O

GAN ENG SENG SCHOOL
Preliminary 2 Examination 2015

CANDIDATE NAME

CLASS

INDEX NUMBER

PHYSICS
Paper 1 Multiple Choice

5059/01

15 September 2015
1 hour

Sec 4 Express

Additional Materials: OTAS

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

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

There are forty questions in this paper. Answer all questions. For each question there are four possible answers **A**, **B**, **C**, and **D**.
Choose the one you consider correct and record your choice in soft pencil on the separate OTAS.

Read the instructions on the OTAS very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.

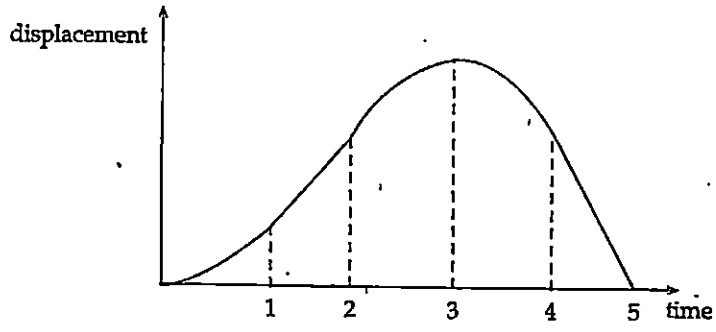
Any rough working should be done in this booklet.

Total Marks
/40

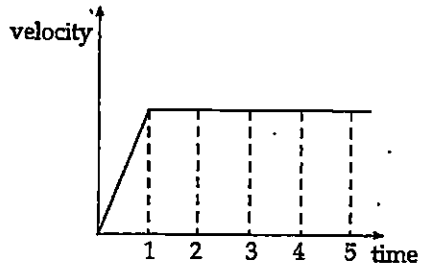
1 Which instrument is used to measure directly the circumference of a table tennis ball?

A measuring tape
B metre rule
C micrometer
D vernier calipers

2 The graph shows the displacement-time graph of the journey of a car.



What is the shape of the velocity-time graph for the journey of the car?

A


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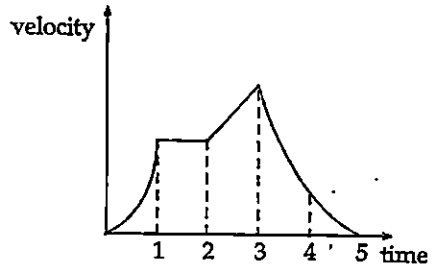

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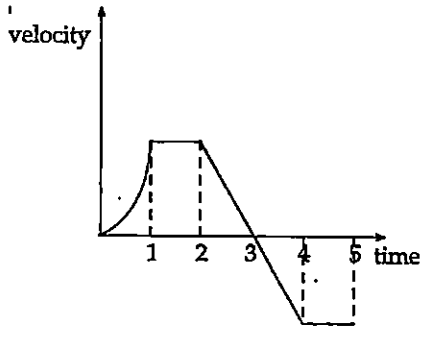
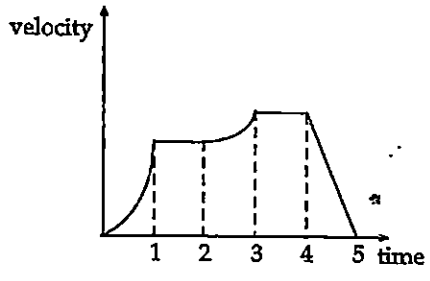


D


3 A bus travelling at 3 m s^{-1} passes a bus stop. What is the speed of the bus when it has travelled 150 m if it has been accelerating at 2 m s^{-2}?

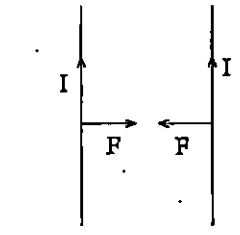
A 25 m s^{-1}
B 30 m s^{-1}
C 35 m s^{-1}
D 50 m s^{-1}

4 At lift off, the mass of the Long March 3C rocket is 3.45×10^5 kg. The rocket engines produce a thrust of 4 443 kN. The gravitational field strength g is 10 N/kg. What is the initial acceleration of the rocket?

A 0.0777 m s^{-2}
B 2.88 m s^{-2}
C 1.29 m s^{-2}
D 12.9 m s^{-2}

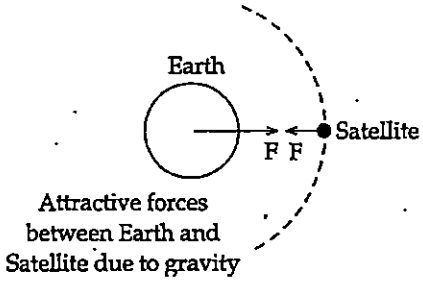
5 Which of the following pairs of forces is not a valid example of action and reaction forces according to Newton's third law of motion?

A



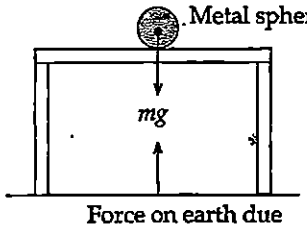
Attractive forces between current carrying wires

B



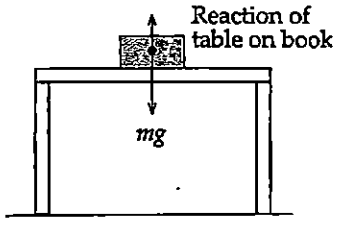
Attractive forces between Earth and Satellite due to gravity

C



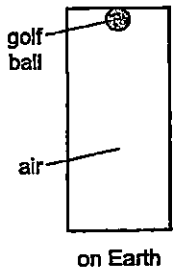
Force on earth due to metal sphere

D



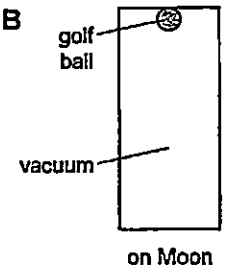
6 The diagrams show four experiments in which a ball falls from the top to the bottom of identical sealed glass tubes. In which experiment does the ball take the shortest time to reach the bottom of the tube?

A



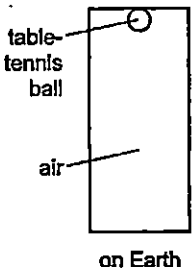
on Earth

B



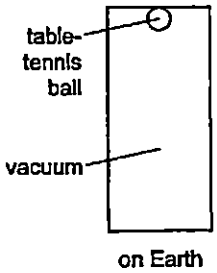
on Moon

C



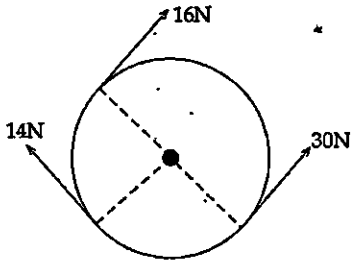
on Earth

D



on Earth

7 Three forces of magnitude 14 N, 16 N and 30 N are applied on a wheel as shown.



Which of the statements regarding resultant force and resultant moment are correct?

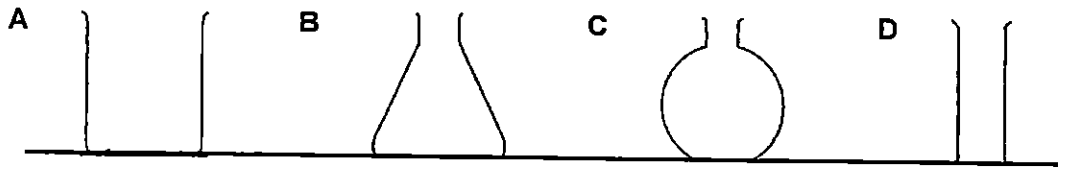
A Both resultant force and resultant moment are non-zero.

B Both resultant force and resultant moment are zero.

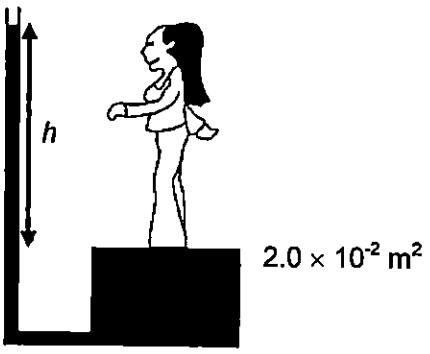
C Resultant force is non-zero but resultant moment is zero.

D Resultant force is zero but resultant moment is non-zero.

8 The diagram shows four containers made from thin glass. Which empty container is the **most** stable?



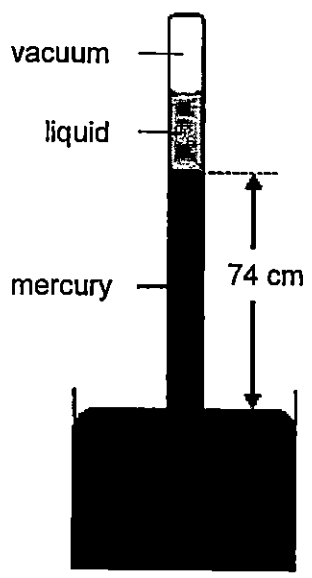
9 The diagram (not drawn to scale) below shows Ziqian of mass 50 kg standing on a platform over the piston of area 2.0×10^{-2} m^2.



What is the height of water *h* that will just support her? Assume that the density of water is 1 000 kg m^{-3}.

A 0.25 m **B** 2.5 m **C** 5.0 m **D** 10 m

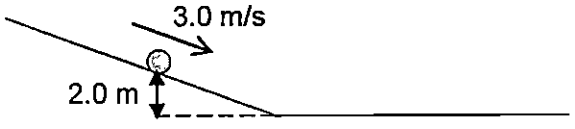
10 The diagram shows a barometer containing a liquid density 1 200 kg m^{-3} above the mercury column. Given that the density of mercury is 13 600 kg m^{-3}.



If the atmospheric pressure is 76 cm Hg, then the height of the liquid is ..... .

A 2 cm **B** 11.3 cm **C** 22.7 cm **D** 76 cm

11 A ball of mass 400 g rolls down a hill. 2.0 m above the bottom of the hill, the speed of the ball is 3 0 m/s.



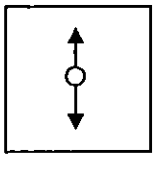
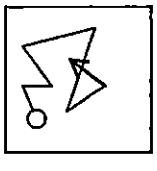
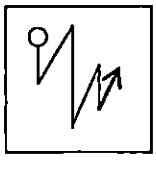
The gravitational field strength g is 10 N/kg. Ignoring the effects of friction and air resistance, what is the kinetic energy of the ball at the bottom of the hill?

A 1.8 J **B** 8.0 J **C** 8.6 J **D** 9.8 J

12 The motor which drives a lift is working at 80 % of its maximum power. The mass of the lift and its load is 500 kg and they are moving vertically upwards at a constant speed of 2 m s^{-1}. What is the maximum power of the motor? (Take g = 10 m s^{-2}.)

A 1 000 W **B** 8 000 W **C** 10 000 W **D** 12 500 W

13 Which one of the following diagrams represents Brownian motion?

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

14 The pressure of a fixed mass of gas at constant volume is smaller at a lower temperature because ..... .

A energy transferred to the walls during collision decreases

B molecules travel shorter distances between collisions with one another

C the mean time between molecular collisions becomes shorter

D the molecules collide with the container walls less frequently

15 The bulb of a thermometer is wrapped in a tube of cotton fabric. The fabric is dipped into water at room temperature and left for some time. The thermometer wrapped in wet fabric is then removed and evaporation takes place. What happens to the thermometer reading?

A It falls. **B** It remains unchanged.

C It rises. **D** It rises and then falls.

16 Four bars, all of exactly the same size, are each placed with one end in boiling water. The times taken for the temperature of the other end to increase by 2 °C are measured.

material of bar	time for 2 °C rise / s
aluminium	10
copper	5
cork	800
styrofoam	1 200

To make a large metal tank with the least heat loss, which materials should be used for the walls of the tank and its insulation?

	tank	insulation
A	aluminium	cork
B	aluminium	styrofoam
C	copper	cork
D	copper	styrofoam

17 A heated body is allowed to cool in air. Which of the following statements is **incorrect**?

A Loss of heat at moderate temperatures under ordinary conditions is mainly through convection.

B Loss of heat by conduction through the air is inefficient because air is a bad conductor.

C Loss of heat through radiation is most effective for small temperatures excesses.

D The processes of conduction, convection and radiation are in operation.

18 Which of the following statement(s) is/are **incorrect**?

I An object of higher mass will have higher internal energy than another object of lower mass.

II An object of higher temperature will have higher internal energy than another object of lower temperature

III Two different solid objects of the same mass and temperature will have the same internal energy.

A III only

B I and II only

C I, II and III

D none of the above

19 The energy required to change liquid water into water vapour at the same temperature is called latent heat of vaporisation. What does this energy do?

