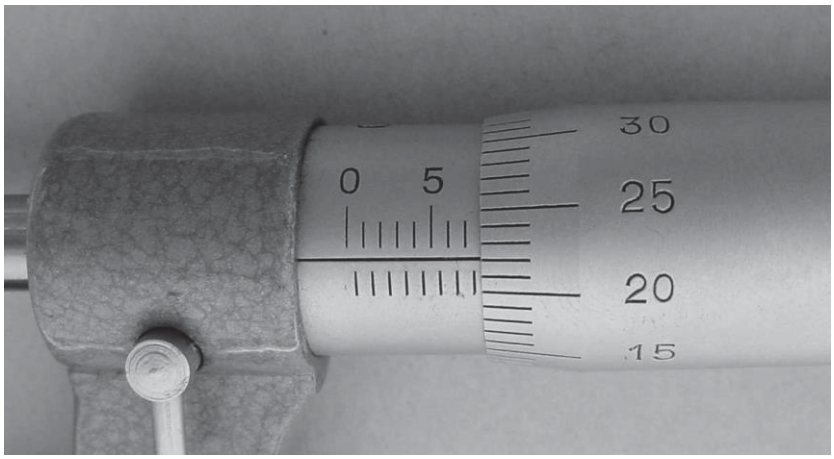
[40 marks]
Answer all questions in this section

1. The light year is defined as the distance light travels in 1 year. Which of the following is the nearest estimate of 1 light year in gigameters (Gm)?

A 100 **B** 1000 **C** 10000 **D** 10000000

2. The following diagram shows the reading on a micrometer screw gauge.

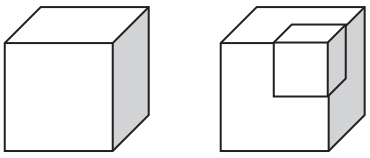


What is the reading on the micrometer screw gauge?

A 7.22 mm **B** 7.72 mm **C** 7.22 cm **D** 7.72 cm

3. A cube of mass 5.0 kg with sides 0.20 m long has a cube of sides 0.10 m cut from its corner as shown. What is the density of the remaining portion?

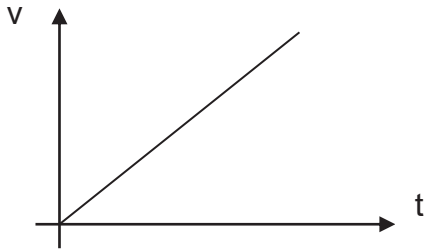
A 25 kg/m³ **B** 547 kg/m³
C 625 kg/m³ **D** 714 kg/m³



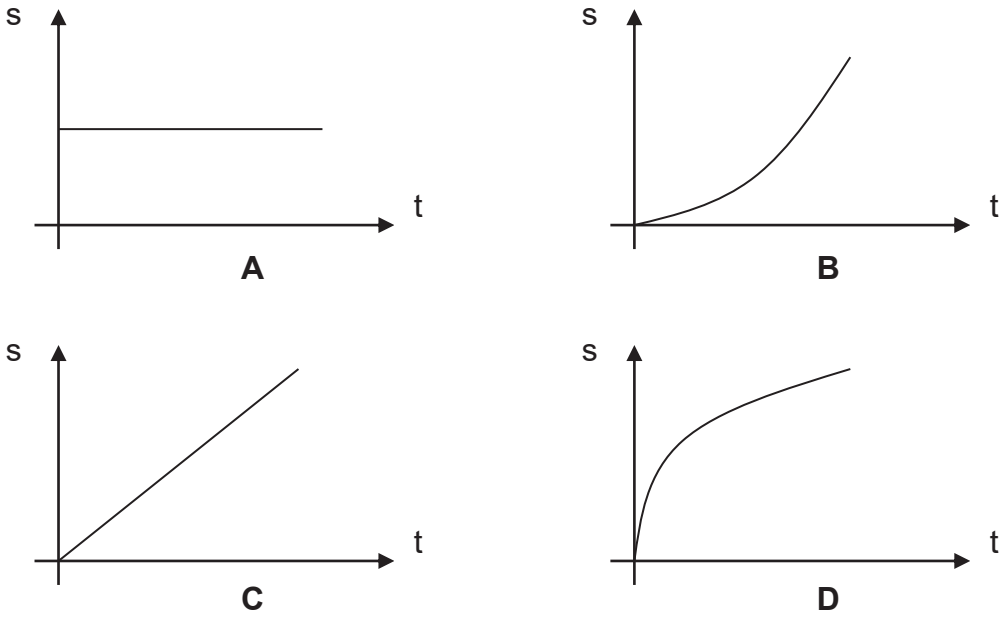
4. The overall stopping distance of a car consists of a 'thinking distance' for the driver to react and the 'braking distance' to stop his car. A driver driving at 20 m/s took 0.50 s to react and a further 5.0 s to stop his car. What is his overall stopping distance?

A 50 m **B** 55 m **C** 60 m **D** 110 m

5. The following graph shows the speed-time graph of a body.



Which of the following graphs shows the distance-time graph of the body?



6. A ball rolling across a field will slow down and eventually stop because

A inertia will cause all objects to remain in a state of rest.

B there is no net force acting on the ball.

C there is a force that acts in the direction opposite its motion.

D the ball has no energy since there is no work done on the ball.

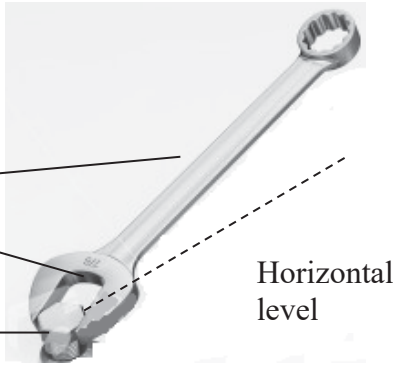
7. A 2000 kg car travelling at a constant velocity of 25 m/s encounters a total resistive force of 50 kN. Assuming there are no other horizontal forces acting on the car, which of these relationships describes the driving force F provided by the engine?

A F = 0 N **B** F < 50 kN **C** F = 50 kN **D** F > 50 kN

8. The pellet of mass 50 mg is fired vertically upwards and reaches a height of 1000 m. What is the total energy at the highest point?

A 0 J **B** 0.5 J **C** 500 J **D** 500000 J

9. A technician tries to loosen a nut with a spanner but the nut does not turn. He has held the spanner above the horizontal level as shown. Which of the following methods is not a logical attempt?



A Use a longer spanner.

B Bring the spanner nearer the horizontal level.

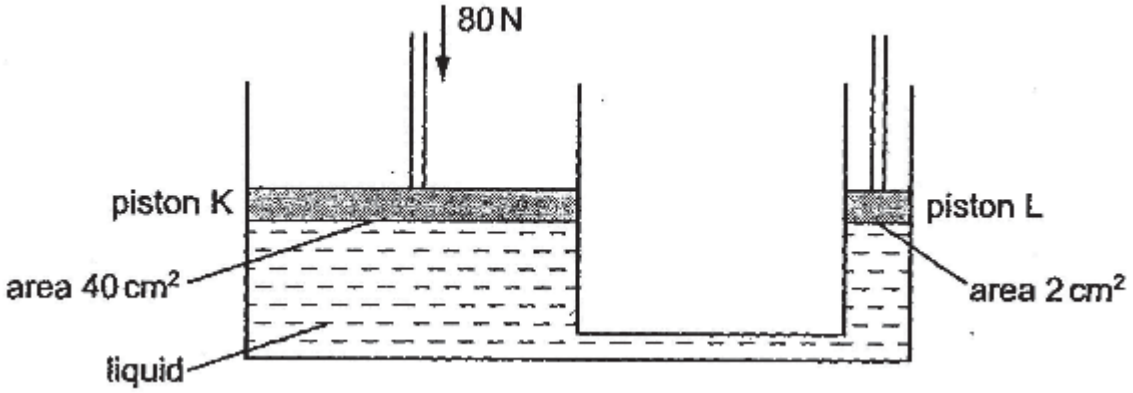
C Apply more force.

D Push the nut further into the gap.

10. A rectangular box of dimensions 4.0 m by 2.0 m by 3.0 m weighs 50 N. What is the minimum pressure it exerts on the surface it rests on?

A 2.1 Pa **B** 4.2 Pa **C** 6.3 Pa **D** 8.3 Pa

11. Which of the following statements is true?



A The force at piston L is 1600 N.

B Piston K will move a longer distance than piston L.

C The pressure at piston K and piston L is the same.

D The pressure at piston K is lower than at piston L.

12. A man lies on a bed of needles. What happens if the number of needles is doubled?

	Force on 1 needle	Force on the man	Pressure at contact
A	Remains the same	Doubled	Remains the same
B	Halved	Remains the same	Halved
C	Remains the same	Doubled	Doubled
D	Halved	Remains the same	Remains the same

13. Illuminated smoke particles, suspended in air, are viewed through a microscope. They appear to move randomly. Which of the following best describes the conversion and transfer of energy that takes place?

A Kinetic energy of air molecules → Kinetic energy of smoke particles

B Potential energy of air molecules → Kinetic energy of smoke particles

C Heat energy from source → Kinetic energy of smoke particles

D Light energy from source → Kinetic energy of smoke particles

14. Which of the following statements is true when the temperature of a solid is raised?

A The molecules expand and the solid occupies a greater volume

B The molecules in the solid start to move around

C The mass of the solid increases as the volume increases

D Heat travels to all parts of the solid in the form of kinetic energy of the molecules

15. A gas in the process of condensation will

A not give off or take in any heat because there is no change in temperature.

B give off heat because its molecules are losing kinetic energy.

C give off heat because intermolecular forces are forming.

D take in heat in order to break the intermolecular forces.

16. Blowing across the surface of a spoon of hot soup will cause it to cool mainly because

A still air is a poor conductor but moving air is good conductor.

B convection cannot occur without blowing.

C blowing across the surface increases the surface area for radiation.

D blowing across the surface allows more evaporation to take place.

17. The interior (which is touching the water) of a vacuum flask designed to hold hot water is shiny because

A shiny surfaces are poor absorbers of radiation.

B shiny surfaces are good absorbers of radiation.

