	Class	Register Number
Name ______________________		

6091/02
PHYSICS
Paper 2

22/4P/6091/02

Wednesday **31 August 2022** **1 hour 45 minutes**

VICTORIA SCHOOL

PRELIMINARY EXAMINATION
SECONDARY FOUR

READ THESE INSTRUCTIONS FIRST
Do not open this booklet until you are told to do so.

INSTRUCTIONS TO CANDIDATES

Write your name, class and index number in the spaces at the top of this page.
Write in dark blue or black pen. Answer all the questions within 1 hour 45 minutes.
You may use a HB pencil for any diagrams or graphs.

INFORMATION FOR CANDIDATES

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

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.

For Marker's Use		
Section A	/50	
Section B	/30	
Deduction	s. f.	
Total	/80	

Setters: Pang JH, Nordin Poh, Koh CK

This paper consists of **21** printed pages, including the cover page.

[Turn over]

Section A

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

1 Limestone is a common type of carbonate sedimentary rock which is the main source of the material lime. Limestone typically has a density of 2.71 g / cm^3.

(a) **(i)** Define *density*.

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

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

(ii) The sides of a cube of limestone is 0.50 m.

Show that the mass of this cube is 340 kg. [1]

(b) A 1000 kg forklift as shown in Fig. 1.1 is used to lift a cube of limestone as in **(a)**.

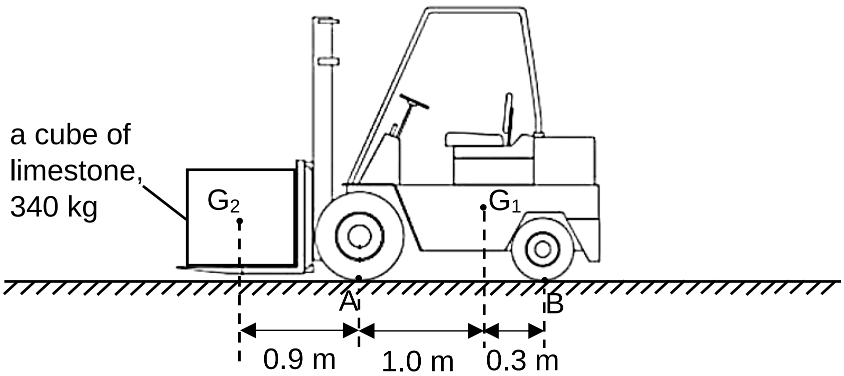

Fig. 1.1

The weight of the forklift acts at G_1 and the weight of the cube of limestone acts at G_2. Points A and B are the points where the wheels are in contact with the ground.

(i) On Fig. 1.2, draw the forces acting on the stationary forklift. [2]

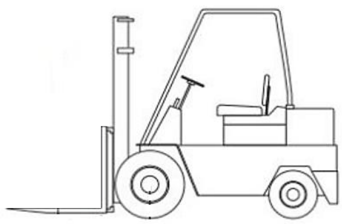

Fig. 1.2

(ii) Determine the maximum number of identical limestone blocks that can be lifted by the forklift before the wheel at point B loses contact with the ground.

The gravitational field strength g = 10 N / kg.

number of blocks = **…………………………** [2]

2 A student throws a basketball of mass 0.60 kg to another student. The basketball rises from point A to a vertical height of 5.0 m at B, as shown in Fig. 2.1.

The effect of air resistance is negligible.

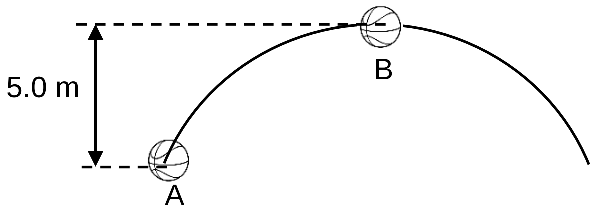

Fig. 2.1

(a) Show that the increase in gravitational potential energy of the basketball between A and B is 30 J. [1]

(b) At B, the kinetic energy of the basketball is 8.5 J.

Determine the kinetic energy of the ball at A.

kinetic energy = **………………………** [2]

(c) The student claims that when the basketball was thrown in the air, it was able to reach its maximum height as there is an upwards acceleration of the basketball throughout this part of its motion.

Comment, in terms of the forces acting, whether the student's claim is valid.

……

……

……

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

3 Fig. 3.1 shows a mercury manometer. The left arm of the manometer contains some trapped gas. The density of mercury is 13 600 kg / m^3. The gravitational field strength g is 10 N / kg.

