SINGAPORE CHINESE GIRLS' SCHOOL
PRELIMINARY EXAMINATION 2022
SECONDARY FOUR

CANDIDATE NAME								
CLASS	4			REGISTER NUMBER				
CENTRE NUMBER				INDEX NUMBER				

PHYSICS 6091/2

Monday **29 August 2022** **1 hour 45 mins**

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Section A

Answer **all** questions.

Section B

Answer **all** questions. Question 11 has a choice of parts to answer.

Candidates are reminded that **all** quantitative answers should include appropriate units.
The use of an approved scientific calculator is expected, where appropriate.
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.

The number of marks is given in brackets [ ] at the end of each question or part question.

Take g = 10 ms^{-2} or 10 Nkg^{-1} unless stated otherwise.

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

This question paper consists of 26 printed pages.

SECTION A

Answer all the questions in this section.

1 **Fig. 1.1** shows two engineers measuring the length of a wall made from concrete.

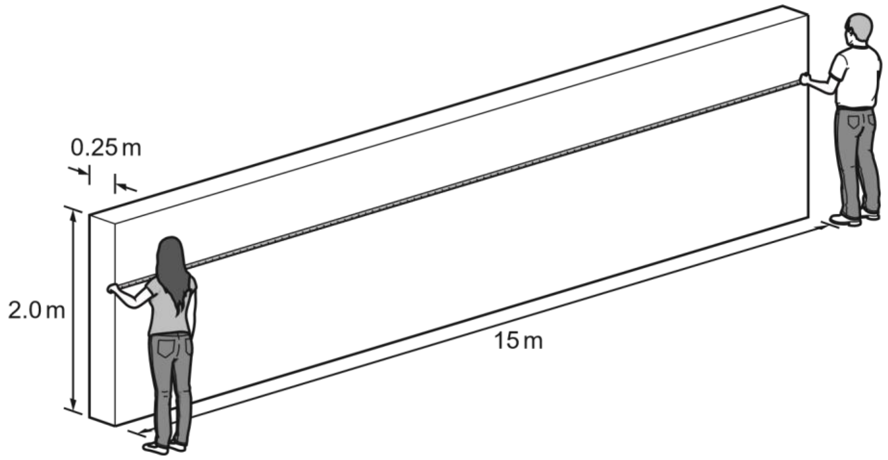

Fig. 1.1 (not to scale)

The wall is 2.0 m high, 15.0 m long and 0.25 m thick. The mass of the wall is 18 000 kg.

(a) The engineers measure the length of the wall in one single measurement.
State the name of the measuring instrument they use.

……………………………………………………………….. [1]

(b) The engineers state that the density of the concrete affects the pressure exerted by the wall on the ground but that the length of the wall does not affect this pressure.

(i) Calculate the average density of the concrete.

Average density = ……………….. [2]

(ii) Calculate the average pressure exerted by the wall on the ground.

Average pressure = …………….. [2]

(iii) Without further calculation, explain why doubling the length of the wall does not change the pressure that the wall exerts on the ground.

………………………………………………………………………………………….

………………………………………………………………………………………….

…………………………………………………………………………………….... [1]

[Total : 6 m]

2 Fig. 2.1 shows a cricket ball as it comes into contact with a cricket bat.

Fig. 2.1

The cricket ball has a mass of 0.16 kg and it hits the bat with a speed of 25 m / s. After being in contact with the bat for 0.0013 s, the ball rebounds with a speed of 22 m / s in the direction exactly opposite to its original direction.

(a) State the difference between *speed* and *velocity*.

....

....

.... [2]

(b) Calculate

(i) the change in velocity of the cricket ball,

Velocity change = ………………… [1]

(ii) the average acceleration of the ball whilst it is contact with the bat,

Acceleration = ………….. [2]

(iii) the average force exerted on the ball by the bat.

Force = ……………… [2]

[Total : 7 m]

3 (a) Explain what is meant by *centre of gravity*.

....

.... [1]

(b) A student is being weighed. The student, of weight *W*, stands 0.30 m from end A of a uniform plank AB, as shown in Fig. 3.1.

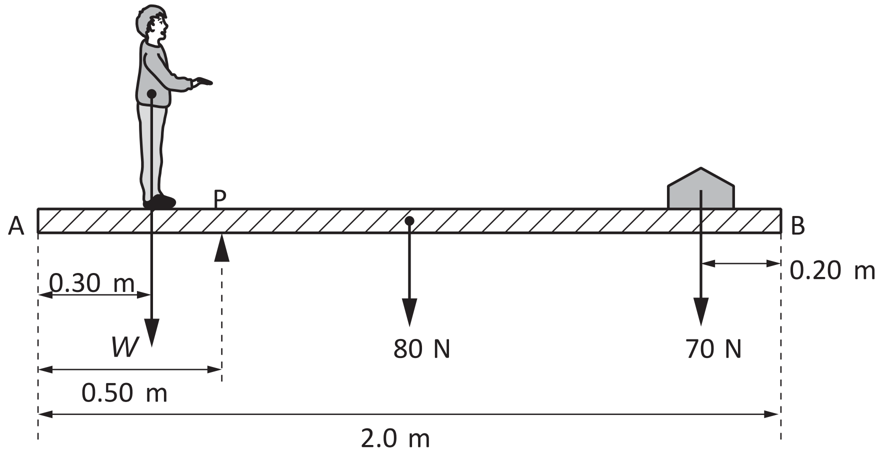

Fig. 3.1 (not to scale)

The plank has weight 80 N and length 2.0 m. A pivot P supports the plank and is 0.50 m from end A. A weight of 70 N is moved to balance the weight of the student. The plank is in equilibrium when the weight is 0.20 m from end B.

