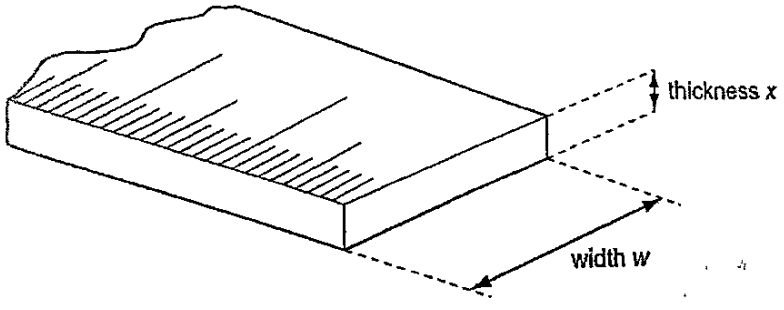
1 In an experiment, the width w and the thickness x of a metre rule are to be measured as precisely as possible using regular laboratory apparatus.



Which combination of instruments is most appropriate for these measurements?

	measurement of w	measurement of x
A	half-metre rule	half-metre rule
B	half-metre rule	vernier caliper
C	vernier caliper	half-metre rule
D	vernier caliper	vernier caliper

2 Diagram 2.1 shows a measuring cylinder containing water.

Five identical steel balls are now lowered into the measuring cylinder.

Diagram 2.2 shows the new water level in the cylinder.

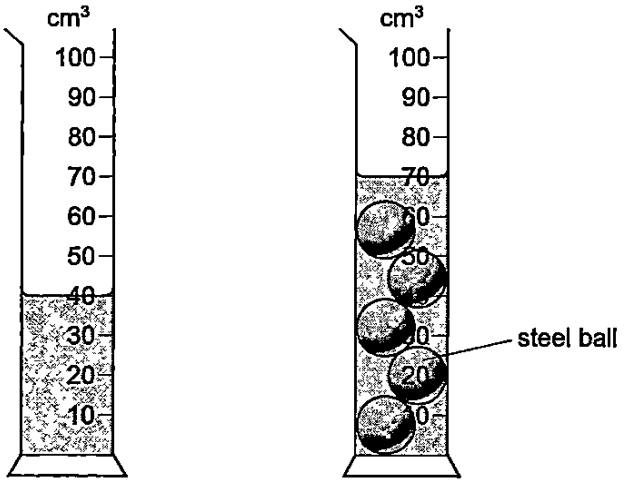
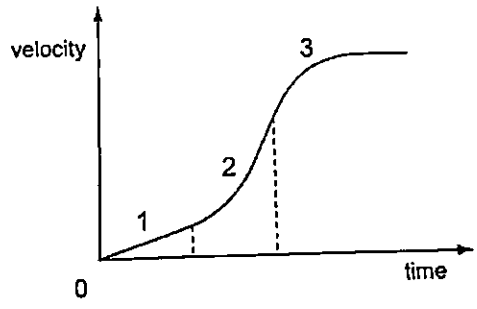


diagram **2.1** diagram **2.2**

What is the volume of each steel ball?

A 6 cm³ **B** 14 cm³ **C** 30 cm³ **D** 70 cm³

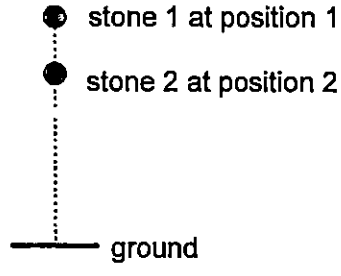
3 The graph shows how the velocity of a racing car changes with time.



Which statement describes the acceleration of the racing car for sections 1, 2 and 3?

	section		
	1	2	3
A	constant and positive	increases positively	negative
B	increases positively	increases positively	decreases to zero
C	positive	increases positively	decreases to zero
D	starts from zero	increases positively	decreases to zero

4 Two identical stones are dropped simultaneously from different heights.
Air resistance is negligible.



As the stones fall, how will the distance between them vary?

A decrease until they touch
B increase continuously
C increase initially then remain constant
D remain constant

5 To avoid an accident, the brakes of a car travelling at 30 m/s were applied suddenly.

If the driver has a mass of 80 kg and it takes 3.0 s for the car to decelerate to rest, what is the average force exerted by the safety belt on the driver during deceleration.

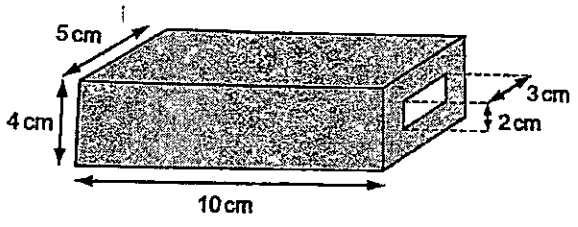
A 240 N
B 400 N
C 500 N
D 800 N

6 While on the moon, an astronaut gives a horizontal push to a 20 kg object, which is hanging freely.

What would be the difference in effort needed on the moon compared with the effort needed on Earth?

A It is easier to push the object on the moon than on Earth.
B It is more difficult to push the object on the moon than on Earth.
C It requires no effort to push the object on the moon.
D It requires the same effort to push the object both on the moon and on Earth.

7 A hollow rectangular metal block has the dimensions shown.



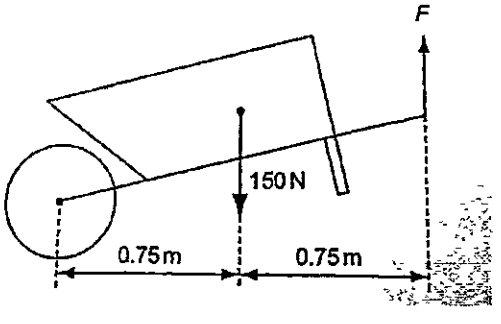
The hole in the middle goes all the way through the block.

The density of the metal is 10 g/cm^3.

What is the mass of the block?

A 14 g
B 400 g
C 1400 g
D 2000 g

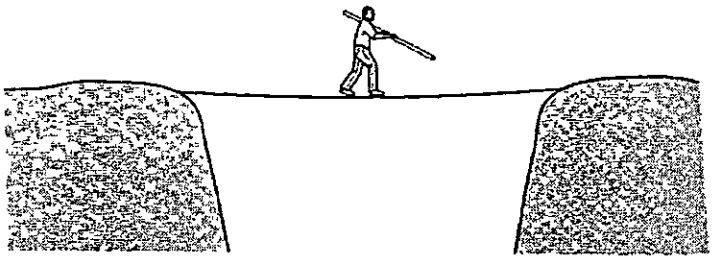
8 The diagram shows a wheelbarrow and its load, which have a total weight of 150 N. This is supported by a vertical force F at the ends of the handles.



What is the value of F?

A 75 N **B** 150 N **C** 225 N **D** 300 N

9 A man walks along a tight rope, carrying a long pole.



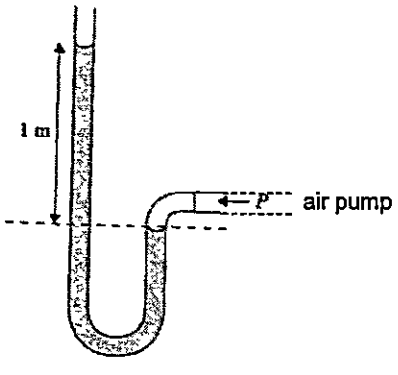
Why does he carry the pole?

A to keep his centre of gravity over the rope.
B to raise his centre of gravity
C to reduce his pressure on the rope
D to spread out his weight

10 Which of the following locations experiences the highest atmospheric pressure?

A At sea level.
B In a coal mine 100 m below sea level.
C Inside a skyscraper.
D On top of Mount Everest.

11 A manometer is connected to an air pump as shown.



The manometer is filled with water of density 1 000 kg/m^3 and the atmospheric pressure is 100 000 Pa.

What is the air pressure P exerted by the air pump? (g=10 N/kg)

A 100 00 Pa
B 110 000 Pa
C 200 000 Pa
D 210 000 Pa

12 Which energy resource is used to boil water to generate electricity?

A hydroelectric
B nuclear
C tides
D waves

13 A person exerts a horizontal force of 600 N on a box that also experiences a frictional force of 200 N.

If it takes 4.0 s to move the box 3.0 m, what is the average useful power?

A 150 W
B 300 W
C 450 W
D 600 W

14 Illuminated smoke particles, suspended in air, are viewed with a microscope. They are seen to move randomly.

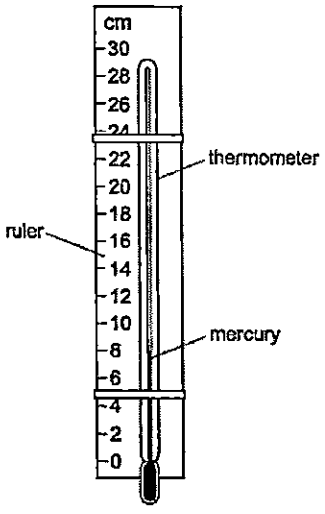
Which of the following best explains the motion of the smoke particles?

A bombarded continually and randomly by air molecules
B moved about by convection currents
C shaken by the vibration of the molecules within them
D supplied with energy by the light illuminating them

15 What is a property of both liquid and gases?

A They always fill their containers.
B They are incompressible.
C They can flow.
D They have molecules in fixed positions.

16 A mercury thermometer with no scale is taped to a ruler as shown.



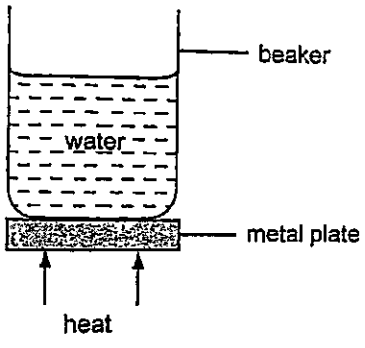
When the thermometer is placed in steam, the mercury level rises to 22.0 cm.

When the thermometer is placed in pure melting ice, the mercury level falls to 2.0 cm.

Which temperature is shown by the mercury level in the diagram?