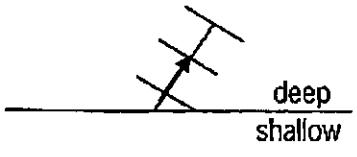
A increases the average separation of the water molecules

B increases the average speed of the water molecules

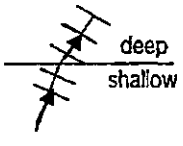
C raises the temperature of the air near the water

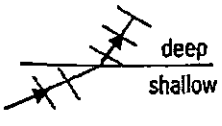
D splits the water molecules into their separate atoms

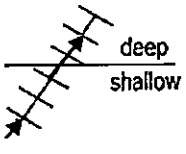
20 The diagram shows planar water waves travelling from shallow water into deep water.

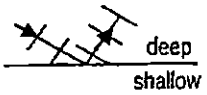


Which one of the following diagrams best describes the water in the shallow water?

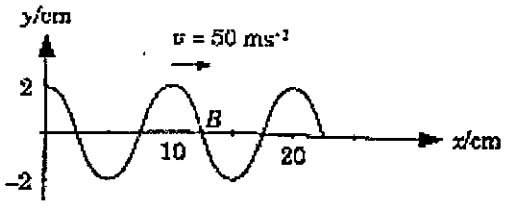
A


B


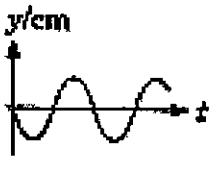
C


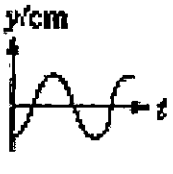
D


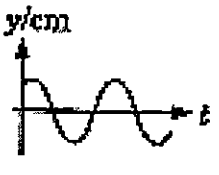
21 The graph represents the shape at a particular instant of part of a transverse wave travelling along a string with a speed of 50 m s^{-1} to the right.

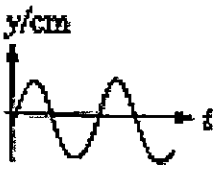


Which of the following graphs represents the subsequent displacement-time relation for particle *B* situated at x = 12.5 cm?

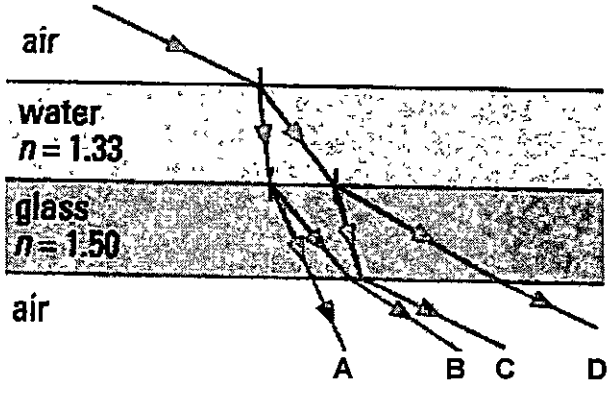
A


B


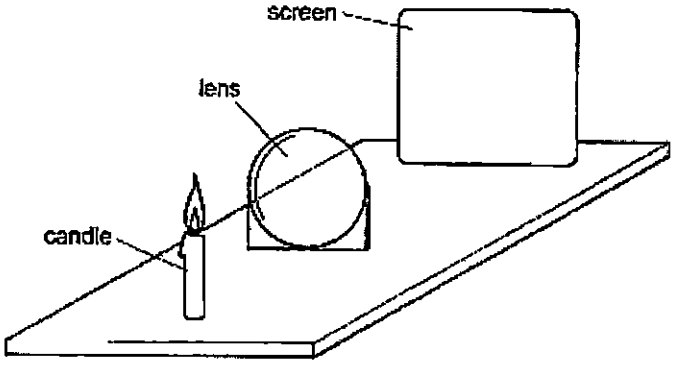
C


D


22 The diagram shows a ray of light passing from air through water, from water through glass and finally into air. Which of the following is the path taken by the light ray?



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 is **always** correct?

A The image is at the principal focus (focal point) of the lens.

B The image is bigger than the object.

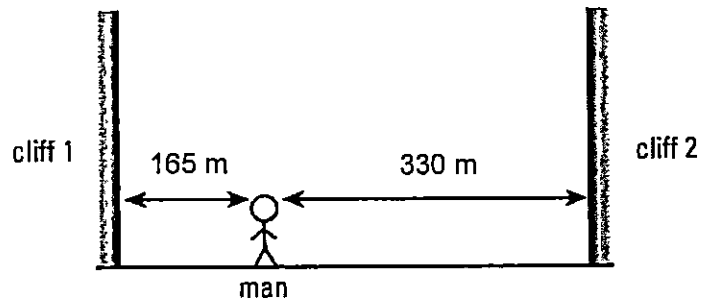
C The image is closer to the lens than the object is.

D The image is inverted.

24 The wavelength of X-rays is roughly the size of an atom. What is the frequency of the X-rays?

A 1×10^{-9} Hz **B** 3×10^{8} Hz **C** 1×10^{9} Hz **D** 3×10^{17} Hz

25 Ryan stands between two tall cliffs as shown in the diagram.



He fires a starting pistol and hears some echoes. Assuming the speed of sound in air is 330 m s^{-1}, what is the time interval between the two loudest echoes?

A 0.5 s **B** 1.0 s **C** 1.5 s **D** 3.0 s

26 Two notes are played on a piano. The second note has a lower pitch but is louder. Which of the following is true of the amplitude and frequency of the second note?

	Amplitude	**Frequency**
A	higher	higher
B	higher	lower
C	lower	higher
D	lower	lower

27 A stationary negative charge in an electric field experiences an electric force in the direction shown.

What is the direction of the electric field?

A horizontally to the left **B** horizontally to the right

C vertically downwards **D** vertically upwards

28 Shernis holds a rod in one hand and rubs the rod with a thin sheet of material held in her other hand. Both the rod and the thin sheet become charged and remain charged. From what could the rod and the thin sheet be made?

	rod	thin sheet
A	copper	silk cloth
B	glass	aluminium foil
C	iron	paper handkerchief
D	nylon	woollen duster

29 Why can birds stand on an overhead high voltage transmission line without suffering any harm?

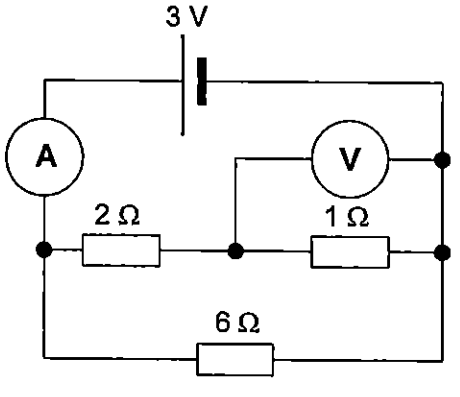
A They are not connected to earth.

B The spaces between their feathers act as insulators.

C Their feet are very good insulators.

D Their bodies have a very high resistance.

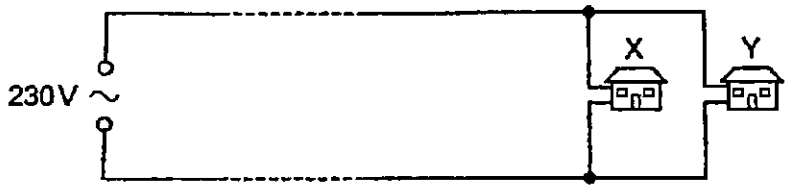
30 The circuit diagram shows an ammeter of negligible resistance, a voltmeter of infinite resistance, three resistors and a cell.



What is the ammeter and voltmeter reading?

	ammeter	voltmeter
A	0.5 A	0.5 V
B	1.5 A	1 V
C	3 A	3 V
D	6 A	6 V

31 The diagram shows a long transmission line supplying energy at 230 V to two house X and Y without using transformers In both houses, electric heaters are switched on.



The occupier of house X switches off the heaters in his house. What happens in house Y?

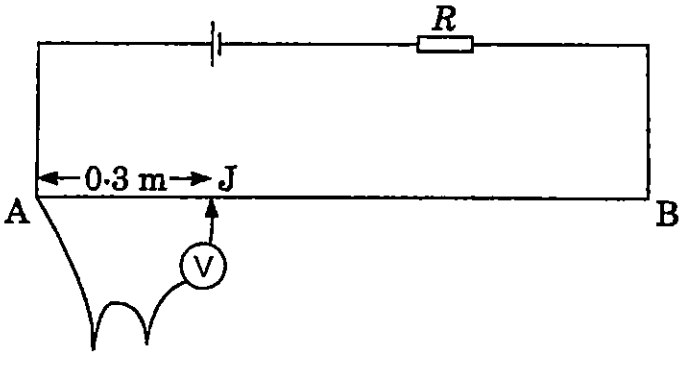
A There is a fall in the voltage supplied and in the power used.

B There is a fall in the voltage supplied but no change in the power used.

C There is a rise in the voltage supplied and in the power used.

D There is a rise in the voltage supplied but no change in the power used.

32 The diagram shows a simple potentiometer circuit adapted to measure the electromotive force (e.m.f.) of a thermocouple.



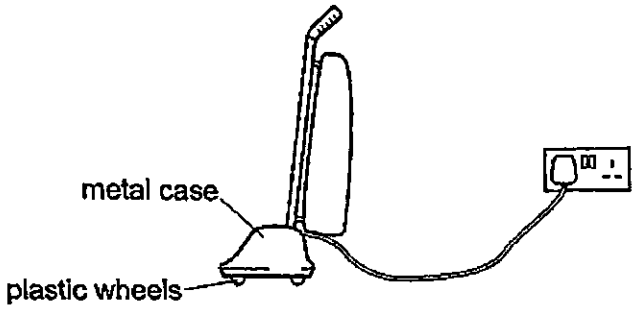
The metre wire AB has a resistance of 5.0 Ω and the cell has an e.m.f. of 2 V. If a balance is obtained 0.3 m along AB when measuring a thermocouple e.m.f. of 6 mV, what is the value of the resistance *R*?

A 95 Ω B 195 Ω C 495 Ω D 995 Ω

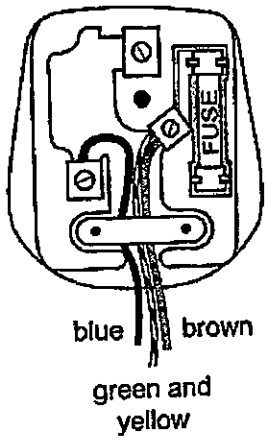
33 A torch light bulb takes a current of 0.2 A from a 1.5 V supply for 3 minutes. How much electrical energy and power is used?

	energy	power
A	0.3 J	54 W
B	0.9 J	7.5 W
C	7.5 J	0.9 W
D	54 J	0.3 W

34 The diagram shows an old vacuum cleaner with plastic wheels and a metal case.



The plug of the vacuum cleaner is wrongly wired as shown.



What is the effect of using the plug wired this way?

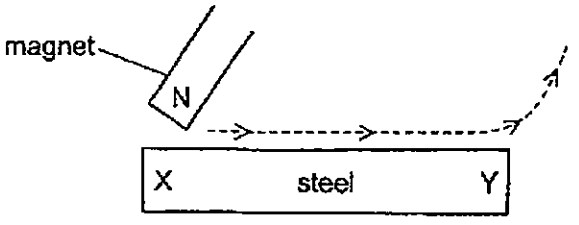
A The fuse in the plug blows.

B The metal case becomes live.

C The vacuum cleaner catches fire.

D The vacuum cleaner does not work.

35 A piece of steel can be magnetised by stroking it with a magnet.



When the magnet is moved in the direction shown, which poles are produced at X and at Y?

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

36 What correctly describes the field produced in the region surrounding a solenoid that carries a current?

A A region where electric charges gain energy.

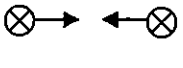
B A region where magnetic poles experience a force.

C A region where magnetic poles gain energy.

D A region where stationary electric charges experience a force.

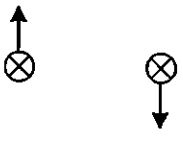
37 Each diagram is a cross-section through two parallel current-carrying conductors. In both conductors, the current direction is **into** the plane of the paper. Which diagram shows the forces on the two conductors?

A

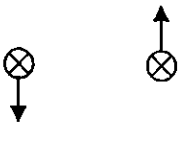


B

C



D

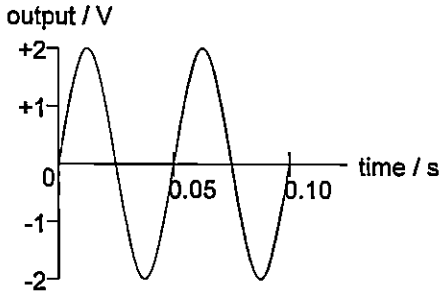


38 The diagram shows a beam of electrons moving into a magnetic field. The direction of the magnetic field is **into** the paper.

As the electron beam passes through the field, in which direction will the electron beam be deflected?