(i) Determine the weight *W* of the student.

Weight = …………… [2]

(ii) If only the 70 N weight is moved, there is a maximum weight of student that can be determined using the arrangement shown in Fig. 3.1. State and explain **one** change that can be made to increase this maximum weight.

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.... [2]

[Total : 5m]

4 Fig. 4.1 shows the variation in volume of ice when the temperature changes from -5°C to 10°C. The mass of ice is 30 g.

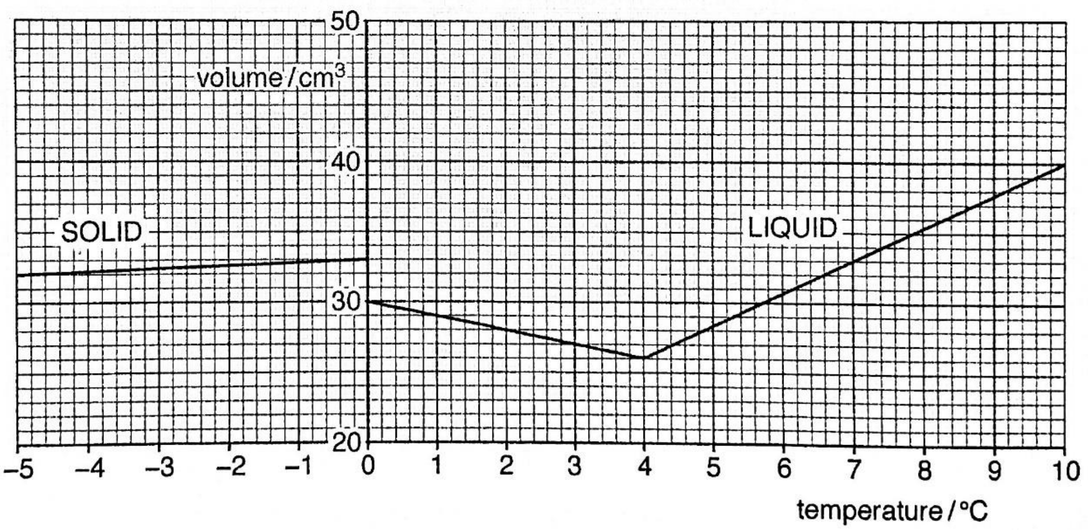

Fig. 4.1

(a) Describe how the density of the ice changes as its temperature increases from -5°C to 0°C.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

………………………………………………………………………………………………… [2]

(b) Calculate the change in the density of ice at 0°C in g/cm^3.

Density = ………….. [2]

(c) The volume of some ice cubes in a freezer decreases when they are left in the freezer for some time. This is because the ice changes from a solid to a vapour without becoming a liquid.

Describe, in terms of molecules, how ice changes from solid to vapour.

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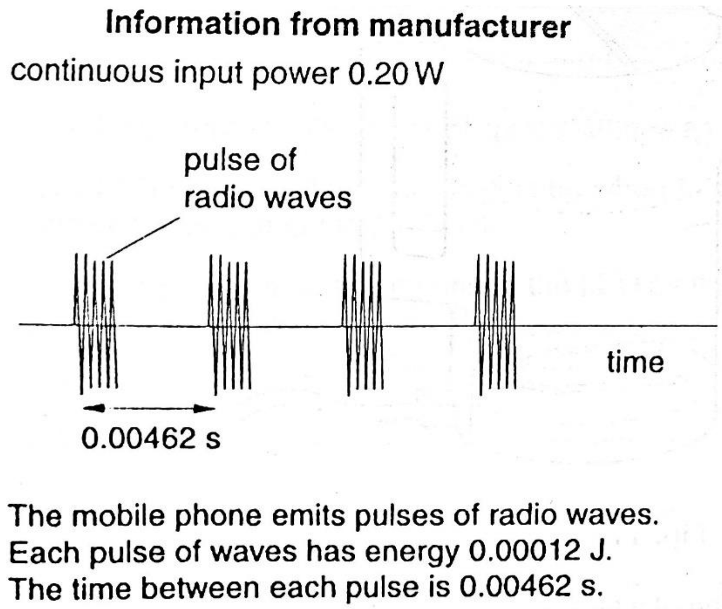
.... [2]

[Total : 6 m]

5 A student wishes to find out whether the energy from the radio waves emitted by mobile phones may affect a temperature rise in his brain. He first obtains the information from the mobile phone's manufacturer shown in Fig. 5.1a.



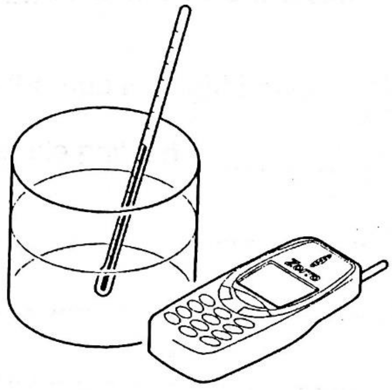


Fig. 5.1a **Fig. 5.1b**

(a) The student switches on the phone for 6 minutes and places it next to a glass beaker containing 50 g of water (Fig. 5.1b). Calculate

(i) the number of pulses of radio waves produced during the 6 minutes of call;

Number of pulses = …………… [1]

(ii) the total energy of the radio waves emitted during the phone call.