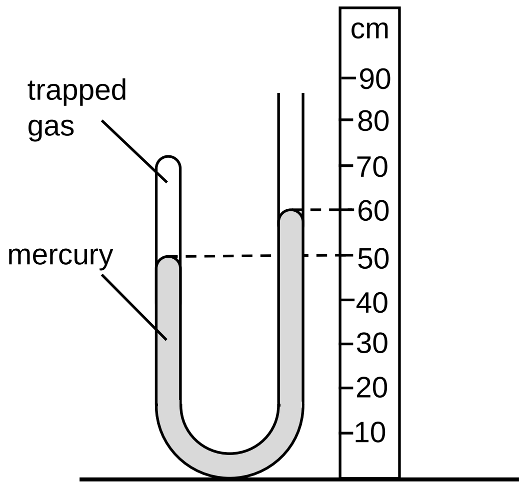

Fig. 3.1

(a) The atmospheric pressure is 76.0 cm Hg.

Determine the pressure in Pascals.

pressure = …………………… Pa [1]

(b) **(i)** Calculate the pressure of the trapped gas.

pressure = …………………… Pa [2]

(ii) A small hole is discovered in the left arm of the manometer such that the trapped gas can escape to the surroundings.

In Fig. 3.2 indicate the new mercury levels in both arms of the manometer. [1]

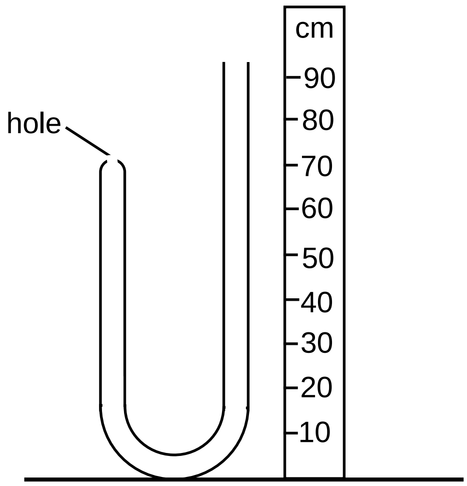

Fig. 3.2

(c) A student tilted a barometer as shown in Fig. 3.3 such that the vertical height of the barometer is 70 cm.

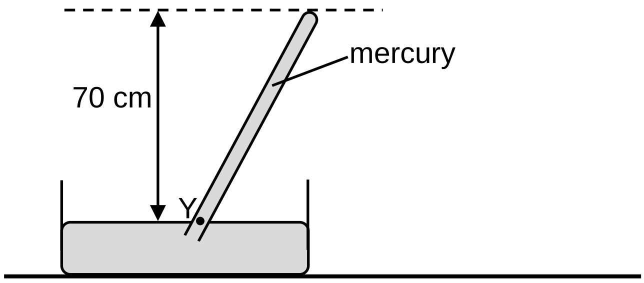

Fig. 3.3

The student then suggests that the pressure at point Y in the barometer is now 70 cm Hg. The surrounding pressure is 76 cm Hg.

Explain whether the student's reading is correct.

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

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

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

4 Fig. 4.1 shows an air-tight beaker completely filled with water.

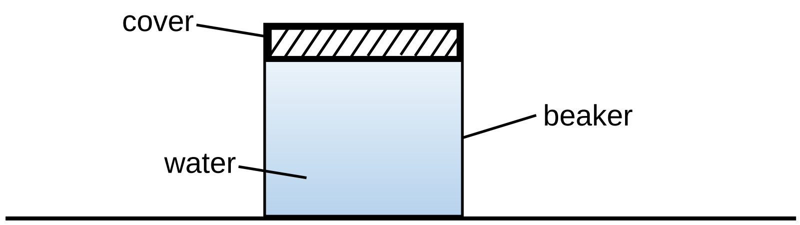

Fig. 4.1

(a) Describe the motion of the water particles in the beaker.

....

.... [1]

(b) The water in Fig. 4.1 is now heated. Using the kinetic model of matter, explain how the pressure in the beaker is affected.

....

....

....

.... [2]

(c) Fig. 4.2 shows the scale on a voltmeter connected to a thermocouple thermometer when the probe is placed in melting ice, steam point and in the water of the beaker respectively.