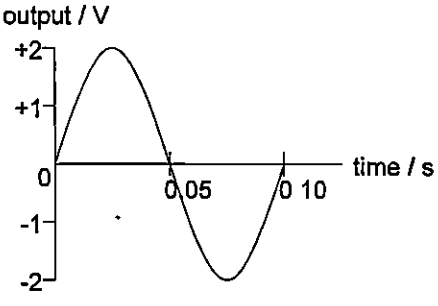
A downwards **B** into the paper **C** out of the paper **D** upwards

39 The graph shows the output of an a.c. generator. The coil in the generator rotates 20 times in one second.

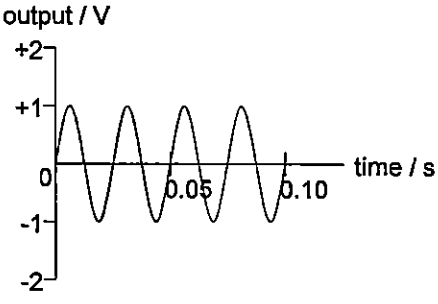


Which graph shows the output when the coil rotates 10 times in one second?

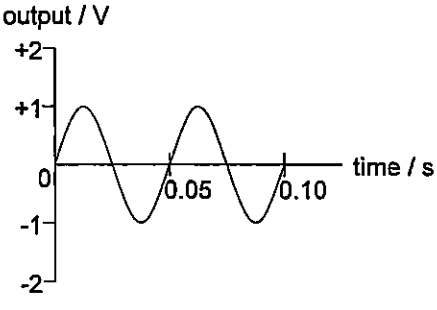
A



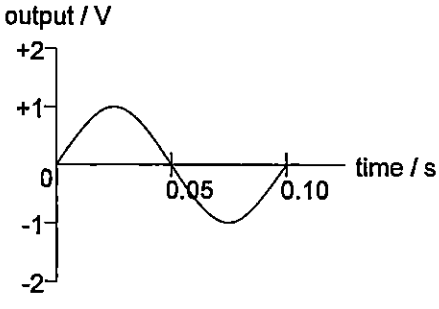
B



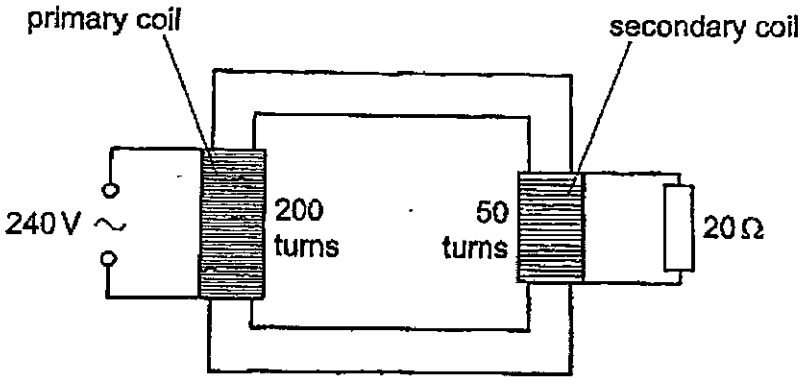
C



D



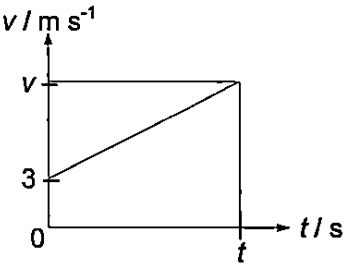
40 The secondary coil of an ideal transformer is connected to a 20 Ω resistor.



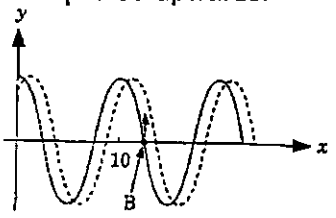
What is the current in the **primary** coil?

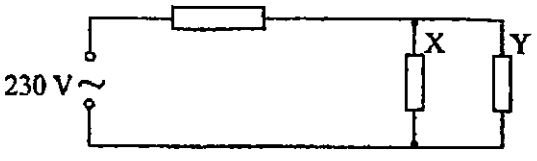
A 0.75 A **B** 1.3 A **C** 3.0 A **D** 12 A

END OF PAPER

Question	Answer	Explanation
1	A	While vernier calipers can be used to measure the diameter of the table tennis ball and the circumference can be calculated, it is not the direct method. The most direct method would be to use measuring tape.
2	C	gradient of displacement-time graph = velocity
3	A	$a = \frac{v-u}{t}$ $2 = \frac{v-3}{t}$ $t = \frac{v-3}{2}$ area under velocity-time graph = displacement travelled $\frac{1}{2}(3+v)t = 150$ $(3+v)\left(\frac{v-3}{2}\right) = 300$ $v^2 - 3^2 = 600$ $v \approx \underline{25\ \text{m s}^{-1}}$ 
4	B	Using Newton's 2nd Law, ↑ thrust – weight = mass × acceleration ↑ $(4\,443 \times 10^3) - [(3.45 \times 10^5) \times 10] = (3.45 \times 10^5) \times a$ ↑ $a \approx \underline{2.88\ \text{m s}^{-2}}$
5	D	Action and reaction forces cannot be acting on the same body.
6	D	The shortest time taken would be the experiment which has the least air resistance (i.e. vacuum) and the largest acceleration due to gravity (i.e. on Earth and not on Moon).
7	C	Resultant force is non-zero as the directions and magnitudes of the three forces are different. Clockwise moment = $(14 \times r) + (16 \times r)$ Anti-clockwise moment = $(30 \times r)$ ∴ Resultant moment = <u>0 N m</u>
8	B	The most stable container is the one with the broadest base. Both beaker and conical flask have the same base area but conical flask is more stable as its top is narrower than its base.
9	B	$\frac{F}{A} = h\rho g$ $\frac{(50 \times 10)}{(2.0 \times 10^{-2})} = h \times 1000 \times 10$ $h = \underline{2.5\ \text{m}}$

Question	Answer	Explanation
10	C	Liquid pressure = 76 cm Hg – 74 cm Hg = 2 cm Hg $h \times 1\,200 \times 10 = 2 \times 13\,600 \times 10$ h = <u>22.7 cm</u>
11	D	By the principle of conservation of energy, E_k at the bottom = sum of E_p and E_k at 2.0 m $= mgh + \frac{1}{2}mv^2$ $= (0.4 \times 10 \times 2.0) + (\frac{1}{2} \times 0.4 \times 3.0^2)$ = <u>9.8 J</u>
12	D	$P = Fv$ $= (500 \times 10) \times 2$ = 10 000 W Maximum power = 10 000 ÷ 0.8 = <u>12 500 W</u>
13	B	Brownian motion is the haphazard and random motion of gaseous and liquid molecules. The particle won't be able to move in a curvy path for Newton's first law of motion states that an object in motion will continue to move with constant speed in a straight line unless a net force acts on it.
14	D	At lower temperature, molecules have lesser kinetic energy and move slower. Hence, they collide with the container walls less often.
15	A	When water evaporates from the bulb of the thermometer, it takes away thermal energy from the thermometer, thus causing the temperature to fall.
16	B	To reduce heat loss, both the insulation and the metal tank should take a longer time to heat up. The best insulator is styrofoam and should be used as the insulation. For the metal tank, it should be aluminium which is a poorer conductor of heat than copper.
17	C	Radiation losses are significant only when temperature differences between the hot body and the surroundings are large. When moderate temperature differences are considered, convection is a more important process of heat loss.
18	C	The internal energy of an object depends on mass, specific heat capacity and temperature ($Q = mc\Delta\theta$).
19	A	During boiling, the intermolecular bonds are broken, thus their separation increases. However, as there is no change in temperature during boiling, therefore the kinetic energy of the molecules (and hence average speed) is constant.
20	A	When water travels from shallow region to deep region, its speed increases. The spacing between the wavefronts in the shallow region is smaller than that in the deep region. The water waves in the deep region bend away from the normal.

Question	Answer	Explanation
21	C	As the wave progresses to the right, particle at x = 12.5 cm will next be displaced upwards. 
22	C	When light travels from an optically less dense medium to an optically denser medium, it bends towards the normal, and vice versa.
23	D	All real images formed by thin converging lens are inverted.
24	D	X-ray has wavelength between 10 nm and 0.1 nm. Let the wavelength of X-ray be 1×10^{-9} m. Assume the speed of X-ray = 3×10^{8} m/s. Using $v = f\lambda$, $f = (3 \times 10^{8}) \div (1 \times 10^{-9})$ $= \underline{3 \times 10^{17}\ \text{Hz}}$
25	B	The loudest echo must be the first echo. Time taken for the first echo from cliff 1 to reach Ryan $= (165 \times 2) \div 330$ = 1.0 s Time taken for the first echo from cliff 2 to reach Ryan $= (330 \times 2) \div 330$ = 2.0 s Time interval between the two loudest echoes = 2.0 s – 1.0 s $= \underline{1.0\ \text{s}}$
26	B	The louder the sound, the higher the amplitude is. The lower the pitch of the sound, the lower the frequency is.
27	A	The direction of electric field lines shows the movement of a positive charge when placed in the electric field. Since this is a negative charge which moves to the right, the direction of the electric field must be to the left.
28	D	For both objects to remain charged, they must be insulators.
29	A	Their feet are on the same high voltage transmission line, thus there is no potential difference between them. No current can flow through them. However, if one foot is connected to earth and the other is on the high voltage transmission line, then current will be able to flow through them.

Question	Answer	Explanation
30	B	p.d. across 2 Ω and 1 Ω resistors = p.d. across 6 Ω resistor = 3 V $\therefore$ p.d. across 1 Ω resistor = $\frac{1}{(2+1)} \times 3$ = 1 V total current = $\frac{3}{(2+1)} + \frac{3}{6}$ = 1.5 A
31	C	As it is a long transmission line, there will be a considerable amount of resistance in the transmission line and can be represented in the circuit diagram below.  When the heaters in X are switched off, Y and the transmission line are connected in series. Since Y has a higher resistance than the total resistance of X and Y, it should have a potential difference (voltage). Since $P = \frac{V^2}{R}$ and the resistance of Y remains the same while the voltage across Y is larger, the power supplied to Y also increases.
32	C	When balanced, V_{AJ} = 6 mV. $\therefore V_{AB} = \frac{1}{0.3} \times 6$ = 20 mV $V_{AB} = \frac{R_{AB}}{R_{total}} \times 2$ $20 \times 10^{-3} = \frac{5}{5+R} \times 2$ R = 495 Ω
33	D	$E = VIt$ = 1.5 × 0.2 × (3 × 60) = 54 J $P = VI$ = 1.5 × 0.2 = 0.3 W
34	B	As the earth wire (green and yellow) which is connected to the metal casing is also touching the live wire (brown), it makes the metal casing live. A user who touches the metal casing would therefore get an electric shock.
35	C	During magnetisation by stroking, the end of the magnet that touches the object first will have the same pole.

Question	Answer	Explanation
36	B	When a current passes through a solenoid, a magnetic field is generated.
37	A	Wires carrying current in the same direction will attract each other.
38	A	Use Fleming's Left Hand Rule. The direction of the electron beam is opposite to the direction of the current.
39	D	When the generator rotates 10 times in one second, its frequency is halved, fewer waves are generated. A lower frequency of rotation reduces the amplitude of the output e.m.f..
40	A	$\frac{N_p}{N_s} = \frac{V_p}{V_s}$ $\frac{200}{50} = \frac{240}{V_s}$ $V_s = \frac{50}{200} \times 240$ $= 60$ V current in secondary coil = $\frac{60}{20}$ $= 3$ A Since this is an ideal transformer, there is no power loss. $I_pV_p = I_sV_s$ $I_p \times 240 = 3 \times 60$ $I_p = \underline{0.75\ A}$

O

GAN ENG SENG SCHOOL
Preliminary 2 Examination 2015

CANDIDATE NAME

CLASS

INDEX NUMBER

PHYSICS
Paper 2

5059/02

1 September 2015
1 hour 45 minutes

Sec 4 Express

Candidates answer on the Question Paper.

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A
Answer **all** questions.

Section B
Answer **all** questions. **Question 12** has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

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

For Examiner's Use	
Section A	50
Section B	30
Total	80

Section A [50 marks]

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

For Examiner's Use

1 A stone falls from the top of a cliff into the sea, as shown in Fig. 1.1. The speed-time graph for the stone is shown in Fig. 1.2.

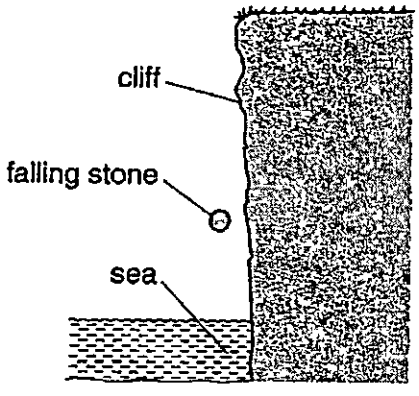


Fig. 1.1

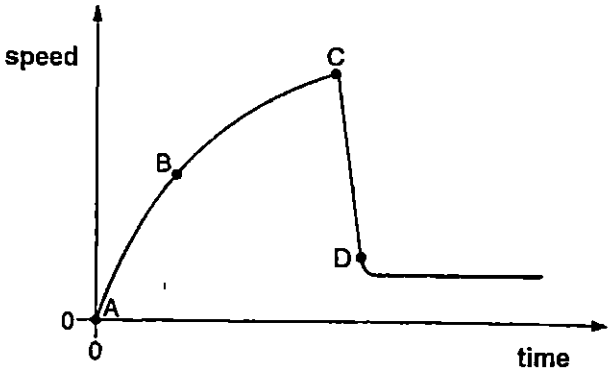


Fig. 1.2

(a) State how the acceleration is found from a speed-time graph.