Total energy = ………… [1]

(iii) the maximum temperature rise produced in the 50 g of water if all the energy calculated in **(ii)** is absorbed by the water. The specific heat capacity of water is 4.2 $Jg^{-1o}C^{-1}$.

Rise in temperature = …………….[2]

(b) Explain why the temperature rise produced in the brain during a 6-minute phone call is different from the calculated temperature rise in the water.

……………………………………………………………………………………………………….

………………………………………………………………………………………………………. [1]

(c) The phone is powered by a battery which provides a continuous input power of 0.20 W .

Calculate the fraction of the energy supplied by the battery that is converted into radio wave energy during the 6-minute phone call. Express your answer in decimals.

Fraction = ………… [2]

[Total : 7 m]

6 Fig. 6.1a shows a barometer tube in which the mercury column is 760 mm high.

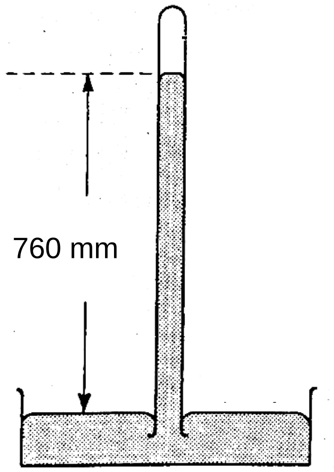


Fig. 6.1a

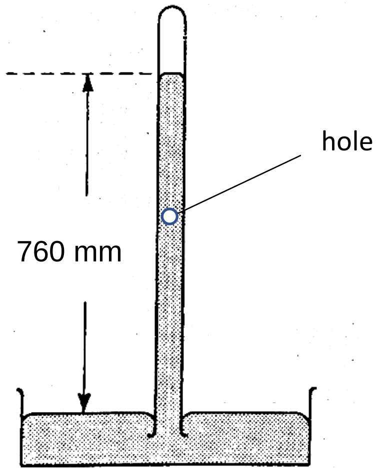


Fig. 6.1b

(a) Given that the density of mercury is 13.6×10^3 kgm^{-3}, determine the atmospheric pressure. (Take g = 10 Nkg^{-1})

Atmospheric pressure = …………….. [2]

(b) Fig. 6.1(b) shows an upright barometer with a hole which was initially covered with a tape.

The tape is subsequently removed. State and explain what happens next.

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…………………………………………………………………………………………… [3]

[Total : 5 m]

7 **Fig. 7.1** below shows a circuit diagram. **A_1, A_2, A_3** and **A_4** are ammeters of negligible internal resistance. **P, Q, R** and **S** are resistance wires of the same material. **Q** is short and thick while **R** is long and thin when compared with **P**. **K** is a switch.

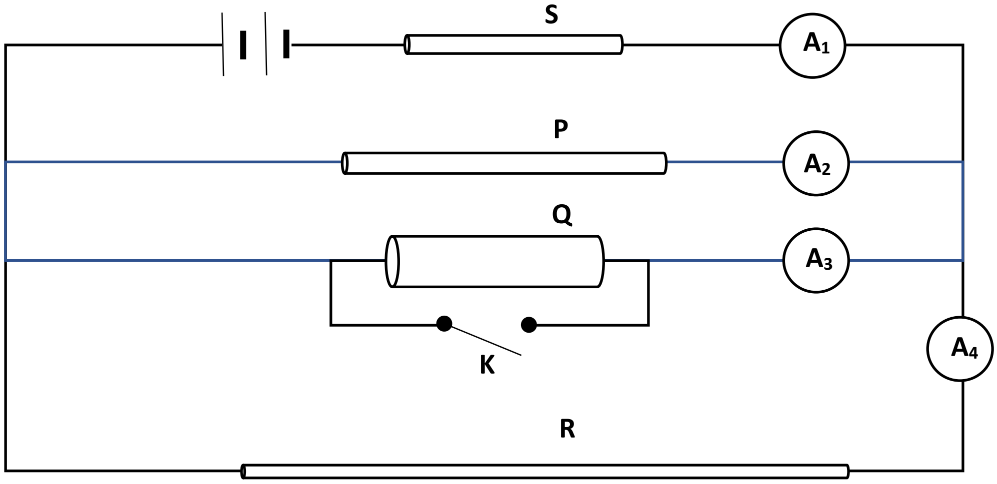

Fig. 7.1 (not drawn to scale)

(a) Identify 2 conductors that are arranged in parallel.

……………………………………………………………………. [1]

(b) If the lengths of **P** and **R** are in the ratio of 3:4 and their cross-sectional areas are in the ratio of 2:1, calculate the ratio of the resistance of **P** to that of **R**. Express your answer as a decimal.

Ratio = …………. [2]

(c) The readings of the ammeters **A_1, A_2, A_3** and **A_4** are a_1, a_2, a_3 and a_4 respectively.

(i) Explain which ammeter registers the highest reading when the switch is not closed.

…………………………………………………………………………………………..

………………………………………………………………………………………… [1]

(ii) Explain which ammeter registers the highest reading when the switch is closed.

…………………………………………………………………………………………..

………………………………………………………………………………………… [1]

(d) Which ammeter(s) would be ruined on closing switch **K** if the resistance **S** were absent? Explain your answer.