A 6 °C **B** 8 °C **C** 30 °C **D** 40 °C

17 Four beakers containing the same amount of water at the same temperature are placed on hot metal plates.



The lower surfaces of the metal plates are kept at the same temperature. The plates are all the same size but are made from four different metals, **A**, **B**, **C** and **D**. The times taken to produce stated temperature rises of the water are given below.

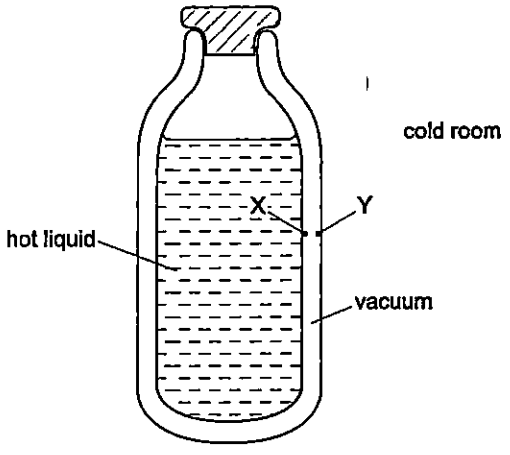
Which metal is the poorest conductor?

plate	temperature rise / °C	time / s
A	11	100
B	13	100
C	17	200
D	19	200

18 Which line in the table is correct about conduction and convection?

	conduction	convection
A	can happen in a solid	can happen in a solid
B	can happen in a solid	only happens in fluids
C	only happens in fluids	can happen in a solid
D	only happens in fluids	only happens in fluids

19 The diagram shows the cross-section of a vacuum flask containing a hot liquid in a cold room.



X and Y are points on the inside surfaces of the walls of the flask.

How is thermal energy transferred between X and Y?

A by conduction and convection
B by conduction only
C by radiation and convection
D by radiation only

20 Four objects of the same mass but different material are placed near each other. The specific heat capacities are indicated in table 20.1.

description	specific heat capacity (J/kg/°C)
bone	440
gold	129
marble	880
wood	1700

table 20.1

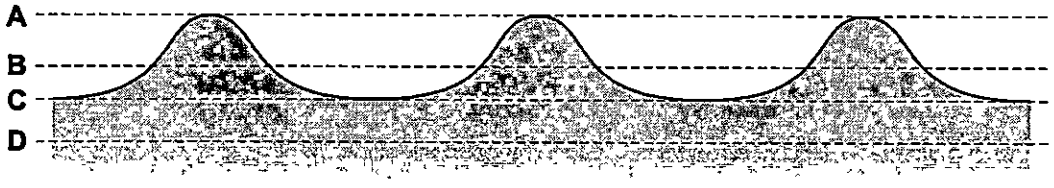
The same quantity of thermal energy is given to each object.

Which object shows the greatest rise in temperature?

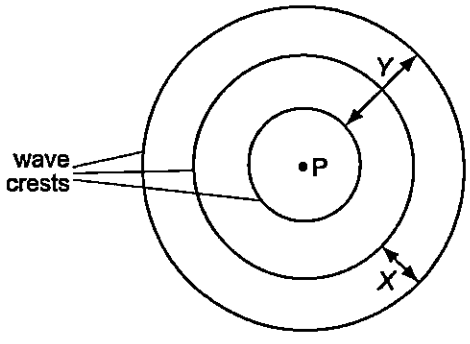
A bone
B gold
C marble
D wood

21 The diagram shows a section through a series of waves on water.

Which dotted line shows the position of the still water surface after the waves have passed?



22 A vertical stick is dipped up and down in water at P.

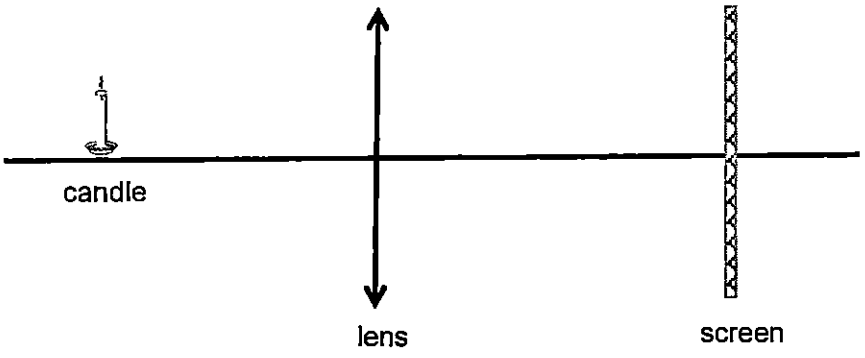


In two seconds, three wave crests are produced on the surface of the water.

Which statement is correct?

A Distance X is the amplitude of the waves.
B Distance Y is the wavelength of the waves.
C Each circle represents a wavefront.
D The frequency of the waves is 3 Hz.

23 A thin converging lens is used to produce, on a screen, a focused image of a candle.

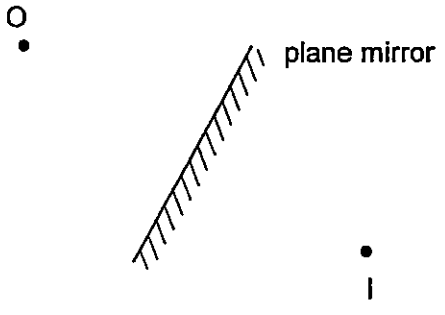


Various focused images are produced on the screen by moving the lens and the screen backwards and forwards.

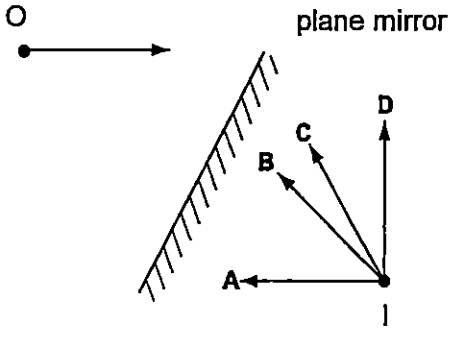
Which statement about the image is always correct?

A The image is at the principal focus (focal point) of the lens.
B The image is bigger than the object.
C The image is closer to the lens than the object is.
D The image is inverted.

24 An object placed in front of a plane mirror at O produces an image at I.



If the object moves towards the mirror in the direction shown by the arrow, in which direction does the image move?

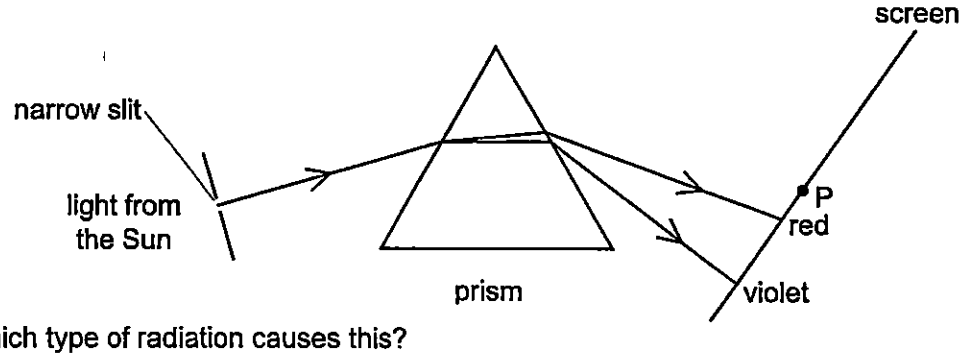


25 Which statement about ultraviolet waves is correct?

A They are used in television remote controllers.
B They can be detected by the human eye.
C They travel as longitudinal waves.
D They have the same speed in a vacuum as radio waves.

26 Light from the Sun passes through a prism and a spectrum is produced on a screen.

A thermometer placed at P shows a large temperature rise.



Which type of radiation causes this?

A infra-red
B microwave
C ultra-violet
D visible light

27 A sound is played on a flute. A sound of the same pitch is played on a trumpet.

Which of the following correctly compares the two sound waves?

	frequency	speed
A	different	different
B	different	same
C	same	different
D	same	same

28 A polythene rod repels an inflated balloon hanging from a nylon thread.

Why do the rod and balloon repel?

A The rod and the balloon have opposite charges.
B The rod and the balloon have like charges.
C The rod is charged but the balloon is not.
D The balloon is charged but the rod is not.

29 Three objects X, Y and Z are metal spheres, each on an insulated stand.

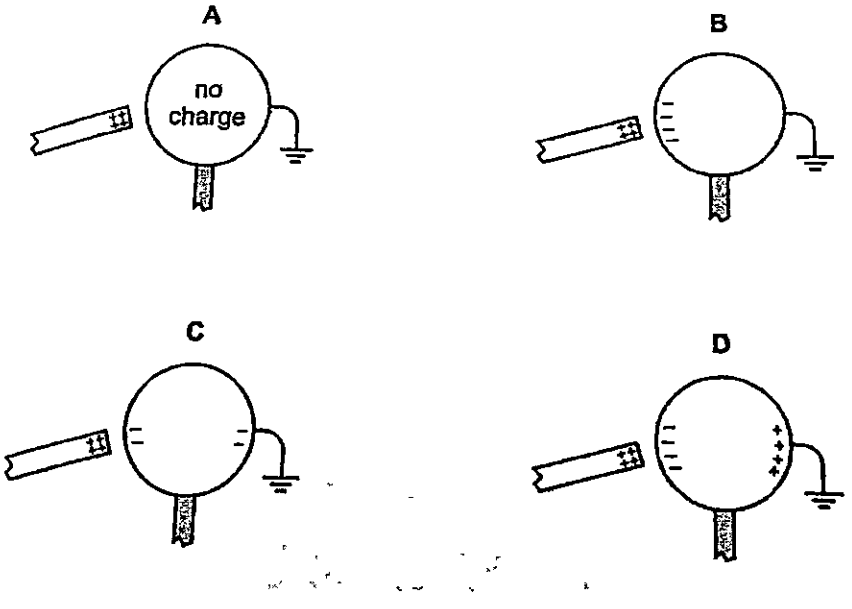
Objects X and Y experience a force of attraction. Objects X and Z experience a force of attraction

