle.

_____

_____

_____

_____

_____

_____[3]

(b) Mercury-in-glass thermometers are commonly used in a school science laboratory. The thermometer can measure up to 1 decimal place. Fig 5.2 shows the length of mercury thread at 0.0 °C and 100.0 °C.

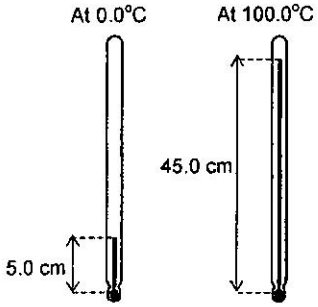


Fig 5.2

(i) Define ice point.

For Examiner's User

_____

_____[1]

(ii) Determine the corresponding temperature when the length of the mercury is 30.0 cm.

Temperature = _____[2]

(iii) State another thermometric property that can be used to determine temperature.

_____[1]

6 (a) Define longitudinal wave.

For Examiner's User

_____

_____[1]

(b) A stethoscope shown in Fig 6.1 is an acoustic medical device for the doctor to listen to the internal sounds of an animal or human body. It is often used to listen to lung and heart sounds. The stethoscope consists of 2 main components, namely the ear piece and the chest piece, which are connected by air-filled hollow tubes.

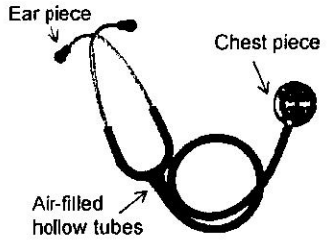


Fig 6.1

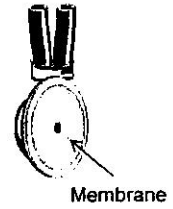


Fig 6.2

Fig 6.2 shows the chest piece which consists of a membrane that can pick up the heart sounds when the chest piece is placed in contact with the skin at the chest area.

Describe how the heart sound is transmitted from the skin to the ear piece. You might want to include a diagram to show how sound wave travels.

_____

_____

_____

_____

_____

_____

_____[3]

(c) Figure 6.3 shows the wavefronts of sound waves travelling from air and into the ear drum (solid medium).

For Examiner's User

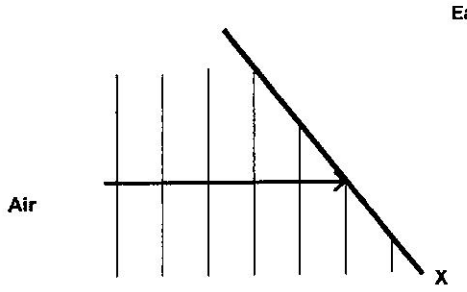


Fig 6.3

Complete the diagram in Fig 6.3 by drawing the wavefronts after they have passed through the boundary **X**. Indicate the direction of travel of the sound waves after passing through **X**. [2]

7 (a) Fig 7.1 shows a car moving in a dry condition. The car body becomes negatively charged. The car tyre is made of rubber and insulates the car body from the ground.

For Examiner's User

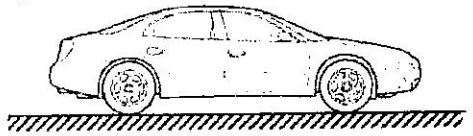


Fig 7.1

Explain why the car body becomes negatively charged.

_____

_____

_____

_____

_____

_____ [3]

(b) A person outside the car attempts to open the car door when the car comes to a stop.

(i) On Fig 7.2, sketch the charge distribution between the car door and the person's hand when the person's hand is near the car door. [1]

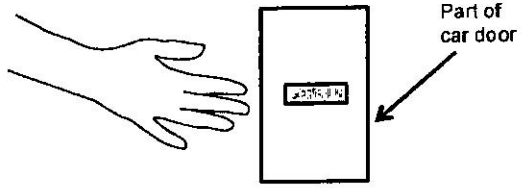


Fig 7.2

(ii) Explain why a person feels a static shock when he touches the negatively charged car body.

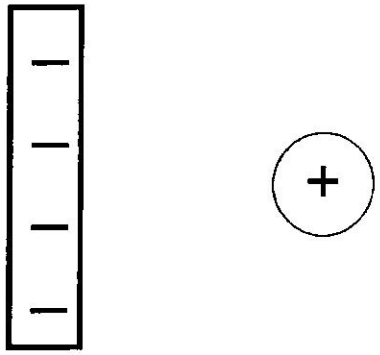
_____

_____

_____ [1]

(c) On the diagram provided, draw the electric field pattern between a negatively charged plate and a positive charge. [2]

For Examiner's User



8 Fig 8.1 shows a cylindrical Neodymium magnet (super strong magnet) being released into a long copper tube. Fig 8.2 shows the magnet moving along the tube.

For Examiner's User

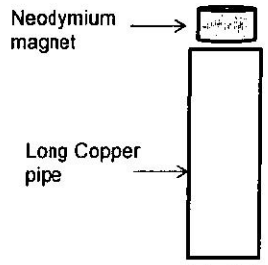


Fig 8.1

Fig 8.2

(a) State *Faraday's Law of Electromagnetic Induction* and *Lenz's Law.*

Faraday's Law: _____

_____

_____ [1]

Lenz's Law: _____

_____ [1]

(b) The magnet is observed to accelerate along the copper tube at the beginning. After a while, the magnet is travelling at constant speed along the copper tube.

(i) On Fig 8.2, draw and label the forces acting on the magnet. Assume air resistance is negligible. [1]

(ii) Using Faraday's Law and Lenz's Law, explain the observation.

_____

_____

_____

_____

_____

_____ [3]

Section B [30 marks]

Answer **all** the questions in this section.
Answer only one of the two alternative questions in **Question 11**.

For Examiner's User

9 Fig 9.1 shows a circuit symbol of a transistor which has three terminals, **X**, **Y** and **Z**.

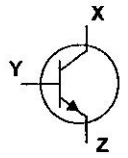


Fig 9.1

A transistor is a semi-conductor that acts like a switch. The transistor will switch on another circuit when the potential difference across terminals **Y** and **Z** is greater than a certain value.

The transistor is connected to the circuit as shown in Fig 9.2 which is to activate the electric bell when there is a fire.

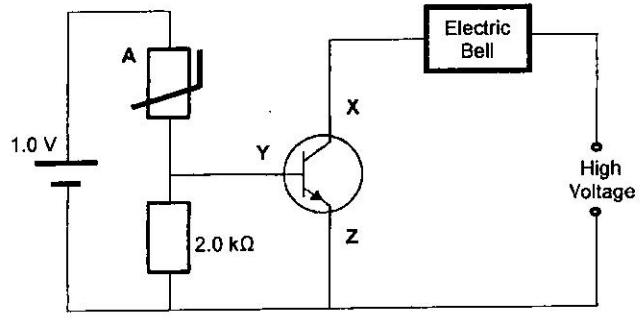


Fig 9.2

The potential difference across **Y** and **Z** is equal to potential difference across 2.0 kΩ resistor.