.....

..... [1]

(b) Describe how the acceleration of the stone changes between point A and point D.

.....

.....

.....

.....

.....

..... [3]

(c) Explain, in terms of the forces acting, why the acceleration changes between point A and point B.

.....

.....

.....

.....

.....

..... [3]

For Examiner's Use

1 (d) Explain how Fig. 1.2 shows that the stone does not reach terminal velocity in the air.

.....

.....

.....

..... [1]

2 A ball is tied to a string and hung from the ceiling. A steady horizontal wind is blowing against the ball. The mass of the ball is 200 g and the string makes an angle of 15 ° with the vertical as shown in Fig. 2. Draw a scaled diagram to determine the force acting on the ball due to the wind.

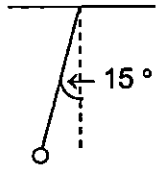


Fig. 2

force acting on the ball due to the wind = ...
[3]

For Examiner's Use

3 Fig. 3.1 shows a helicopter stationary in air. Vertical lift forces are produced by the front rotor and by the back rotor.

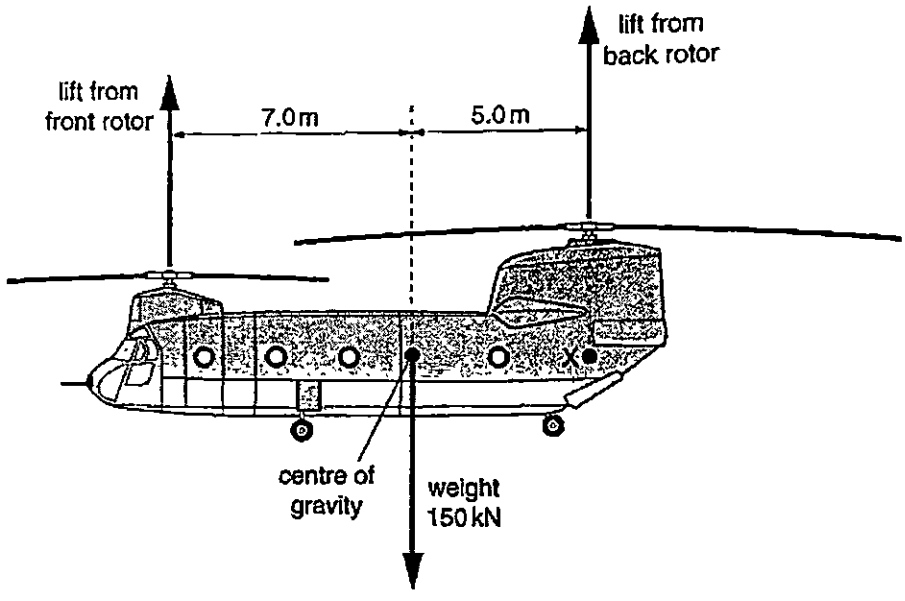


Fig. 3.1

The weight of the helicopter is 150 kN. Horizontal distances are marked on Fig. 3.1.

(a) (i) Describe the difference between mass and weight.

.....

.....

.....

..... [1]

(ii) Determine the mass of the helicopter. The gravitational field strength g is 10 N/kg.

mass = ... [1]

For Examiner's Use

3 (b) (i) By taking moments about point X, calculate the lift force from the front rotor.

lift force = ... [2]

(ii) Calculate the lift force from the back rotor.

lift force = ... [1]

(c) The helicopter pilot adjusts the lift forces at the front and back of the helicopter. The front of the helicopter tilts down, whilst the centre of gravity of the helicopter stays at the same height. State how the lift forces from the rotors are adjusted to achieve this effect.

.....

.....

.....

..... [1]

For Examiner's Use

4 A stationary Quah Ting Wen starts to swim by pushing off from the side of a swimming pool, as shown in Fig. 4.1.

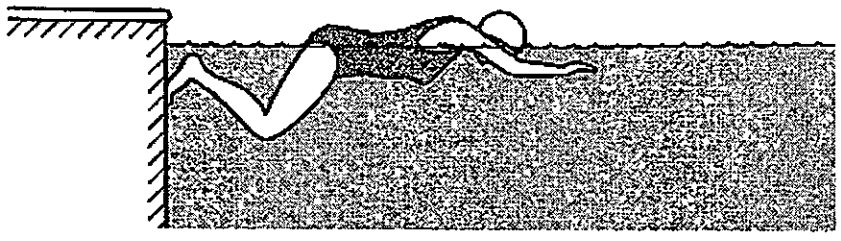


Fig. 4.1

(a) State the useful energy change that occurs as Ting Wen pushes off from the side.

.....

..... [1]

(b) Ting Wen has a mass of 60 kg. Calculate her kinetic energy when she is moving at a speed of 0.80 m/s.

kinetic energy = ... [2]

(c) **(i)** Describe how Ting Wen does work on the water.

.....

..... [1]

(ii) State what eventually happens to the work done by Ting Wen on the water.

.....

..... [1]

For Examiner's Use

5 Fig. 5.1 shows the inner tube of a bicycle tyre, and a bicycle pump.

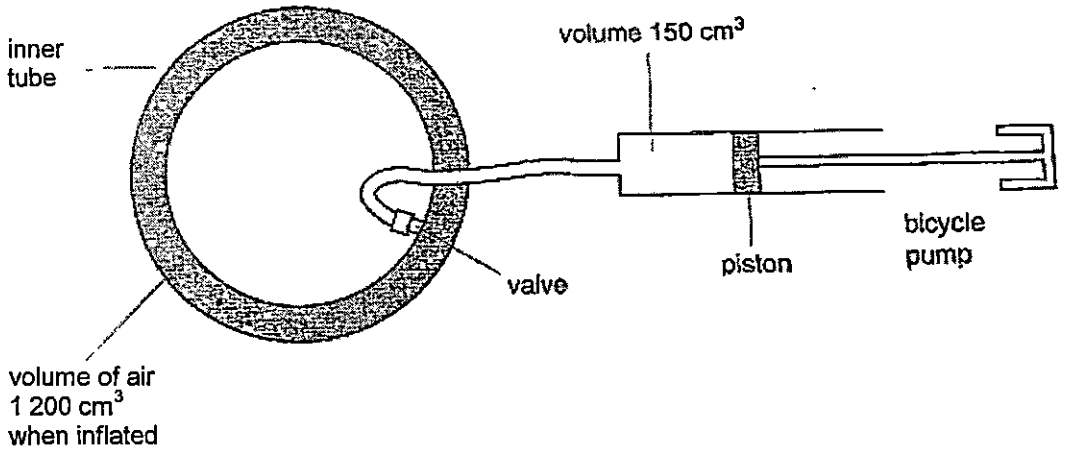


Fig. 5.1

Each stroke of the bicycle pump pushes 150 cm^3 of air at a pressure of 1.0×10^5 Pa from the pump into the inner tube. The inner tube is initially deflated and has no volume. After 10 strokes, the volume of air inside the inner tube is 1 200 cm^3. The temperature of the air remains constant.

(a) Determine the pressure of the air inside the inner tube after 10 strokes. State the formula that you use in your calculation.

pressure = ... [3]

(b) After 10 strokes, more air is pumped into the inner tube. The volume of the air inside the inner tube remains constant. Explain, in terms of the molecules of air, why the pressure inside the tube increases with each stroke.

.....

.....

.....

.....

.....

..... [2]

For Examiner's Use

6 (a) In an ordinary refrigerator, the freezer is at the top. State the advantage of placing the freezer in this position.

.....

.....

..... [1]

(b) Explain why the bottom of a saucepan is usually dull and black but its sides are often shiny and polished.

.....

.....

.....

..... [2]

7 Fig. 7.1 gives some information about two types of lamp that can be used in a desk light.

	input electrical power / W	efficiency %
filament lamp	40	9
compact fluorescent lamp	10	40

Fig. 7.1

(a) (i) State what is meant by *efficiency*.

.....

..... [1]

(ii) Determine which lamp produces the greater useful output power. Show your working. [1]

For Examiner's Use

7 (a) (iii) The desk light is used for 600 hours per year. The cost of 1 kW h is 25 cents. Calculate the saving in cost of using the 10 W lamp for one year rather than the 40 W lamp.

saving = ... [3]

(b) The filament lamp emits electromagnetic radiation with a range of wavelengths. Fig. 7.2 shows the energy emitted per second at each wavelength.

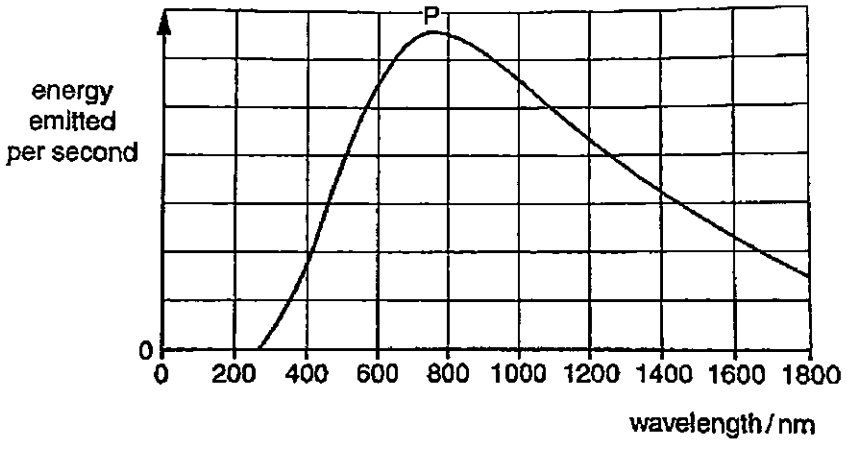


Fig. 7.2

The wavelength of visible light is between 400 nm and 700 nm.

(i) The point P on Fig. 7.2 shows the wavelength at which most energy is emitted. State the component of the electromagnetic spectrum that contains this wavelength.

..... [1]

(ii) Use Fig. 7.2 to explain why the efficiency of the filament lamp is low.

.....

.....

..... [1]

For Examiner's Use

7 (b) (iii) The glass of the filament lamp transmits about 96 % of all radiation with a wavelength greater than 400 nm. Rilwan suggests using less absorbent glass in the filament lamp. He suggests that the efficiency of the filament lamp will then be close to the efficiency of the fluorescent lamp. Explain whether the suggestion is correct.

.....

.....

..... [1]

8 A perfectly lagged container of negligible heat capacity contains 80 g of water and 20 g of ice at 0 °C. The specific heat capacity of water is 4.2 J g^{-1} $°C^{-1}$ and the specific latent heat of fusion of ice is 336 J g^{-1}.

(a) Calculate the total amount of energy required to melt the ice and raise the temperature of all the water to 30 °C. [3]

(b) If the heating coil is rated at 200 W, calculate the time taken to melt the ice and raise the temperature of all the water to 30 °C. [2]

For Examiner's Use

9 **(a)** A liquid is 45 cm deep and its refractive index is 1.25.

(i) Calculate its apparent depth when viewed from the top. [1]

(ii) Calculate the critical angle of the liquid. [1]

(iii) The speed of light in air is 3.0×10^8 m s^{-1}. Calculate the speed of light in the liquid. [1]

(b) Draw two rays on Fig. 9.1 to locate the image. Label the image as *I*. [3]

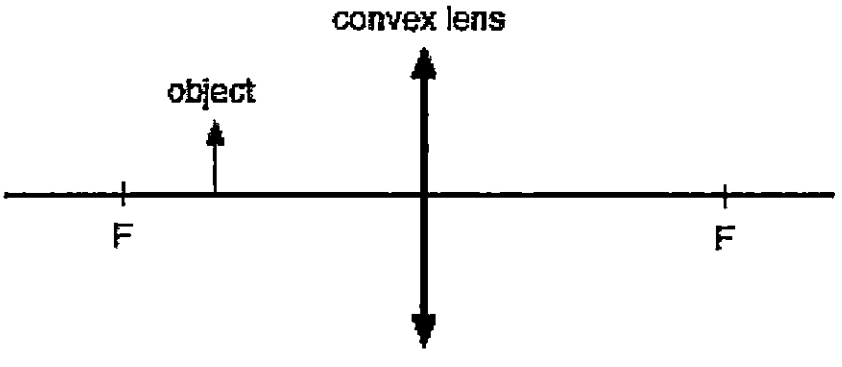


Fig. 9.1

State all the three characteristics of the image formed by the thin converging lens as shown in Fig. 9.1.