Which set of charges CANNOT be correct?

	charge on X	charge on Y	charge on Z
A	positive	negative	negative
B	positive	negative	positive
C	uncharged	positive	negative
D	uncharged	positive	positive

30 A charged rod is held close to one side of a metal ball and the other side is earthed.

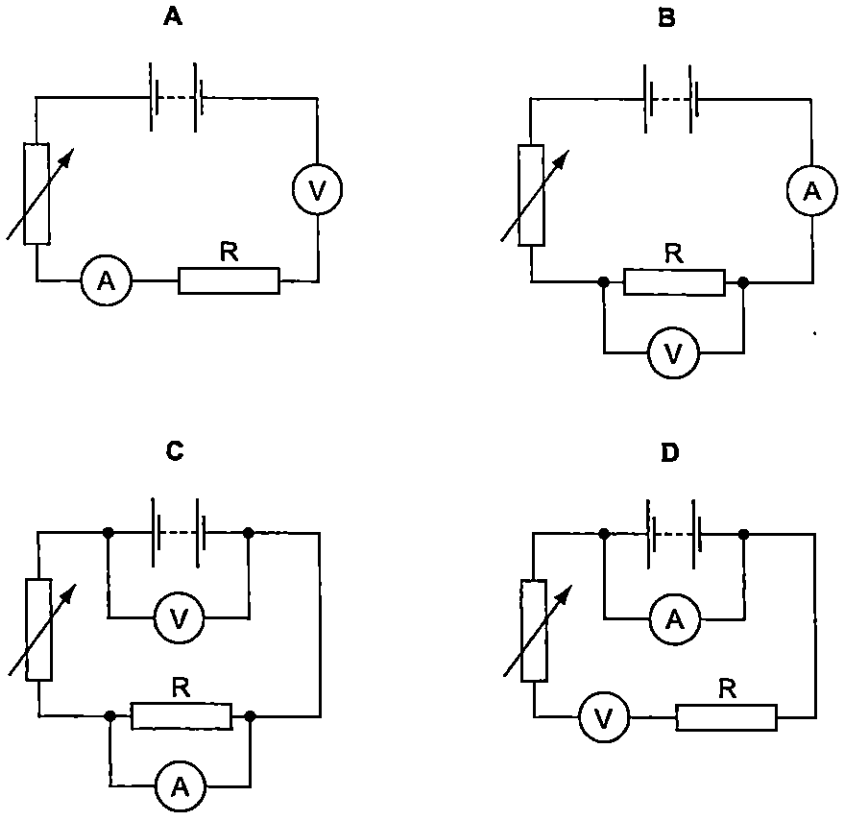
Which diagram shows the final charge distribution?



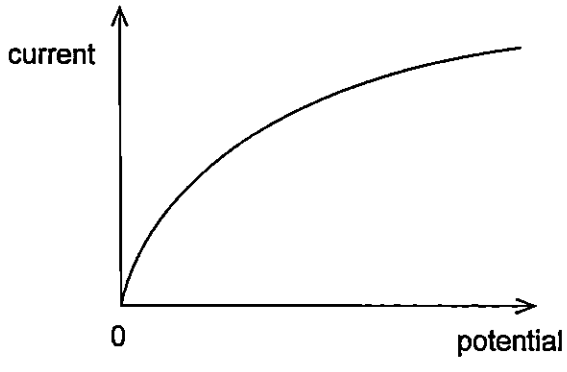
31 Which copper wire would have the smallest electrical resistance?

A a long, thick wire
B a long, thin wire
C a short, thick wire
D a short, thin wire

32 Which circuit could be used to determine the resistance of the resistor R?



33 The graph shows how the current through a lamp filament varies with the potential difference across it.



Which statement explains the shape of this graph?

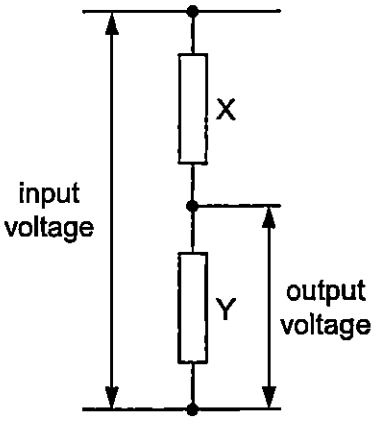
A As the filament temperature rises, electrons can pass more easily through the filament.

B It takes time for the filament to reach its working temperature.

C The power output of the filament is proportional to the square of the current through it.

D The resistance of the filament increases with a rise in temperature.

34 An engineer uses the potential divider shown in the diagram.



He needs the output voltage to be one tenth (1/10) of the input voltage.

Which pair of values could he use for the two resistors X and Y?

	X / kΩ	Y / kΩ
A	1.0	9.0
B	1.0	10.0
C	9.0	1.0
D	10.0	1.0

35 The cost of electrical energy is $ 0.22 per kWh.

What is the cost of using a 1800 W kettle for the total of 30 min?

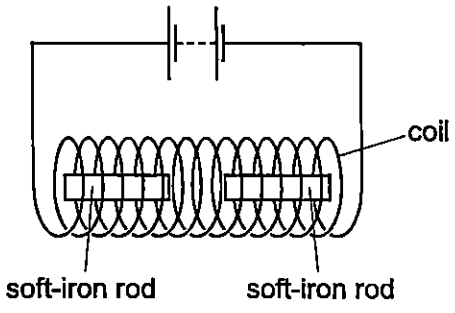
A $ 0.12 **B** $ 0.20 **C** $ 0.22 **D** $ 22

36 A mains electrical circuit uses insulated copper cable and the cable overheats.

To prevent the cable from overheating, how should the cable be changed, and why?

A Use thicker copper cable which has less resistance.
B Use thicker insulation to reduce conduction.
C Use thinner copper cable which has more resistance.
D Use thinner insulation to reduce conduction.

37 Two soft-iron rods are placed end to end inside a coil which is connected to a battery.

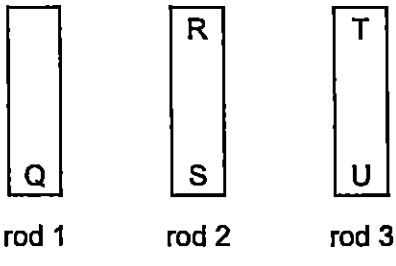


The connections from the battery to the coil are now reversed.

What happens to the soft-iron rods in each case?

	battery connections as shown	battery connections reversed
A	rods attract	rods attract
B	rods attract	rods repel
C	rods repel	rods attract
D	rods repel	rods repel

38 The ends of three metal rods are tested by holding end Q of rod 1 close to the others in turn.



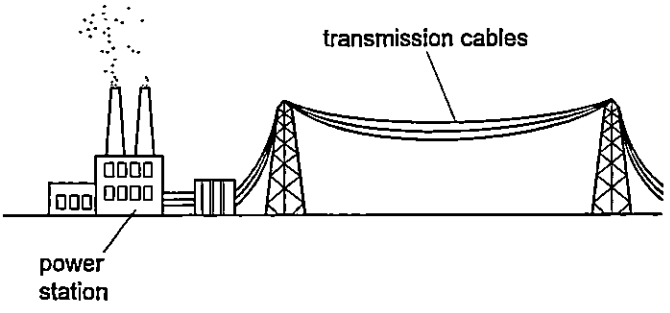
The results are as follows.

End Q: attracts end R, attracts end S, attracts end T, repels end U.

Which of the metal rods is a magnet?

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

39 The diagram shows cables used in the transmission of electrical energy.

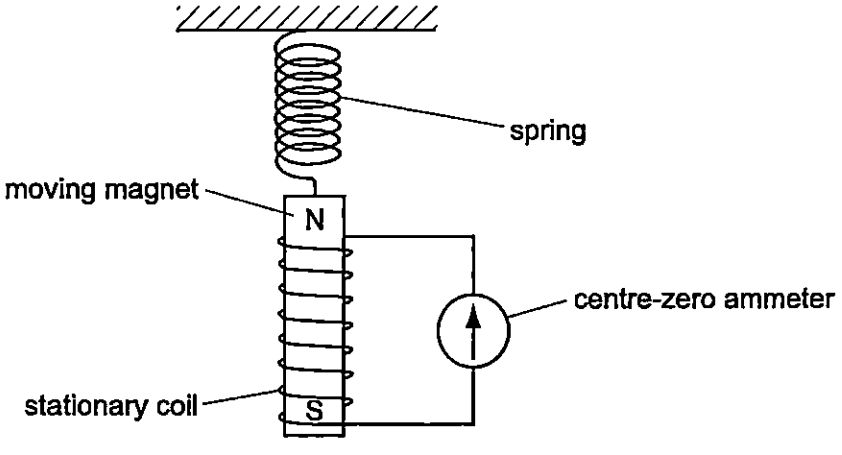


High voltages are used for the transmission.

Why are high voltages used for the transmission of electrical energy?

A Fear of high voltages stops people from interfering with the cables.
B Heat loss in the cables is smaller than if low voltages are used
C High voltages increase the current in the cables.
D High voltages produce large magnetic fields, so less insulation is needed.

40 A magnet is suspended from a spring so that it can move freely inside a coil. The coil is connected to a sensitive centre-zero ammeter.



How does the ammeter needle behave when the magnet repeatedly moves slowly up and down?

A The needle remains at the zero reading.
B The needle swings from left to right and right to left.
C The needle swings to the left and remains stationary.
D The needle swings to the right and remains stationary.

End of Paper

Section A [50 marks]

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

1 (a) Fig 1.1 shows an airplane cruising in air at a constant velocity.

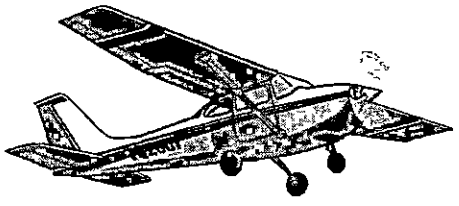


Fig 1.1

When the airplane is moving, there is resistive force from the air acting on the airplane.