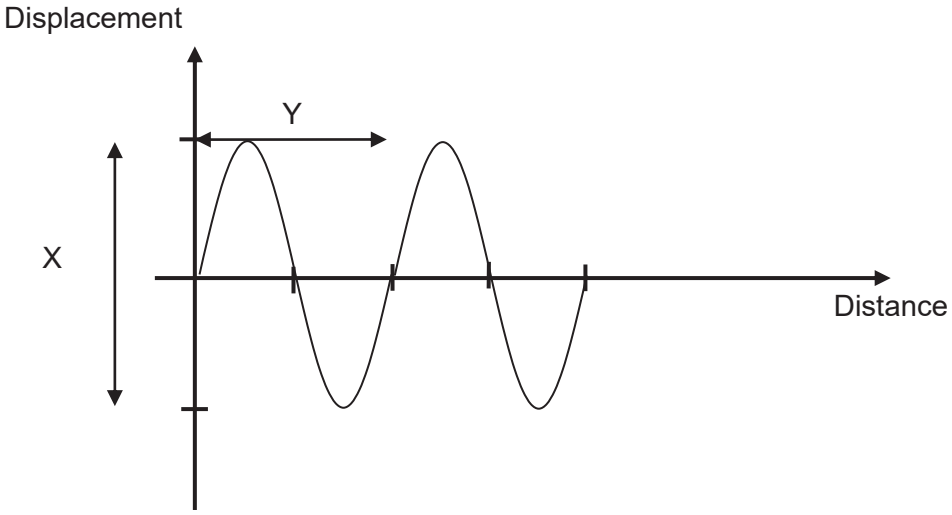
C shiny surfaces are poor emitters of radiation.

D shiny surfaces are good emitters of radiation.

18. A 3 kW kettle containing 500 g of a boiling liquid is placed on a balance. The balance reads 200 g after 5 minutes. What is the value of the specific latent heat of vapourisation of the liquid?

A 2.0 kJ/kg **B** 3.0 kJ/kg **C** 3.0 MJ/kg **D** 4.5 MJ/kg

19. What information can you conclude from the graph describing a wave?



A The amplitude is X. **B** The amplitude is X/2.

C The period is Y. **D** The period is Y/2.

20. Which of the following can be used to calculate the period of a wave?

A frequency divided by wave speed

B frequency divided by the wavelength

C wavelength multiplied by the frequency

D wavelength divided by the wave speed

21. Given that the critical angle of a medium is 45°, what is the refractive index?

A 0.71 **B** 1.00 **C** 1.33 **D** 1.41

22. An object is placed 12 cm from a lens of focal length 8 cm. Which of the following best describes the property of the image?

A real, inverted, diminished **B** real, inverted, magnified

C virtual, upright, magnified **D** virtual, upright, diminished

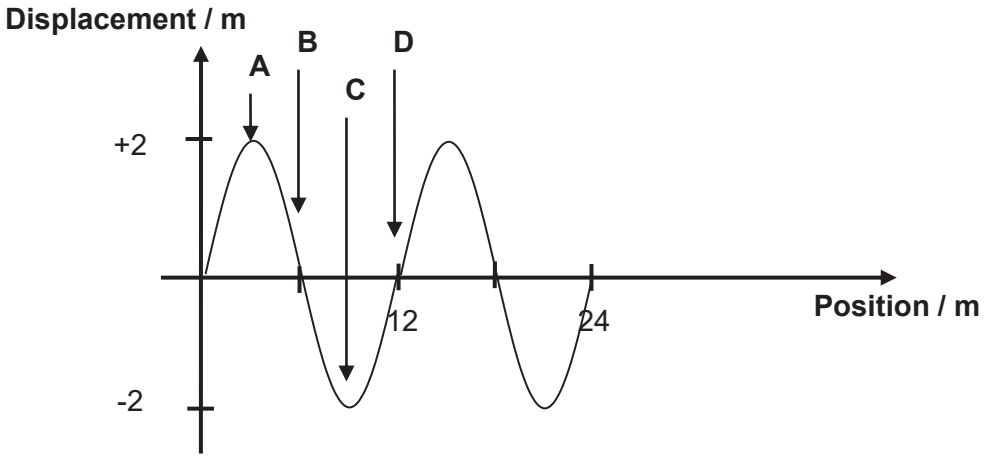
23. The refractive index of water is 1.33. What is the speed of light in water?

A 7.5×10^7 m/s **B** 2.25×10^8 m/s **C** 3.00×10^8 m/s **D** 4.00×10^8 m/s

24. A boy shouts on a mountain and hears the echo from the nearest neighbouring mountain after 2.0 s. Given that the speed of sound in air is 300 m/s, how far is the neighbouring mountain from the boy?

A 75 m **B** 150 m **C** 300 m **D** 600 m

25. The following graph describes a longitudinal wave, with left defined as the positive direction. Which is a region of compression?



26. Which of the following methods can be used to test whether an unknown material X is a magnet?

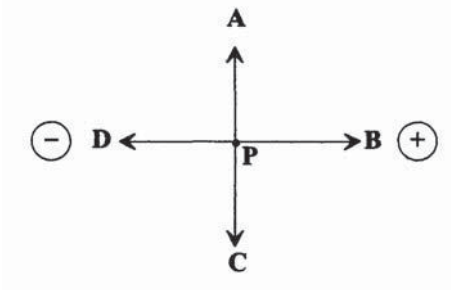
I Find out whether a compass needle is deflected when a wire carrying a current is wound around it.

II Find out whether a North pole of a permanent magnet will attract X.

III Find out whether a South pole of a permanent magnet will repel X.

A I and III only **B** II and III only **C** I and II only **D** III only

27. The diagram shows two charges. In which direction will the electric field act?



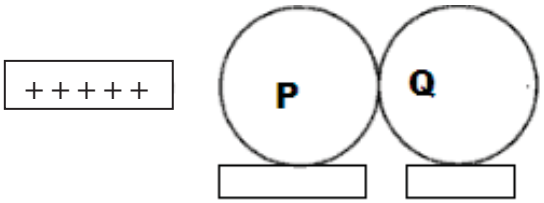
28. The diagram shows two insulated metal spheres P and Q. The steps are, in order:

Step 1: Bring the (+) charged rod close to P

Step 2: Momentarily earthed P

Step 3: Separate P from Q

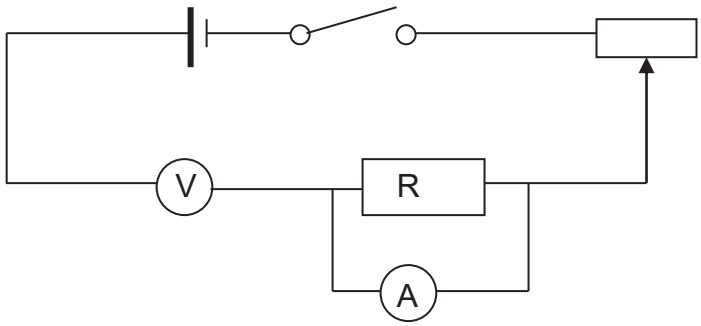
Step 4: Remove the charged rod



What are the charges on P and Q?

Option	**A**	**B**	**C**	**D**
Charge on P	Positive	No charge	Negative	Negative
Charge on Q	Positive	Positive	No charge	Negative

29. A circuit is set up as shown. The cell has an emf of 3.0 V and the resistance of R is 5.0 Ω.



What are the readings on the ammeter A and voltmeter V when the jockey is adjusted to give minimum resistance and the switch is closed?

Option	**A**	**B**	**C**	**D**
Reading on A	0.6 A	Shoots to full scale deflection	0 A	0 A
Reading on V	3.0 V	3.0 V	3.0 V	0 V

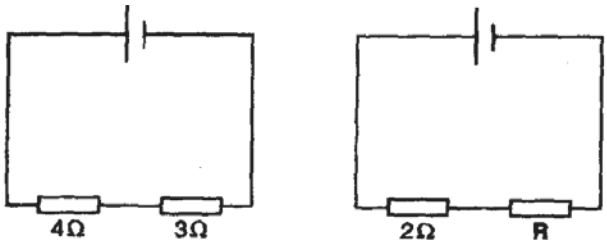
30. Which of the following best describes the characteristics of a thermistor as current increases?

Option	**A**	**B**	**C**	**D**
Voltage	Increases	Increases	Decreases	Decreases
Resistance	Increases	Decreases	Increases	Decreases

31. A wire has resistance R. A wire half as long with twice the diameter made of the same material will have resistance

A R/8 **B** R/4 **C** R **D** 2R

32. Two identical cells are connected to two circuits. It is found that both circuits have the same current flowing in them. What is the value of R?



A 1.5 Ω **B** 5.0 Ω **C** 7.0 Ω **D** 12.0 Ω

33. The most suitable fuse rating for a heater marked 240 V, 1.2 kW is

A 5 A **B** 7 A **C** 12 A **D** 20 A

34. The cost of a unit (kWh) of electricity is 24 cents. What is the cost, to the nearest cent, to turn on a 0.5 kW computer for 30 minutes?

A $0.06 **B** $3.60 **C** $21.60 **D** $60.00

35. A current of 4 A flows in the live wire of a socket when the appliance is functioning normally. Which of the following is true?

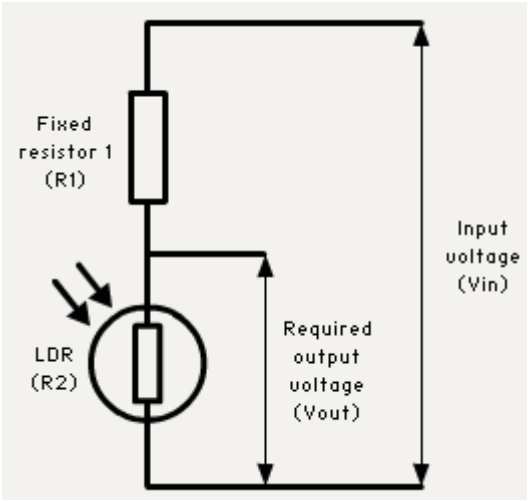
A A current of 4 A flows in the neutral wire

B A current of 4 A flows in the earth wire

C A current of less than 4 A flows in the neutral wire

D A current of less than 4 A flows in the earth wire

36. A LDR is connected in series with a fixed resistor R_1 = 5.0 Ω. The input voltage is 6 V and the output voltage is 1 V. Which is the likely physical condition of the surrounding?



