Index Number

Anglo-Chinese School
(Independent)

END-OF-YEAR EXAMINATION 2019
YEAR 3 INTEGRATED PROGRAMME

PHYSICS **PAPER 2**

Monday **7 October 2019** **1 hour 45 minutes**

INSTRUCTIONS TO STUDENTS

Write your index number in the box provided on the top right corner of this page.

Do not open this booklet until you are told to do so.

Section A
Answer **all** questions in the spaces provided in the paper.

Section B
Answer **all** questions in the spaces provided in the paper.

INFORMATION FOR STUDENTS
Candidates are reminded that all quantitative answers should include appropriate units.
Candidates are advised to show their answers 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 N kg^{-1}.
Calculators are allowed for this paper.
There are **24** printed pages.

Marks Awarded	
Section	**Marks**
A	
B	
Penalty	
Sig. Fig.	
Units	
TOTAL SCORE	

Section A [50 Marks]

A1 A 6.0 kg parcel is dropped off vertically from a helicopter 800 m above the ground. Its parachute is activated some time after the fall. The speed-time graph for the first 25 seconds of its journey is shown in **Fig. A1.1**.

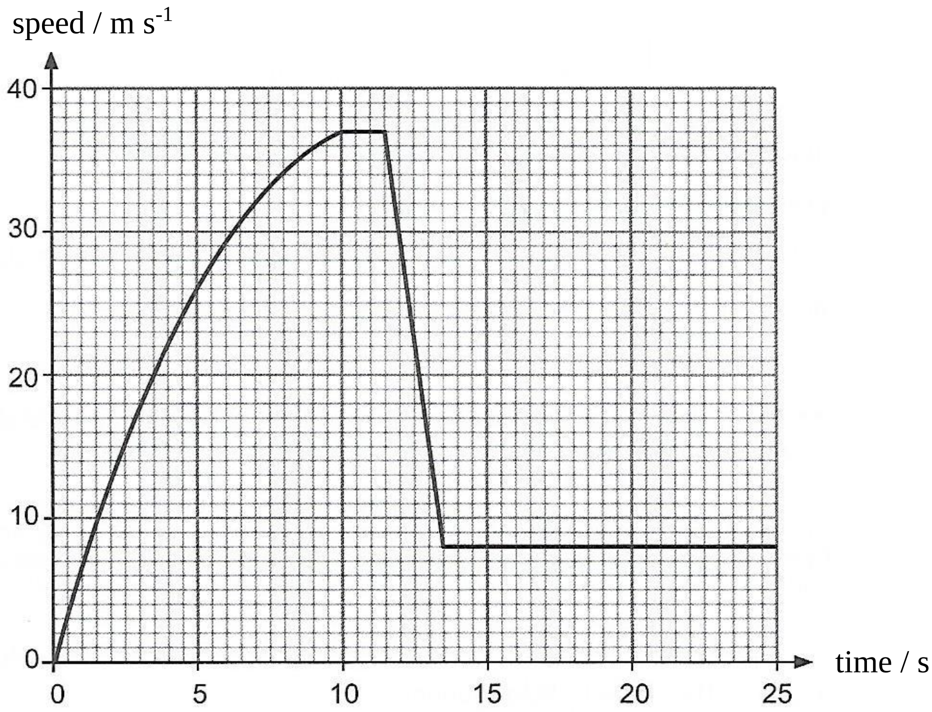

Fig. A1.1

(a) Explain what is meant by "The Earth's gravitational field strength has a magnitude of 10 N kg^{-1}". [1]

(b) Explain, in terms of forces, why the parcel's velocity increased immediately after being dropped. [2]

(c) State the time at which the parcel first achieves terminal velocity. [1]

(d) Draw a labelled diagram to show all the forces that act on the parcel at t = 15 s. Indicate the values of these forces on your diagram. [2]

(e) As the parcel falls, the Earth exerts a downward force on the parcel. Name the reaction force in the action-reaction pair of forces. [1]

A2 A ball of weight **W** in equilibrium is suspended by two ropes at points **A** and **B** as shown in **Fig. A2.1** (not drawn to scale). The tension in the ropes are 870 N and 500 N.