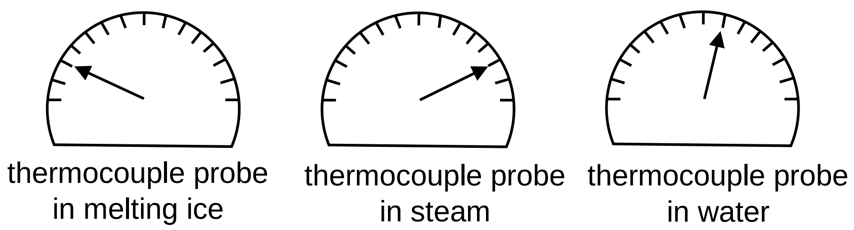

Fig. 4.2

Determine the temperature of the water.

temperature = ………………….. [2]

5 A stick is held against a rotating toothed wheel, as shown in Fig. 5.1.

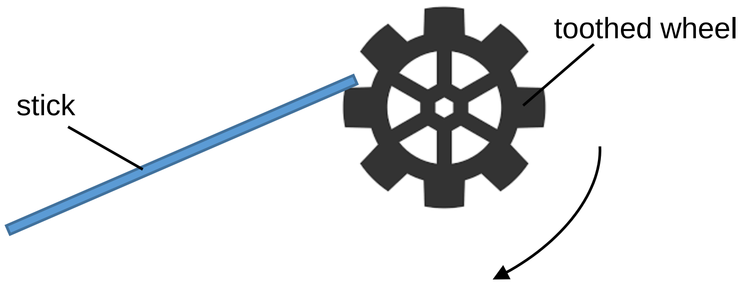

Fig. 5.1

There are 8 teeth on the wheel and it rotates at a frequency of 2.0 Hz. Every time the stick moves from one tooth to the next it produces a click.

(a) State what is meant by *a frequency of 2.0 Hz*.

....

.... [1]

(b) Given that the speed of sound in air is 330 m s^{-1}, determine the wavelength of the sound produced.

wavelength = ... [2]

(c) The waveform of the sound produced is shown in Fig. 5.2.

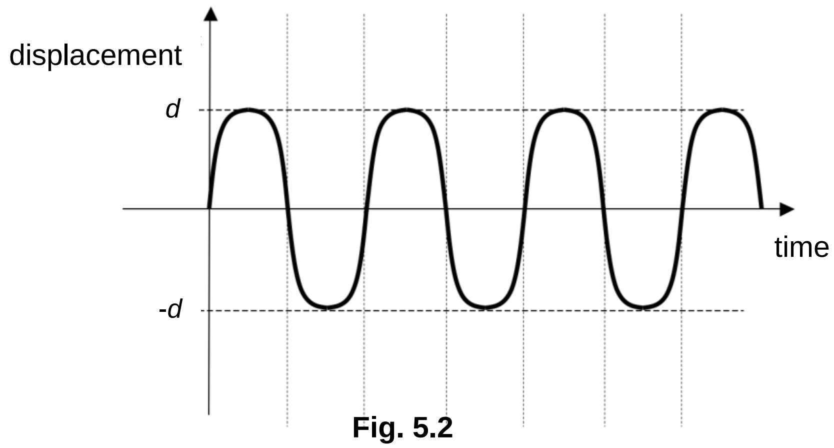

Fig. 5.2

If the wheel rotates at half the frequency and produces a sound half as loud, state the change(s) to the waveform in Fig. 5.2.

....

....

.... [2]

6 Fig. 6.1 shows a beam of uncharged particles and a beam of gamma wave entering a region of strong electric field below a positively charged plate.

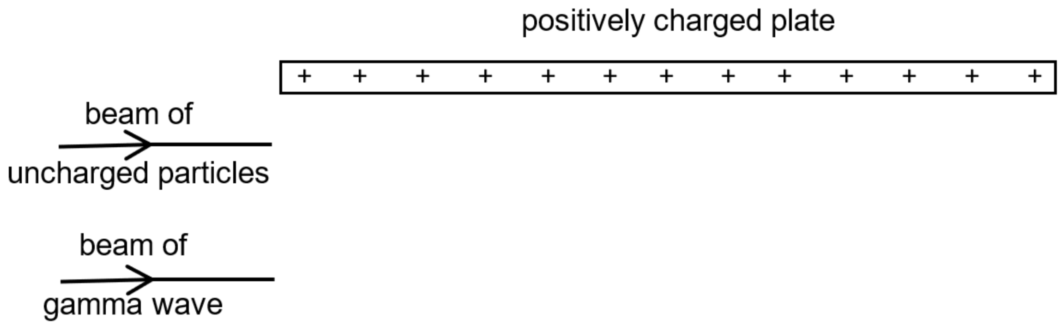

Fig. 6.1 (not to scale)

(a) State what is meant by *an electric field*.

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

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

(b) On Fig. 6.1, draw the two paths below the charged plate for the beam of uncharged particles and the beam of gamma wave. [2]

(c) Explain the path taken by the beams of uncharged particles and the gamma wave as shown in **(b)**.