A bright

B dark

C hot

D cold

37. Which of the following best describes why a magnet will attract a piece of soft iron?

A The piece of soft iron becomes an induced magnet.

B The piece of soft iron becomes a temporary magnet.

C The piece of soft iron becomes a permanent magnet.

D An induced current will flow in the piece of soft iron.

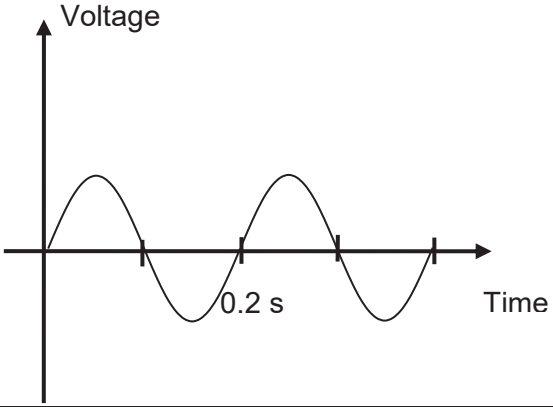
38. A beam of electron experiences a magnetic field from the top to the bottom of the page. A force to the right of the page acts on the electron beam. What is the direction which the electron beam travels and which rule determines the direction?

Option	**A**	**B**	**C**	**D**
Direction	Into the page	Into the page	Out of the page	Out of the page
Rule: Fleming's ____ Hand Rule	Left	Right	Left	Right

39. An a.c. input of 240 V is connected to the primary coil of an ideal transformer. The output current is 6 A. Which of the following is a possible combination of the input current and output voltage?

Option	**A**	**B**	**C**	**D**
Input Current	12 A	480 A	1 A	0 A
Output Voltage	120 V	24 V	40 V	0 V

40. An ac generator produces an output voltage as shown in the diagram.



Which of the following best describes the changes if the generator is turned twice as fast?

Option	**A**	**B**	**C**	**D**
Output Voltage	Doubles	Halves	Doubles	Unchanged
Period	Doubles	Doubles	Halves	Doubles

---------- END OF PAPER ----------

Section A (50 marks)

Answer all the questions in the space provided.

1. A car describes a linear motion represented by the graph shown in Fig.1.1.

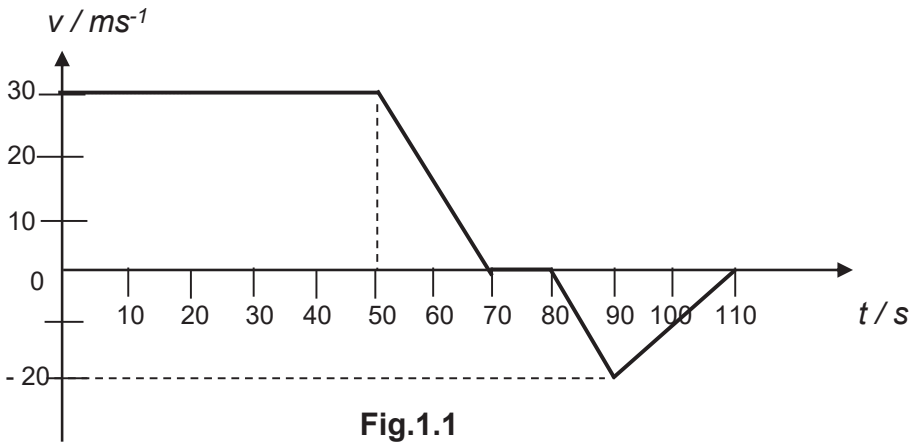


Fig.1.1

(a) **(i)** Describe the motion of the car from t = 0 to 110 s. [2]

……

……

……

(ii) What is the value of the retardation of the car from t = 50 to 70 s? [1]

……

……

(b) Find the total displacement travelled by the car for the whole journey. [2]

(c) Sketch the displacement-time graph for the car's motion.
Indicate all relevant values. [2]

2. A uniform rod **PQ** of length 80.0 cm and weight 2.0 N is placed on the pivot as shown in Fig. 2.1 below. A spring balance is attached to the other end of the rod. A load of 8.0 N is placed 20.0 cm from the spring balance.

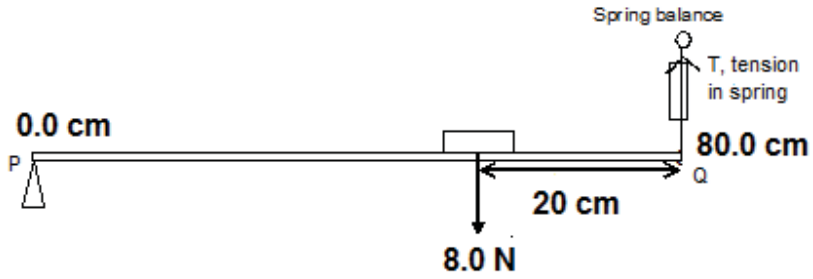


Fig. 2.1

(a) What is the reading on the spring balance in order for the rod to balance horizontally? [2]

(b) Determine the magnitude and direction of the reaction (force) on the pivot. [2]

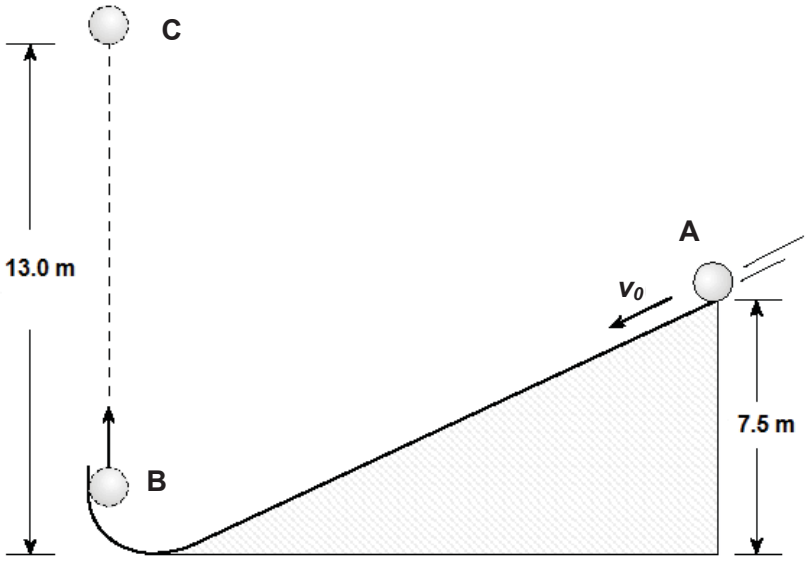
(c) If the 8.0 N weight is gradually moved along the rod towards **P**, the rod being kept horizontal, state and explain the change in the magnitude of **T**. [2]

……

……

……

3. A 0.50 kg ball starting from position **A** which is 7.5 m above the ground, slides down from an incline with an initial speed of v_o m/s as shown. Friction on the rough incline produces 10.7 J of heat energy. The ball leaves the incline at position **B** travelling vertically upward and reaches a height of 13.0 m above the floor (position **C**) before Falling vertically down.



(a) State the Principle of Conservation of Energy. [1]

……

……

……

(b) What is/are the energy/energies that the ball possesses at position **A**? [1]

……

(c) Calculate the gravitational potential energy at position **C**. [1]

(d) Calculate the initial speed, v_0, at position **A**. [2]

(e) State one assumption for your calculation in **(d)**. [1]

……

4. Fig.4.1 shows the plan view of a fish tank containing one goldfish.
The diagram is drawn **full scale**.

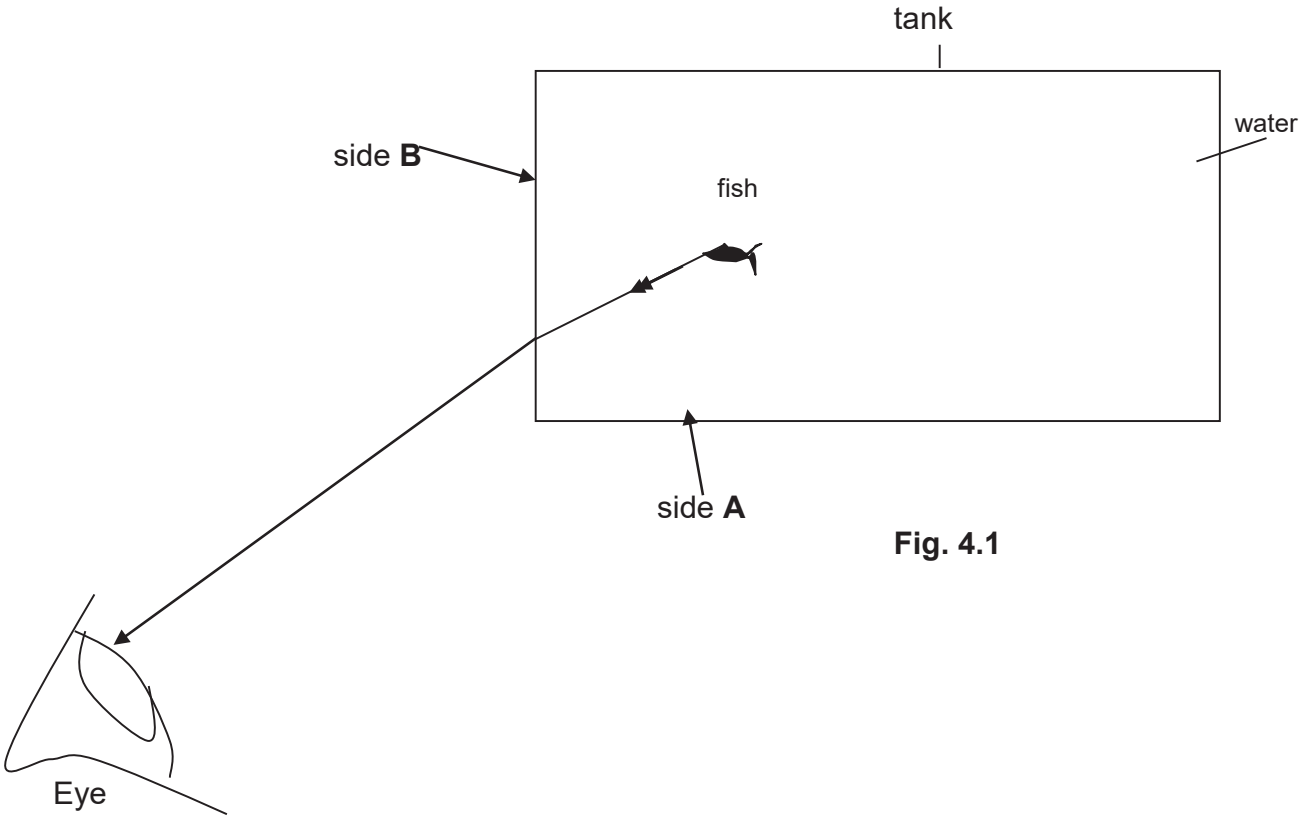


Fig. 4.1

A boy can see two images of the fish when he looks from the position shown.
Fig. 4.1 shows a ray of light, from the fish, that is refracted at side **B** of the tank.
The ray enters the eye as shown.