(i) Explain why the forward force acting on the airplane must be greater than the resistive force for the airplane to accelerate.

.....

.....[1]

(ii) The resistive force is 2 000 N and the mass of the airplane is 20 000 kg. The airplane accelerates at 5.0 m/s^2.

Calculate the minimum forward force that the airplane requires to accelerate.

minimum force =.....

[2]

(b) Fig 1.2 shows the top view of the airplane at cruising height, making an angle 45° with North.

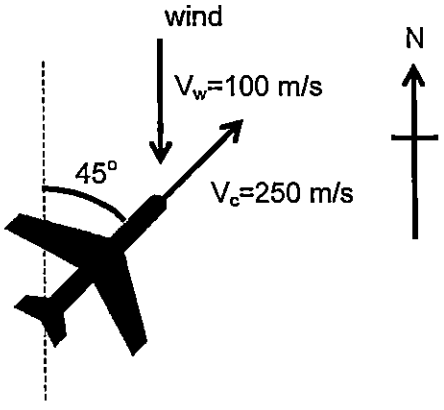


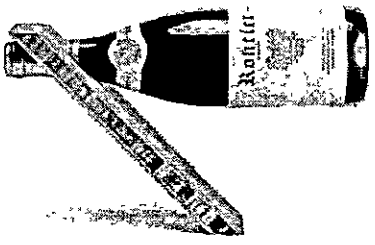
Fig 1.2

The cruising velocity, v_c of the airplane is 250 m/s. The airplane encounters a strong wind blowing due South at v_w = 100 m/s.

In the space below, determine graphically, the size of the resultant velocity of the airplane and the angle between the resultant velocity and the direction North. Include the scale that you used in the answer.

[4]

2 Fig 2.1 shows a wine bottle holder supporting a full wine bottle (without trapped air) in mid air.



wine bottle holder

Fig 2.1

(a) Fig 2.2 shows a side view of the wine bottle holder.

Indicate the position of centre of gravity, CG of the setup and indicate in Fig 2.2 with **X**.

[1]

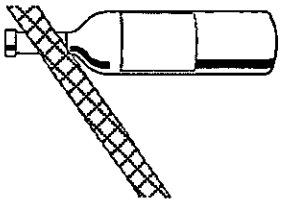


Fig 2.2

(b) Hence, explain how the wine bottle holder is able to support the wine bottle in this position without toppling.

.....

.....

.....[2]

(c) The bottle, completely empty of wine is placed on the wine bottle holder again. The empty bottle topples.

Suggest a reason for this, in terms of the position of the CG.

.....

.....

.....[2]

3 Fig 3.1 shows a bicycle wheel being inflated with air by a bicycle pump.

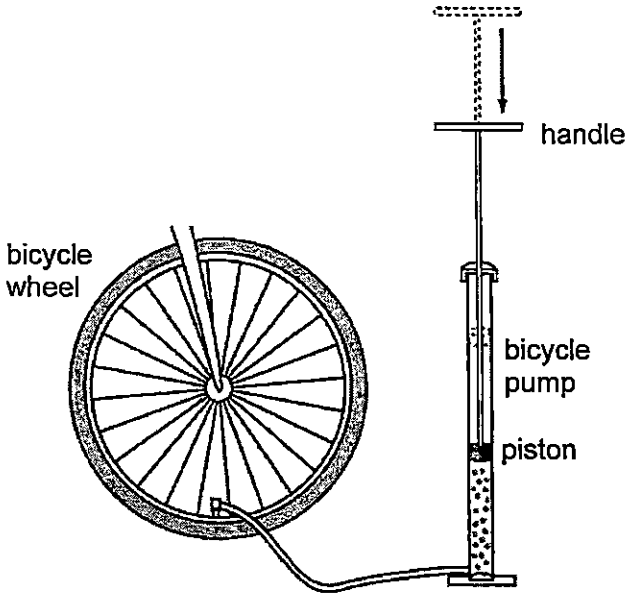


Fig 3.1

(a) **(i)** State the definition of pressure.

.....[1]

(ii) The air pressure in the tyre is now 300 kPa. The cross sectional area of the piston is 1.26×10^{-3} m.

Calculate the force exerted on the piston by the air in the tyre.

Force =.....[2]

(b) As the air pressure in the tyre increases, the temperature of the air in the tyre rises.

Using the kinetic model of gases, explain why this happens.

.....

.....

.....

.....

.....[3]

4 A copper rod and a plastic rod each pass through holes in rubber bungs, so that their ends are inside a tank, as shown in Fig 4.1

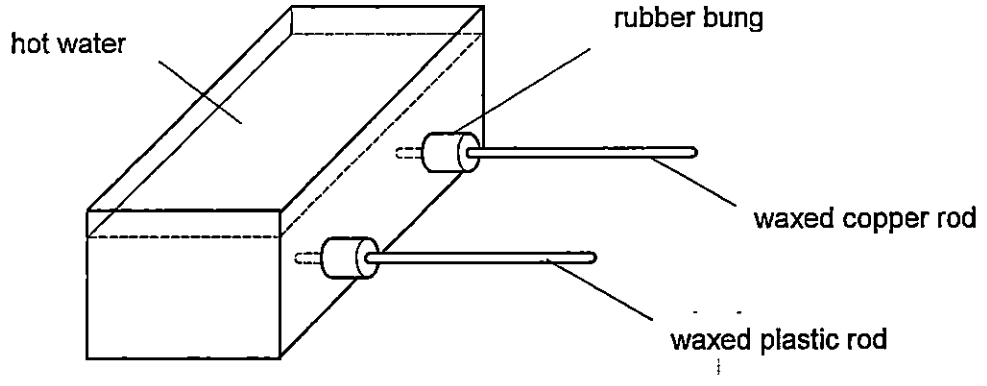


Fig 4.1

Both rods are covered with wax.

Very hot water is poured into the tank, covering the end of each rod.

(a) Suggest what will be observed on each rod after a prolonged period of time.

.....

.....

[2]

(b) Explain how thermal energy is transferred across the copper rod in terms of molecular motion.

.....

.....

[2]

5 Fig 5.1 shows a ray of light PQRS as it enters and leaves a semi-circular glass block.

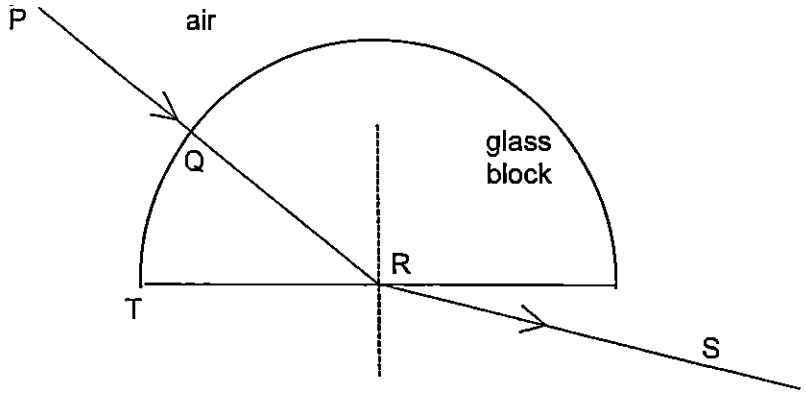


Fig 5.1

The refractive index of glass is 1.5.

(a) Explain why there is no change in the direction of the ray as it enters the block at Q

.....

[1]

.....

(b) **(i)** State the relationship of the refractive index of a medium with reference to the speed of light.

[1]

(ii) Calculate the speed of the light ray QR in the glass block.

speed of light = ...[2]

(c) The incident light ray PQ is rotated anti-clockwise about R (i.e. R is at the centre of rotation), towards T.

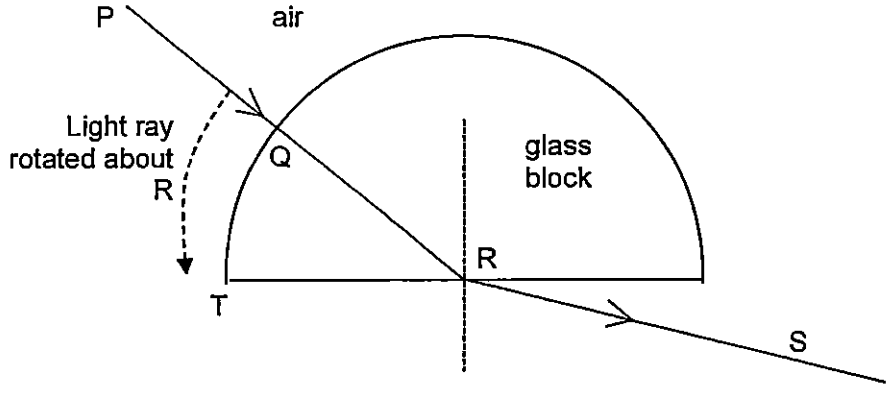


Fig 5.2

Describe what happens to light ray RS as light ray PQ is rotated.

.....

[2]

.....

6 The setup of an experiment shown in Fig 6.1 was carried out to measure the speed of sound.

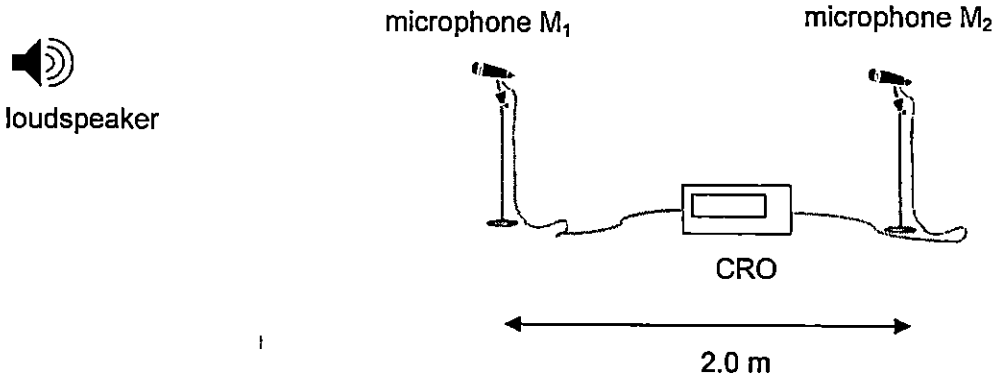


Fig. 6.1

Two microphones M_1 and M_2 are placed 2.0 m apart and are connected to a Cathode Ray Oscilloscope (CRO). The CRO is used to measure the time taken for sound to travel between M_1 and M_2.