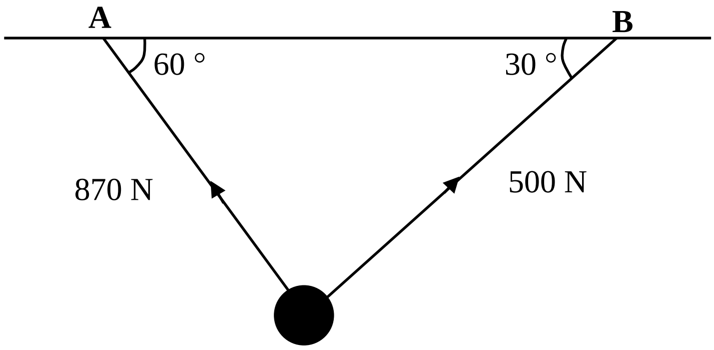

Fig. A2.1

(a) What is the resultant force acting on the weight **W**? [1]

(b) By means of a scaled diagram, determine the weight **W**. [4]
State the scale used.

Scale :

(c) State the effect on the tension of each rope when the ropes are placed closer to each other by reducing the distance between points **A** and **B**. The weight **W** remains unchanged. [1]

A3 Jonathan applies a vertical force **F** on a pedal of his bicycle, as shown in **Fig. A3.1**.

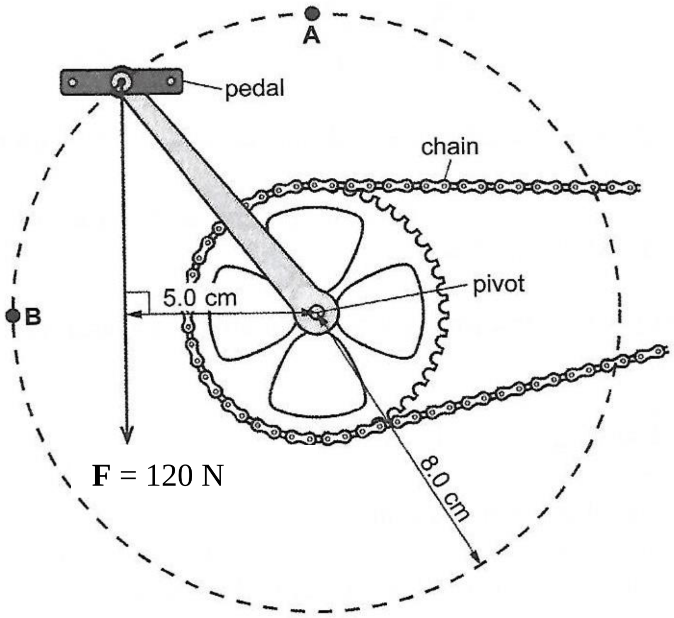

Fig. A3.1

(a) As he travels along, the pedal moves through a circle of radius 8.0 cm. For the pedal in the position as shown in **Fig. A3.1**, the line of action of the force, **F** is 5.0 cm from the pivot. Calculate the moment of force, **F**, about the pivot when **F** = 120 N. [2]

(b) Subsequently, the pedal now moves from position **A** to position **B** as shown in **Fig. A3.1**. Explain why the same force of 120 N applied at **A** will have a different turning effect from the same force applied at **B**. Show calculations to justify your answer. [3]

(c) Jonathan and Tony are cycling at the same speed. The combined mass of Johnathan and his bicycle is 100 kg while the combined mass of Tony and his bicycle is 120 kg. Both decided to stop for a break. Who do you think will find it more difficult to stop? Why? [2]

A4 **Fig. A4.1** shows a slide in a playground. A boy of mass 35.0 kg climbs up from the side **AB** in 10.0 seconds and slides down from **B** to **C**. Then he decelerates uniformly in the horizontal section **CD** to a complete stop. The vertical height of the slide is 5.000 m. The horizontal section **CD** is 0.500 m above ground level.