…………………………………………………………………………………………………..

…………………………………………………………………………………………………..

……………………………………………………………………………………………………

…………………………………………………………………………………………………… [2]

[Total : 7 m]

8 Fig. 8.1 shows a trumpet producing a single note in front of a microphone

Fig. 8.1

Fig. 8.2 shows the variation of the pressure with time of the air between the trumpet and the microphone.

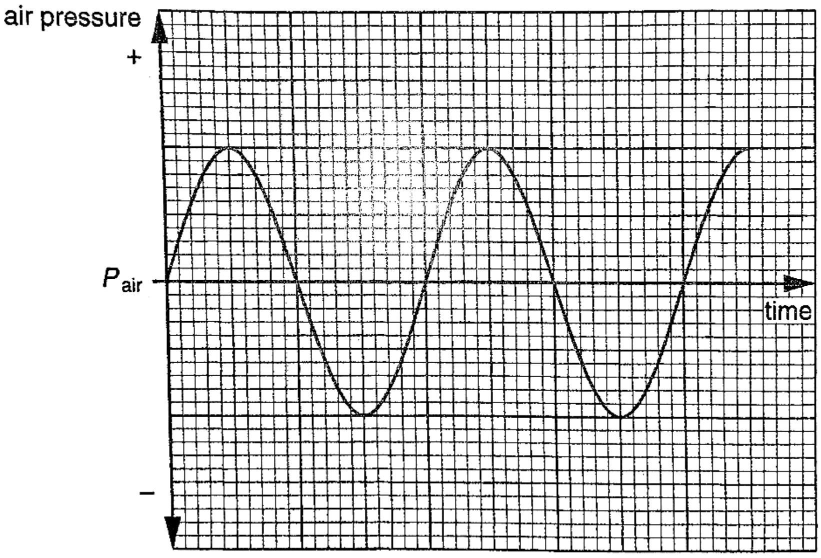

Fig. 8.2

The air pressure when there is no sound is P_{air}.

(a) **(i)** The same note is played again but is now louder. On Fig. 8.2, draw the graph to show the waveform of this louder note. [1]

(ii) A new note of higher pitch but of the same loudness as the note produced in Fig. 8.1. Describe how the graph would be different compared to Fig. 8.2.

....

.... [1]

(b) The note produced by the microphone is first converted into an electrical signal. This signal is then fed into a mixer, an amplifier and finally to speaker as shown in Fig. 8.3a.

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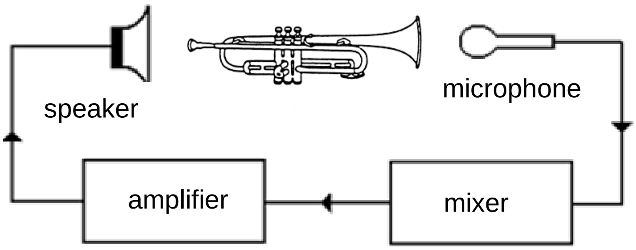

Fig. 8.3a

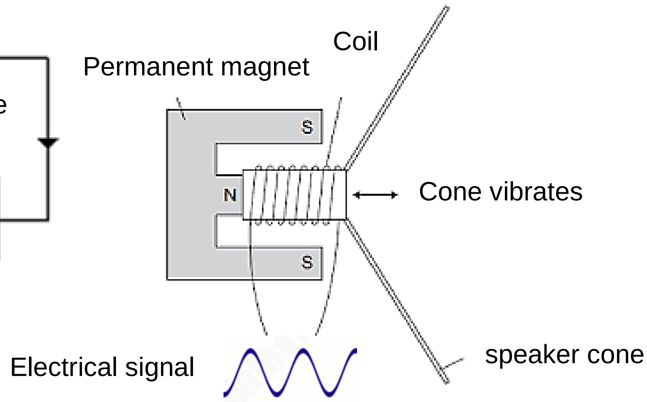

Fig. 8.3b

Fig. 8.3b shows the internal structure of a speaker. The speaker cone vibrates when the electrical signal flows through the coil.

Explain how the speaker cone vibrates when this electrical signal flows through the coil.

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.... [3]

(c) The single note on a trumpet is then analysed using an oscilloscope. Fig. 8.4 shows the waveform displayed on the oscilloscope screen.

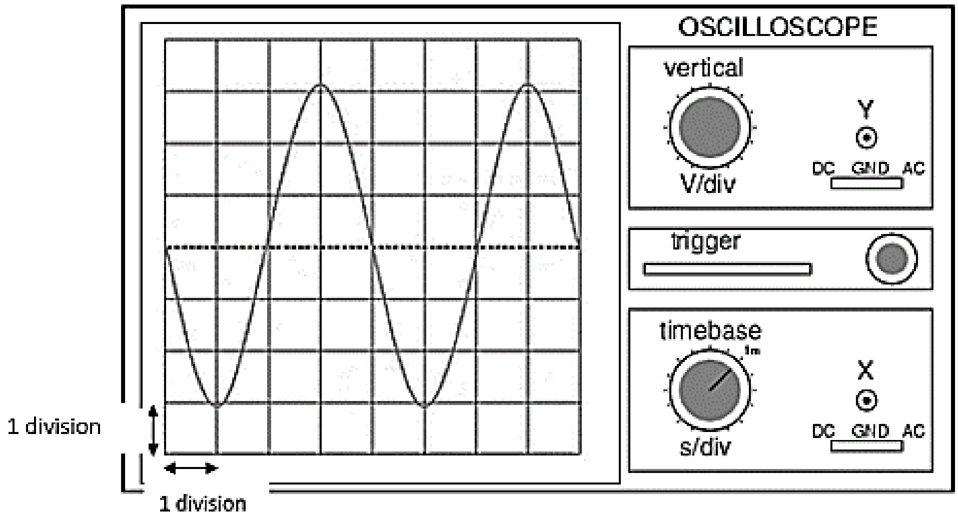

Fig. 8.4

(i) Given that the time-base is set at 200 ms / div, determine the frequency of the note produced by the trumpet.