(a) Suggest a reason why the CRO is used to measure the time taken for sound to travel between M_1 and M_2 instead of a student using a stopwatch.

.....[1]

(b) The loudspeaker produces a loud bang and the time taken recorded by the CRO is 5.9 ms.

Calculate the speed of sound in air.

speed of sound in air = ...[2]

(c) Suggest a modification to the experimental set-up to improve the accuracy of the time for sound to travel between M_1 and M_2.

.....

.....[1]

7 **(a)** A piece of plastic is held in the hand and rubbed with a cloth. Both the plastic and the cloth become charged.

(i) Describe how the plastic becomes negatively-charged and the cloth becomes positively-charged.

.....

.....

.....

.....[2]

(ii) Suggest why a piece of metal held in the hand does not become charged when it is rubbed with the cloth.

.....

.....

.....[2]

(b) Fig 7.1 shows a positively charged rod placed near to two conducting spheres mounted on insulating stands. The spheres are in contact with each other.

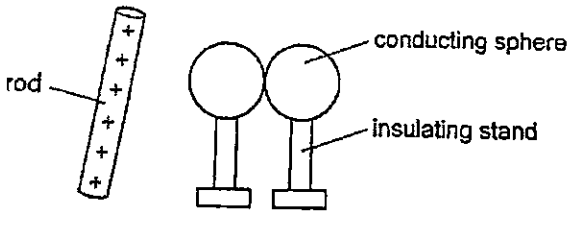


Fig 7.1

The spheres are separated and the charged rod is then removed.

In Fig 7.2, draw the charges on the spheres, after the charged rod is removed.

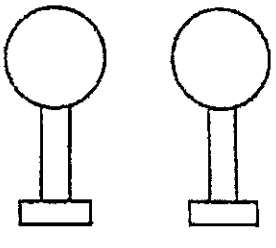


Fig 7.2

[2]

8 A student connects the circuit shown in Fig. 8.1.

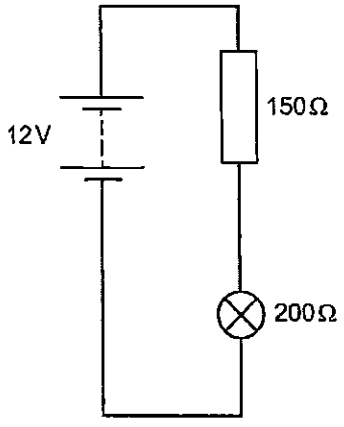


Fig 8.1

(a) Calculate the current in the circuit.

current =.....[2]

(b) Calculate the potential difference (p.d.) across the lamp.

potential difference = ...[1]

(c) Using appropriate circuit symbols, draw on Fig. 8.1 to suggest how the circuit may be modified with additional electrical component so that the brightness of the lamp can be controlled.

[1]

(d) The circuit is re-arranged as shown in Fig. 8.2.

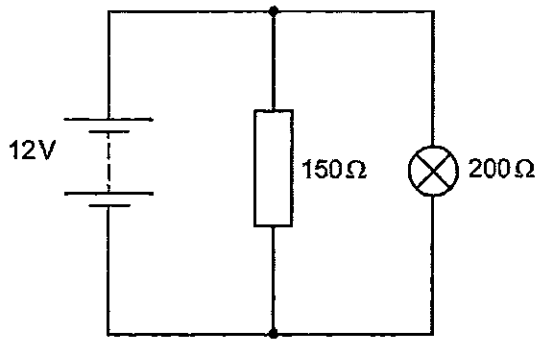


Fig 8.2

Explain how the brightness of the lamp in Fig. 8.2 compares with the lamp in Fig. 8.1.

.....

.....[2]

9 Fig 9.1 shows a solenoid carrying a current.

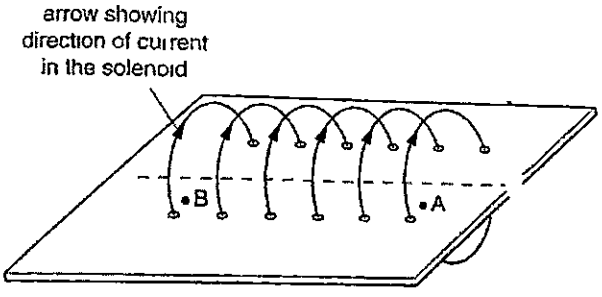


Fig 9.1

The current in the solenoid creates a magnetic field.

(a) A magnetic field line passes through A and B. Fig 9.2 shows the top view of the solenoid.

Draw the magnetic field lines created by the solenoid and the polarities of the solenoid in Fig 9.2.

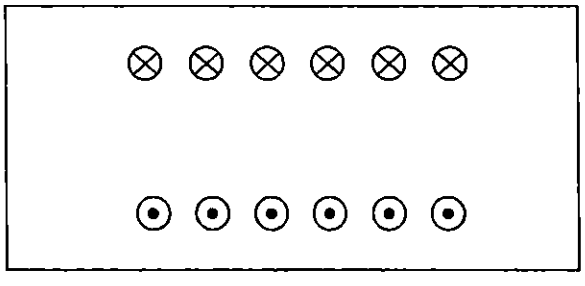


Fig 9.2

[2]

(b) **(i)** The current in the solenoid is reversed.

State the effect this has on the strength and direction of the magnetic field lines.

.....

.....[2]

(ii) State how the pattern of the magnetic field lines inside the solenoid changes when the current through the solenoid increases.

.....

.....[2]

Section A [50 marks]

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

Name: _____ Class _____ Index Number _____

Section B (30 marks)

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

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

10 Fig. 10.1 shows the lens of a simple camera being used to photograph an object.

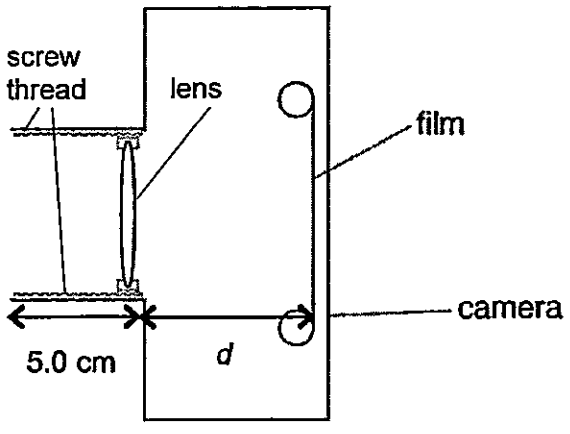


Fig. 10.1

(a) **(i)** The object in Fig. 10.1 is very far away from the camera. The lens is then adjusted to distance *d* from the film so that the sharpest image is produced.

State what distance *d* represents of a lens.

..... [1]

(ii) State the characteristics of the image formed.

..... [1]

(b) The lens used in the camera may also be used to produce a virtual image of an object.

State where the object is placed, relative to the lens, for a virtual image to be formed.

..... [1]

(c) Fig. 10.2 shows the lens forming a focused image of the object on the film when the object distance, u, is changed.