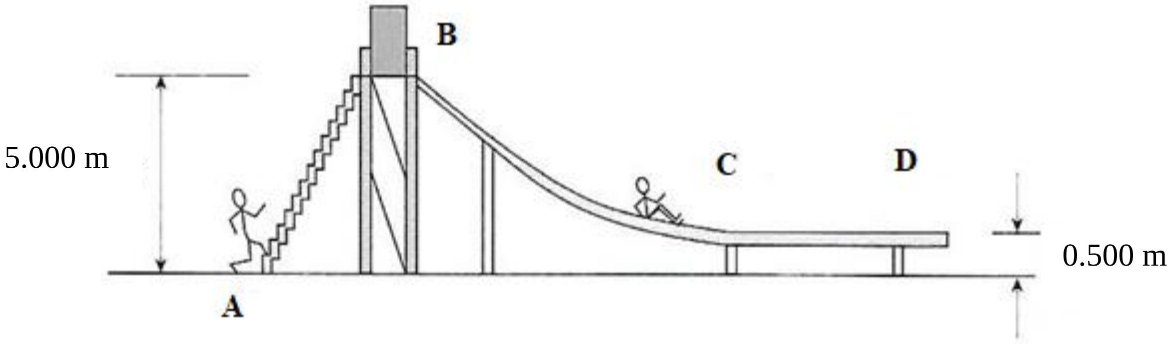

Fig. A4.1

(a) Find the average power developed by the boy when he climbs up the slide. [2]

(b) What is the loss in gravitational potential energy of the boy when he moves from point **B** to point **C**? [1]

(c) If the work done against friction when he moves from **B** to **C** is 1000 J, what is the kinetic energy possessed by the boy at point **C**? [2]

(d) State the energy transformation in the horizontal section **CD**. [1]

(e) The length of the horizontal section **CD** is 5.0 m. Find the magnitude of friction, assuming that friction is constant. [2]

A5 **Fig. A5.1** shows two vessels, **X** and **Y**, connected by a narrow tube and kept in water baths of temperatures **323 K** and **363 K** respectively. Compared to vessel **Y**, vessel **X** has a larger volume. The vessels contain the same type of gas.

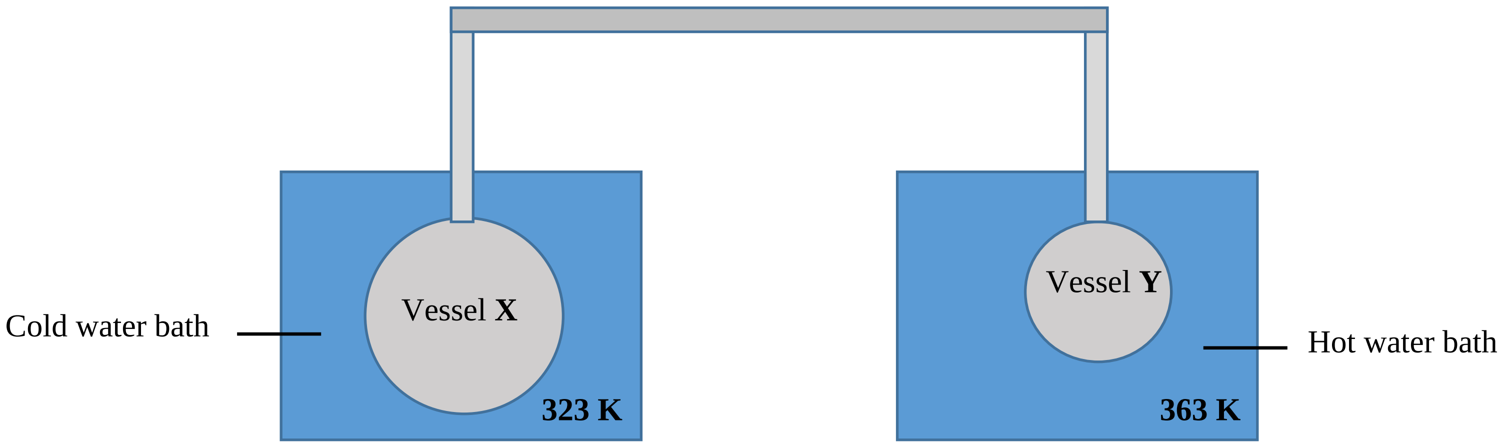

Fig. A5.1

(a) Discuss whether the following statements are true or false.