Frequency = ……………… [1]

(ii) The time-base is now adjusted to 50 ms/div. Draw on Fig. 8.4 the appearance of the waveform after this adjustment. [1]

[Total : 7 m]

SECTION B

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

9 **Fig. 9.1** shows a student doing a bungee jump from a bridge. The student has a mass of 80 kg and he jumps from a bridge which is 85 m above the river. His legs are tied to an elastic rope which starts to stretch after 30 m of free fall.

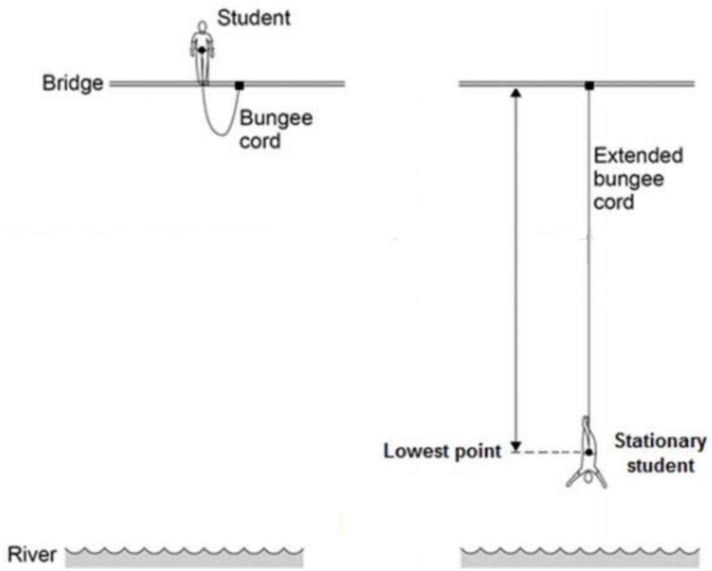

Fig. 9.1

Fig. 9.2 below shows the values of gravitational potential energy, kinetic energy of the jumper, elastic potential energy stored in the elastic rope at various stages of jump, height of the man above the river, *h* and his speed, *v.*

h / m	Gravitational potential energy / kJ	Kinetic energy / kJ	Elastic potential energy / kJ	*v* / ms^{-1}
85	68.0	0	0	0
80	64.0	4.0	0	10.0
70	56.0	12.0	0	17.3
60	48.0	20.0	0	22.4
50	40.0	27.3	0.7	26.1
45	36.0	29.0	3.0	26.9
40	32.0		6.7	
35	28.0	28.1	11.9	26.5
30	24.0	25.5	18.5	25.2
25	20.0	21.3	26.7	23.1
20	16.0	15.7	36.3	19.8
15	12.0	8.6	47.4	14.7
10	8.00	0	60.0	0

Fig. 9.2

The total distance of fall for the student before he stops for the first time is 75 m.

(a) Show that the gravitational potential energy of the student at the bridge is 68.0 kJ. [1]

(b) Explain how the data from **Fig. 9.2** shows that energy is conserved during the jump.

....

....

.... [1]

(c) Determine the values in **Fig. 9.2** for h = 40 m.

Kinetic energy = …………………..   Speed = ………………. [1]

(d) Describe the changes in the acceleration of the student when h = 60 m to h = 25 m.

....

....

....

.... [2]

(e) With reference to **Fig. 9.2**, explain the variation in the resultant force acting on the student from h = 60 m to h = 25 m.

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.... [2]

(f) **Fig. 9.3** shows the different forces acting on the student at one point of the jump when h = 40 m.