(a) **Measure** the angle of incidence and refraction and use the angles to determine the refractive index of the water in the tank. [2]

On Fig.4.1,

(b) **(i)** sketch a second **ray** (no need to draw to scale) from the fish to the eye that is refracted at side **A** of the tank,

(ii) show the positions of the **two images** of the fish. [3]

5. **(a)** Explain, by writing about molecules, how the air inside a car tyre exerts a pressure on the walls of the tyre. [2]

……..

……..

……..

……..

(b) A vessel closed by a piston contained a constant mass of gas. Keeping the temperature of the gas constant, weights are placed on top of the piston which reduces the volume of the gas.

Complete the table below, using the words **increases, decreases** or **no effect** to describe the changes that have occurred. [1]

Property of the gas	**Change that has occurred**
Number of molecules in every cm^3	
Frequency of collisions of the gas molecules with the piston	
Average kinetic energy of the gas molecules	
Pressure of the gas	

6. A light perspex ball is placed near a highly positively charged metal dome in a Van de Graaff generator. The ball swings away from the positively charged metal dome and remains stationary at position **X.** (Fig. 6.1)

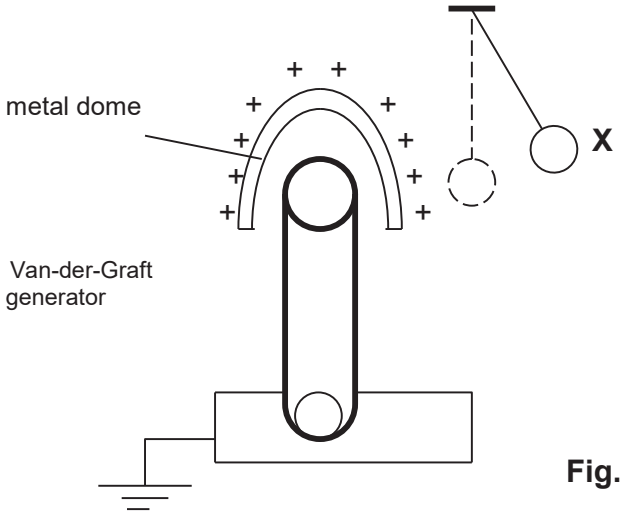


Fig. 6.1

(a) Explain why the perspex ball moves away from the metal dome. [2]

……

……

(b) The perspex ball has a mass of 5.0 g.

At the instant where the ball is stationary at **X**, there is a horizontal electric force, F_E = 0.15 N acting to the right, a tension **T** in the string and the weight **W**, (Fig. 6.2)

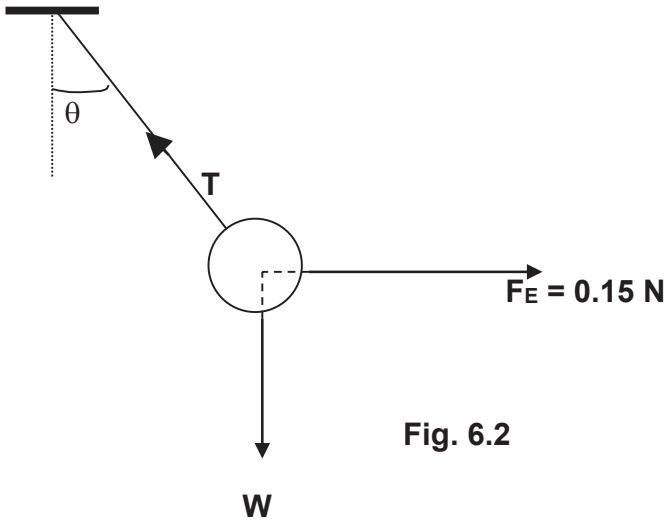


Fig. 6.2

By using a scale drawing, determine the tension **T** and the angle θ that the string makes with the vertical. (Take g = 0.01 N / g) [4]

7. **(a)** Fig. 7.1 shows an electric circuit powered by a 12.0 V battery of negligible internal resistance.

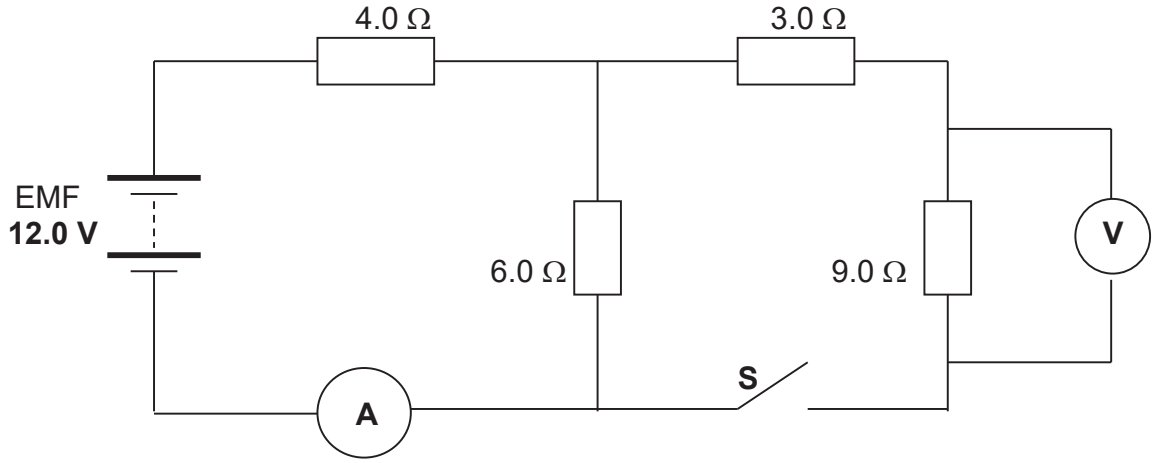


Fig. 7.1

Determine the ammeter and the voltmeter readings when

(i) the switch **S,** is open; [2]

(ii) the switch **S,** is closed. [2]

(b) The same power source is now connected to a potential divider consisting of an LDR and a resistor. (Fig. 7.2).

An LDR (light-emitting diode) is an *input transducer* whose resistance can change according to the amount of light falling on it.

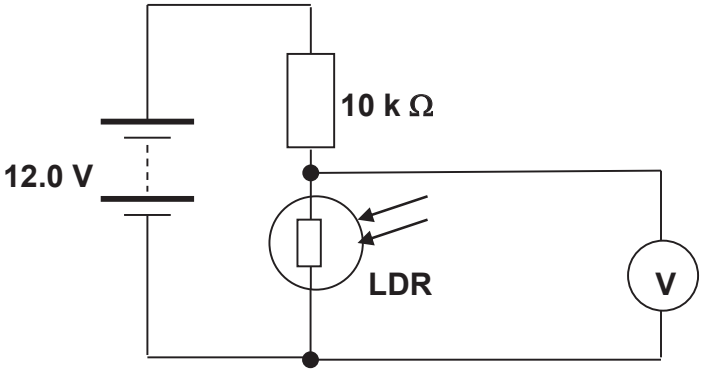


Fig. 7.2

(i) Explain the word '*input transducer'.* [1]

……

……

(ii) What is the resistance of the LDR when the voltmeter reads 2.0 V? [1]

8. A pupil makes a simple d.c motor as shown in Fig. 8.1 using some common materials and connected to a 6.0 V battery.

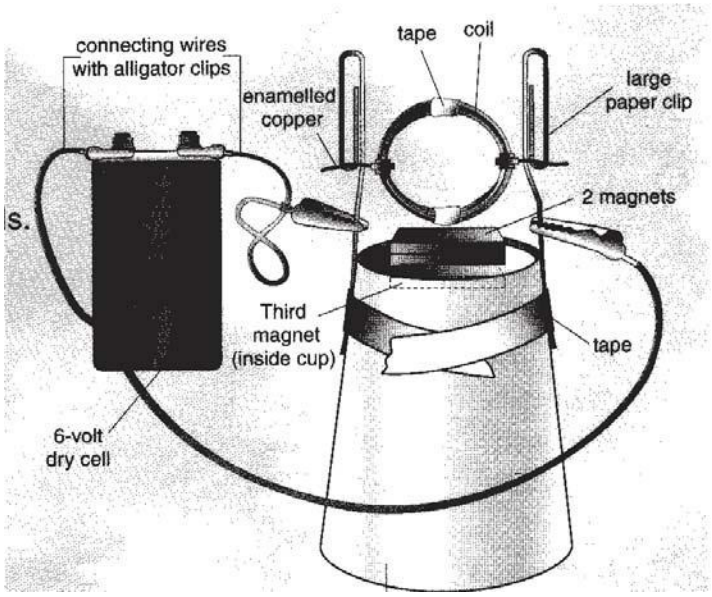


Fig. 8.1

The enamelled copper wire is an insulated wire with **part of its insulation** removed. The ends of the coil are placed on the large paper clip.

When the power source is turned on, the coil is given a *slight push* and the coil begins to *spin*.

(a)(i) Why is the coil given a *slight push*? [1]

……

(ii) Explain why the coil starts to rotate continuously. [3]

……

……

……

……

(b) If a stronger power source is used, state its effect on the rotation of the coil. [1]

……..