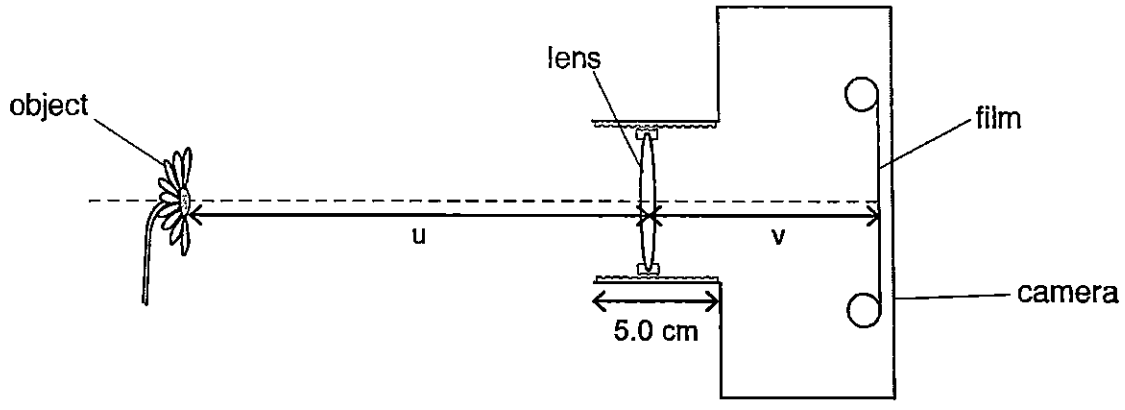


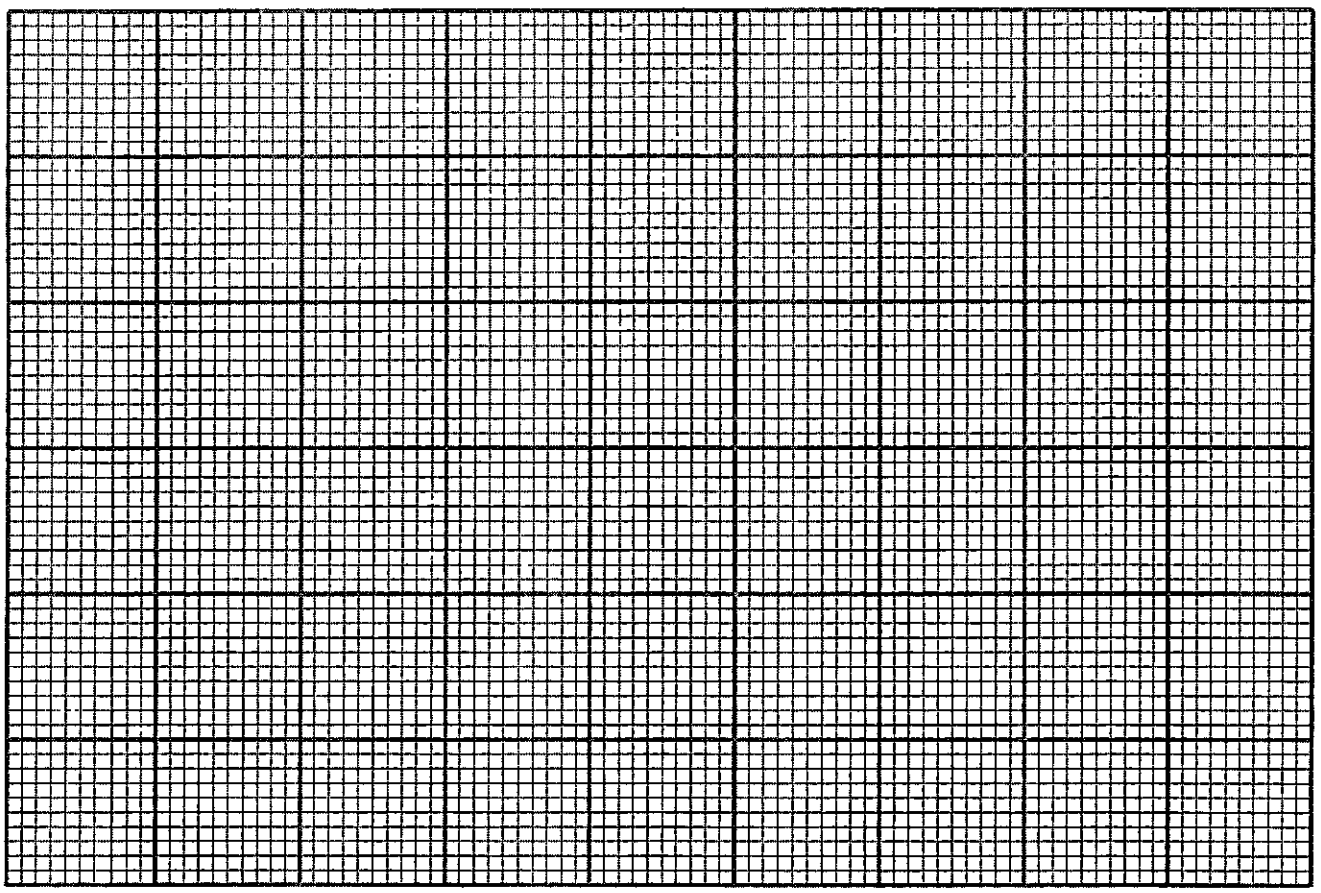
Fig. 10.2

Fig. 10.3 shows the information gathered based on different object distances, u.

Data Set	Object distance, u / cm	Image distance, v / cm	Object height, h_o / cm	Image height, h_i / cm
1	300.0	10.3	20.0	0.7
2	200.0	10.5	20.0	1.1
3	100.0	11.1	20.0	2.2
4	50.0	12.5	20.0	5.0
5	25.0	16.7	20.0	13.3

Fig. 10.3

(i) **1.** Based on the data set **4** from Fig. 10.2, use the grid below to draw a scaled ray diagram of the set-up.



2. Determine the focal length of the converging lens used.

..... [1]

(ii) Explain why the rays of light change direction as they enter the lens.

.....

..... [1]

(iii) Using Fig. 10.3, determine which data set shows the situation when the camera is unable to focus a sharp image on the film.

..... [1]

(iv) Explain your answer in **(c)(iii)**.

..... [1]

(v) Describe what would happen to the image formed for Data Set 1 if the lower half of the converging lens is chipped off.

..... [1]

11 **(a)** Fig. 11.1 shows a setup with an electric current *I* passing through wire XY.

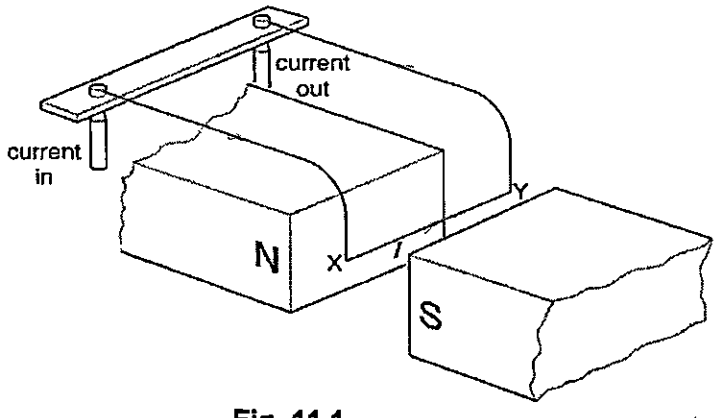


Fig. 11.1

State the direction of the force acting on XY and describe how Fleming's Left Hand rule is used to determine this force.

.....

.....

..... [2]

(b) In order to measure the force exerted on wire XY in **(a)**, Fig. 11.2 shows a pan and some weights added to the setup. The force exerted on XY is then measured by putting weights in the pan until XY is brought back up to its original position.

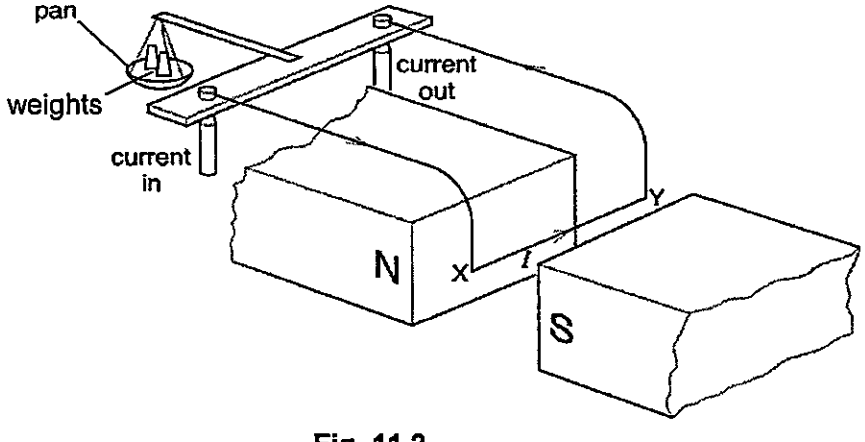


Fig. 11.2

(i) State whether the pan will move up, move down or remain at the original position when the two magnets are brought closer to each other.

..... [1]

(ii) Explain your answer in **(b)(i)**.

.....

.....

..... [2]

(c) An iron bar has many turns of wire wrapped around it, as shown in Fig. 11.3. The wire is connected to an alternating current supply. Some more wire is made into a flat coil and connected across a low voltage lamp.

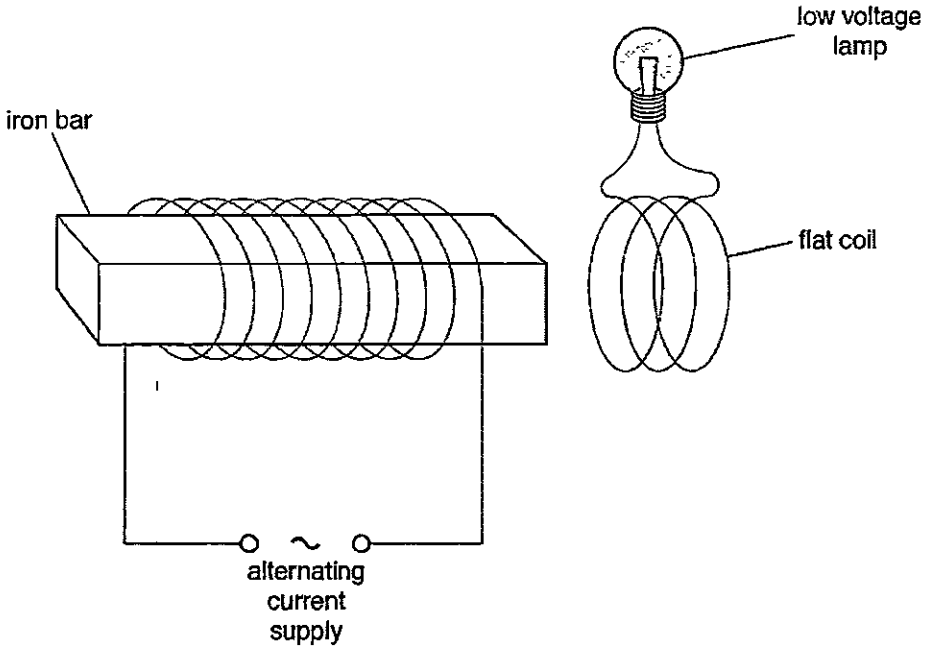


Fig. 11.3

(i) When the flat coil is held close to the end of the iron bar, the lamp glows.

Explain why this happens.

.....

.....

.....

.....

.....

.....

..... [3]

(ii) An alternating current of a lower frequency is then supplied to the set up in Fig. 11.3.

Explain what would be observed of the lamp in Fig. 11.3.

.....

.....

..... [2]

12 EITHER

Fig. 12.1 shows the horizontal forces as a cyclist travels forward from A to B.