Table 9.3 shows the relationship between the resistance of device **A** with temperature.

For Examiner's User

Temp / °C	Resistance / kΩ
0	3.8
50	3.6
100	2.8
150	1.2
200	0.4
250	0.2

Table 9.3

(a) State the name of the electrical device **A**.

_____ [1]

(b) Explain, in general, why the electric bell will be activated when there is a fire.

_____

_____

_____

_____

_____

_____

_____

_____ [3]

(c) State one advantage of using the circuit in Fig 9.2 to activate the electric bell.

_____

_____

_____ [1]

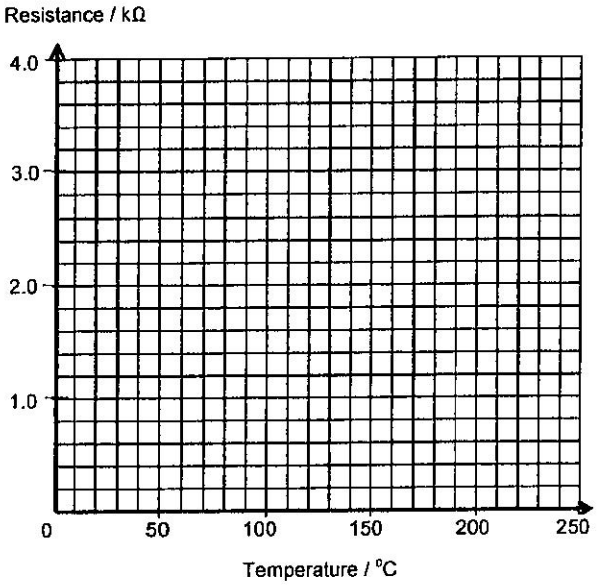
(d) To activate the bell, the minimum potential difference across terminals **Y** and **Z** is 0.60 *V*. Assume the current flowing into point **Y** is negligible.

For Examiner's User

(i) Determine the maximum resistance of the device **A** to activate the bell.

Resistance = _____[2]

(ii) Using the given grid, plot the graph of resistance of device **A** against temperature. [2]



(iii) Hence, using the graph in part (ii), determine the minimum temperature of the surroundings that can activate the bell.

Temperature = _____[1]

10 Fig 10.1 shows a magnified d.c motor which is connected to an external d.c power supply and housed within a metal casing. The motor is connected to the power supply via wire **A** and **B**. Metal casing is connected to the external power supply via wire **C**.

For Examiner's User

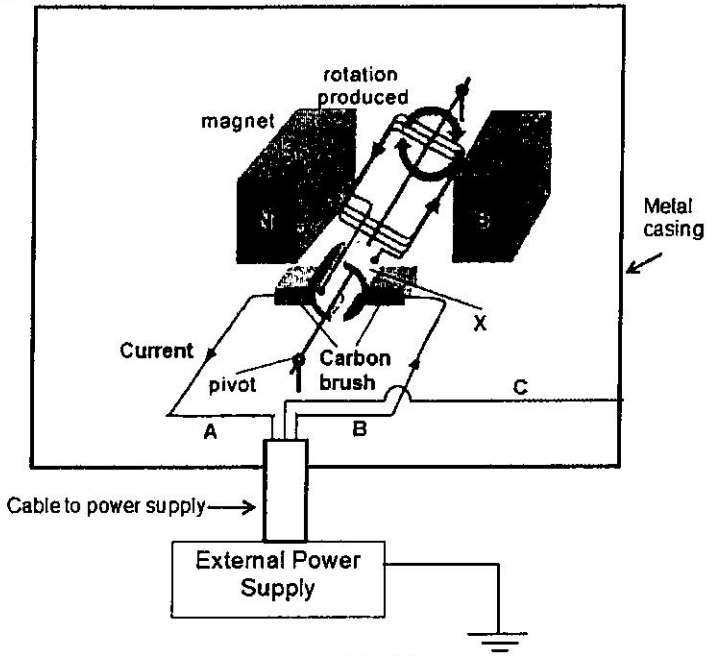


Fig 10.1

(a) State and explain which wire (**A**, **B** or **C**) should the switch for the d.c motor be placed along.

_____

_____

_____

_____

_____

_____[3]

(b) State the name of wire **C** and its purpose.

For Examiner's User

[2]

(c) State the name of component **X** and its purpose.

[2]

(d) Explain, using suitable magnetic field pattern, why the motor turns in the manner as shown in Fig 10.1.

[3]

Either

11 Fig 11.1 shows the position of the radar and the fighter plane at the instant when the fighter plane first sends out the radio wave signal to the radar. The fighter plane is moving along a straight path towards the control tower.

For Examiner's User

Fig 11.2 shows a CRO screen that displayed the fighter plane sending radio wave signal to the radar at 2 different timings with a time lapse of 4.0 s. At both instances, the fighter plane sends out signal of the same strength.

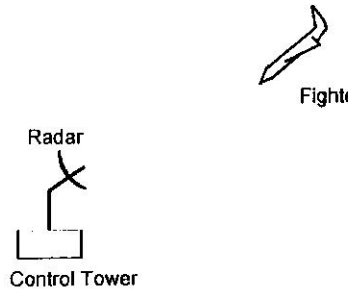


Fig 11.1

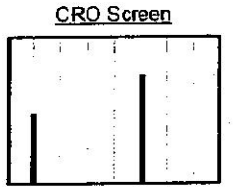


Fig 11.2

The fighter plane is moving with a velocity of 30 ms^{-1} when it sends out the first signal. At the second signal, the plane is moving with a velocity of 60 ms^{-1}. The plane is travelling with a constant acceleration. The total mass of the plane and the pilot is 10 000 kg.

(a) Explain why the second signal received by the radar is stronger than the first one.

[2]

(b) State why high frequency electromagnetic waves such as X-rays and gamma rays are not used in this case.

[1]

(c) Calculate the acceleration of the fighter plane.

For Examiner's User

Acceleration = _____[1]

(d) Determine the distance travelled by the fighter plane between the first and second signal. State one assumption in your calculation.

Distance travelled = _____ [2]

Assumption: _____

_____[1]

(e) After sending of the second signal, the plane decelerates. At one instant, it experiences deceleration of 5.0 ms^{-2} and the forward thrust acting on the plane is 75 000 N.

(i) Determine the total frictional force acting on the plane.

Total Frictional Force = _____[2]

(ii) Explain why the air resistance acting on the plane will not be constant when it decelerates.

_____

_____[1]

Or

11 (a) Converging lens is sometimes used as a magnifying glass.

For Examiner's User

(i) Define converging lens.