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

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

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

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

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7 A student measures the current and potential difference (p.d.) to determine the resistance of a fixed resistor P. The variable resistor is set to maximum resistance.

Fig. 7.1 shows the circuit diagram of part of the circuit that he uses.

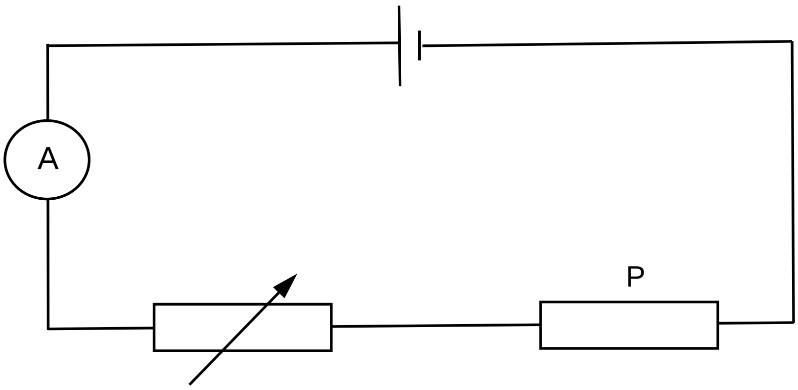

Fig. 7.1

(a) On Fig. 7.1, complete the circuit by adding the voltmeter at the correct position. [1]

(b) The potential difference across the fixed resistor P is 1.2 V and the ammeter reading is 0.12 A.

(i) Calculate the resistance of fixed resistor P.

resistance of P = ………..………… [1]

(ii) The cross-sectional area of the fixed resistor P is 6.0×10^{-3} cm^2 and its length is 4.0 cm.

Determine the resistivity of fixed resistor P.

resistivity = …………………… Ω m [2]

(c) Fixed resistor P is now connected in parallel with another fixed resistor Q with identical resistance value.

Suggest, with a reason, what will happen to the reading of the ammeter.

……………………………………………………………………………………………

……………………………………………………………………………………………

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

8 The variation with temperature of the resistance R of a thermistor is shown in Fig. 8.1.

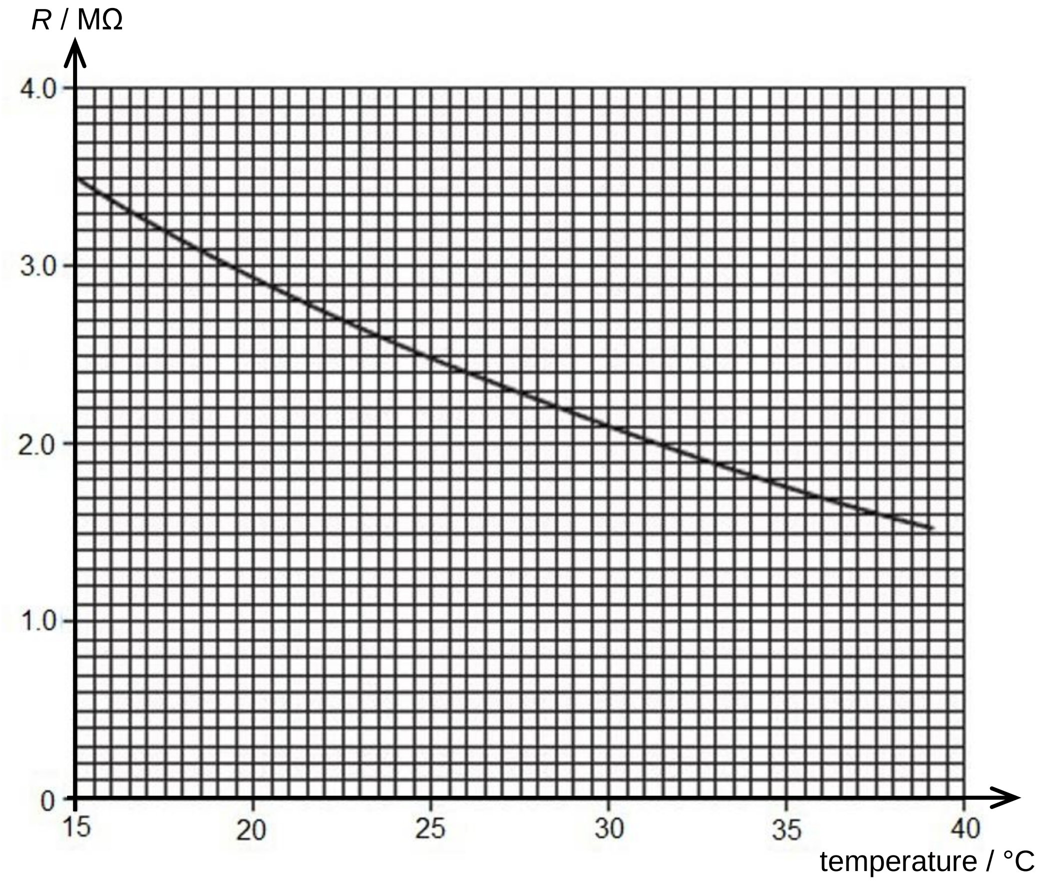

Fig. 8.1

The thermistor is connected into the circuit of Fig. 8.2.