..... [1]

For Examiner's Use

Section B [30 marks]

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

10 Jade wanted to build a temperature probe so she set up the circuit as shown in Fig. 10.1.

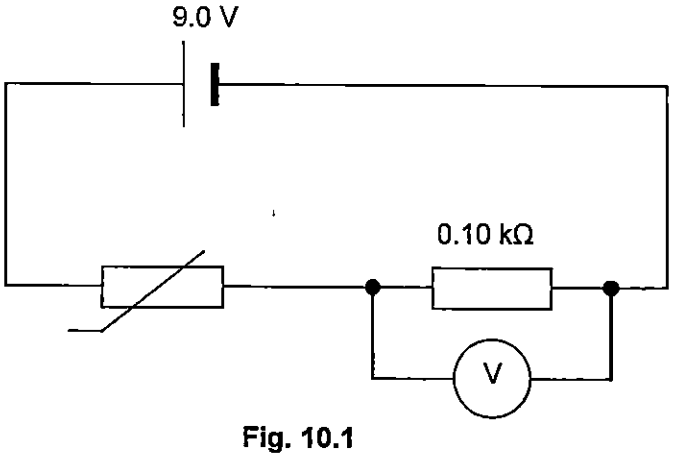


Fig. 10.1

The battery has e.m.f. 9.0 V and negligible internal resistance and the voltmeter has infinite resistance. The calibration curve for the thermistor is shown in Fig. 10.2.

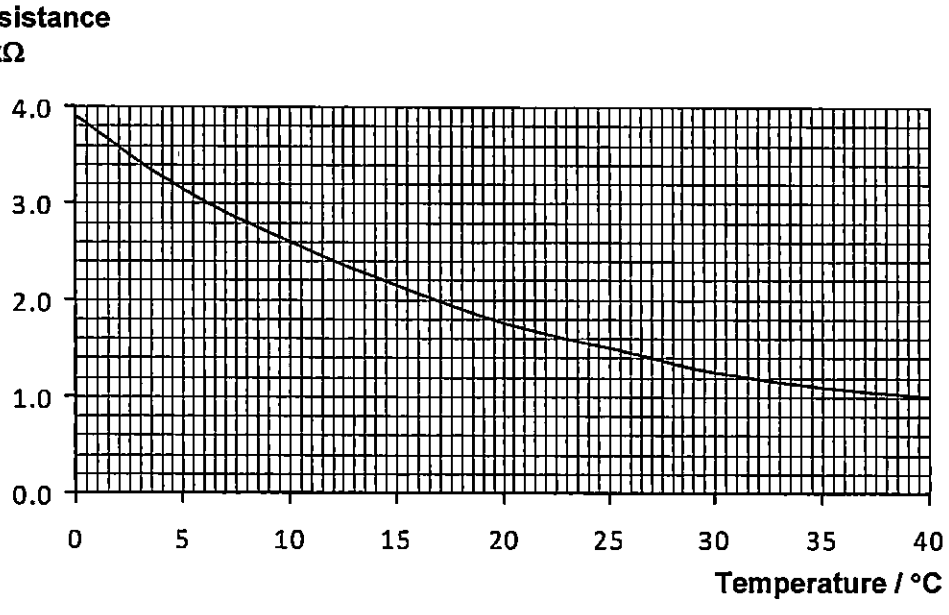


Fig. 10.2

For Examiner's Use

10 Joey decided to modify the temperature probe designed by Jade in Fig. 10.1 and set up the circuit shown in Fig. 10.3.

She replaced the battery with an a.c. supply of 50 Hz which has a peak voltage 9.0 V. The circuit also includes a diode and the voltage output V_0 across the terminals M, N are connected to the Y-plates of a CRO.

As the same thermistor is used, the calibration curve in Fig. 10.2 is still valid.

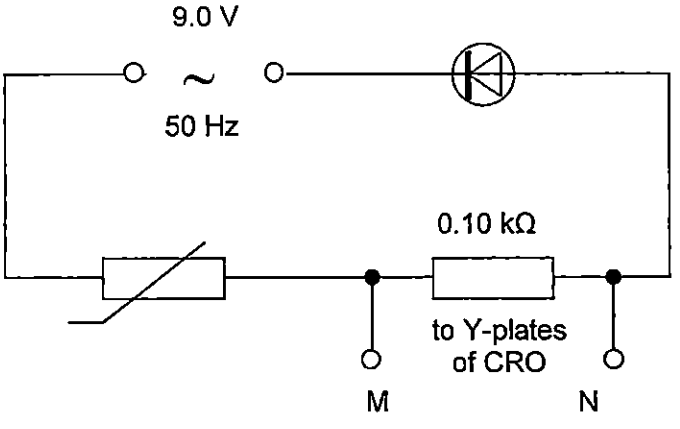


Fig. 10.3

Before using the probe to measure temperature, Joey investigated theoretically the results. A spreadsheet is used to make the calculations below.

She inputs: the temperature (T),

the corresponding resistance (R_T) of the thermistor,

the resistance (R) of the fixed resistor and

the peak voltage (V_P) of the supply.

	A	B	C	D	E	F
1	Temperature of thermistor	Resistance of thermistor	Resistance of fixed resistor	Peak voltage of supply	Current through thermistor	Voltage output to CRO
2	T / °C	R_T / k Ω	R / k Ω	V_P / V	I / mA	V_0 / V
3	0	3.90	0.10	9.0	2.3	0.23
4	5	3.15	0.10	9.0	2.8	0.28
5	10	2.60	0.10	9.0	3.3	0.33
6	15	2.15	0.10	9.0	4.0	0.40
7	20	1.75	0.10	9.0	4.9	0.49
8	25	1.50	0.10	9.0	5.6	0.56
9	30	1.25	0.10	9.0	6.7	0.67
10	35	1.10	0.10	9.0	7.5	0.75

For Examiner's Use

10 **(a)** How are the values in **column B** obtained?

.....

..... [1]

(b) Giving an example in each case, explain how the calculations are performed to find

(i) the current values in **column E**, and

.....

.....

.....

.....

.....

..... [3]

(ii) the voltage output values in **column F**.

.....

.....

.....

..... [2]

(c) Joey dipped the probe into water at 15 °C and the output voltage is connected to the CRO. The time base of the CRO is 5.0 ms cm^{-1} and the Y-sensitivity is 0.20 V cm^{-1}. Draw and explain the shape of trace seen on the CRO screen in Fig. 10.4. [4]

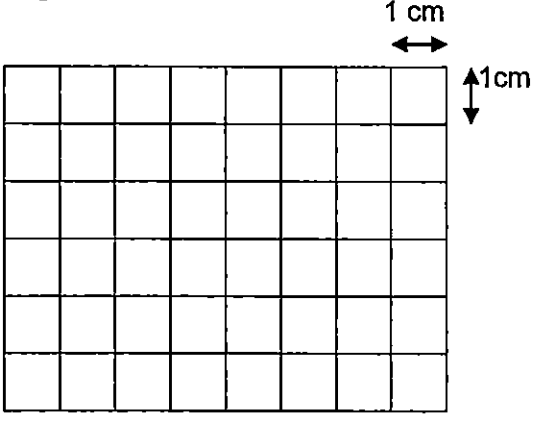


Fig.10.4

.....

.....

.....

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.....

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.....

.....

For Examiner's Use

11 Fig.11.1 shows how the currents in a lamp L and in a wire W vary with the potential difference (p.d.) applied.

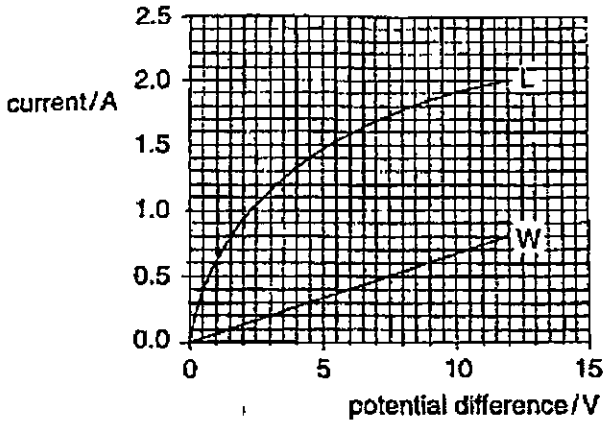


Fig. 11.1

(a) Describe how the resistance of lamp L varies as the p.d. increases.

.....

.....

..... [1]

(b) Fig. 11.2 shows the lamp and the wire connected in series. The current is 0.8 A.

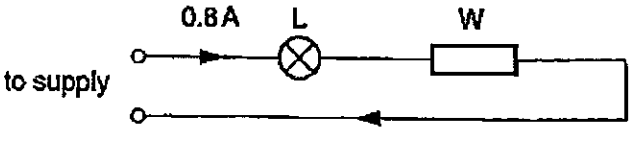


Fig. 11.2

(i) Use the graph to determine the p.d. of the supply.

p.d. = ... [2]

(ii) Calculate the resistance of the lamp L in the circuit shown in Fig. 11.2.

resistance = ... [2]

For Examiner's Use

11 (c) Fig. 11.3 shows the lamp and the wire connected in parallel. A p d. of 12 V is connected across them.

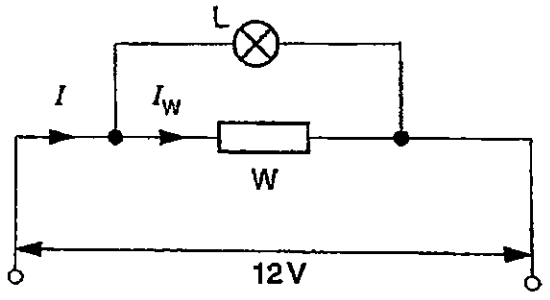


Fig. 11.3

(i) Use the graph to determine the current I_w in the wire W.

current = ... [1]

(ii) Use the graph to determine the current I in the circuit.

current = ... [2]

(iii) Calculate the resistance of the wire W.

resistance = ... [1]

(iv) Calculate combined resistance of the lamp and wire in the parallel circuit of Fig.11.3.

resistance = ... [1]

For Examiner's Use

12 EITHER

(a) Fig. 12.1 shows a d.c. motor. Fig. 12.2 shows how the moment acting on the coil depends on time.

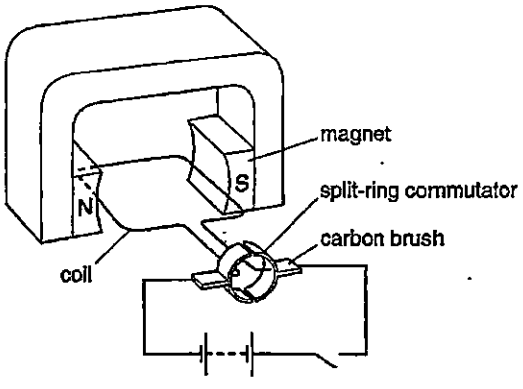


Fig. 12.1

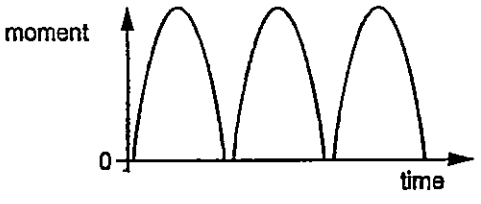


Fig. 12.2

The coil is horizontal, as shown in Fig. 12.1.

(i) Explain why the coil turns when the switch is closed.

.....

.....

.....

..... [2]

(ii) Explain why the coil continues to turn in the same direction when it has turned 180 °.

.....

.....

.....

..... [2]

(iii) On Fig. 12.2, mark with a letter H one time when the coil is horizontal. [1]

(iv) The e.m.f. of the battery is increased. State two changes that this causes to Fig. 12.2.

1. .....

2. ..... [2]

12 **(b)** Fig. 12.3 shows a setup to illustrate how the wind power can be used to generate electricity When the wind blows, the blades of the generator turn, causing the magnet to turn.

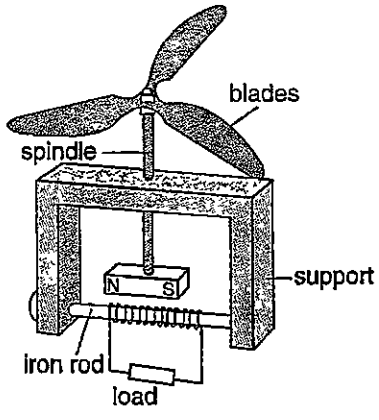


Fig. 12.3

(i) Explain how electricity can be generated when the blades turn.

.....

.....

.....

..... [2]

(ii) State one advantage of a rotating magnet generator over a rotating coil generator.

.....

..... [1]

For Examiner's Use

12 OR

(a) Fig. 12.4 shows a beam of positively charge particles passing between the poles of a powerful U-shaped electromagnet.

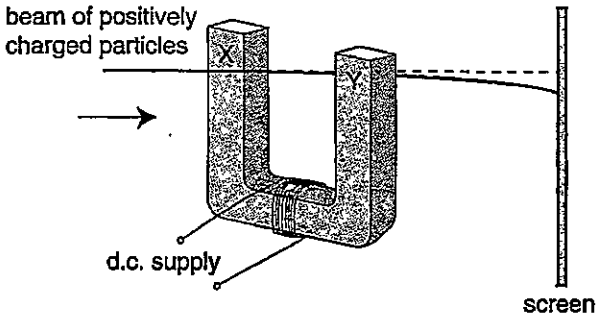


Fig. 12.4

(i) State the polarity of the magnet at X and Y.