_____

_____

_____[1]

(ii) On Fig 11.1, sketch a ray diagram that illustrates the use of converging lens as magnifying glass with the object on the left side of the lens. The point **F** denotes the point which is one focal length from the lens. You are required to draw the position of the object on your own. Label the ray diagram. [3]

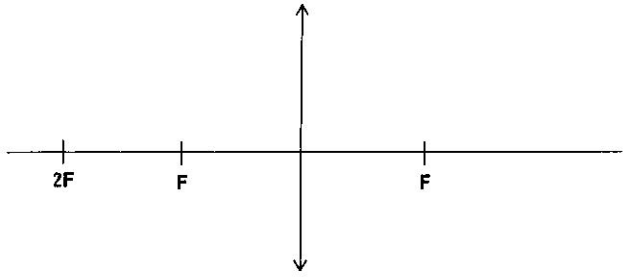


Fig 11.1

(iii) Describe how you can use the ray diagram to determine the number of times the image is magnified.

_____

_____

_____[1]

(b) Fig. 11.2 shows a light ray enters a diamond with a refractive index of 2.42.

For Examiner's User

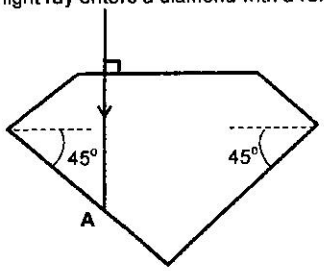


Fig 11.2 (not drawn to scale)

(i) Explain what you understand by the phrase "refractive index of 2.42".

_____

_____

_____[1]

(ii) Determine the critical angle of the light ray in the diamond.

Critical Angle = _____[2]

(iii) On Fig 11.2, complete the ray diagram after the ray hits the diamond at point **A**. [2]

—— END OF PAPER ——

Answer **ALL** the questions in this paper.

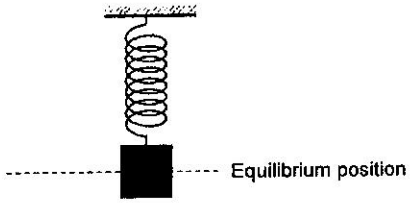
1 A student lists out the following quantities:

Acceleration, Distance, Velocity, Time, Work Done , Moment, Pressure, Electrical Current, Electromotive Force

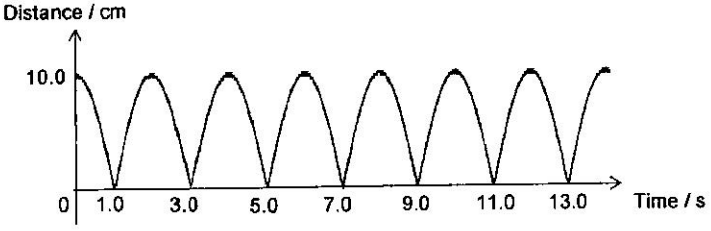
How many vector quantities can be found in the list?

A 2 **B** 3 **C** 4 **D** 5

2 The diagram shows a mass hanging from the bottom of a spring.



The mass is pulled slightly downward and released at time t = 0 s. The graph of how distance of the mass from the equilibrium position varies with time is shown below:



What is the period of the motion?

A 1.0 s **B** 2.0 s **C** 3.0 s **D** 4.0 s

3 Fig 3.1 shows a micrometer screw gauge when it is completely closed with nothing between the anvil and the spindle.

Fig. 3.2 shows the reading of the thickness of a wood.

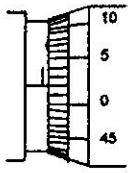


Fig. 3.1

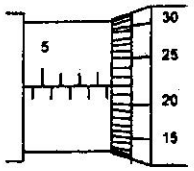


Fig. 3.2

What is the actual thickness of the wood?

A 8.70 mm **B** 8.74 mm **C** 12.20 mm **D** 12.24 mm

4 A small steel ball is thrown down with an initial speed of 2.0 ms^{-1} from a low balcony.

Ignoring air resistance, which of the following best describes the velocity and acceleration of the steel ball during the downward motion?

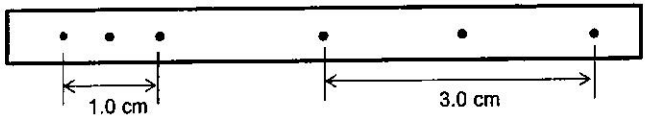
A Both velocity and acceleration of the ball increase.

B Both velocity and acceleration of the ball decrease.

C Velocity of the ball increases and acceleration of the ball decreases.

D Velocity of the ball increases and acceleration of the ball remains constant.

5 A ticker tape is operating at a frequency of 50 Hz. The tape pulled by a trolley is as shown:



What is the average acceleration of the trolley?

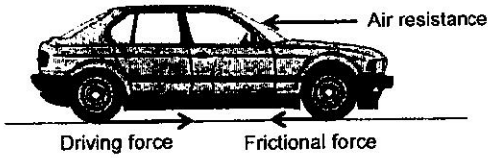
A 500 cms^{-2} **B** 833 cms^{-2} **C** 1000 cms^{-2} **D** 1670 cms^{-2}

6 When driving on a straight road, a man saw a child dashing across the road at time t = 0 s. He tried to stop the car immediately. The human reaction time of the man is 1.0 s. The velocity-time graph of the car is as shown.

What does the shaded area represent?

A Thinking distance
B Total distance travelled after the man saw the child
C Braking distance
D Deceleration of the car

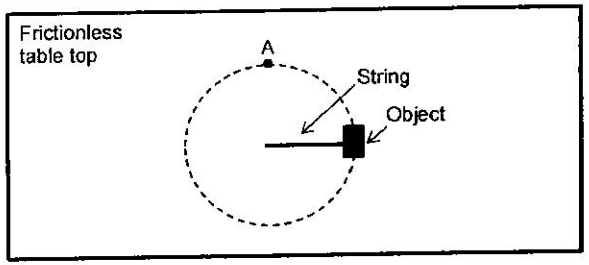
7 The diagram shows the horizontal forces acting on a moving vehicle.



Which combination of forces would result in the car moving at constant speed?

	Air Resistance / N	Frictional Force / N	Driving Force / N
A	700	300	1100
B	700	1000	300
C	300	700	1000
D	300	1000	700

8 The diagram shows the top view of an object attached to a string and moving in circular path on a frictionless table and in anti-clockwise direction due to the tension in the string.

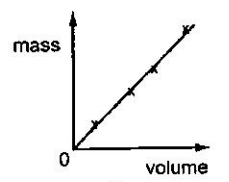


When the object reaches point A, the string is cut. Which of the following best describes the subsequent motion of the object?

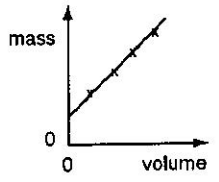
A The object will come to a rest.
B The object will continue to move along the circular path.
C The object will move along a non-straight line path towards the left.
D The object will move along a horizontal straight line path towards the left.

9 Some students measure the masses and volumes of different sized samples of a type of wood.

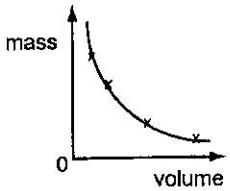
Which graph shows their results?