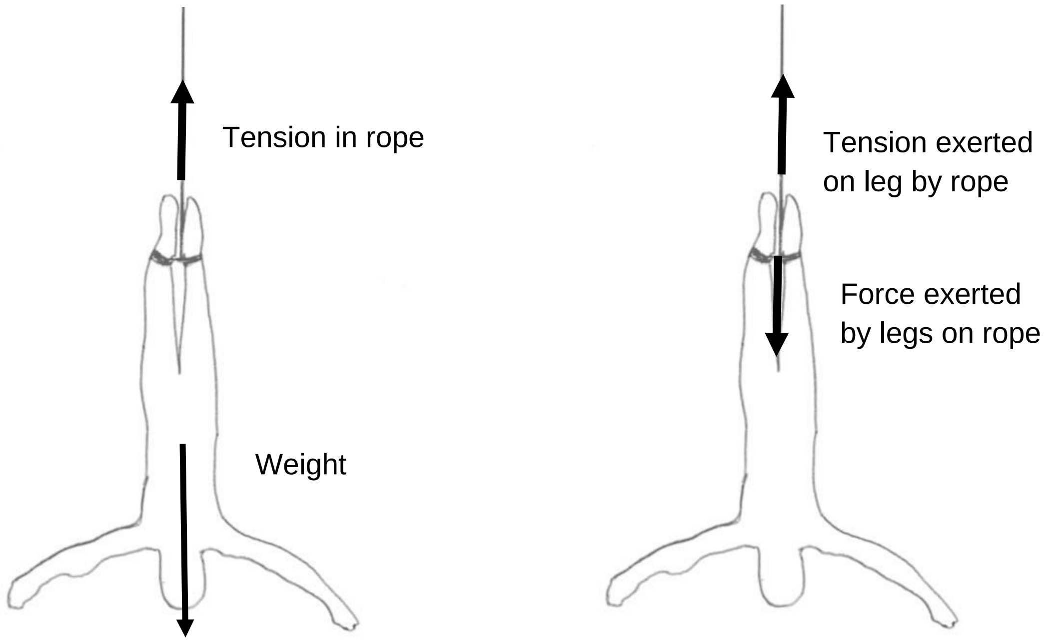

Fig. 9.3a **Fig. 9.3b**

Explain the difference between the labelled forces in Fig. 9.3a and those in Fig. 9.3b.

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.... [2]

10(a) Distinguish between *electromagnetic induction* and *magnetic induction.*

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……………………………………………………………………………………………………

…………………………………………………………………………………………………… [2]

(b) A simple apparatus used to demonstrate electromagnetic induction is shown in Fig. 10.1(a).

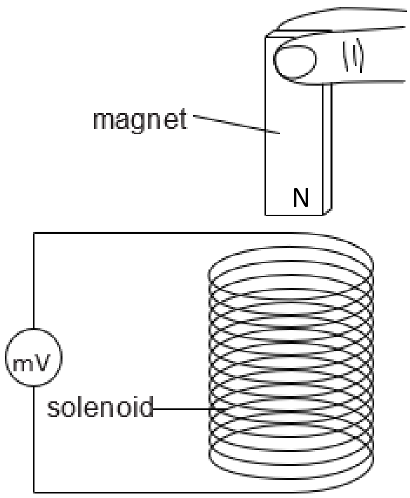

Fig. 10.1(a)

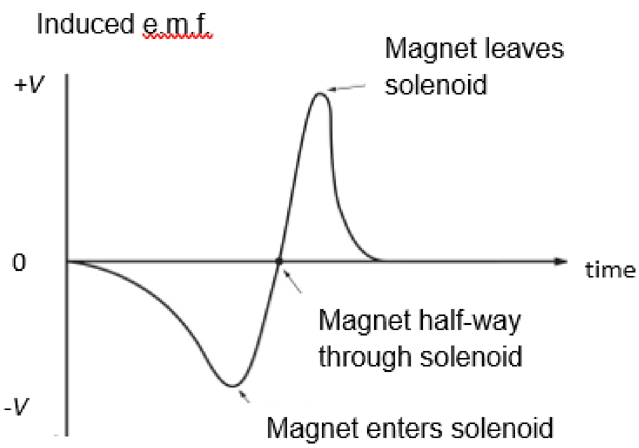

Fig. 10.1 (b)

A student drops a magnet so that it falls vertically through the solenoid. Fig. 10.1(b) shows the induced electromotive force (induced e.m.f.) from the moment of dropping the magnet to its leaving the solenoid.

(i) By indicating the direction of the induced current in the solenoid, explain why there is a build-up of the induced e.m.f. from the time the magnet is released to just before it enters the solenoid. Explain also why the increase is non-uniform.

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……………………………………………………………………………………………………

…………………………………………………………………………………………………… [3]

(ii) When the magnet is half-way through the solenoid, the e.m.f. is zero.

Explain why the induced e.m.f. drops to zero from the point when the magnet enters the coil to when it is half-way through the solenoid.

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…………………………………………………………………………………………… [3]

(c) Fig. 10.3a shows a circuit breaker with the contacts closed. Fig.10.3b shows the same circuit breaker when a large current has passed through the circuit.

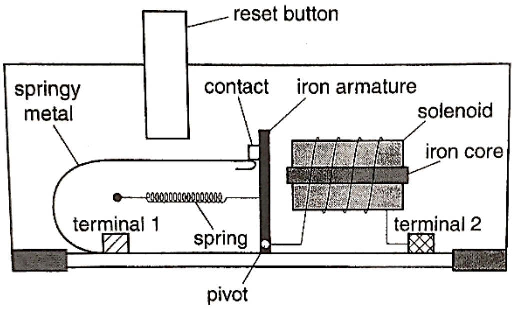

Fig. 10.3a

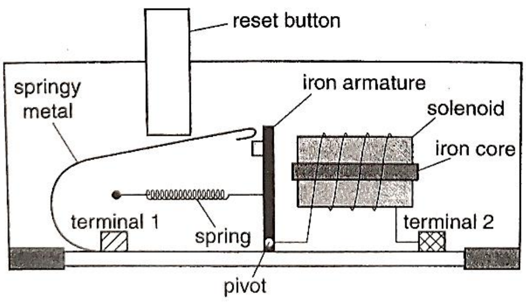

Fig. 10.3b

Explain how the circuit breaker is able to switch off the current when a fault causes the current to become too large.

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…………………………………………………………………………………………… [3]

EITHER

11 **Fig. 11.1** shows the formation of an image on a screen using a converging lens.