..... [1]

(ii) State the material that the magnet can be made of and explain your answer.

.....

.....

.....

..... [2]

(iii) Explain why the power supply must be a direct current and show the direction of the current in Fig. 12.4.

.....

.....

.....

..... [2]

(iv) Suggest two ways to increase the distance through which the beam is deflected.

.....

.....

.....

..... [2]

For Examiner's Use

12 (b) The generators at a power plant produce a voltage of 25 000 V. For long distance transmission, on overhead power lines, this is stepped up to 480 000 V. It is later stepped down to 240 V for domestic use.

(i) Explain why the voltage is stepped up for long distance transmission.

.....

.....

.....

..... [2]

(ii) Calculate the ratio of the number of turns in the primary coil to the number of turns in the secondary coil for the transformer used to step down the power for domestic use. [1]

END OF PAPER

O

GAN ENG SENG SCHOOL
Preliminary 2 Examination 2015

CANDIDATE NAME	
CLASS	
INDEX NUMBER	

Marking Scheme

PHYSICS
Paper 2

5059/02

1 September 2015
1 hour 45 minutes

Sec 4 Express

Candidates answer on the Question Paper.

Calculators are allowed in the examination

READ THESE INSTRUCTIONS FIRST

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use a soft pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid/tape.

Section A
Answer **all** questions.

Section B
Answer **all** questions. **Question 12** has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
Candidates are advised to show all their working in a clear and orderly manner, as more marks are awarded for sound use of Physics than for correct answers.

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

For Examiner's Use	
Section A	50
Section B	30
Total	80

Section A [50 marks]

For Examiner's Use

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

1 A stone falls from the top of a cliff into the sea, as shown in Fig. 1.1. The speed-time graph for the stone is shown in Fig. 1.2.

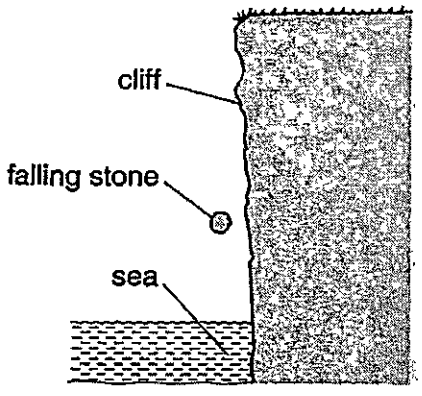


Fig. 1.1

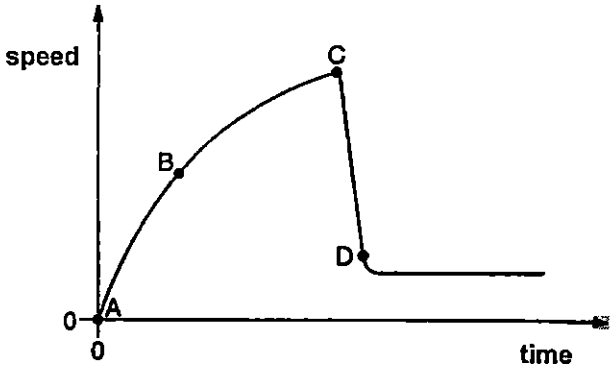


Fig. 1.2

(a) State how the acceleration is found from a speed-time graph.

The acceleration is the gradient of the speed-time graph. [B1]

(b) Describe how the acceleration of the stone changes between point A and point D.

From A to C, the acceleration of the stone decreases as the gradient of the graph decreases. [B1] **From C to D, the acceleration of the stone is negative and constant.** [B1] **The constant deceleration in CD is greater than the decreasing acceleration in AC.** [B1]

(c) Explain, in terms of the forces acting, why the acceleration changes between point A and point B.

When the stone is falling, its weight is acting downwards while air resistance acts against it. [B1] **As the stone's speed increases from A to B, there is also increasing upward air resistance.** [B1] **Since the stone's weight remains the same, the resultant downward force is reduced, thus resulting in decreasing acceleration.** [B1]

(d) Explain how Fig. 1.2 shows that the stone does not reach terminal velocity in the air.

The stone hits the water at C. From the graph, the stone does not have a constant velocity from A to C, thus showing that the stone does not reach the terminal velocity in the air. [B1]

For Examiner's Use

2 A ball is tied to a string and hung from the ceiling. A steady horizontal wind is blowing against the ball. The mass of the ball is 200 g and the string makes an angle of 15 ° with the vertical. Draw a scaled diagram to determine the force acting on the ball due to the wind.

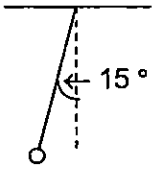
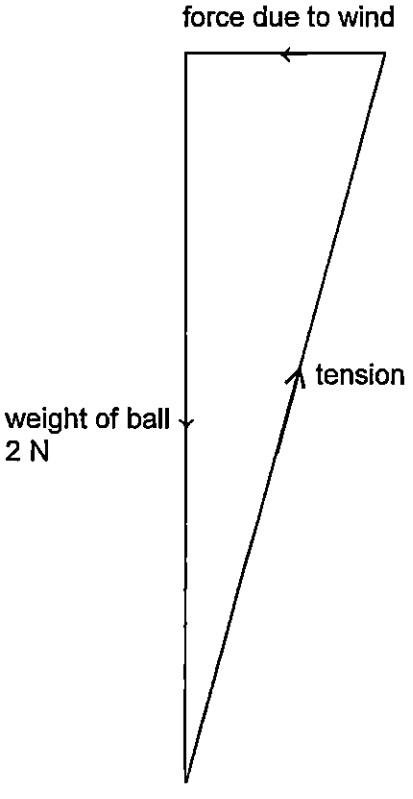


Fig. 2

Let 1 cm represent 0.2 N.



force acting on the ball due to the wind = **0.54 ± 0.02 N** [B1]

[B1] for drawing the weight of the ball ↓ to scale
[B1] for drawing the enclosed right-angled triangle to scale

For Examiner's Use

3 Fig. 3.1 shows a helicopter stationary in air. Vertical lift forces are produced by the front rotor and by the back rotor.

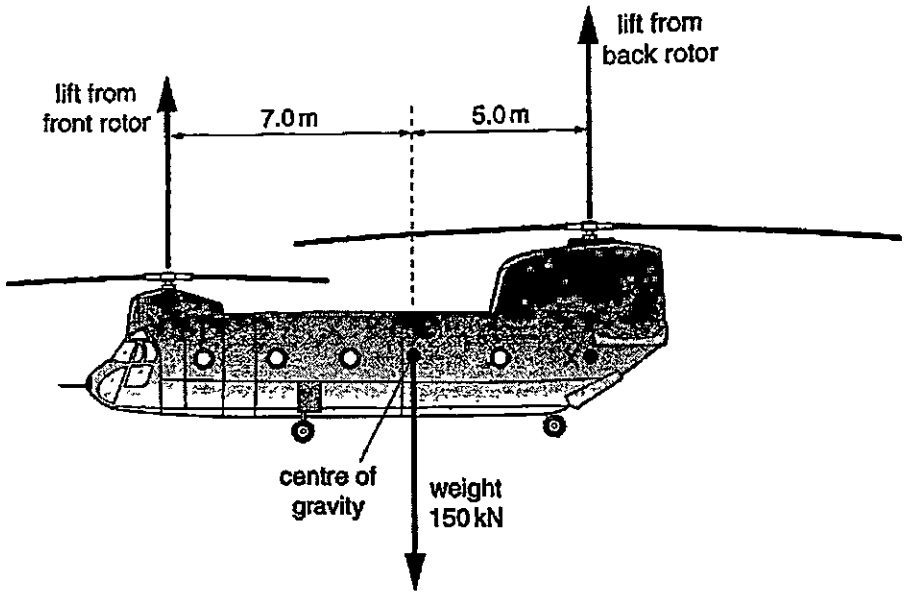


Fig. 3.1

The weight of the helicopter is 150 kN. Horizontal distances are marked on Fig. 3.1.

(a) (i) Describe the difference between mass and weight.

Mass is the amount of matter in an object but weight is the gravitational force acting on the object. [B1]

Can also accept other differences as long as there is a comparison between mass and weight.

(ii) Determine the mass of the helicopter. The gravitational field strength g is 10 N/kg.

$$W = mg \Rightarrow m = \frac{W}{g}$$
$$= \frac{(150 \times 10^3)}{10}$$
$$= 15\,000 \text{ kg}$$

mass = **15 000 kg** [B1]

For Examiner's Use

3 **(b)** **(i)** By taking moments about point X, calculate the lift force from the front rotor.

By the principle of moments,
total clockwise moments about X = total anti-clockwise moments by X
$F \times (7.0 + 5.0) = (150 \times 10^3) \times 5.0$ [M1]
$F = 62\ 500$ N

lift force = **62 500 N** [A1]

(ii) Calculate the lift force from the back rotor.

↑ lift force from the front and back rotors = weight of helicopter
↑ lift force from the back rotor + 62 500 = 150×10^3
↑ lift force from the back rotor = 87 500 N

lift force = **87 500 N** [B1]

(c) The helicopter pilot adjusts the lift forces at the front and back of the helicopter. The front of the helicopter tilts down, whilst the centre of gravity of the helicopter stays at the same height. State how the lift forces from the rotors are adjusted to achieve this effect.

For the front of the helicopter to tilt down, the lift from the front rotor must be reduced, while the lift from the back rotor is increased to keep its centre of gravity at the same height. [B1]

For Examiner's Use

4 A stationary Quah Ting Wen starts to swim by pushing off from the side of a swimming pool, as shown in Fig. 4.1.

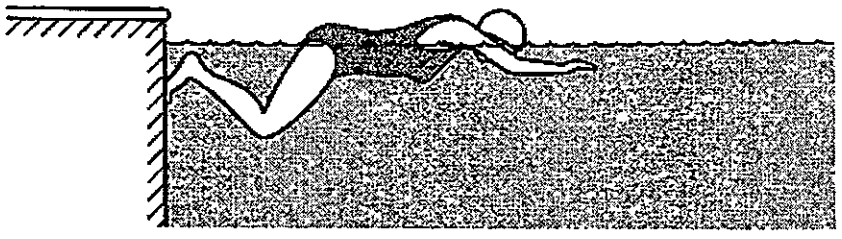


Fig. 4.1

(a) State the useful energy change that occurs as Ting Wen pushes off from the side.

Chemical potential energy is converted to kinetic energy. [B1]

(b) Ting Wen has a mass of 60 kg. Calculate her kinetic energy when she is moving at a speed of 0.80 m/s.

$E_k = ½ mv^2$
$= ½ \times 60 \times 0.80^2$ [M1]
$= 19.2$ J

kinetic energy = **19.2 J** [A1]

(c) **(i)** Describe how Ting Wen does work on the water.

She does work on the water to overcome the water resistance and to push aside the water so that she can pass through the water. [B1]

(ii) State what eventually happens to the work done by Ting Wen on the water.

The work done on the water is converted to kinetic energy of the water and eventually converted to thermal energy of the water. [B1]

For Examiner's Use

5 Fig. 5.1 shows the inner tube of a bicycle tyre, and a bicycle pump.

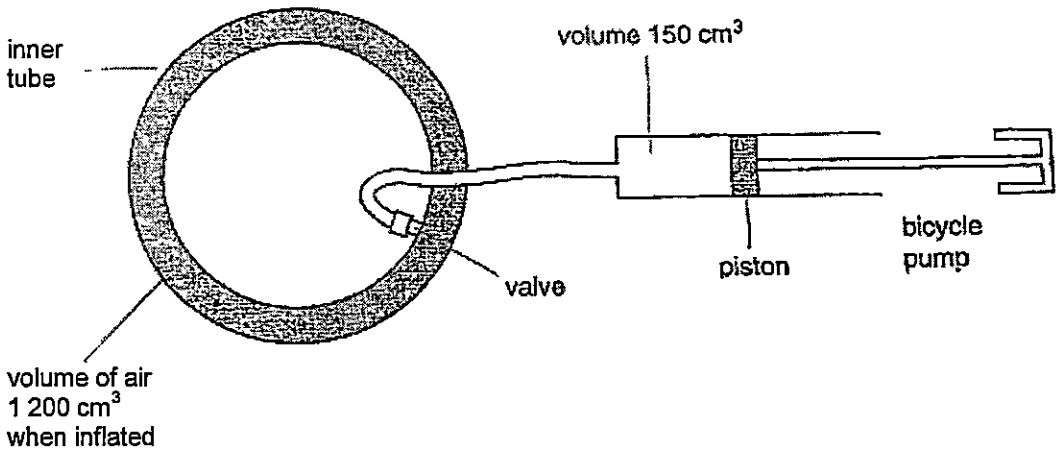


Fig. 5.1

Each stroke of the bicycle pump pushes 150 cm^3 of air at a pressure of 1.0×10^5 Pa from the pump into the inner tube. The inner tube is initially deflated and has no volume. After 10 strokes, the volume of air inside the inner tube is 1 200 cm^3. The temperature of the air remains constant.