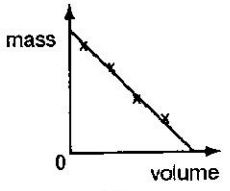
A



B

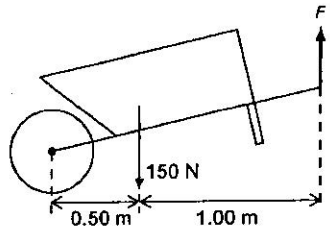


C



D

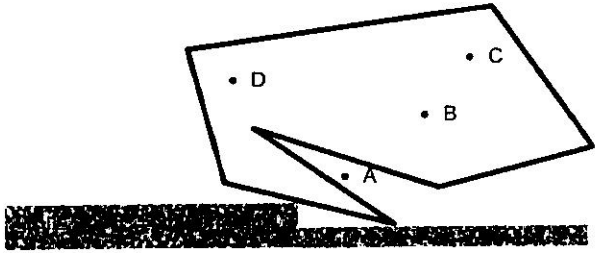
10 The diagram shows a wheelbarrow and its load, which have a total weight of 150 N. This is supported by an upward force F at the ends of the handles.



What is the normal force acting on the wheel by the ground?

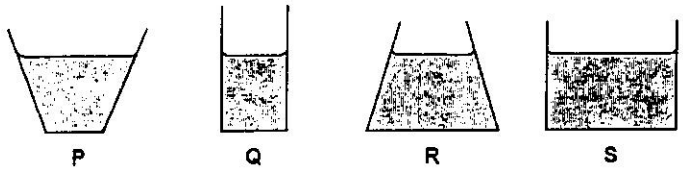
A 50 N **B** 75 N **C** 100 N **D** 200 N

11 The diagram shows an irregular shaped object resting on the edge of a step. The object does not have a uniform density.



Which point is the centre of the gravity of the object?

12 The diagrams show, to the same scale, the vertical sections of a set of circular vessels. Each vessel contains the same depth of water. Vessels **P** and **Q** have the same base area, and vessels **R** and **S** have the same base area.



A student makes the following conclusion:

Statement 1 : The water exerts the same pressure on the base of each vessel.

Statement 2 : The water exerted the same force on the base of each vessel.

Statement 3 : The force exerted on the surface of the water due to the atmospheric pressure is the smallest in vessel **S**.

Which of the following statements are false?

A Statement 1 and 2 only

B Statement 2 and 3 only

C Statement 1 and 3 only

D All statements

13 What are the energy changes in a battery-operated torch?

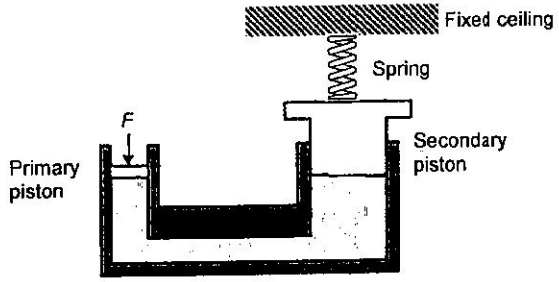
A Electrical energy → Kinetic energy → Light and Heat

B Electrical energy → Kinetic energy → Light and Sound

C Chemical potential energy → Electrical energy → Light and Heat

D Chemical potential energy → Electrical energy → Light and Sound

14 The diagram shows a hydraulic press and a force of F is applied at the primary piston. The primary piston has a radius of 0.20 m. The secondary piston is connected to a spring and the force exerted by the spring on the secondary piston is 500 N. The radius of the secondary piston is 0.40 m.

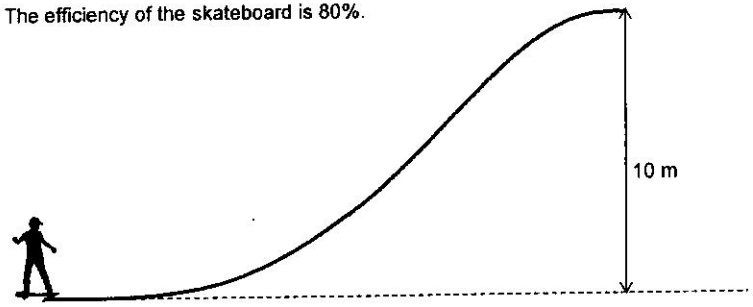


What is the value of F?

A 2000 N B 1000 N C 250 N D 125 N

15 A man of weight 600 N rides up a curved ramp on a skateboard in 5.0 seconds. The length of the curved ramp is 20 m and the vertical height of the ramp is 10 m.

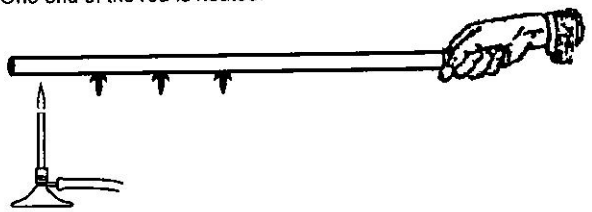
The efficiency of the skateboard is 80%.



What is the average power input by the man to ride up the curved ramp? Assume there is no change in both the initial and final speed of the man.

A 960 W B 1500 W C 1920 W D 3000 W

16 The diagram shows a hand holding a copper rod. Some thumb nails are glued along the rod. One end of the rod is heated.

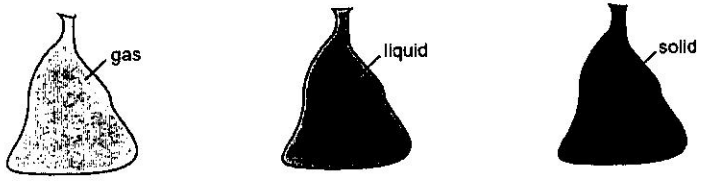


Why does the thumb nail nearest to the flame drop first?

A Convection current set up in air melts the glue.
B Heat transfer from the flame by radiation melts the glue.
C Heat transfer from the flame by conduction melts the glue.
D All of the above modes of heat transfer are responsible in melting the glue.

17 A student has three sealed plastic bags. One bag is filled with gas, one with liquid and one with solid.

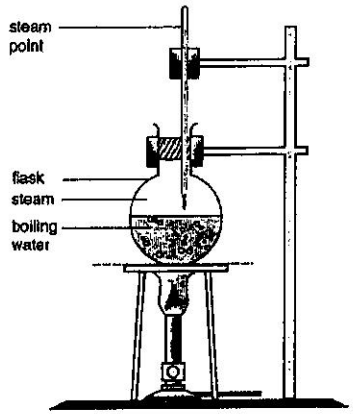
The student squeezes each bag to see if it changes shape, and warms each bag to see if it expands.



Which bag contains solid?

A The one that is fixed in shape and expands the least when heated.
B The one that is fixed in shape and expands the most when heated.
C The one that changes shape easily and expands the least when heated.
D The one that changes shape easily and expands the most when heated.