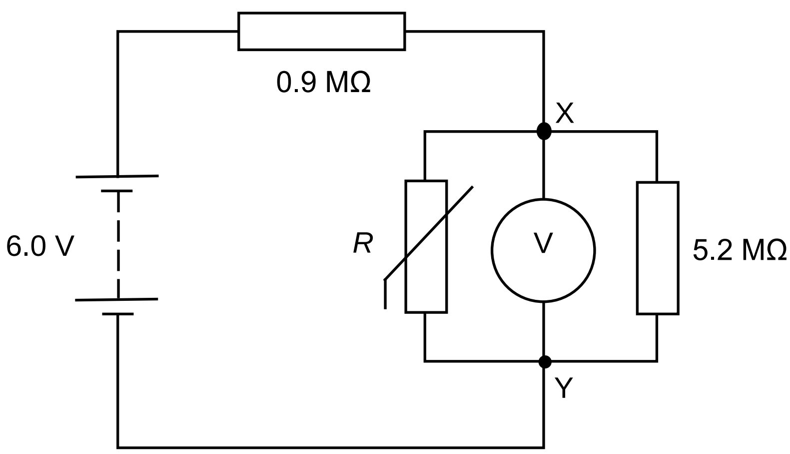

Fig. 8.2

The battery has an electromotive force (e.m.f.) of 6.0 V.

The voltmeter reads 4.0 V.

(a) Determine

(i) the total resistance between points X and Y,

total resistance = ……………….. [2]

(ii) the temperature of the thermistor using Fig. 8.1.

temperature = ………………… [2]

(b) A student suggests that the circuit in Fig. 8.2 could be calibrated to measure temperature.

Suggest a disadvantage of using the thermistor for the measurement of temperature.

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

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

9 A lamp is rated at 50 W and is designed to be used with a 230 V supply.

(a) Calculate the resistance of the lamp.

resistance = **……………………** [2]

(b) A room is lit by three of these lamps connected in parallel.

The lamps are lit for an average time of 3.6 hours a day for a year. Electricity costs $0.29 / kWh.

Calculate the cost of using these lamps for a year.

cost = **……………………..** [2]

10 Fig. 10.1 shows a vertical solenoid of steel wire connected in series with a battery and a switch.

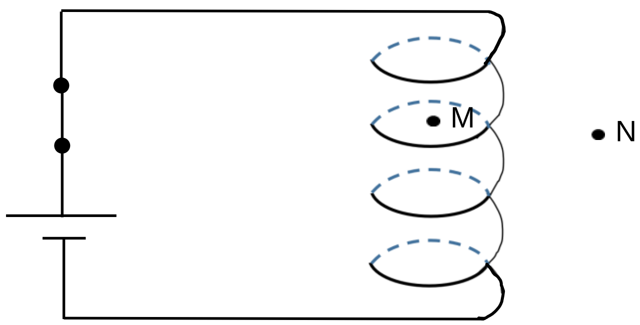

Fig. 10.1

(a) Describe two ways in which the magnetic field at M differs from the magnetic field at N.

1 ……………………………………………………………………………………………

……………………………………………………………………………………………

2 ……………………………………………………………………………………………

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

(b) A student holds a steel paper clip and touches the bottom of the solenoid. When he releases the paper clip, it stays in contact with the solenoid.

(i) Explain why the paper clip does not fall upon release.

……………………………………………………………………………………………

……………………………………………………………………………………………

……………………………………………………………………………………………

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

(ii) The switch is now opened.

Explain whether the paper clip would remain in contact with the solenoid.

……………………………………………………………………………………………

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

Section B

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

Answer only one of the two alternative questions in **Question 13**.

11 A favourite drink at our local drink stall is Milo Kosong, a hot drink with only Milo powder added to hot water.

(a) The drink maker in our school canteen added Milo powder to a cup of hot water.

Using ideas about molecules, explain how the powder gains heat from the hot water in the cup.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

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

(b) The hot drink is placed on the table and after 15 minutes it was noted that the temperature dropped by 20 ^{o}C.