(a) Determine the pressure of the air inside the inner tube after 10 strokes. State the formula that you use in your calculation.

$P_1V_1 = P_2V_2$ [B1]
$(1.0 \times 10^5) \times (10 \times 150) = P_2 \times 1\,200$ [M1]
$P_2 = 125\,000$ Pa

pressure = **125 000 Pa** [A1]

(b) After 10 strokes, more air is pumped into the inner tube. The volume of the air inside the inner tube remains constant. Explain, in terms of the molecules of air, why the pressure inside the tube increases with each stroke.

By pumping more air molecules into the inner tube and keeping the volume constant, the space between the air molecules become smaller. The number of air molecules per unit volume increases. [B1] **Hence, the frequency of molecules hitting the wall of the tube increases. The pressure increases because more molecules per second hit the tyre walls.** [B1]

For Examiner's Use

6 **(a)** In an ordinary refrigerator, the freezer is at the top. State the advantage of placing the freezer in this position.

The space below the freezer is cooled by convection currents of the cooled air from the freezer. [B1]

(b) Explain why the bottom of a saucepan is usually dull and black but its sides are often shiny and polished.

The bottom of a saucepan is dull and black so as to be good absorbers of radiation for the content in the saucepan to heat up quickly. [B1] **The sides of the saucepan are often shiny and polished so as to be poor emitters of radiation to minimise heat lost to the surroundings.** [B1]

7 Fig. 7.1 gives some information about two types of lamp that can be used in a desk light.

	input electrical power / W	efficiency %
filament lamp	40	9
compact fluorescent lamp	10	40

Fig. 7.1

(a) (i) State what is meant by *efficiency*.

Efficiency is the ratio of the amount of useful output power to the total input power. [B1]

(ii) Determine which lamp produces the greater useful output power. Show your working. [1]

$$\text{output power of filament lamp} = \frac{9}{100} \times 40$$
$$= 3.6\ \text{W}$$

$$\text{output power of compact fluorescent lamp} = \frac{40}{100} \times 10$$
$$= 4\ \text{W}$$

Compact fluorescent lamp produces greater useful output power. [B1]

(iii) The desk light is used for 600 hours per year. The cost of 1 kW h is 25 cents. Calculate the saving in cost of using the 10 W lamp for one year rather than the 40 W lamp.

$$\text{Saving in cost} = \left[\left(\frac{40}{1000} \times 600\right) \times \$0.25\right] - \left[\left(\frac{10}{1000} \times 600\right) \times \$0.25\right] \quad \text{[M1, M1]}$$
$$= \$4.50$$

saving = **$4.50** [A1]

For Examiner's Use

7 (b) The filament lamp emits electromagnetic radiation with a range of wavelengths. Fig. 7.2 shows the energy emitted per second at each wavelength.

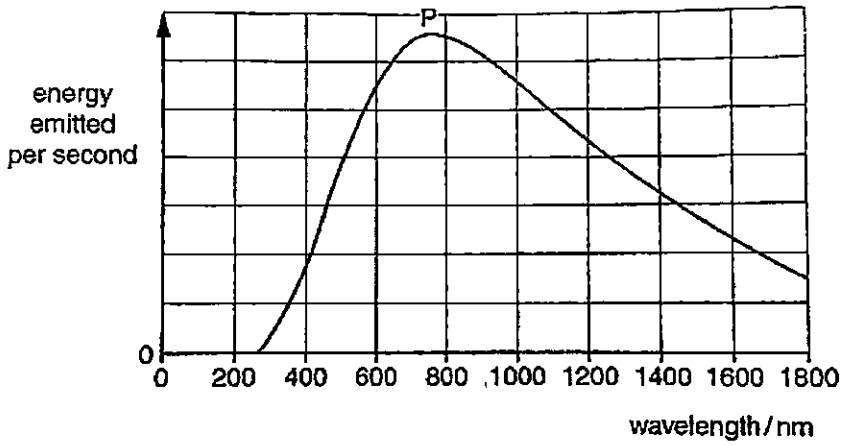


Fig. 7.2

The wavelength of visible light is between 400 nm and 700 nm.

(i) The point P on Fig. 7.2 shows the wavelength at which most energy is emitted. State the component of the electromagnetic spectrum that contains this wavelength.

infrared [B1]

(ii) Use Fig. 7.2 to explain why the efficiency of the filament lamp is low.

Much of the energy emitted by the filament lamp is in the infrared region which is thermal energy and not useful as a lamp. [B1]

(iii) The glass of the filament lamp transmits about 96 % of all radiation with a wavelength greater than 400 nm. Rilwan suggests using less absorbent glass in the filament lamp. He suggests that the efficiency of the filament lamp will then be close to the efficiency of the fluorescent lamp. Explain whether the suggestion is correct.

The suggestion is not correct. The current efficiency of filament lamp is 9 % which means only 9 % of the energy input is being transmitted as visible light. Even if the glass allows for 100 % transmission of radiation, it would not increase the efficiency to 40 % which is the efficiency of the compact fluorescent lamp. [B1]

For Examiner's Use

8 A perfectly lagged container of negligible heat capacity contains 80 g of water and 20 g of ice at 0 °C. The specific heat capacity of water is 4.2 J g^{-1} $°C^{-1}$ and the specific latent heat of fusion of ice is 336 J g^{-1}.

(a) Calculate the total amount of energy required to melt the ice and raise the temperature of all the water to 30 °C. [3]

20 g of ice at 0 °C → 100 g of water at 0 °C → 100 g of water at 30 °C

Total amount of energy = (20 × 336) + [(20 + 80) × 4.2 × 30] [M1, M1]
= 19 320 J
= **19 300 J** [A1]

(b) If the heating coil is rated at 200 W, calculate the time taken to melt the ice and raise the temperature of all the water to 30 °C. [2]

time taken = 19 320 ÷ 200 [M1]
= **96.6 s** [A1]

For Examiner's Use

9 **(a)** A liquid is 45 cm deep and its refractive index is 1.25.

(i) Calculate its apparent depth when viewed from the top. [1]

$$n = \frac{\text{real depth}}{\text{apparent depth}}$$

apparent depth = 45 ÷ 1.25

= **36 cm** [B1]

(ii) Calculate the critical angle of the liquid. [1]

$$\sin c = \frac{1}{n}$$

c = **53.1 °** [B1]

(iii) The speed of light in air is 3.0×10^8 m s^{-1}. Calculate the speed of light in the liquid. [1]

$$n = \frac{\text{speed of light in air}}{\text{speed of light in liquid}}$$

speed of light in liquid = $(3.0 \times 10^8) \div 1.25$

= **2.4×10^8 m s^{-1}** [B1]

(b) Draw two rays on Fig. 9.1 to locate the image. Label the image as *I*. [3]

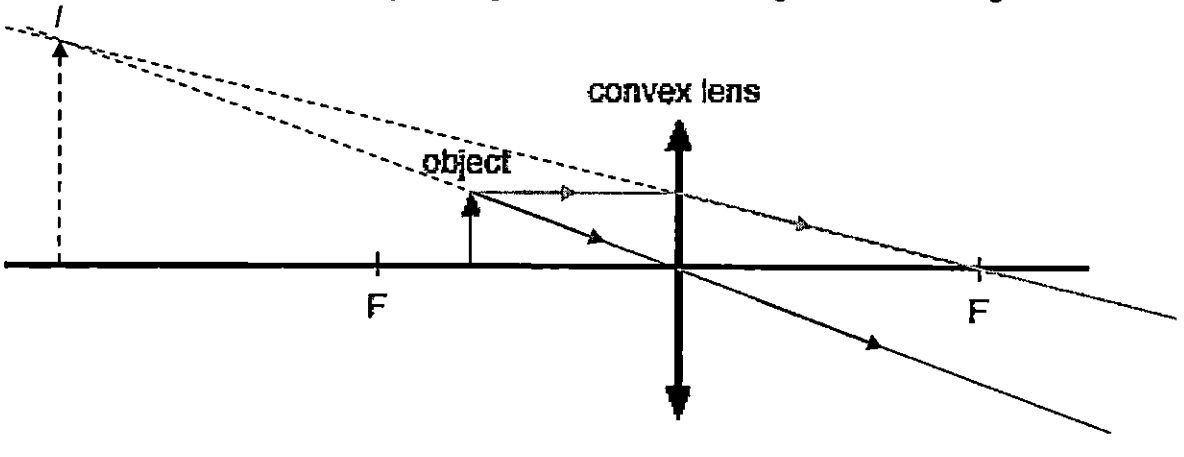


Fig. 9.1

[B1] for each correct light ray drawn
[B1] for drawing and labelling image (dotted lines) correctly

State all the three characteristics of the image formed by the thin converging lens as shown in Fig. 9.1.

The image is virtual, upright and magnified. [B1]

For Examiner's Use

Section B [30 marks]

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

10 Jade wanted to build a temperature probe so she set up the circuit as shown in Fig. 10.1.

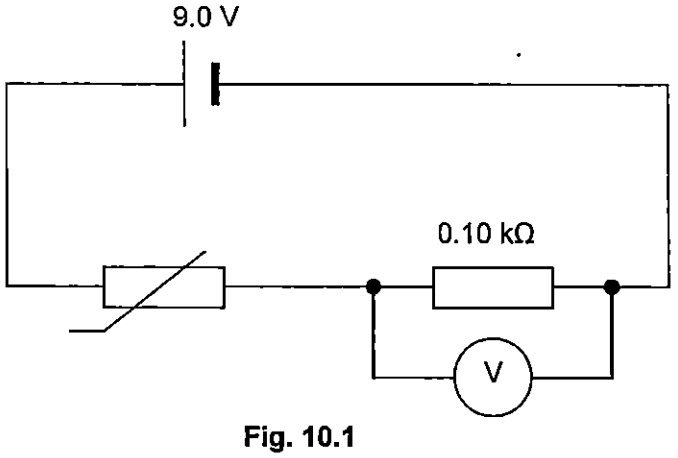


Fig. 10.1

The battery has e.m.f. 9.0 V and negligible internal resistance and the voltmeter has infinite resistance. The calibration curve for the thermistor is shown in Fig. 10.2.

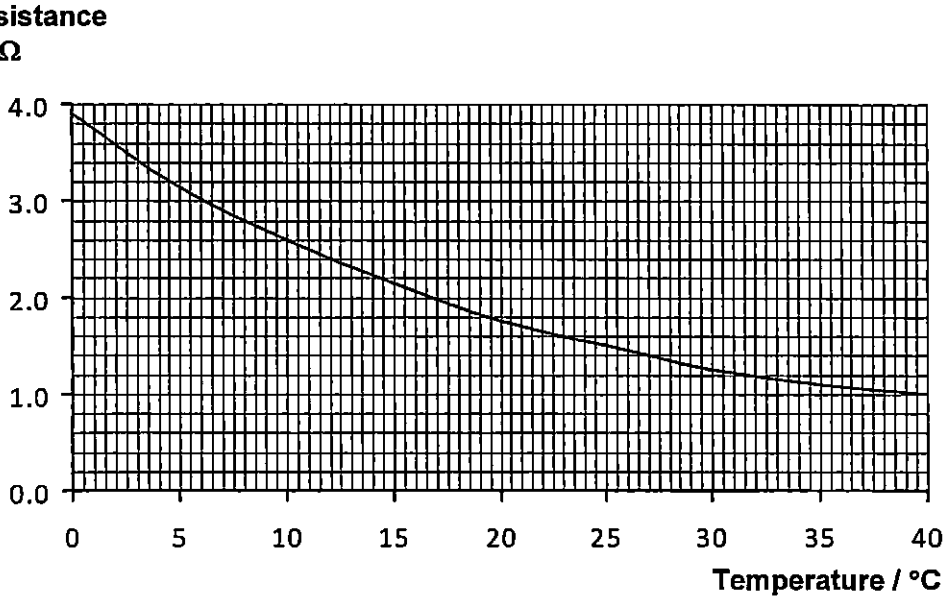


Fig. 10.2

For Examiner's Use

10 Joey decided to modify the temperature probe designed by Jade in Fig. 10.1 and set up the circuit shown in Fig. 10.3.

She replaced the battery with an a.c. supply of 50 Hz which has a peak voltage 9.0 V. The circuit also includes a diode and the voltage output V_0 across the terminals M, N are connected to the Y-plates of a CRO.

As the same thermistor is used, the calibration curve in Fig. 10.2 is still valid.