18 The diagram shows a setup that a student uses in an attempt to determine the steam point.



What is wrong with the setup?

A The flask should not be in contact with the clamp of the retort stand.

B The thermometer should be immersed into the boiling water and near to the base of the flask.

C The thermometer should be placed further away from the surface of the boiling water.

D The gas pressure in the flask is not maintained at standard atmospheric pressure.

19 Heat energy is supplied at the same rate to 2.0 kg of substance **X** and to 500 g of substance **Y** in similar containers for the same amount of time.

Why does the temperature of substance **X** rise more quickly?

A Substance **X** has absorbed more heat energy than substance **Y**.

B Substance **X** has absorbed less heat energy than substance **Y**.

C Substance **X** has a larger specific heat capacity than substance **Y**.

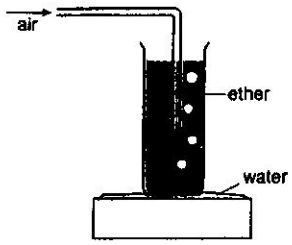
D Substance **X** has a lower specific heat capacity than substance **Y**.

20 Using an electric kettle, 0.10 kg of water at 100 °C is converted into steam at 100 °C. The specific latent heat of vaporisation of water is 2250 J / g.

Assume there is no heat loss, what is the amount of thermal energy supplied?

A 22.5 J B 225 J C 22 500 J D 225 000 J

21 In the diagram, air is blown through a tube containing some ether which is a volatile liquid. Underneath the beaker of ether is a small pool of water. Which of these best describes what will happen?



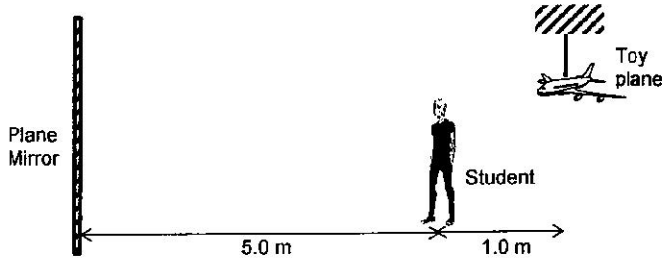
A Ether freezes and water boils.

B Ether boils and water evaporates

C Ether evaporates and water freezes.

D Ether condenses and water evaporates.

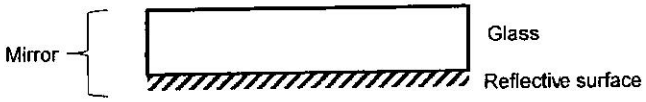
22 The diagram shows a student is standing 5.0 m in front of a plane mirror. A toy plane is 1.0 m behind him and is hanging from the ceiling.



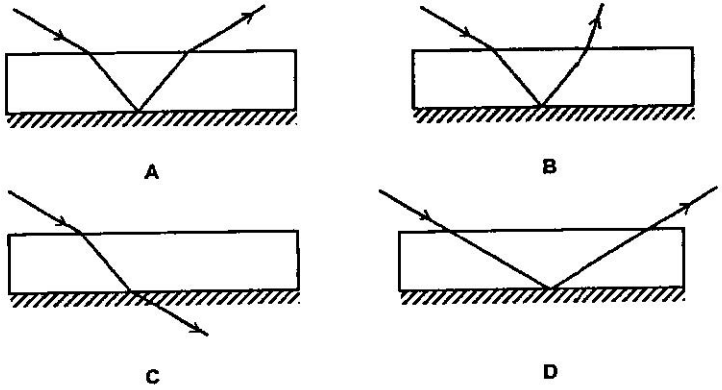
What is the horizontal distance of the image of the toy plane from the student?

A 11.0 m B 10.0 m C 7.0 m D 6.0 m

23 The diagram shows a mirror consisting of a reflective surface and a thick glass.



Which ray diagram shows the correct path of a light ray incident on a mirror with a thick glass?



24 What are the properties of the image formed by an object placed in front of a diverging (concave) lens?

A Real and larger than the object.

B Real and smaller than the object.

C Virtual and smaller than the object.

D The properties of the image are dependent on the distance of the object from the lens.

25 What is the definition of wavefront?

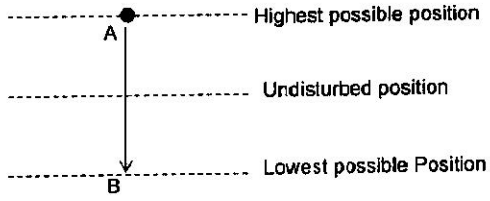
A It is a line that connects all successive crests in the wave.

B It is the path that a particle would have moved for one complete oscillation.

C It is part of the wave that is formed right at the beginning of the wave motion.

D It is a line that connects all the identical points on the waves and they are in the same phase.

26 The diagram shows a particle along a transverse wave with an amplitude of 0.20 m. When the particle moves from point A to point B, it takes 0.40s. The wavelength of the wave is 3.0 m.



What is the speed of the wave?

A $0.5\ ms^{-1}$ B $1.0\ ms^{-1}$ C $3.8\ ms^{-1}$ D $7.5\ ms^{-1}$

27 Which of the following is a property for all electromagnetic waves?

A All of them are affected by magnetic field.

B All of them can be detected by the human eye.

C All of them can travel faster than the speed of light.

D All of them can either be reflected, refracted or absorbed as they pass through a medium.

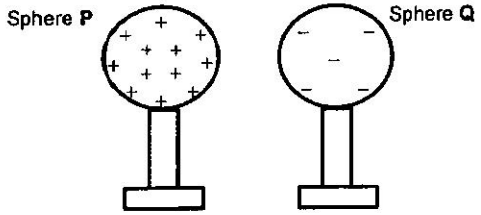
28 Which row lists the applications of parts of the electromagnetic spectrum?

	Microwave wave	Ultra-Violet	Gamma rays
A	Tv communication	Sunbeds	Bone Scanning
B	Satellite phone	Sunbeds	Treatment of cancer
C	Tv communication	Intruder alarms	Treatment of cancer
D	Satellite phone	Intruder alarms	Bone Scanning

29 Which of the following statement best describes ultrasound?

A Sound with particles moving with a period of 5.0 μs
B Sound that cannot be heard by human
C Sound with a frequency of 10 kHz
D Sound with a very high loudness

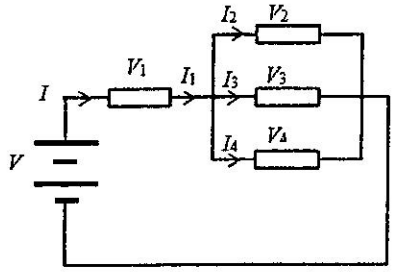
30 Two charged conducting spheres, **P** and **Q**, mounted on insulating stands. Sphere **P** is positively charged and sphere **Q** is negatively charged. Sphere **P** has more excess charges than sphere **Q**.



Both spheres **P** and **Q** are first moved to touch each other and then move apart. What are the final state of charge in sphere **P** and **Q**?