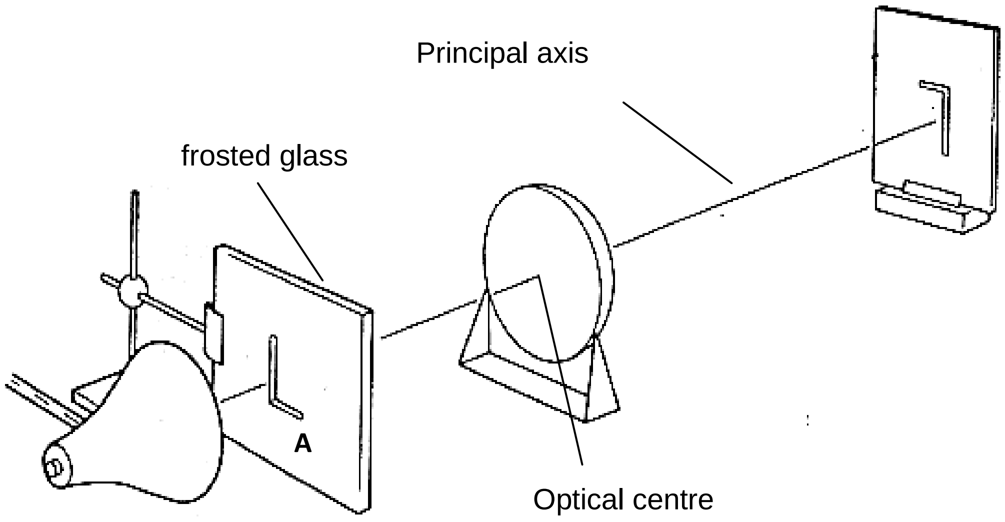

Fig. 11.1 (not to scale)

(a) By drawing a ray parallel to the principal axis on **Fig. 11.2** below, show clearly how the image of point **A** on the letter L is formed on the screen. Indicate on **Fig. 11.2** the principal focus, **F**, of the lens. [2]

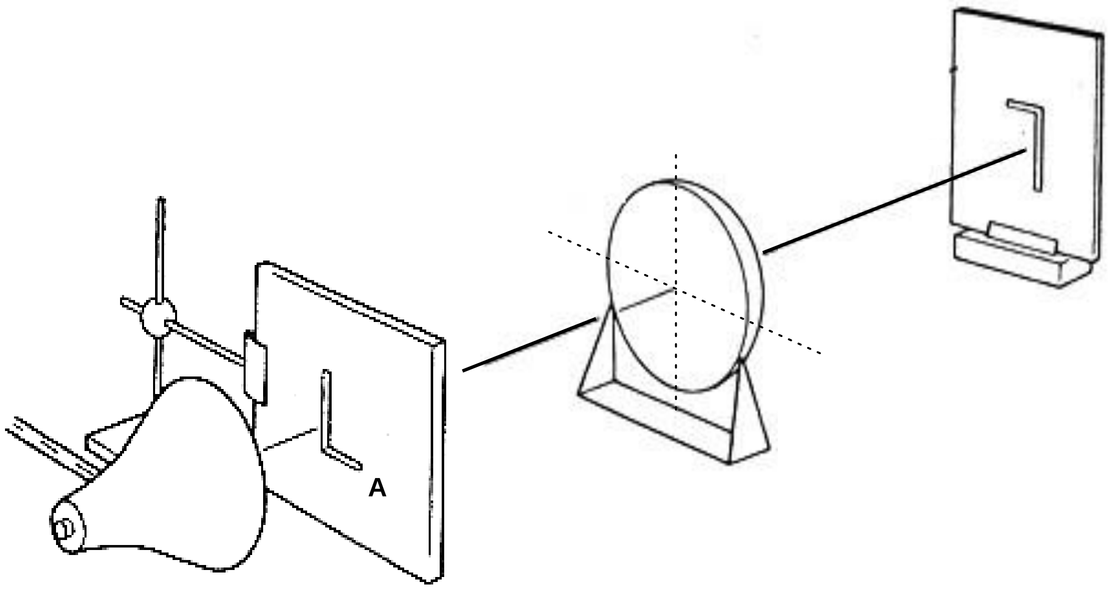

Fig. 11.2

(b) Describe the nature of image formed on the screen.

………………………………………………………………………………………………….. [1]

(c) A lens is used to focus a parallel beam of light to a point on a plastic rectangular disc. In order for this to occur, the plastic disc must be at the correct height.

10 x scale drawing

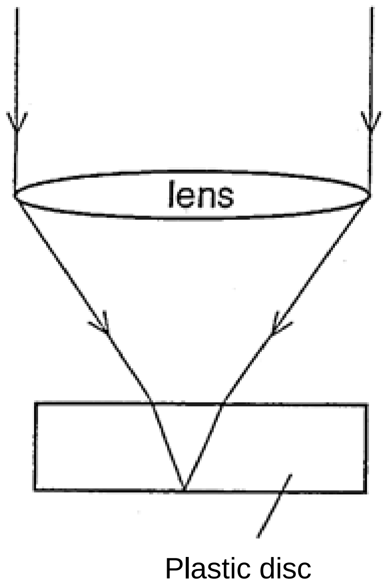

Fig. 11.3

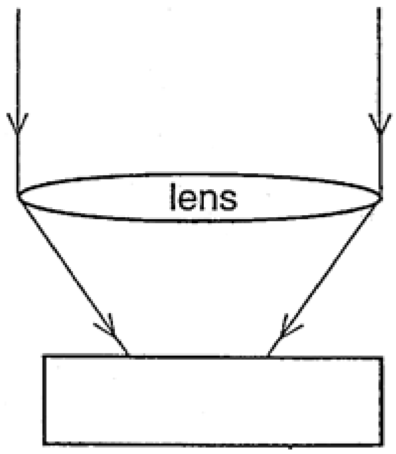

Fig. 11.4

Fig. 11.3 shows the side-view of the disc in the correct position, and Fig 11.4 shows the disc raised too high. Each drawing is drawn to scale and is 10 times larger than the true size of this set-up.