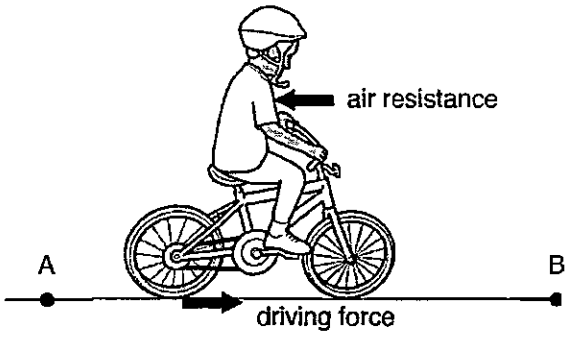
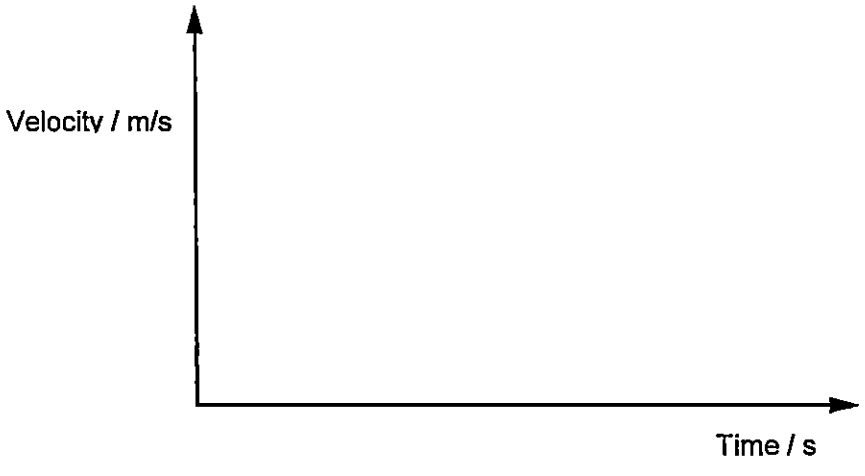


Fig. 12.1

The cyclist produces a constant driving force that acts on the back wheel. As her speed increases, the air resistance increases.

She accelerates from rest at A until a velocity of 4.0 m/s is reached. She then continues at that constant velocity towards B.

(a) Complete the velocity-time graph of the bicycle until the constant velocity is reached. [2]



(b) The total mass of the bicycle and the cyclist is 75.0 kg.

Calculate the kinetic energy of the bicycle and the cyclist at B.

kinetic energy = ... [2]

(c) Fig. 12.2 shows the subsequent journey taken by the cyclist beyond point B.

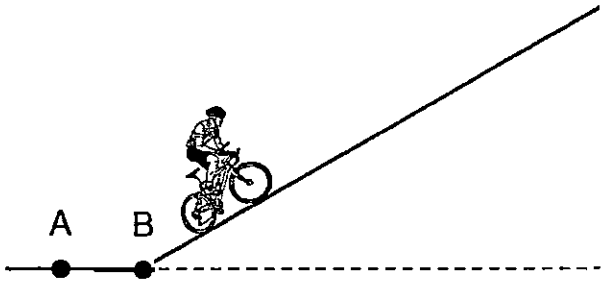


Fig. 12.2

Describe the energy changes that take place as she pedals up the hill at constant speed.

.....

.....

.....

.....

.....

.....

..... [3]

(d) Some bicycle frames are made from low density materials. Suggest and explain, in terms of energy changes, why this is an advantage.

.....

.....

.....

.....

.....

.....

..... [3]

OR

Fig. 12.3 shows a room heater used during winter in some countries. Fig. 12.4 is a diagram of the electric circuit of the heater.

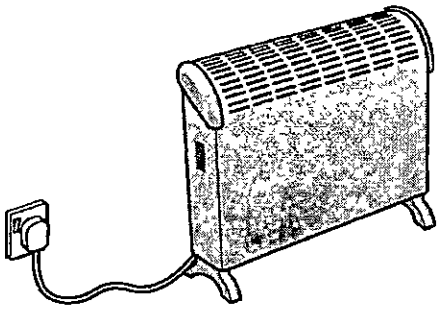


Fig. 12.3

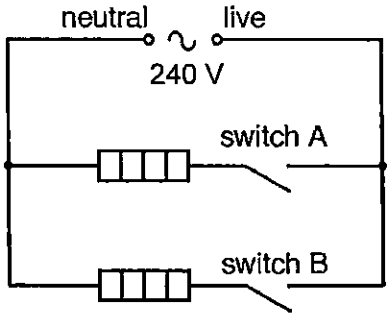


Fig. 12.4

The fuse has not been drawn on the circuit diagram in Fig. 12.4.

(a) (i) On Fig. 12.4, draw the symbol for a fuse in the correct position. [1]

(ii) Describe why it can be dangerous when a fuse of the wrong value is used in the plug.

.....

..... [1]

(iii) State the part of the room heater to which the earth wire is connected.

..... [1]

(iv) The earth wire reduces the chance of an electric shock if a fault develops in the room heater.

1. State one fault that causes an electric shock when a person uses the room heater without an earth connection.

.....

..... [1]

2. Explain how using an earth connection prevents an electric shock.

.....

.....

.....

.....

..... [2]

(b) Fig. 12.5 shows the power output of the room heater when each switch is closed.

	power / W
switch A only closed	600
switch B only closed	1500
both switches closed	2100

Fig. 12.5

(i) Determine the current through the room heater when only switch B is closed.

current = ... [2]

(ii) The room heater is used with both switches closed for 2.5 hours.
Calculate the energy output of the room heater in joules.

energy = ... J [1]

(c) Fig. 12.6 shows a mains extension lead. The six sockets allow several electrical appliances to be connected to the mains supply through one cable.

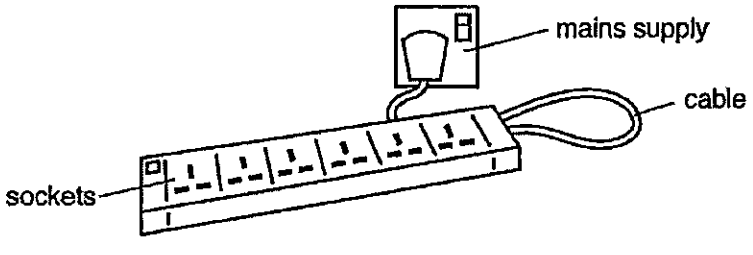


Fig. 12.6

Six powerful lamps are plugged into the sockets and switched on, one by one.

Suggest what happens in the cable as the lamps are switched on, one by one.

.....

..... [1]

--- End of Paper ---

Answer Scheme (Sec 4 Prelim Exam 2015)
Paper 1 - MCQ

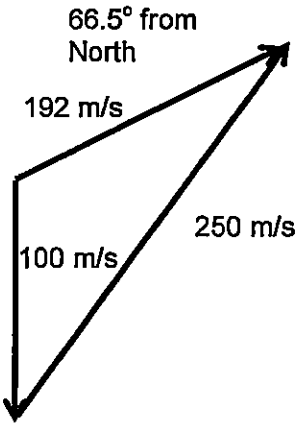
1	2	3	4	5	6	7	8	9	10
D	A	C	D	D	D	C	A	A	B
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
B	B	B	A	C	C	C	B	D	B
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
B	C	D	C	D	A	D	B	B	B
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
C	B	D	C	B	A	A	C	B	B

Section (A)

1 **(a)** **(i)** A <u>resultant force and acceleration</u> is produced when the forward force is greater than the frictional force. B1

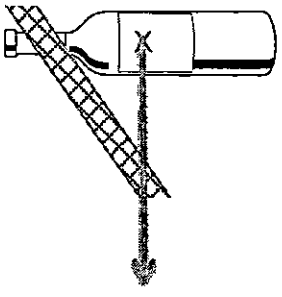
(ii) F=frictional F – ma = 2000 + (20000 x 5) C1
= 102,000 N A1

(b)



B1 – arrow is correct direction & shape of triangle
B2 – accuracy of answers
B1 – appropriate scale used (diagram should fit the space given in the paper)

2 (a)



B1

(b) Line of action of force of CG acts at the B1
base of the bottle holder B1

(c) The line of action of force of CG is not located within the base of the bottle holder. B1

Net moment is not zero. B1
OR
CW moments is more than ACW moments
OR
ACW moments is more than CW moments
OR any statement to that effect

3 (a) (i) Pressure is force per unit area. B1

(ii) $F=PA = 300 \times 10^3 \times 1.26 \times 10^{-3}$ C1
$= 378$ N A1

(b) Workdone by pump on gas increases internal energy B1
Energy is transformed into faster movement of air molecules, having more collisions B1
Avg KE of air molecules increase B1

4 (a) Wax in both rods melts. B1
Wax on Cu rod will melt more quickly. B1

(b) Thermal energy is transferred from hot end to cold end through particles colliding with less energetic neighbours. B1
Free electron diffusion – when heated, free e- gain energy and move faster across to colder region B1

5 (a) Incident ray is same angle as normal. B1

b(i) N=speed of light in vacuum/speed of light in medium B1

(b) $c/v = n$

(ii) $v = 3x10^8/1.5$ C1

$= 2.0x10^8$ m/s A1

(c) Ray RS will move anti clockwise towards glass block boundary. B1

RS - TIR will occur after the ray PR (incident angle) exceeds critical angle. B1

6 (a) Human reaction time to operate stop watch is too slow to measure the time duration. B1

(b) $V=d/t = 2/5.9x10^{-3}$ C1

$=339$ m/s A1

(c) Relocate loudspeakers to opposite ends to reduce effects of wind. B1

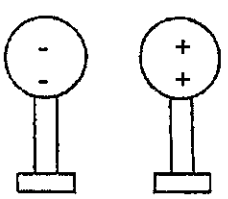
7 (a) (i) Friction removes e- from cloth and transfers to the plastic. B1

Cloth has excess +ve charges. B1

(ii) Metal is a conductor that conducts charges through the skin and is able to B1

discharge the excess charges to earth B1

(b)



B1 correct placement of +ve and –ve charges

B1 Same # of charges for both spheres.