	Sphere P	Sphere Q
A	Positively Charged	Positively Charged
B	Positively Charged	Neutrally Charged
C	Neutrally Charged	Positively Charged
D	Neutrally Charged	Neutrally Charged

31 The circuit shows identical resistors connected to a cell. Which pair of equations is correct for this circuit?



where V_i = voltmeter reading across the device i
I_i = ammeter reading connected in series with the device i

	Current	Potential Difference
A	$I = I_1$	$V = V_3$
B	$I = I_1 + I_3$	$V = V_1 + V_2$
C	$I = I_2 + I_3 + I_4$	$V = V_1 + V_2$
D	$I = I_1 + I_2 + I_3 + I_4$	$V = V_1 + V_2 + V_3 + V_4$

32 In a circuit, a dry cell with an emf of 6.0 V drives 10 C of charges around a circuit for 15.0 s.

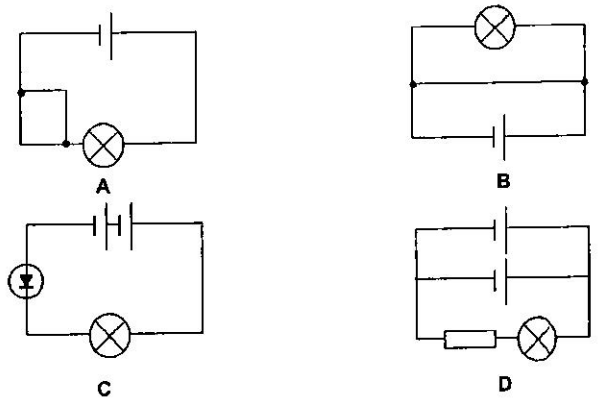
What is the power supplied to the circuit?

A 4.0 W B 24 W C 60 W D 240 W

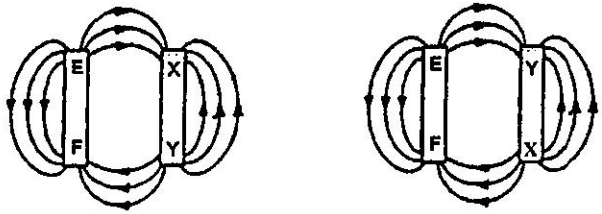
33 The power rating of a vacuum cleaner and a fan is 2000 W and 100 W respectively. For a day, the vacuum cleaner and the fan are switched on for 45 minutes and 6.0 hours respectively. How much will it cost to run these appliances in one day if the cost price of 1.0 kWh of electricity is 22 cents?

A $0.33 B $0.46 C $3.30 D $4.62

34 In which circuit will the bulb glow brightest? [The cells and bulbs are identical.]



35 The two diagrams below show the magnetic field pattern near two objects **EF** and **XY**.

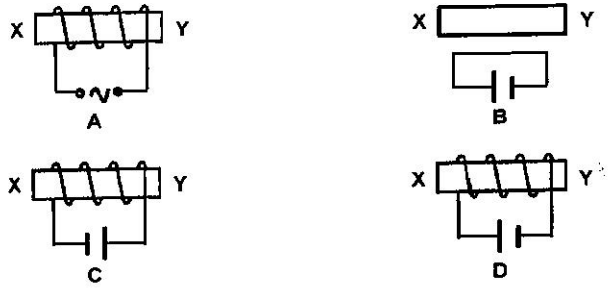


What two objects are **EF** and **XY** likely to be?

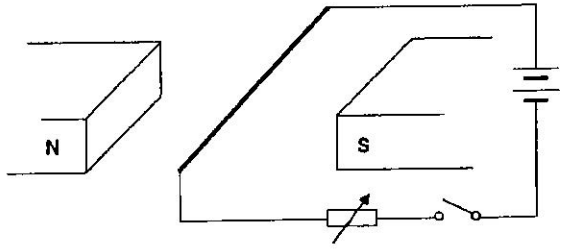
	EF	XY
A	an iron rod	a bar magnet
B	a bar magnet	an iron rod
C	an iron rod	a copper rod
D	a steel rod	a copper rod

36 It is desired to produce a magnet as shown below, with the ends labelled **X** and **Y** having a polarity of South and North respectively.

Which of the following circuit arrangement will produce the desired magnet?



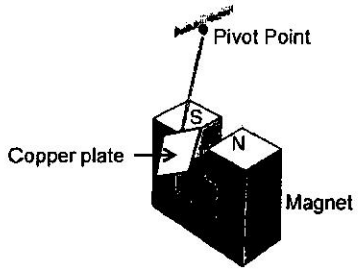
37 A wire connected to a direct current (d.c) supply is placed between the poles of a magnet as shown. The switch is then closed.



Which of the following best describes the magnetic field strength around the wire?

A The magnetic field above the wire is stronger than that below the wire.
B The magnetic field below the wire is stronger than that above the wire.
C The magnetic field at the left side of the wire is stronger than that at the right side of the wire.
D The magnetic field at the right side of the wire is stronger than that at the left side of the wire.

38 The diagram shows a copper plate hung from a pivot point and pulled to one side of the U-shaped magnet.



Which of the following best describes the subsequent motion of the plate after it is released?

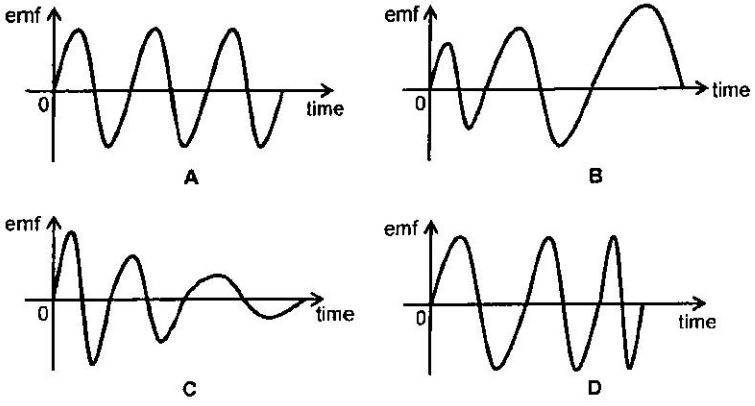
A The copper plate will swing to the other side of the magnet and stop at that side.

B The copper plate will move towards the magnet, be repelled away by the magnet and return back to the original position.

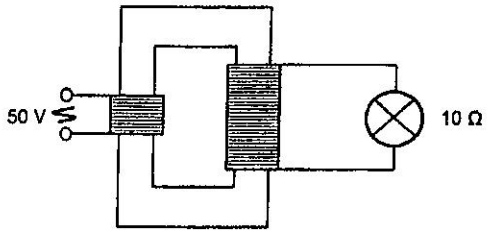
C The copper plate will swing about the pivot point for a few cycles before stopping vertically below the pivot point.

D The copper plate will move towards the magnet, slow down and stop at a position vertically below the pivot point.