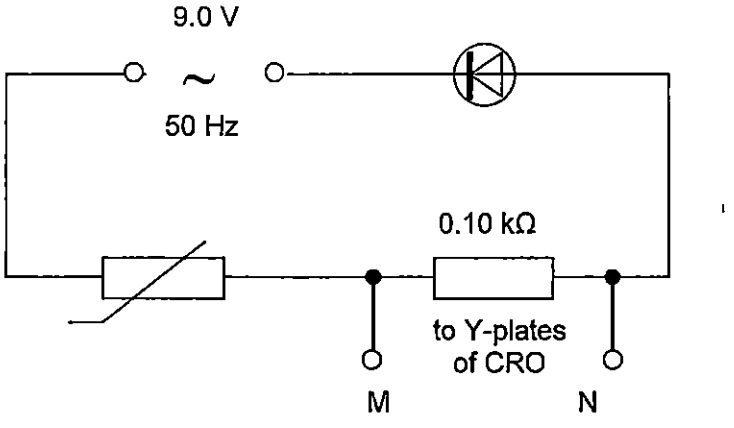


Fig. 10.3

Before using the probe to measure temperature, Joey investigated theoretically the results. A spreadsheet is used to make the calculations below.

She inputs: the temperature (T),

the corresponding resistance (R_T) of the thermistor,

the resistance (R) of the fixed resistor and

the peak voltage (V_P) of the supply.

	A	B	C	D	E	F
1	Temperature of thermistor	Resistance of thermistor	Resistance of fixed resistor	Peak voltage of supply	Current through thermistor	Voltage output to CRO
2	T / °C	R_T / k Ω	R / k Ω	V_P / V	I / mA	V_0 / V
3	0	3.90	0.10	9.0	2.3	0.23
4	5	3.15	0.10	9.0	2.8	0.28
5	10	2.60	0.10	9.0	3.3	0.33
6	15	2.15	0.10	9.0	4.0	0.40
7	20	1.75	0.10	9.0	4.9	0.49
8	25	1.50	0.10	9.0	5.6	0.56
9	30	1.25	0.10	9.0	6.7	0.67
10	35	1.10	0.10	9.0	7.5	0.75

For Examiner's Use

10 **(a)** How are the values in **column B** obtained?

They are read from the calibration curve in Fig. 10.2. [B1]

(b) Giving an example in each case, explain how the calculations are performed to find

(i) the current values in **column E**, and

Use $I = \frac{V_P}{R_T + R}$ [B1]

e.g. E3 = D3 / (B3 + C3) [B1]
The calculation is repeated down the column. [B1]

(ii) the voltage output values in **column F**.

Use $V_0 = \frac{R}{R_T + R} \times V_P$ or $V_0 = I \times R$ [B1]

e.g. F3 = (C3 / (B3 + C3) * D3 or F3 = E3 * C3 [B1]
The calculation is repeated down the column.

(c) Joey dipped the probe into water at 15 °C and the output voltage is connected to the CRO. The time base of the CRO is 5.0 ms cm^{-1} and the Y-sensitivity is 0.20 V cm^{-1}. Draw and explain the shape of trace seen on the CRO screen in Fig. 10.4. [4]

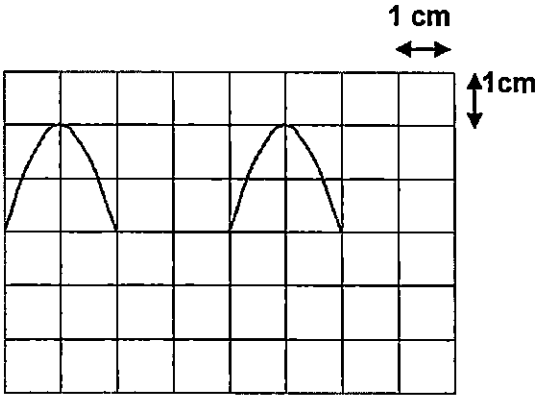


Fig.10.4

shape [B1]

positive part the curve is shown, negative part is not shown [B1]

vertical height = 2 cm (because voltage = 0.40 V) [B1]

horizontal length = 4 cm (because time = 1 / 50 Hz = 0.02 s = 20 ms) [B1]

For Examiner's Use

11 Fig.11.1 shows how the currents in a lamp L and in a wire W vary with the potential difference (p.d.) applied.

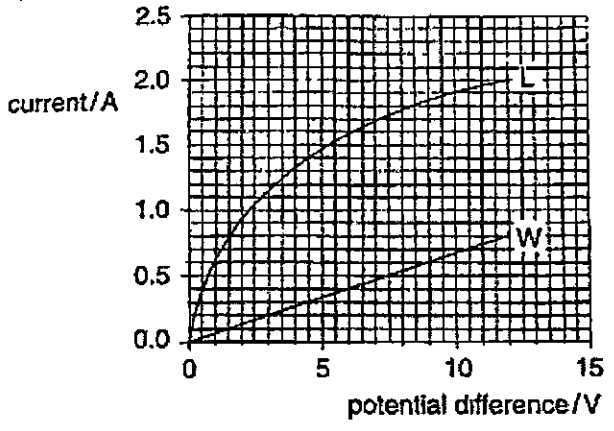


Fig. 11.1

(a) Describe how the resistance of lamp L varies as the p.d. increases.

The curve is showing decreasing gradient which indicates an increasing resistance as this is a I-V graph. The resistance of lamp L increases as the p.d. increases. [B1]

(b) Fig. 11.2 shows the lamp and the wire connected in series. The current is 0.8 A.

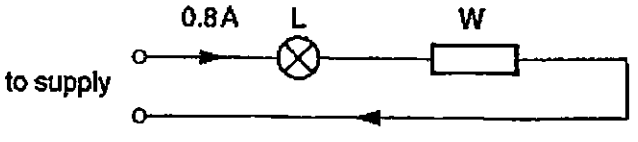


Fig. 11.2

(i) Use the graph to determine the p.d. of the supply.

When I = 0.8 A, p.d. of lamp L and wire W are 1.5 V and 12.5 V respectively from the graph.
Since lamp L and wire W are connected in series as shown in Fig. 11.2,
p.d. of the supply = 1.5 V + 12 V [M1]
= 13.5 V

p.d. = **13.5 V** [A1]

(ii) Calculate the resistance of the lamp L in the circuit shown in Fig. 11.2.

$$R = \frac{V}{I}$$ [M1]

$$= \frac{1.5}{0.8}$$
= 1.875 Ω
= 1.88 Ω

resistance = **1.88 Ω** [A1]

For Examiner's Use

11 (c) Fig. 11.3 shows the lamp and the wire connected in parallel. A p.d. of 12 V is connected across them.

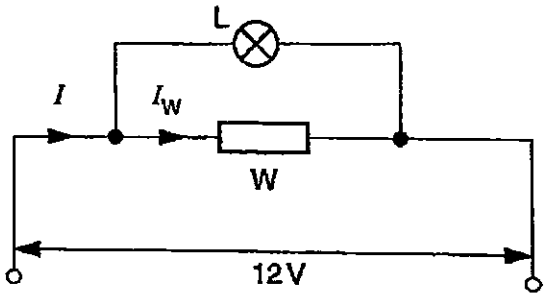


Fig. 11.3

(i) Use the graph to determine the current I_w in the wire W.

current = **0.8 A** [B1]

(ii) Use the graph to determine the current I in the circuit.

From the graph, the current in lamp L is 2.0 A.
Since lamp L and wire W are connected in parallel as shown in Fig. 11.3,
$I = 0.8 + 2.0$ [M1]
$= 2.8$ A

current = **2.8 A** [A1]

(iii) Calculate the resistance of the wire W.

$$R = \frac{V}{I}$$
$$= \frac{12}{0.8}$$
$$= 15\ \Omega$$

resistance = **15 Ω** [B1]

(iv) Calculate combined resistance of the lamp and wire in the parallel circuit of Fig.11.3.

$$R = \frac{V}{I}$$
$$= \frac{12}{2.8}$$
$$= 4.29\ \Omega$$

resistance = **4.29 Ω** [B1]

For Examiner's Use

12 EITHER

(a) Fig. 12.1 shows a d.c. motor. Fig. 12.2 shows how the moment acting on the coil depends on time.

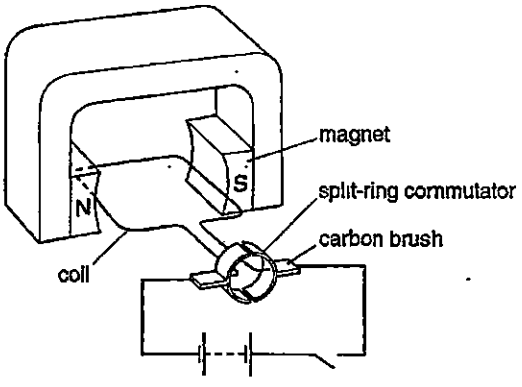


Fig. 12.1

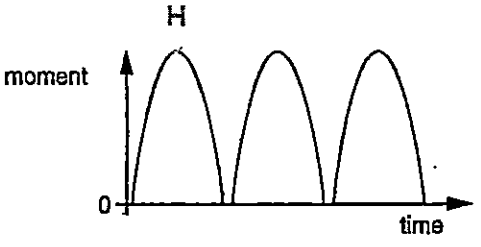


Fig. 12.2

The coil is horizontal, as shown in Fig. 12.1.

(i) Explain why the coil turns when the switch is closed.

When the switch is closed, a current flows in the circuit and the coil. Since there is a current in a magnetic field between the magnets, a force is produced. [B1] **The force produced is upwards on the left side and downwards on the right side. As a result, the coil turns.** [B1]

(ii) Explain why the coil continues to turn in the same direction when it has turned 180 °.

After a 180 ° rotation, the split-ring commutator reverses the direction of the current in the coil. [B1] **This causes the force acting on the coil to reverse direction and ensures that the force on the side of the coil next to the N-pole was always in the same direction, allowing the coil to turn continuously as the force on the top side of the coil is now upwards and on the bottom side of the coil downwards.** [B1]

(iii) On Fig. 12.2, mark with a letter H one time when the coil is horizontal. [B1]

(iv) The e.m.f. of the battery is increased. State two changes that this causes to Fig. 12.2.

1. **The maximum moment exerted will be greater (stretched vertically).** [B1]

2. **The period of the wave will be shorter (compressed horizontally).** [B1]

For Examiner's Use

12 (b) Fig. 12.3 shows a setup to illustrate how the wind power can be used to generate electricity. When the wind blows, the blades of the generator turn, causing the magnet to turn.

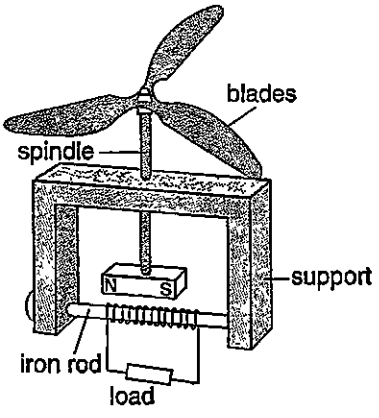


Fig. 12.3

(i) Explain how electricity can be generated when the blades turn.

As the magnet turns, it creates a changing magnetic field. [B1] **This changing magnetic field induces an e.m.f. in the coil of wire and an induced current flows in the circuit.** [B1]

(ii) State one advantage of a rotating magnet generator over a rotating coil generator.

Slip rings and carbon brushes are not needed in a rotating magnet generator. [B1]

For Examiner's Use

12 OR

(a) Fig. 12.4 shows a beam of positively charge particles passing between the poles of a powerful U-shaped electromagnet.

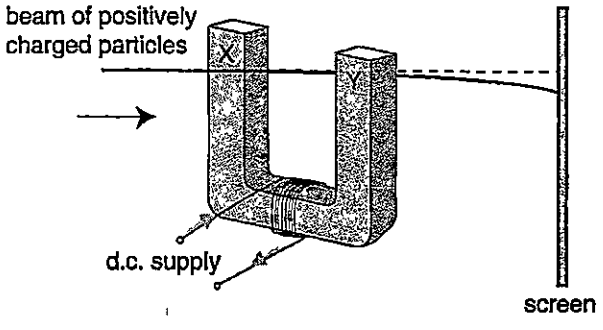


Fig. 12.4

(i) State the polarity of the magnet at X and Y.

X is north pole and Y is south pole. [B1]

(ii) State the material that the magnet can be made of and explain your answer.

The magnet can be made of iron. [B1] **Iron is a soft magnetic material that can be magnetised and demagnetised easily, thus it is suitable for use as an electromagnet.** [B1]

(iii) Explain why the power supply must be a direct current and show the direction of the current in Fig. 12.4.

For the poles of the magnet to be fixed, the supply must be a direct current. [B1]

(iv) Suggest two ways to increase the distance through which the beam is deflected.

Increase the current in the power supply to the electromagnet. [B1]
Increase the charge of the particles. [B1]

For Examiner's Use

12 **(b)** The generators at a power plant produce a voltage of 25 000 V. For long distance transmission, on overhead power lines, this is stepped up to 480 000 V. It is later stepped down to 240 V for domestic use.

(i) Explain why the voltage is stepped up for long distance transmission.

When power is transmitted at high voltage, the current through the wires is low. [B1] **Hence, power loss in the cables is reduced.** [B1]

(ii) Calculate the ratio of the number of turns in the primary coil to the number of turns in the secondary coil for the transformer used to step down the power for domestic use.

Ratio = 480 000 : 240
= **2 000 : 1** [B1]

END OF PAPER