(i) Define the focal length of a converging lens.

………………………………………………………………………………………………….. [1]

(ii) Estimate the focal length of the lens.

…………………………………………………………………………………………………. [1]

(iii) Describe what happens to the light as it enters the plastic disc.

………………………………………………………………………………………………

……………………………………………………………………………………………… [2]

(iv) 1. Complete Fig. 11.4 to show the rays of light inside the plastic disc. [1]

2. Measure and state the diameter of the spot of light formed on the bottom of the disc in Fig. 11.4. You should take account of the scale of the diagram.

Diameter = ……………………………………………………………………………… [1]

(v) State one adjustment that may be made to the lens in Fig. 11.4 so that the rays meet at the point on the bottom of the disc.

………………………………………………………………………………………………….. [1]

OR

11(a) Fig. 11.5 shows an electric kettle connected to a 240 V mains supply by a flexible cable. The kettle has a power rating of 2500 W.

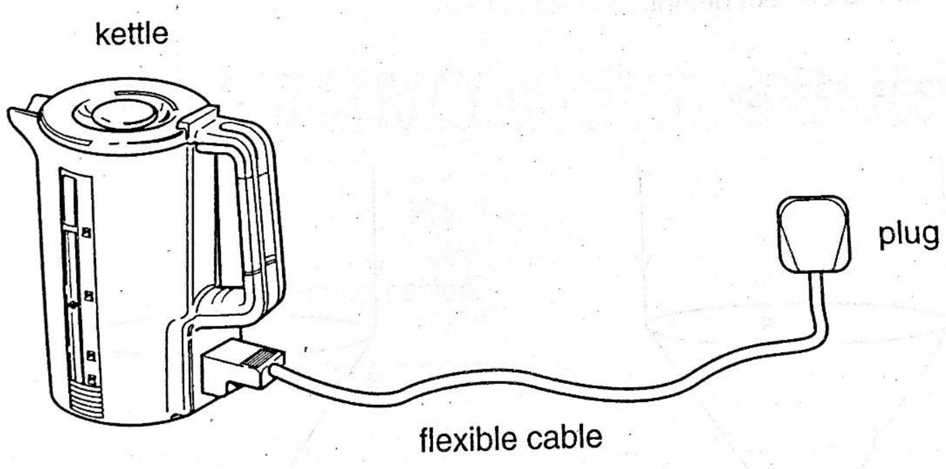

Fig. 11.5

The table shows the maximum current that may be carried by wires of various diameters.

Wire diameter / mm	Maximum current / A
0.50	3
0.75	6
1.00	10
1.25	13
1.50	15

(i) Show that the current in the cable when the kettle is in use is 10.4 A. State clearly any equation that you use. [2]

(ii) From the table select the smallest diameter of wire that can safely be used for this kettle. Explain why it is dangerous to use a wire thinner than the diameter you selected.

………………………………………………………………………………………………………

………………………………………………………………………………………………………

……………………………………………………………………………………………………… [1]

(iii) Describe one fault that may occur in the flexible cable that will cause the fuse in the plug to melt.

……

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…… [1]

(iv) Fig. 11.6 shows an electrical plug that is used to connect the kettle to the wall socket.

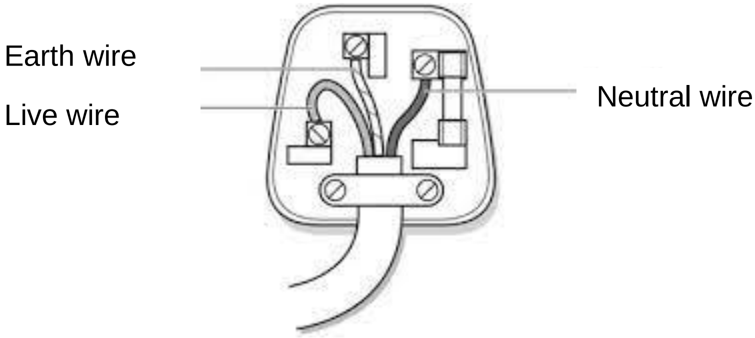

Fig. 11.6

Explain why the wiring in Fig .11.6 causes a hazard even when the switch of the kettle is turned off.

……

……

…… [1]

(b) Fig. 11.7 shows a girl using a hair dryer. The hair dryer is double-insulated.

Fig. 11.7

(i) Explain what you understand by double-insulation.

……

…… [2]

(ii) The hair dryer delivers a power of 1.25 kW energy.

If the hair dryer is used for 45 mins per week and the kettle in **(a)** is used for 15 mins per day, calculate the cost of using both appliances in two weeks if 1 kWh of electricity costs 40 cents.

Cost = …………….[3]

END OF PAPER