39 Which graph shows the relationship of induced emf with time if the speed of rotation of the coil in a generator decreases gradually after each round of rotation?



40 The diagram shows an ideal transformer. The primary coil and secondary coil have 200 turns and 1000 turns respectively. The primary coil is connected to an alternating current supply with a voltage of 50 V. The secondary coil is connected to a light bulb with a resistance of 10 Ω.



What is the power supplied by the alternating current supply?

A 6250 W **B** 1000 W **C** 250 W **D** 10 W

—— END OF PAPER ——

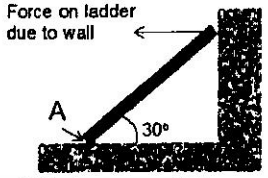
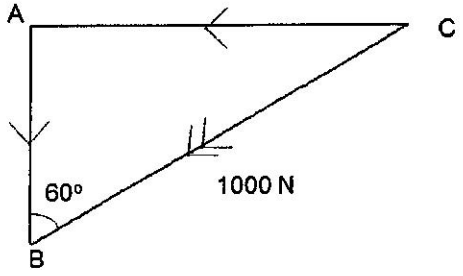
TKGS16

Solution to Sec 4 Physics Prelim Paper 1 2016

1	B	6	C	11	A	16	C	21	C	26	C	31	C	36	D
2	D	7	C	12	B	17	A	22	A	27	D	32	A	37	B
3	A	8	D	13	C	18	D	23	A	28	B	33	B	38	D
4	D	9	A	14	D	19	D	24	C	29	A	34	A	39	C
5	B	10	C	15	B	20	D	25	D	30	A	35	B	40	A

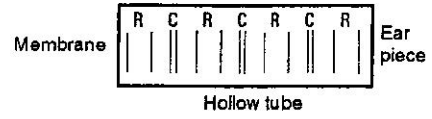
Solution to Sec 4 Physics Prelim Paper 2 2016

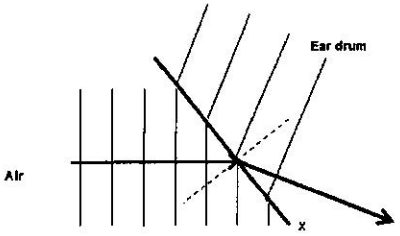
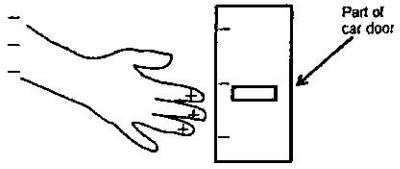
Section A

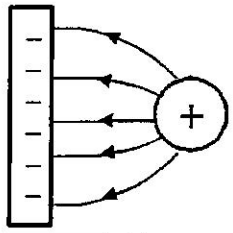
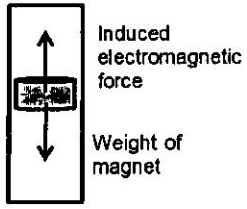
Qn	Solution
1(a)	
(b)	Moment is equal to the product of force and the perpendicular distance between the line of action of force and the pivot point. Since the ladder is at equilbrium, the resultant moment about point A will be equal to zero. As the resultant force of the weight and the force acting on ladder due to wall is not equal to zero, this means that the line of action of the resultant force must pass through pivot point A so that the perpendicular distance is equal to zero.
(c)	Scale: 1.0 cm to 100 N  Length of AC = 8. 7 cm

	Force acting on ladder due to the wall = 8.7 x 100 = 870 N

2(a)	The work done by the backward force is converted to the elastic potential energy of the stretched rubber. Some of the work done is also converted to thermal energy gained by the stretched rubber. The work done by the backward force is equal to the sum of the elastic potential energy and the thermal energy.
(b)	Kinetic energy of the stone $= \frac{1}{2} m v^2$ $= \frac{1}{2} \times (10.0/1000) \times 16.0^2$ $= 1.28$ J
c(i)	Gain in thermal energy by the rubber band = 10% of the work done by the force **F** = 1.28 / 9.00 = 0.142 J
(ii)	Gained in thermal energy = $mc\Delta\theta$ $0.142 = 2.00 \times 1.25 \times \Delta\theta$ $\Delta\theta = 0.0568$ °C
3(a)	It is a point at which the entire (or total) weight of the object appears to act at.
(b)	Moment due to the weight of blanket about point A $= 2.0 \times (3.0 \times 10)$ = 60 Nm Direction: Clockwise
(c)	Moment due to the weight of the water = 100 – 60 = 40 Nm Weight of the water = 40 / 2.0 = 20 N Mass of the water = 20 / 10 = 2.0 kg Volume of water = 2000 / 1.02 = 1960 cm^3
4(a) (i)	Pressure at Point A = Pressure of Gas 1 + pressure due to liquid X $= 200 \times 10^3 + (20.0/100) \times 5000 \times 10$ $= 200 \times 10^3 + 10 \times 10^3$ $= 210 \times 10^3$ Pa or = 210 kPa
(ii)	Pressure at left hand column is equal to the pressure at right hand column liquid level at point A.

	Pressure at Point A = $P_{gas\ 2} + 0.05\ \rho_y g$ We can use this equation to get pressure of gas 2.
(b)	For barometer with constant atmospheric pressure, the height of the liquid column is inversely proportional to density of the liquid ($P_{atm} = h\rho g$). If mercury-filled barometer required a height of 1.0 m, then a liquid of 2000 kg m^{-3} will required a height of about 7.0 m and it will be not be practical as a ladder will be required to take the barometer reading.
5(a)	When heat is supplied to the gas, the gas molecules gain kinetic energy and hitting the interior surface of the egg more frequently and with a greater force as compared when no heat is supplied. Since pressure = force/ surface area, the gas molecules exerts a greater pressure on the interior surface of the egg. This gas pressure is now larger than the atmospheric pressure acting on the exterior surface of the egg. This provides a resultant downward force to push the egg out of the bottle.
(b)(i)	Ice point is the temperature of pure melting ice at standard atmospheric pressure (or 1 atmospheric pressure)
(ii)	Temperature $= \frac{30.0-5.0}{45.0-5.0} \times 100°C$ $= \frac{25.0}{40.0} \times 100°C$ $= 62.5°C$
(iii)	One of the following: Resistance of a wire, density of liquid, electromotive force, pressure of a fixed mass of gas
6(a)	Longitudinal wave is wave with direction of travel parallel to the direction of the vibration of the source.
(b)	 As the skin vibrates, the membrane which rests on the skin also vibrates according to the same frequency.