(c) What is the purpose of the third magnet inside the cup? [1]

……..

9. Fig. 9.1 shows the structure of a transformer which is used in the transmission of electrical power through the cables.

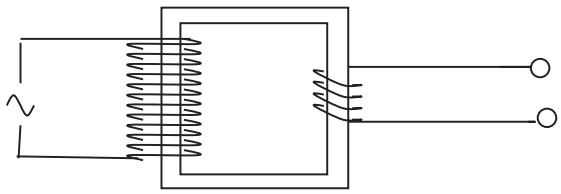


Fig. 9.1

Coil	Number of turns
J	50
K	100
L	1 000
M	1 500

Table 1

An engineer is assigned to build a step-down transformer for stepping down the voltage from 3.3 kV to 220 V in the substation of a housing estate. He has the choice of using four types of coils with different number of turns as shown in Table 1 above.

(a) Based on Table 1, select the most suitable pair of coils for making the primary coil and secondary coil of the transformer. Explain your choice. [2]

……..

……...

……

(b) Assume that the transformer is 75 % efficient and the power output is 15 kW, determine the current flowing in the primary coil. [2]

(c) State and explain **one** feature that can improve the efficiency of this transformer. [1]

……..

……...

……

-END OF SECTION A-

Section B [30 marks]

Answer all the questions from this section. Question 12 has a choice of section to answer.

10. **Fig. 10.1** shows the hydraulic braking system for a car from the brake pedal to the braking discs of the wheel.

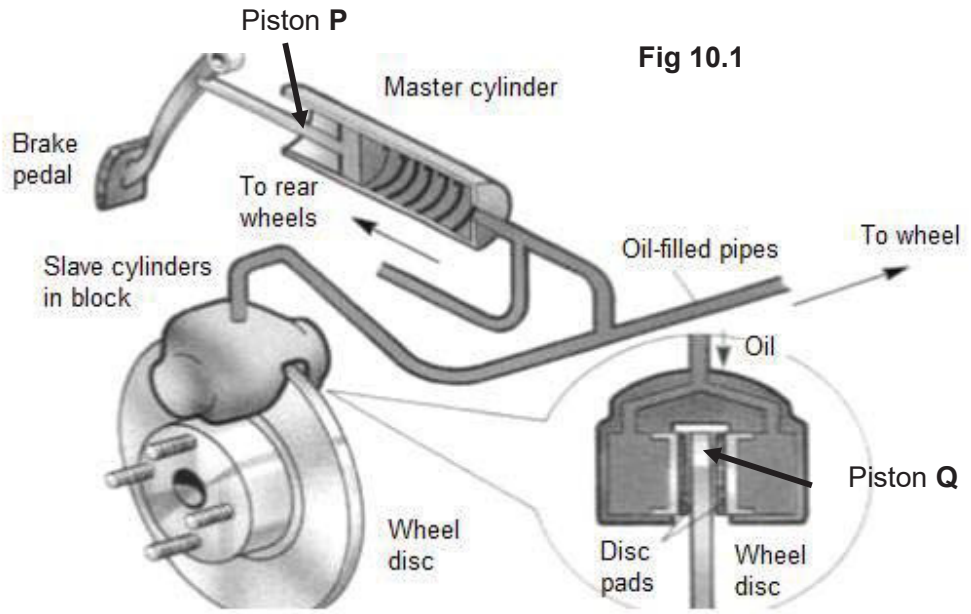


Fig 10.1

A force is applied downwards on the brake pedal in order to slow down the wheels of the car.

(a) Using **Fig. 10.1**, explain clearly how a force applied on the brake pedal can slow down a moving car. [2]

……

……

……

……

(b) The surface area of piston **P** in contact with the brake fluid at the master cylinder is 5.0×10^{-4} m^2 and the area of piston **Q** of the slave cylinder is 7.5×10^{-3} m^2.

(i) Explain why the area of piston **P** has to be smaller than piston **Q**. [1]

……

……

(ii) Find the force exerted on Piston **Q** when a force of 120 N is exerted on the brake pedal. [2]

(iii) If piston **P** moves down by 6 cm when the brake pedal is depressed, calculate the distance moved by piston **Q**. [1]

(c) In order to ensure that the braking system functions properly, air cannot be trapped in the brake fluid. Explain clearly how trapped air in the braking fluid can affect the performance of the hydraulic braking system. [1]

……

……

(d) When the road is wet, a sudden hard braking when the car is moving at a high speed can cause the wheels to stop rotating instantly and the car will skid (slide uncontrollably).

(i) Explain why a fast moving car skids on the wet road when the brake is suddenly pressed very hard and the wheels stop rotating. [2]

……

……

……

(ii) To reduce the possibility of a car skidding on a wet surface, the wheels of the car have specially designed threads as shown in **Fig.10.2**. Suggest how these threads are able to reduce the chances of the car skidding on a wet surface. [1]

Tyre threads

Fig. 10.2

……

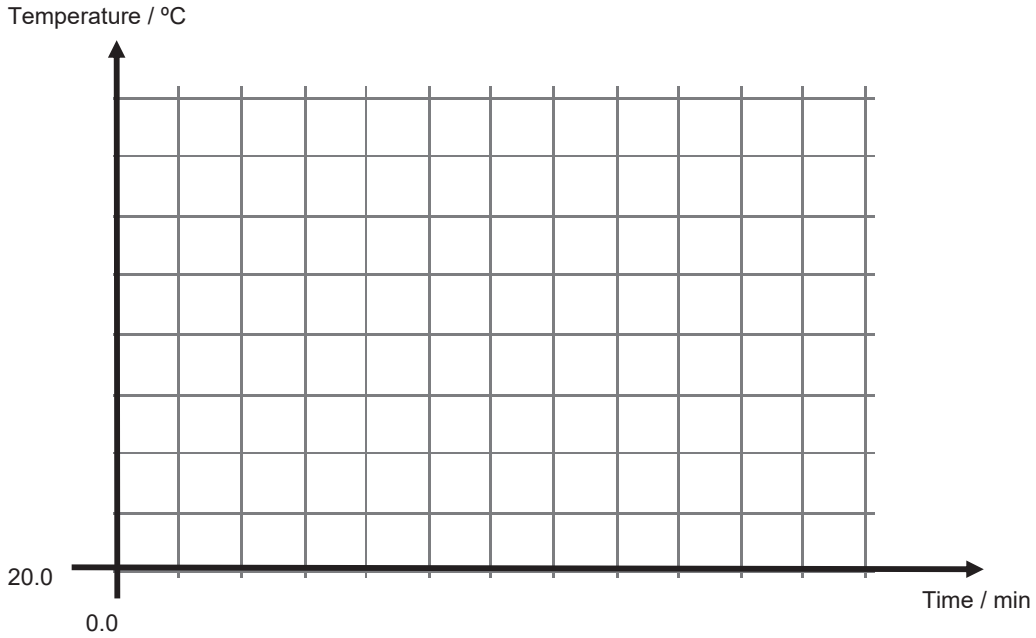
……

11. (a) 2 kg of pure substance **X** was heated uniformly from its solid state until it reaches the gaseous state. The temperature of **X** was taken in intervals of 5.0 minutes and are tabulated as shown in **Fig.11.1**. Assume that the heat supplied was constant and no heat was lost during the heating process.

Melting point of pure **X** = 40.0 ºC
Boiling point of pure **X** = 70.0 ºC
Time when **X** began melting = 2.5 minutes
Time taken for all of solid **X** to melt = 5.0 minutes
Time when **X** began boiling = 10.0 minutes
Specific latent heat of vaporization of **X** = 30.0 kJ/kg
Power = 100 W

Time / min	**Temperature / ºC**
0.0	25.0
5.0	40.0
10.0	70.0
15.0	70.0
20.0	70.0
25.0	85.0

Fig. 11.1



(i) By analyzing the data obtained and using the given information, plot the heating curve of pure substance **X** in the grid lines provided. [3]

(ii) Calculate the specific heat capacity of the solid **X**. [2]

(b) **Fig. 11.2** below shows the cooling curve graphs of two pure liquids, **Y** and **Z,** of the same mass.

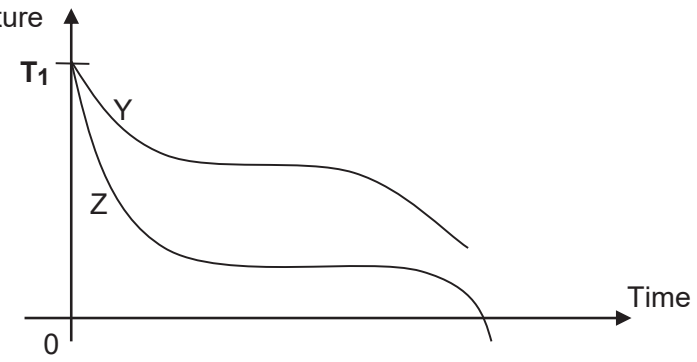


Fig. 11.2

(i) Which substance (**Y** or **Z**) has a lower melting point? [1]

……

(ii) Which substance (**Y** or **Z**) has a greater specific heat capacity in the liquid state? Explain your answer clearly. [2]

……

……

(iii) Which substance (**Y** or **Z**) has a greater specific latent heat of fusion? Explain your answer clearly. [2]

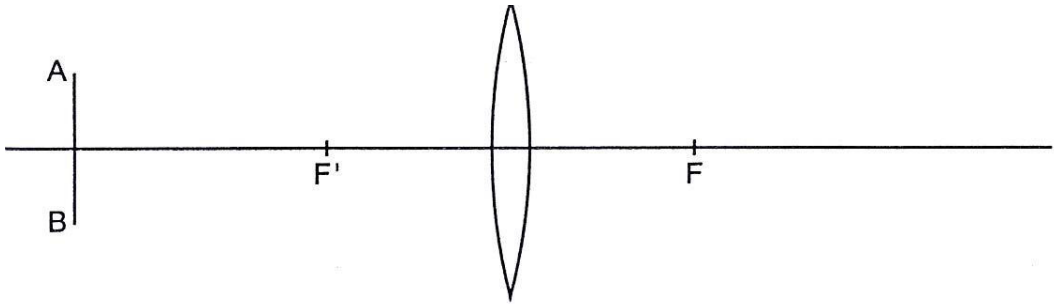
……

……

EITHER

12A.(a) **Fig. 12.1** shows an object **AB** near a thin converging lens. The principal foci of the lens are at **F** and **F'**

Fig. 12.1



(i) By means of an accurate drawing, draw rays to find the positions of the images of the points **A** and **B**. [2]

(ii) If object **AB** is brought closer and closer to the converging lens until a distance less than one focal length, describe clearly the changes to the image of **AB**. [2]

……

……

(b) **Fig. 12.2** shows a scaled drawing of an object **PQ** and its image **P'Q'** after passing through a thin converging lens. By locating the position of the converging lens and drawing rays on the diagram, find the focal length of the converging lens. [2]

Fig. 12.2

Focal length = ……..