(i) Explain the process(es) of transfer of thermal energy leading to the cooling.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

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

(ii) State and explain the most effective way to minimize heat lost by the drink to its surrounding.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

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

(c) Another favourite version is Milo ice which involves the adding of ice to hot Milo drink.

The drink maker has prepared 400 cm^3 of hot Milo drink at 90 ^oC in a cup.

He adds 50 g of ice at 0 ^oC to the Milo drink.

Given:

mass of 1 cm^3 of hot Milo drink = 1.0 g
specific heat capacity of water/Milo drink = 4200 J kg^{-1} K^{-1}
specific latent heat of fusion of ice = 3.36 x 10^5 J kg^{-1}

(i) Define *specific latent heat of fusion of ice*.

....

.... [1]

(ii) Calculate the final temperature of the Milo drink.

You may assume that the evaporation and heat loss to cup and surrounding are negligible.

temperature = ... [3]

12 **(a)** Besides emitting visible light, the Sun also emits ultraviolet rays.

(i) State a difference between visible light and ultraviolet rays.

……………………………………………………………………………………………

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

(ii) Describe an effect on living tissues when ultraviolet rays are absorbed.

……………………………………………………………………………………………

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

(b) A progressive wave is represented by the following displacement-position graph and displacement-time graph in Fig. 12.1.

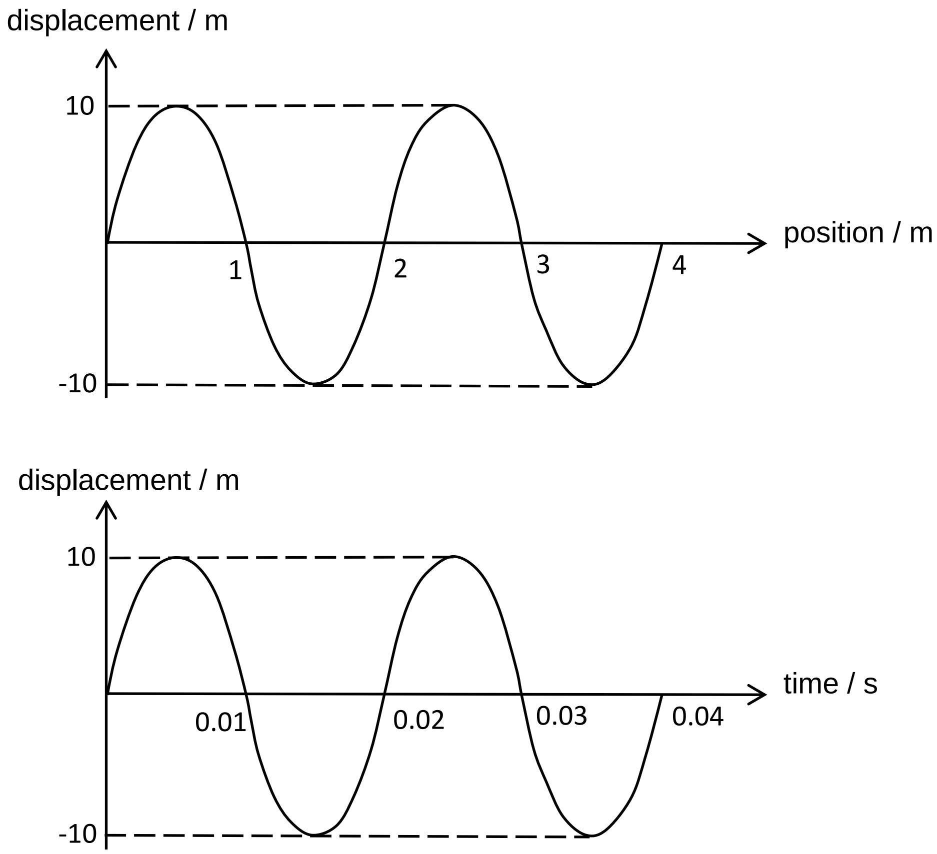

Fig. 12.1

(i) Determine the speed of the wave.

speed of wave = ……………………….. [2]

(ii) On Fig. 12.1, sketch the new wave on the displacement-position graph after half a period has passed. [1]

(iii) If the frequency of the wave increases, state the effect on the speed of the wave.

....

.... [1]

(c) Fig. 12.2 shows a converging lens used in a camera to form an image **IA'** of the object **OA**. F represents the principal foci of the lens.