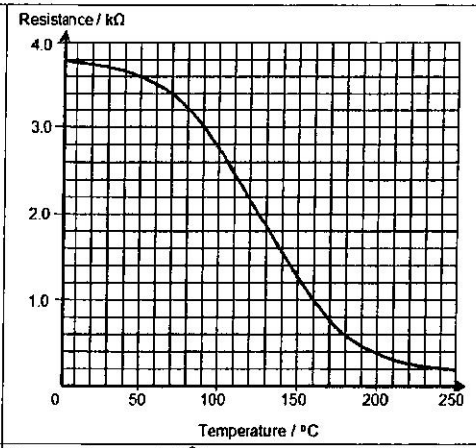
	The layer of air molecules next to the membrane acquires the same oscillatory motion at the same frequency. From the membrane to the ear piece via the hollow tube, the oscillatory motion is passed on to neighbouring layers of air molecules producing a series of high air pressure (compressions) and low air pressure (rarefactions) along the longitudinal wave motion in the hollow tube.
(c)	 Ear Drum is denser than Air => speed of sound increases => direction of travel bends away from the normal at the boundary X. Note: Wavefronts must always be perpendicular to direction of travel.
7(a)	When the car is moving against the air, the air is rubbing against the body of the car and the car body is charged by friction. The electrons from the air are transferred to the car body. Electrons are not able to flow to the ground as the tyre is an insulator. Since the number of electrons is more than the number of protons in the car body, the car body becomes negatively charged.
(b)(i)	
(ii)	When the hand touches the car body, there is a flow of electrons from the car body to the hand. As the excess charges earth through the person, this causes the static shock.

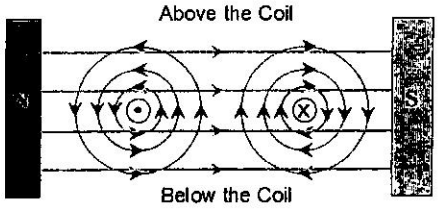
(c)	
8(a)	Faraday's Law: The magnitude of e.m.f. induced in a conductor is directly proportional to the rate of change of magnetic field lines linking the circuit. (Also accept: When the conductor cuts the magnetic field, there is a changing magnetic field. This induces an emf in the conductor.) Lenz's Law: The direction of the induced e.m.f and hence the induced current in a closed circuit, is always such that its magnetic effect opposes the motion or change producing it.
(b)(i)	 • As the magnet falls due to **gravitational force**, the **magnetic flux** through a cross-section of the pipe will be **changing**, so a **current** is **induced (eddy current)** in the copper pipe. • This induced current flows to produce a magnetic field in the copper pipe which will **oppose the downward movement** of the magnet, so it will **slow down** the falling magnet. • Eventually an equilibrium is reached where the magnetic force and the gravitational force balance, and the magnet falls at **constant velocity** until the end of the pipe.
(ii)	As the magnet drops into the copper tube, the copper tube cuts the magnetic field lines of the magnet. By Faraday's Law of Electromagnetic Induction, there is an induced emf produced in the copper tube. By Lenz's Law, the direction on the induced emf and hence the induced current produced an opposing force to act against the downward motion.

	The magnet will accelerate until the induced emf is large enough to produce an opposing force that is equal to the weight of the magnet. When this happens, the magnet will move with constant speed.

Section B

Qn	Solution
9(a)	Thermistor
(b)	When there is a fire, the temperature increases. The resistance of the device A will decrease. The potential difference across 2.0 kΩ resistor will increase. Since 2.0 k kΩ resistor is connected in parallel to terminals Y and Z, the potential difference across terminals Y and Z will increase and the transistor will switch on the secondary circuit and activate the bell.
(c)	A small voltage supply is required to ensure the system is "live" and on standby mode, rather than using a high voltage supply at all time. Thus, it saves electrical energy.
(d)(i)	Using potential divider concept, $0.60 = \frac{2000}{2000 + R_{TH}} \times 1.0$ $R_{TH} = \frac{2000}{0.60} - 2000$ $= 1333$ $\approx 1300\Omega$

(ii)	
(iii)	Temperature = 145 °C
10(a)	Wire B. Since current is flowing out of the current supply, wire B is the live wire. A switch in the live wire will ensure no flow of current to the motor at all time when the switch is open. Even when there is a fault such that the live wire touches the motor, the motor will not be 'live' when the switch is open. Hence, this protects the person from electrical shock when the person touches the motor.
(b)	Earth Wire. The earth wire will ensure the metal casing is at zero potential and will not be live. Thus, this protects the person from electrical shock when the live wire touches the metal casing and the person is touching the metal casing.
(c)	Split Ring Commutator The ring ensures that the motor will always turn in the same direction when there is a change in the direction of the current in the coil for every half of revolution. Also accept: The ring ensures that the current in the coil will always move in the same direction (in this case, anti-clockwise) and hence ensuring the coil is always turning in the same direction.

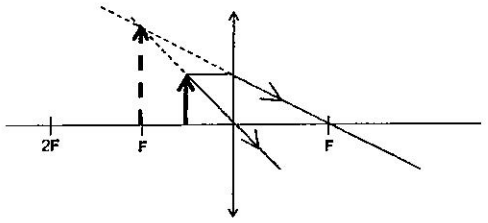
(d)	Viewing from the front:  Magnetic field due to current in coil interacts with magnetic field due to the magnet. For the left coil, the magnetic fields interacts causing the magnetic field above the coil is weaker than the magnetic field below the coil. The resultant magnetic force will be acting upwards. For the right coil, the magnetic fields interacts causing the magnetic field above the coil is stronger than the magnetic field below the coil. The resultant magnetic force will be acting downwards. Hence, these forces cause the coil to turn in clockwise direction.

Either

11(a)	The distance travelled by the 2nd signal is smaller than that of the 1st signal. Thus, the energy loss by the 2nd signal to the surrounding will be smaller. Hence, the 2nd signal received by the radar is stronger than the first one.
(b)	High frequency EM waves have high ionisation energy and can cause harm to the human body when get absorbed by the body.
(c)	Acceleration of the plane $= \frac{60-30}{4}$ $= 7.5\ ms^{-2}$
(d)	Distance travelled = average speed x time duration $= \frac{60+30}{2} \times 4$ $= 180\ m$ Assumption: The time taken for the reflected signal to travel from the plane to the radar is negligible.

	(Distance travelled by the plane during this time lapse is not taken into consideration).
(e)(i)	Using Newton's 2nd Law, $F_{net} = ma$ $75\,000 - f_r = 10\,000 \times (-5.0)$ $f_r = 125\,000\ N$ Also accept: $F_{net} = ma$ $f_r - 75\,000 = 10\,000 \times 5.0$ $f_r = 125\,000\ N$
(ii)	As the plane decelerates, the velocity of the plane decreases. Since air resistance is dependent on the velocity of the plane (and hence speed at which the plane contacting the air particle), the air resistance will not be constant.

Or

11a(i)	Converging lens are lens that causes the light rays (parallel) to bend towards a common point when the light rays passes through it.
(ii)	
(iii)	By measuring the heights of the image and the object and the ratio of the height of the image to the height of the object will provide the information the number of times the image is magnified.
(b) (i)	Refractive index of 2.42 means that the speed of light in the diamond will be 2.42 times slower than the speed of light in vacuum.
(ii)	For critical angle, the angle of refraction is 90°