(c) Light rays passing into an eyeball undergo two refractions; once as they pass through the cornea and another as they pass through the lens of the eye. **Fig.12.3** shows how light rays pass through the eyeball and the image of an object is formed at the back of the eye (retina) for an individual with perfect eyesight. For a short-sighted person, the image of a distant object is formed in front of the retina.

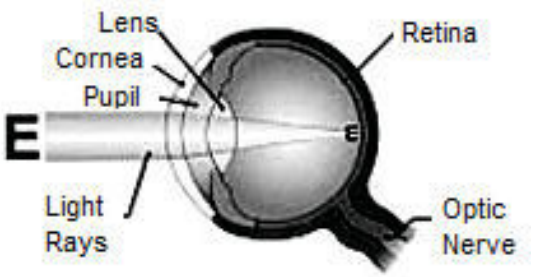


Fig. 12.3

(i) One way to correct short-sightedness is to use a pair of spectacles. Which type of spectacle lens (converging or diverging) would be suitable to correct short-sightedness? Explain your answer clearly. [2]

……

……

……

(ii) Another method to correct short-sightedness is by performing a 'lasik surgery' which removes a small portion of tissue in the cornea to make the cornea less rounded. Suggest how the less-rounded cornea in front of the eye's lens can help to correct short-sightedness. [2]

……

……

……

OR

12B. (a) **Fig. 12.4** shows a solenoid with an alternating current (a.c) supply coiled around a soft iron core. An aluminium ring is placed through the soft iron and rests on the solenoid. When the a.c supply is turned on, the ring 'floats' above the solenoid as shown in **Fig. 12.5**.

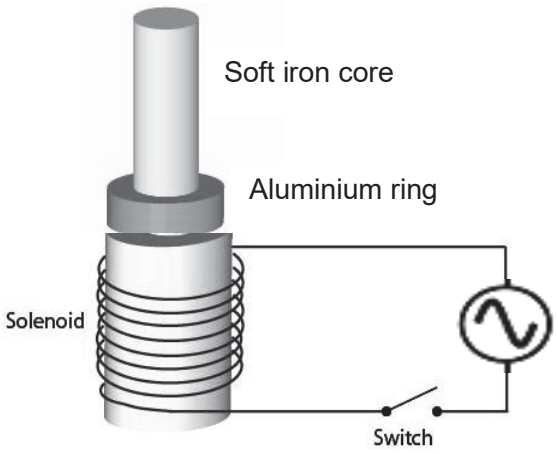


Fig. 12.4

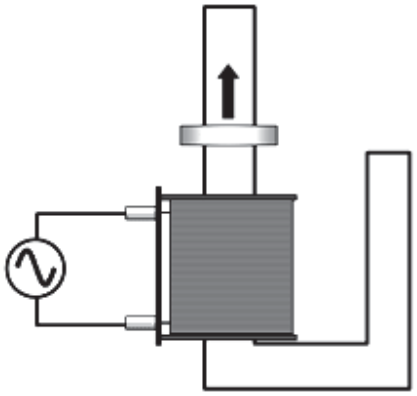


Fig. 12.5

(i) Explain clearly why the aluminium ring 'floats' when the a.c supply is turned on. [3]

……

……

……

……

……

……

(ii) If the a.c supply is now replaced by a d.c supply, what will be observed after the supply is turned on? [1]

……

……

(iii) The solenoid has an a.c supply but the aluminium ring is replaced with a 'C'-shaped ring instead as shown in **Fig. 12.6.** When the supply is turned on, the C-shaped ring does not 'float' upwards but continued to remain at rest on the solenoid instead. Explain the reason why this happens. [2]

Fig. 12.6

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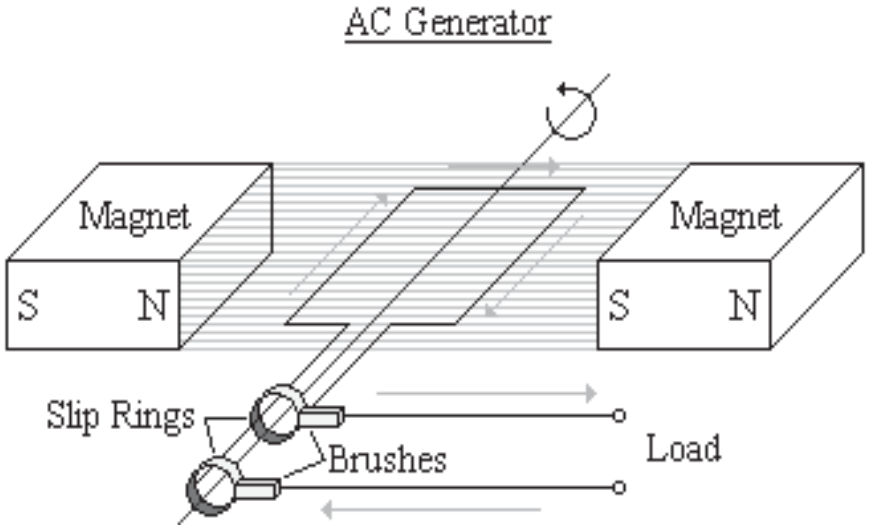
(b) **Fig.12.7** shows a simple a.c generator which has a frequency of 60 Hz and peak voltage 12 V.

Fig. 12.7



(i) Sketch the graph of the voltage produced against time for two complete cycles below. Take the position of the coil to be that in **Fig. 12.7** when time = 0 s. [1]

(ii) If the speed of rotation is **reduced by** ¼ times the original speed, sketch the new graph of the voltage produced on the same axis above. Label this new graph with **(ii)**. [2]

(iii) Explain clearly the differences between the graph for **b(i)** and **b(ii)**. [1]