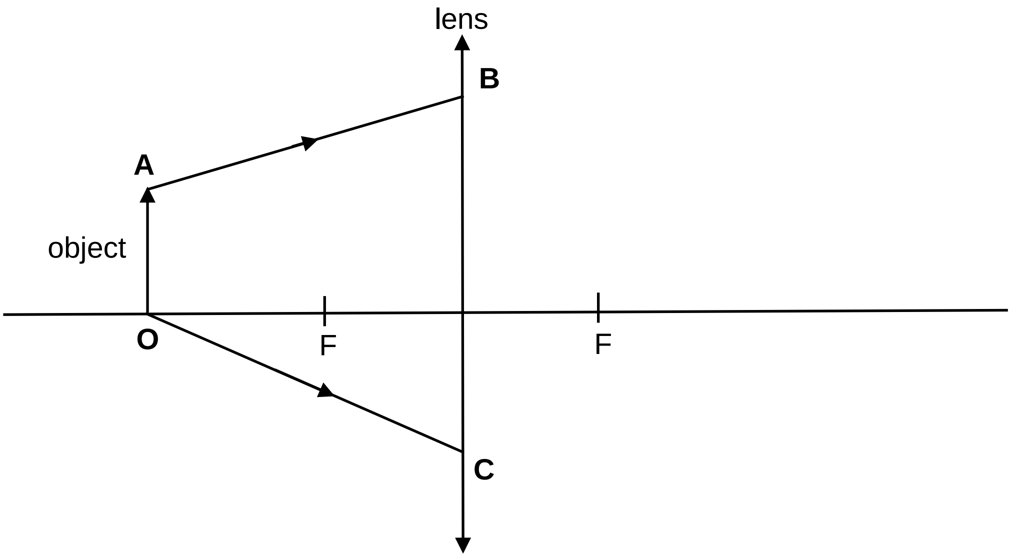

Fig. 12.2

(i) Draw construction rays from **OA** to locate the image **IA'**. [2]

(ii) Complete the paths of the rays **AB** and **OC** to the image **IA'**. [1]

(iii) State what would happen to the image when the object **OA** is shifted slightly further away from the lens.

.... [1]

13 Either

A car of mass 1500 kg moves along a straight, horizontal road. The variation with time t of the velocity v of the car is shown in Fig. 13.1.

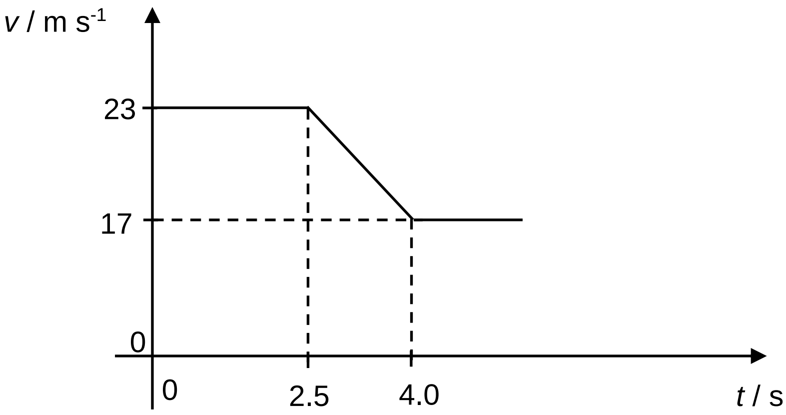

Fig. 13.1

(a) The car is moving at a uniform speed of 23 m / s. State the meaning of *uniform speed*.

....

.... [1]

(b) The brakes of the car are applied from t = 2.5 s to t = 4.0 s.

For the time when the brakes are applied,

(i) calculate the distance moved by the car,

distance = ... [2]

(ii) calculate the magnitude of the resultant force on the car.

resultant force = ... [2]

(c) Sketch the distance-time graph of the motion of the car for the first 4 seconds in Fig. 13.2. [2]

Fig. 13.2

(d) The direction of motion of the car in **(b)** at time t = 3.0 s is shown in Fig. 13.3.

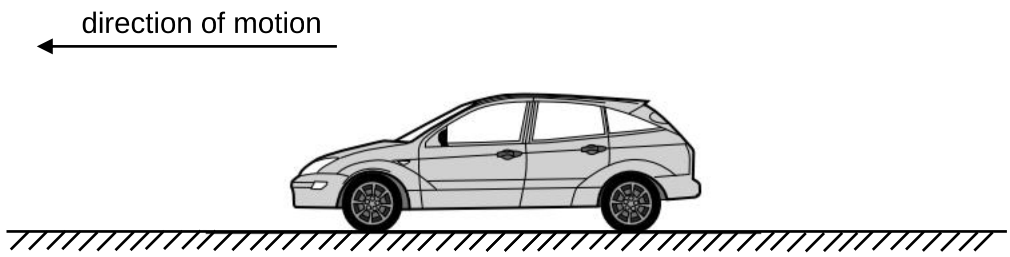

Fig. 13.3

On Fig. 13.3, show with arrows the direction of the forces acting on the wheels of the car by the ground. [1]

(e) The car then turns around a bend at constant speed from t = 4.0 s onwards.