8 (a) $V/R=I$

$12/350 =$ C1

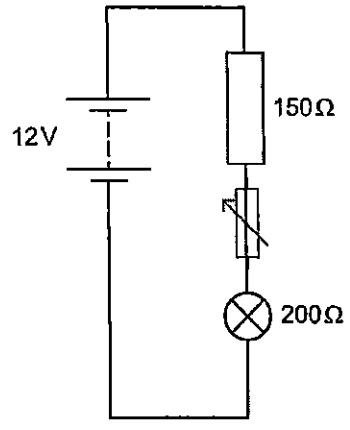
0.034 A A1

(b) $V=IR$

$=200 \times 0.034$ A1

$= 6.8$ V

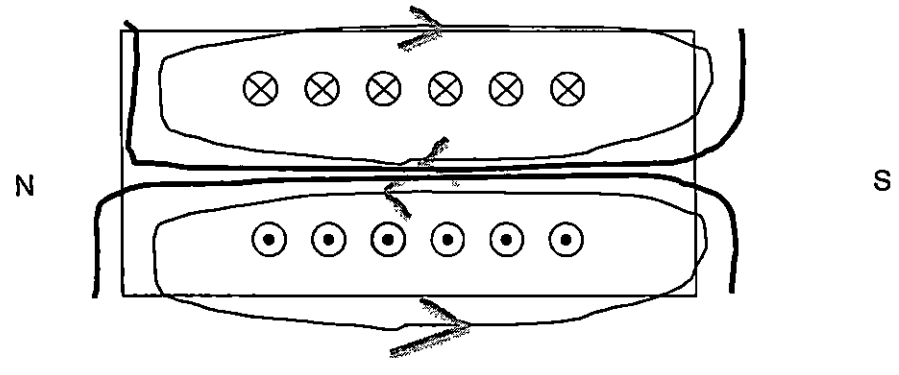
(c) B1



variable resistor symbol drawn in suitable position on circuit (symbol must be correct)
LDR is accepted (provided correct symbol is used)

(d) brighter B1
p.d. / voltage (across lamp) and/or current is greater B1

9 **(a)**



B1 Correctly identify polarity
B1 correct magnetic field lines drawn

(b) (i) Polarity is reversed but B1
magnetic field strength remains unchanged. B1

(ii) More magnetic field lines and B1
more densely packed. B1

Section B

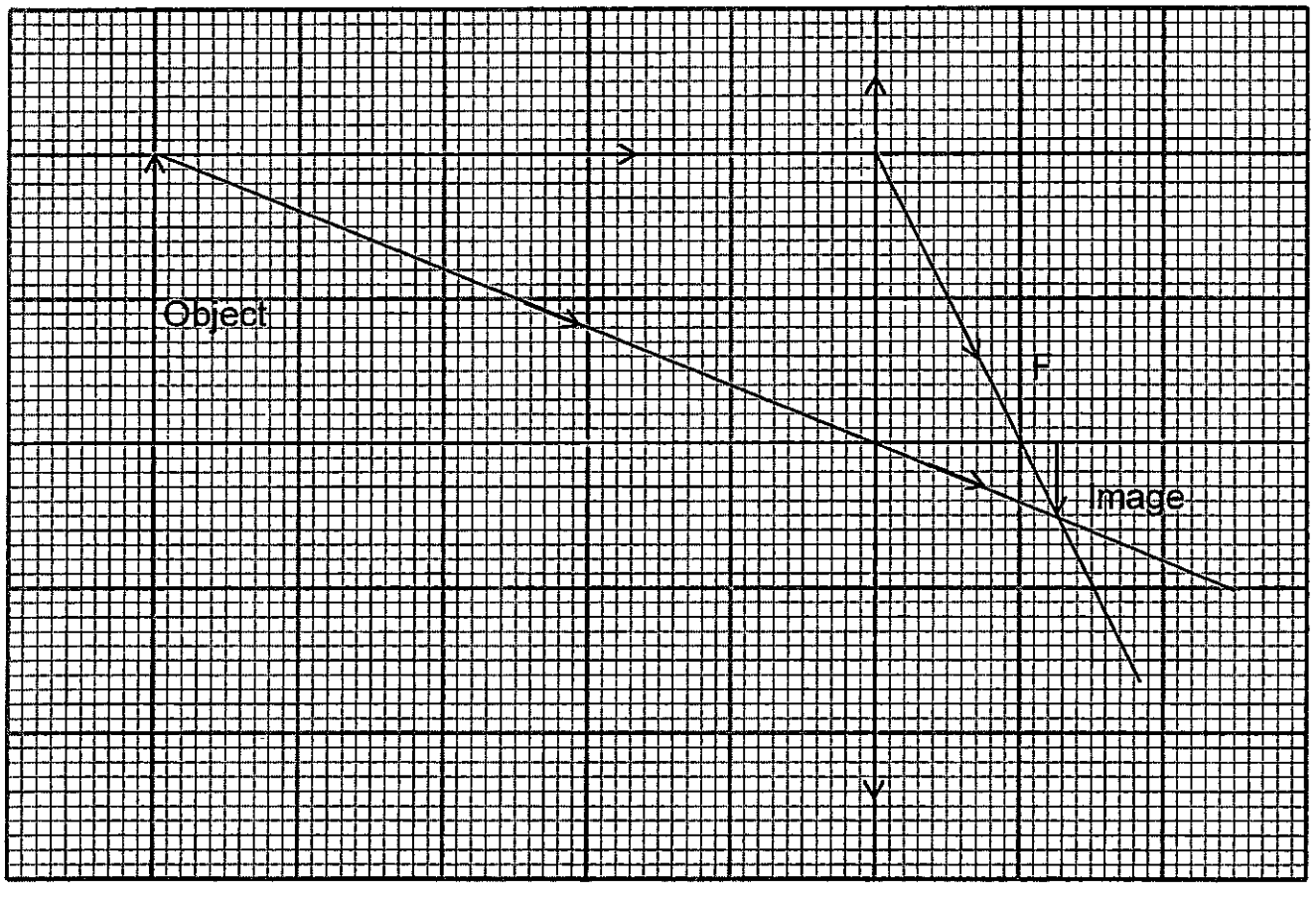
10 (a) (i) focal length of the lens [B1]

10 (a) (ii) inverted, real and diminished [B1]

10 (b) at a distance less than the focal length / d.
OR distance between focal point and the (optical centre of the) lens [B1]

10 (c) (i) 1. [B2] 2 rays correctly drawn

[B1] correctly identified focal length



2. focal length = 10.0 ± 1.0 cm (to the correct d.p., this is a measurement!)

10 (c)(ii) As light enters the lens, ***the speed of light decreases as it moves from an optically less dense to an optically denser medium.***
OR There is a ***change in speed of light as it travels from one medium to another.*** [B1]

10 (c) (iii) Data Set 5 [B1]

10 (c) (iv) (ecf on focal length)

The ***maximum distance between the lens and the film is 15.0 cm*** (5.0 cm + focal length).

OR image will not be able to focus any sharp image when the ***image distance greater than 15.0 cm.*** [B1]

10 (c) (v) ***Dimmer / less bright*** but no difference in the image formed [B1]

11 (a) Downwards [B1]

Thumb to point to the force that results due to magnetic field indicated by the index (1st) finger, and the middle (2nd) finger to point in the direction of the current *at right angle to each other* [B1]

11 (b) (i) Pan moves up [B1]

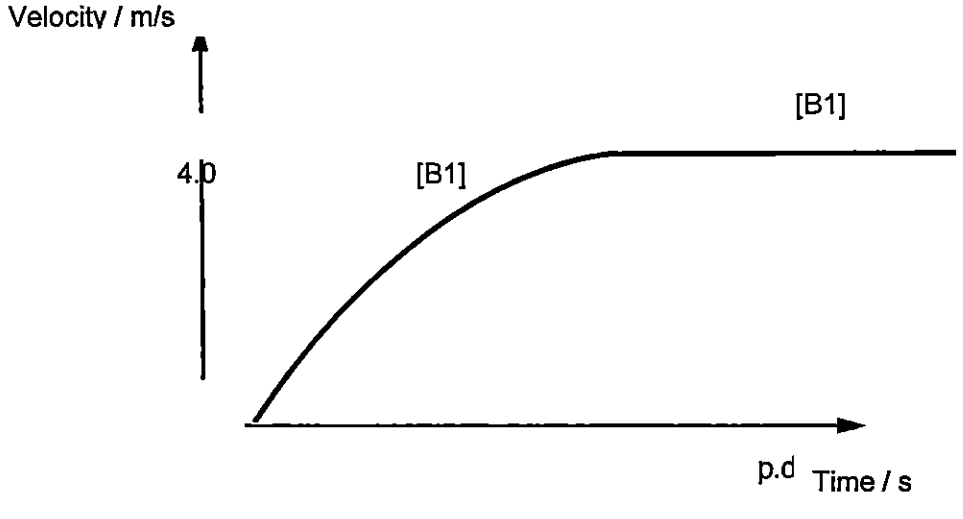
11 (b) (ii) magnetic field strength increases / stronger magnetic field / magnetic field lines are closer [B1]

a larger clockwise moment about pivot is produced [B1]

11 (c) (i) changing magnetic field [B1]
magnetic flux linkage / magnetic field lines being cut etc. [B1]
induced emf / current / electricity [B1]

11 (c) (ii) lamp will be blinking / flickering at a lower rate (speed)
OR dimmer [B1]
Lower rate of cutting of magnetic field lines / magnetic flux linkage [B1]

12 Either
(a)



(b) $E = \frac{1}{2} mv^2$

= ½ (75) $(4)^2$ [C1]
= 600 J [A1]

(c) Kinetic Energy remains constant throughout [B1]

chemical (potential) energy at start ⇒ GPE *increases* [B1]

+ thermal energy/heat/internal energy produced [B1]

(d) lower mass / weight of cycle, *with volume constant* [B1]

Any of the following:
- less energy / work (input) to go uphill [B1]
- due to less friction / [B1]

OR
- less kinetic energy / ½ mv^2 less
- able to travel at the same speed / less stopping distance

OR
- keeping kinetic energy the same
- travel at a higher speed move faster

OR
- less GPE
- greater distance moved up the hill

12 OR

(a) (i) fuse symbol correct and in live wire before junction of two elements [B1]

(a) (ii) (wire) melts/causes fire (not blows/melts fuse) [A1]

(a) (iii) the (metal) case/outside [B1]

(a) (iv) 1. live wire touches case [B1]

2. earth wire of a low resistance [B1]
current goes to earth [B1]

(b) (i) I = 1500 / 240 = **6.25 A**
[C1, A1]

(b) (ii) Energy in Joule = 2100 x 2.5 x 3 600
= **18.9 MJ = 1.89 x 10^7 J** [A1]

(c) (wire) heats up/current increases/electrons move faster [C1]

--- End of Paper ---