……

……

……

--End of Section B—

CCHY 2018 Pure Physics Prelim Exam Mark Scheme

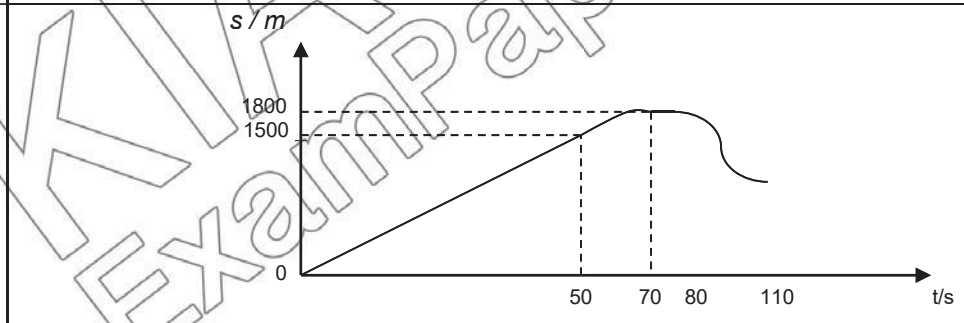
Paper 1

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

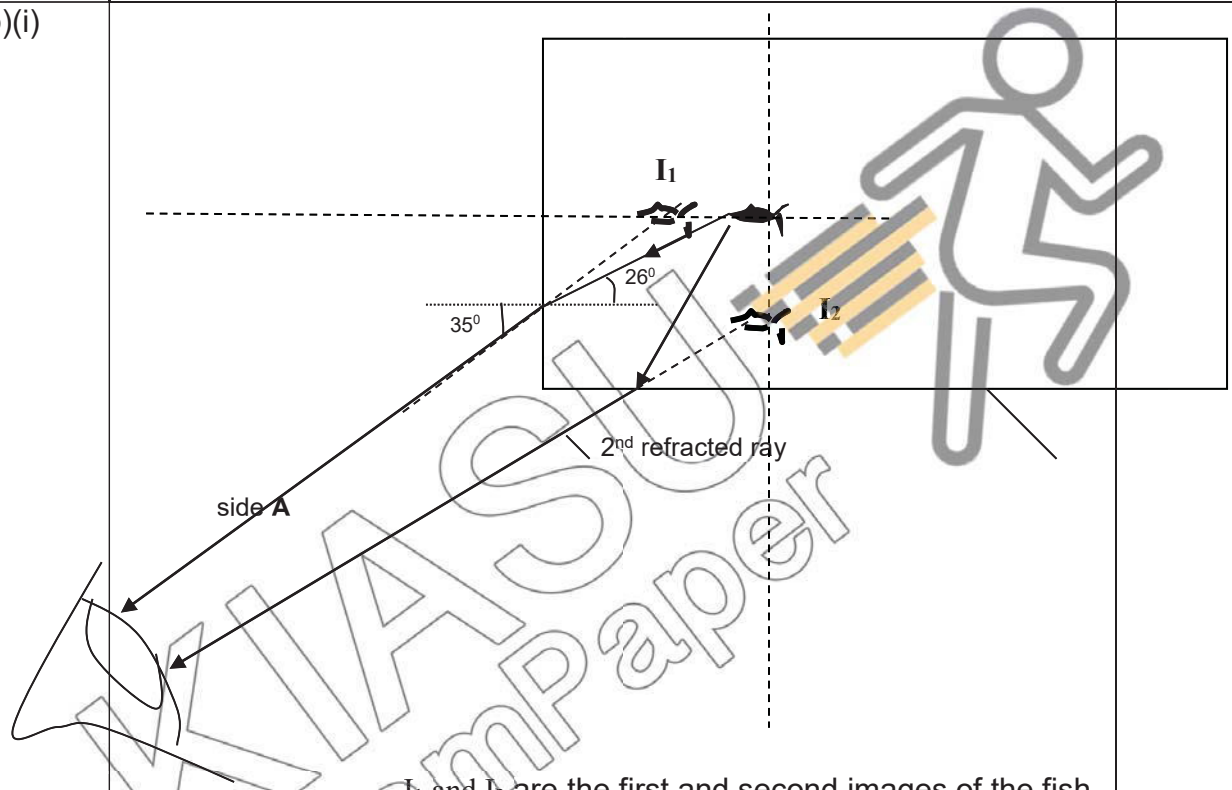
Paper 2

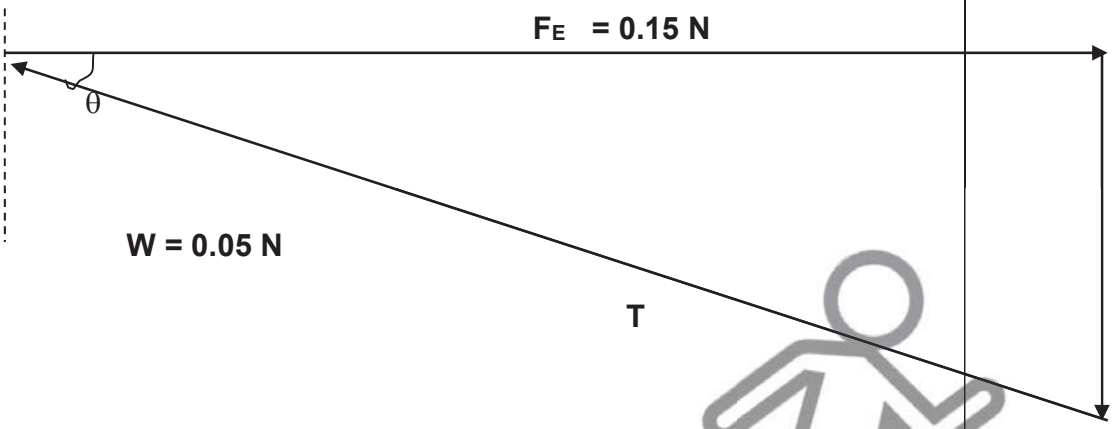
Note: ***1*** *mark will be deducted for not expressing numerical value to 2/3 sig. fig on 1 occasion. 2 marks to be deducted for more than 1 occasion.*
50% mark for each part of qn will be deducted for missing or wrong "unit".

Section A

Qn no.	Suggested Solution	Marks
1(a)(i)	The car travelled at constant speed at 30 m/s from t = 0 to 50 s, then decelerates uniformly to stop from t = 50 s to 70 s, and remain stationary / at rest for a further 10 s, It reverses / change direction and accelerates uniformly	1 1
(ii)	Either, by graphical method Retardation (r) = gradient = 30/ (70-50) = 1.5 ms^{-2} Or, using formula a = (v – u) / t = (0 – 30) / 20 = - 1.5 ms^{-2} or, r = 1.5 ms^{-2} (No mark awarded if working is not shown)	1
(b)	Total displacement = distance moved during the first 70 s - distance moved during t=80 - 110s = ½ (50 + 70) x 30 - {½ x 30 x 20} = 1500 m	1 1
(c)	 ➢ Show a **constant slope** for first 50 s up to 1500 m; ➢ a **reducing gradient** for the next 20 s to 1800 m, ➢ a **horizontal line graph** between t = 70 – 80 s at 1800 m ➢ an (increasing and decreasing) **curve** for showing the last 30 s *1 mark will be deducted for not stating / labeling the axes.*	1 1

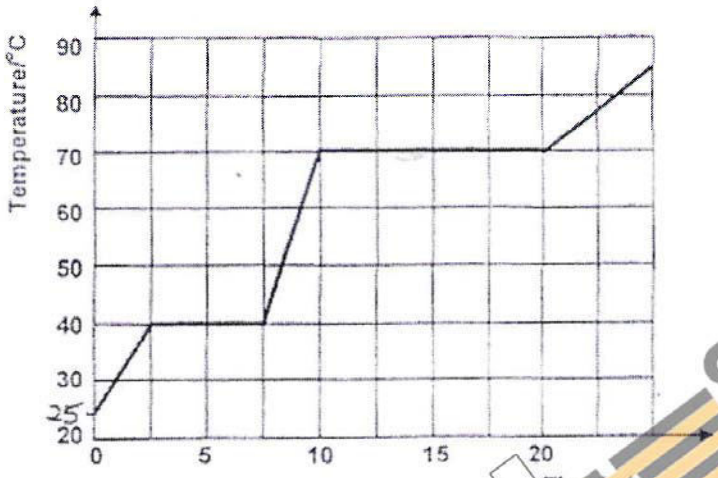
2(a)	*Let the spring balance reading (or tension) be T* *To balance about (pivot) P,* Net moment about P = 0 Total anticlockwise moment = Total clockwise moment T x 80 = (2 x 40) + (8 x 60) T = **7.0 N**	 1 1
(b)	**Either,** Let the reaction force at the pivot be R. Since net force = 0 (not moving / at balance) Hence, Total upward force = Total downward force T + R = 2 + 8 7 + R = 10 R = **3.0 N** Direction of R is (vertically) **upward** **OR , using POM and take moment about the spring position**	 1 1
(c)	Magnitude (size) of the spring balance reading **decreases** The total clockwise moment has decreased as the clockwise moment by the 8 N weight about P has decreased with the reduction in the (perpendicular) distance. To maintain equilibrium, the anticlockwise moment by spring must also decrease proportionately. As moment = force x perpendicular distance (and the distance is constant), the spring force must decrease to compensate the reduction in the moment.	1 1
3(a)	Total energy is always conserved (remain unchanged) Energy cannot be created or destroyed; They can only be converted from one form to other form(s)	1
(b)	kinetic and gravitational potential energy	1
(c)	Ep = mgh = 0.5 x 10 x 13 = **65 J**	 1
(d)	Assume no energy is loss and total energy is conserved, EP (at C) + $W_{friction}$ = total energy at A (PE + KE) 65 + 10.7 = ½ (0.5) (v_0^2) + (0.5 x 10 x 7.5) v_0 = **12.4 m/s** **OR** **E_K** (at A) = Work done against friction + Ep gain ½ (0.5)v_0^2 = 10.7 + (0.5 x 10 x {13 – 7.5}) v_0 = **12.4 m/s**	 1 1
(e)	There is negligible loss of energy due to sound/heat energy (on base)	1
4(a)	Using the Principle of Reversibility of Light **By measurement**	

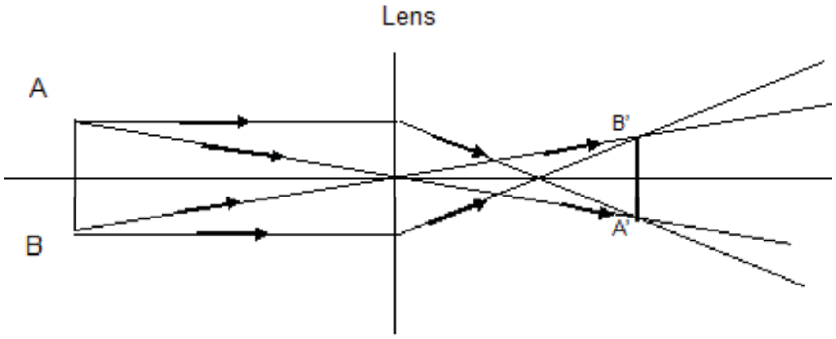
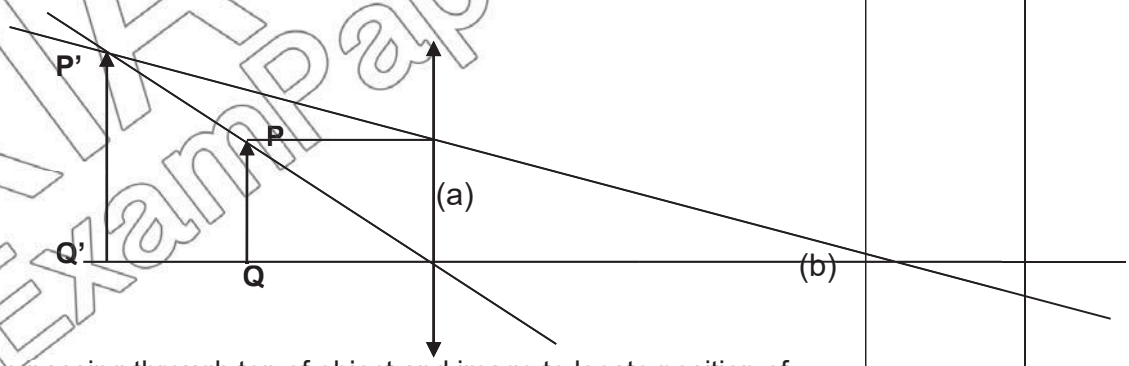
	∠i (in air) = 35^0 ∠r (in water) = 26^0 ($\pm 1^0$)	1
	n_{water} = sin i / sin r = sin 35 / sin 26 = **1.31** (or between 1.28 to 1.39)	1
(b)(i)	 I_1 and I_2 are the first and second images of the fish Show correct 2nd refracted ray from side A to eye	1 1
(ii)	show correct positions of the 2 images, I_1 and I_2	2
5(a)	air molecules moving randomly and <u>bombarding / colliding with the (tyre) walls and rebounding off.</u> exert a <u>force on the unit area</u> of wall's surface. This produces a pressure (as pressure is force per unit area)	1 1
(b)	**Increase , increases, no effect , increases** All 4 are correct	1
6(a)	perspex ball has been charged with induced positive charges on its surface atoms near to the Van de Graaff generator As **like charges repel**, the (+) charged ball will be repelled off by the (+) charged metal dome.	1 1