Explain why the car is accelerating even though its speed is constant.

…………………………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

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

13 Or

(a) Fig. 13.4 shows a simple relay used to switch a mains electric motor on and off.

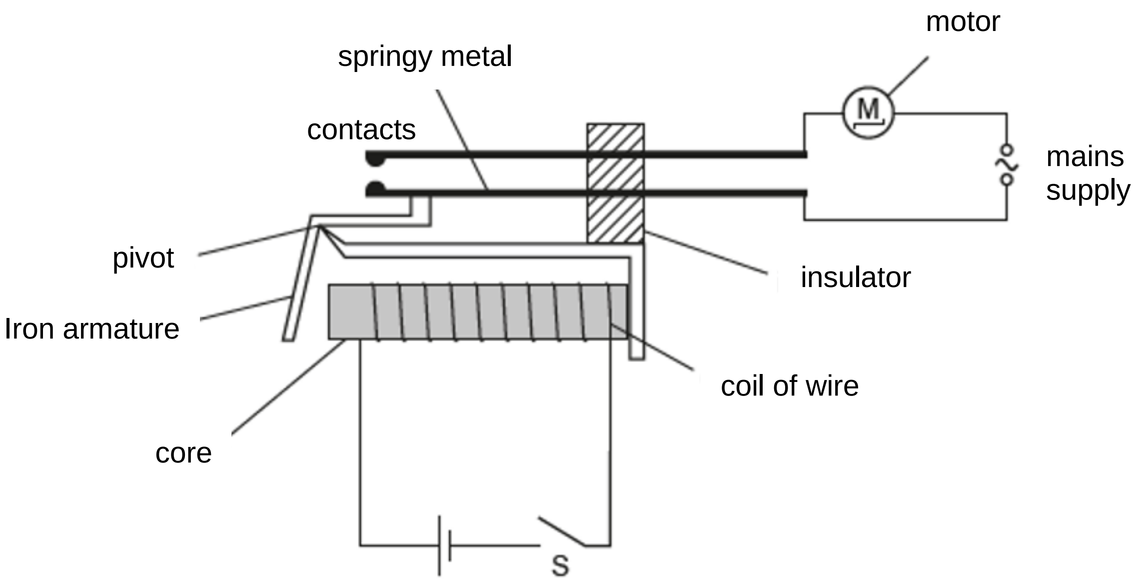

Fig. 13.4

(i) Explain why the motor turns on when switch S is closed.

....

....

....

....

....

.... [3]

(ii) A student suggests that the motor can be turned on and off without a relay.

He suggests connecting the mains supply to a simple switch in series with the motor.

Suggest a reason why, in some situations, using the relay is a better choice for this application.

....

.... [1]

(b) Fig. 13.5 shows an ideal transformer that can be found inside the motor in Fig. 13.4.

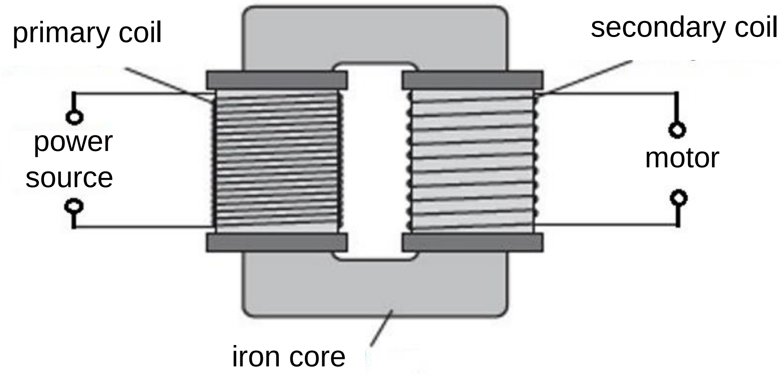

Fig. 13.5

(i) State the purpose of the iron core in the transformer.

....

.... [1]

(ii) Explain why there is an output voltage produced in the secondary coil.

....

....

....

....

....

.... [3]

(iii) The primary coil is connected to the 230 V power source. There are 1950 turns on the primary coil. The output voltage to the motor is 20 V.

Calculate the number of turns on the secondary coil.

number of turns = ... [2]

End of Paper