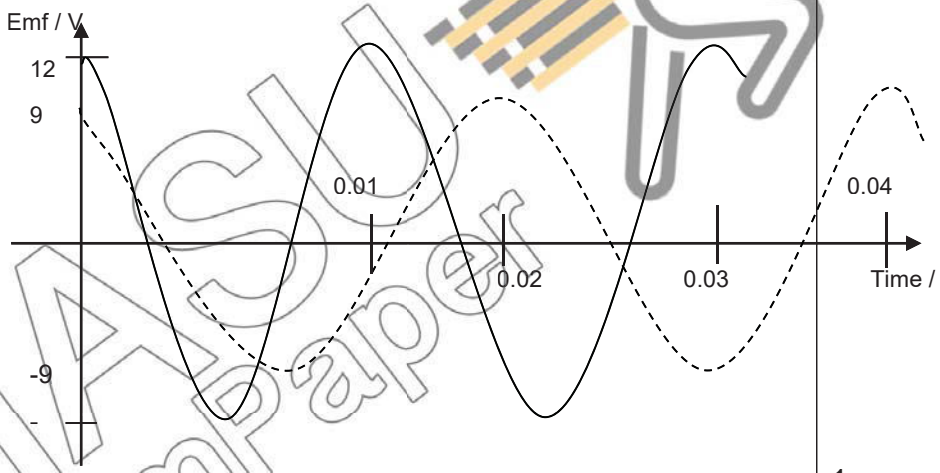
(b)	5 g has a weight (W) of 5 x 0.01 = 0.05 N Scale : 1 cm to 0.01 N (or less)  **F_E** and **W** are correctly shown (both magnitude and direction) Correct **triangle** shown (or parallelogram showing the **resultant** of F and W) Correct T and θ values (T = 0.16 N , θ = 72^0) *(Deduct 1 mark each for not expressing T to 2 or 3 sf / not labeling the forces on the scale drawing/ not indicating the direction of the force(s)*	1 1 1 1
7(a)(i)	S open, voltmeter reading is **0** as there is no current. Combined resistance = 4 + 6 = 10 Ω I = V / R = 12 / 10 = 1.2 A Ammeter reads **1.2 A**	1 1
(ii)	S closed, combined resistance = 4 + {(6 x 12) / (6 + 12)} = 8 Ω I = V / R = 12 / 8 = 1.5 A Ammeter now reads 1**.5 A** p.d across 4 Ω = IR = 1.5 x 4 = 6.0 V hence, p.d across parallel network = 12 – 6 = 6 V Current through 9 Ω = V / R = 6 / 12 = ½ A P.d across 9 Ω = IR = ½ x 9 = 4.5 V Voltmeter now reads **4.5 V**	1 1
(b)(i)	A device that converts <u>other form of energy(s) to electrical energy</u>.	1
(ii)	Using potential divider, As p.d α R at constant I hence R_{LDR} / 10 kΩ = 2 V / 10 V R_{LDR} = **2.0 kΩ**	1

	Alternatively let $x = R_{LDR}$ $x / (x + 10) = 2 / 12$ $6x = x + 10$ $5x = 10$ $x =$ **2.0 kΩ**	
8(a)(i)	To overcome inertia of the coil so that it can start to turn / enable the conducting (enameled) part of the wire to be in contact with paper clip to allow current to pass into the coil.	1
(ii)	When electric current flows into the coil via the paper clip say from right to left, (assume the coil is vertical, as shown in the diagram) *Explanation of the force set up* it sets up a magnetic field at the bottom coil which interact with the magnetic field of the permanent magnets below (with a north pole up) The net resultant field produces a force pushing the bottom coil (using Fleming's LHR) near the bottom tape which turns the coil. This causes the conducting enameled copper wire to rotate. (Alternatively, when the coil is slightly displaced to one side, the current produces a magnetic pole in the coil which will cause the coil to turn as it is repel by the magnet pole. If it is attracted, the coil will not turn and you have to displace coil on the other side) *Explanation for continuous rotation* No current flows into the coil when the insulated part of enameled wire is in contact with the paper clip, and hence no more magnetic force. But, inertia will continue to rotate the coil until the conducting enameled copper wire connects up the circuit again. This again set up a force pushing the coil in again, repeating the cycle and causing the coil to continue to turn.	1 1 1 1
(b)	The rotation speed will increase. *Mention ' increased rotation' – zero mark*	1
(c)	To secure the 2 magnets strongly in the same position on top of the base of holder by attracting them /prevent magnet attracting the coil above it.	1

9(a)	Coils **M**.: Primary coils and coil **K : secondary coil** Comparing the voltages of primary coil to secondary coil: Step down ratio = 3 300 : 220 = 15 : 1 Hence the coils must be step down to the same ratio of 15 : 1 Comparing the turn ratio i.e Coil M : Coil K = 1 500 : 100 = 15 : 1 (*If working is not clearly shown, award maximum 1 mark)*	 1 1
(b)	Input power = 100 / 75 x 15 kW = 20 kW Using I = P / V = 20 000 / 3 300 = **6.1 A**	1 1
(c)	Any one of the following….. Laminating the iron core will reduce the power loss due to heat produced by induced current (known as eddy current) in the core itself. Using low resistance (primary and secondary) coils will minimize the amount of heat produced in the coils. To increase the magnetic flux linkage between the primary and secondary coils by using a soft magnetic material (iron core) to link them up…	1
	Section B	
10(a)	A force exerted on the brake pedal **acts on the surface area of Piston P in contact with the oil** in the master cylinder **to create a pressure** This **pressure in the oil is transmitted to all parts of the oil** Since **oil is incompressible, t**his **creates a force pressing on the disc pads** of the wheels. **Friction between the disc pads and the wheels** slows the car down.	1 1
(b)(i)	Since the **pressure acting in the liquid is the same throughout**, A **small area at Piston P would require a smaller force** exerted **to produce a larger force at Piston Q**.	1
(ii)	Force exerted on piston Q = $(F_P \times A_Q)/A_P$ = $(120 \times 7.5 \times 10^{-3})/ 5.0 \times 10^{-4}$ = **1800 N** (Pressure on piston P = $120 / 5.0 \times 10^{-4}$ = 240 000 Pa if got the above wrong) [1]	1 1
(iii)	Assuming no energy loss, $F_P \times d_P = F_Q \times d_Q$ $d_Q = (120 \times 6)/ 1800$ = **0.4 cm**	1
(c)	Since **air is compressible** **Pressure exerted at the master cylinder will not be fully transmitted** to the disc brakes Resulting in a **greater force required at brake pedal to obtain the same force on the disc brake** for the ideal system **Force on Piston Q is smaller**	1
(d)(i)	The fast moving car has **high inertia** On a **wet road, there is less friction between the wheels and the road**	1

	When wheels suddenly stops turning, the **forward force is greater than the resistive force**	1
(ii)	The threads **allows water to pass through** the surface of the tyre This **increases the friction between the car and the road surface** to prevent skidding.	1
11(a)(i)	 each correct part/shape of the graph with correctly labeled values for axes (total 5 parts) 0 to 2.5 min 2.5 min to 7.5 min 7.5 min to 10 min 10 min to 20 min 20 min to 25 min	2 correct - 1 mark 4 correct - 2 marks All 5 correct - 3 marks
(ii)	Heat energy supplied = power x time = 100 x 2.5 x 60 = **15 kJ** Temperature change = 40 – 25 = **15 ºC** Heat capacity of solid Z = Heat energy supplied / (mass x temperature change) = 15 000 / (2 x 15) = **500 J/kgºC**	1 1 1
(b)(i)	Substance Z	1
(ii)	Substance **Y** When subjected to the **same cooling condition**, the **fall in temperature for substance Y is slower than substance Z** This indicates that a **higher amount of energy needs to be lost** by substance Y compared to Z for the **same amount of fall in temperature**.	1 1
(iii)	Substance **Z** For the **same mass**, **same period of time**, Substance Z takes a **longer time to change state** Indicating that **higher amount of latent heat needs to be lost** by Z compared to Y to change from liquid to solid state	1 1

Either		
12A(a)(i)	 Correct **pair of rays** from A, one refracted through the lens and passing F, the other straight through optical centre Correct **pair of rays** from B, one refracted through the lens and passing F, the other straight through optical centre Correct **smaller straight image** drawn **Arrowheads drawn** for every light ray and **image labelled** with A' and B' (no arrowheads or incomplete arrow heads – minus 1 mark) (image is not straight – minus 1 mark)	1 1
(ii)	As the object is brought nearer to the lens towards one focal length distance, image becomes **magnified** but **remain inverted and real** When the object is less that one focal length distance from the lens, the image becomes magnified, **Upright** and **virtual**.	1 1
(b)	 Correct line passing through top of object and image to locate position of lens, (a) Correct line from object to lens, combined with line (b) Focal length between 5.9 to 6.2 cm	1 1
(c)(i)	**Diverging** lens. Diverging lens will **spread the incoming rays** before it reaches the lens The more diverged rays entering the lens will be **focused at a further distance in the eye** onto the retina	1 1
(ii)	When rays enter the less rounded cornea, it **undergoes lesser refraction/less converging** This causes the lesser refracted rays to be **focused at a further distance in**	1

	the eye after passing through the lens.	1
12B(a)(i)	When the supply is turned on, a **changing magnetic field** is produced around the solenoid The <u>changing magnetic flux/magnetic field lines</u> cutting the aluminium **ring induces an emf on the ring** By **Lenz's law**, the induced emf on the ring is such that the **magnetic field induced around the aluminum ring opposes the magnetic field of the solenoid** that produced it **Like poles** will exist between the aluminium ring and the solenoid And repel the ring upwards since **like poles repel**	1 1 1
(ii)	The ring will **move upwards momentarily** and subsequently **falls back down and rest** on top of the solenoid.	1
(iii)	The C-shaped ring **does not allow current to pass around the aluminium continuously**. This **does not allow any induced current, magnetic force/field to be produced** around the c-shaped ring. Hence the ring will remain at rest on the top part of the solenoid.	1 1
(b)(i)	 Correct sine curve starting from max Correct max. emf, min emf and period	1
(ii)	Correct sine curve (dotted) starting from max Correct max. emf = 9 V min emf = -9 V period = 0.022 s	1 1
(iii)	A rotation 1/4 times slower would result in a) **Output e.m.f = 9.0 V** which is 1/4 times lesser than initial b) **Period becomes 0.022 s** since frequency becomes 45 Hz c) A **<u>slower rotation causes lesser e.m.f to be induced</u>** in the generator **<u>and it the period for each oscillation is longer.</u>**	1