(i) After some time, the gases in both vessels **X** and **Y** would reach the same equilibrium temperature. [2]

(ii) After a long time, the gas pressure in vessel **X** is smaller than the gas pressure in vessel **Y**. [2]

(b) Vessel **Y** is removed from the water bath and is then connected to a U-tube manometer as shown in **Fig. A5.2** below.

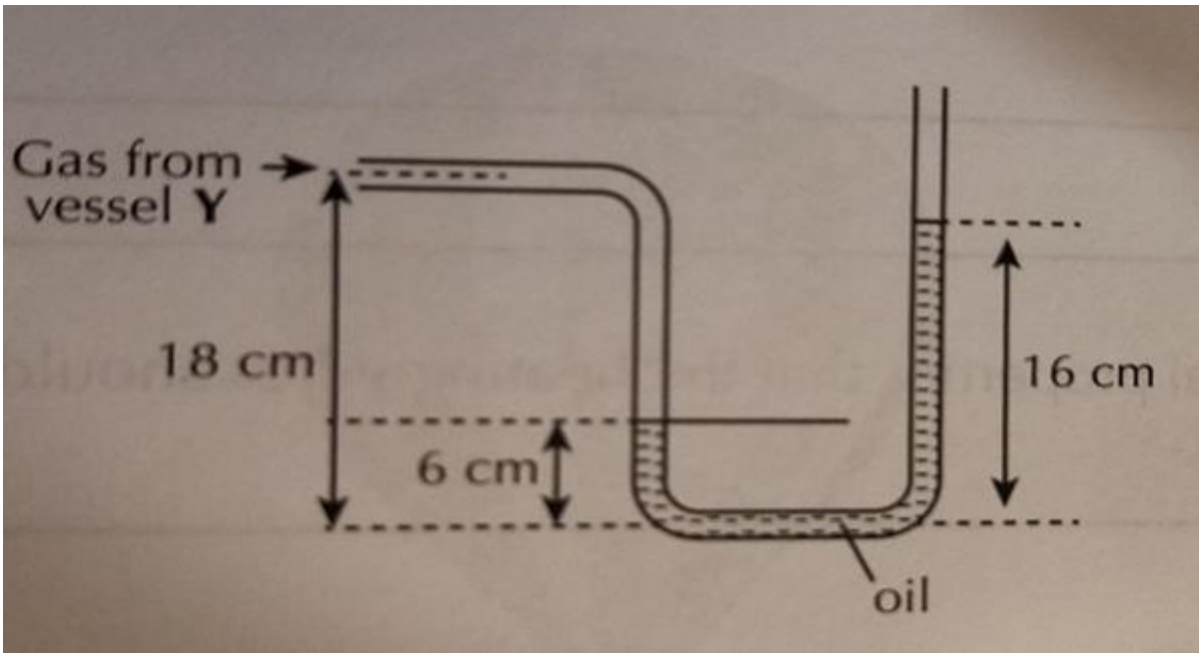

Fig. A5.2

(i) Given that the density of oil is 850 kg m^{-3} and atmospheric pressure is 1.0×10^5 Pa, calculate how much greater than atmospheric pressure is the pressure of the gas in vessel **Y**. [2]

(ii) If the oil inside the manometer is replaced by water, would the level of water in the vertical arm of the manometer which is exposed to atmospheric pressure increase or decrease in height? Explain your answer given that the density of water is 1000 kg m^{-3}. [2]

A6 **Fig. A6.1** shows a column of gas trapped in an air-tight container. A tight-fitting piston prevents the gas from escaping. The piston can move up and down the container smoothly.

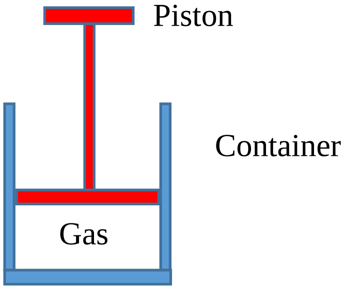

Fig. A6.1

If the piston is slowly pulled upwards, thereby allowing the gas to expand at constant temperature, discuss whether each of the following statements is true or false.

(a) The average distance between the gas particles increases. [2]

(b) The average kinetic energy of the gas particles becomes larger. [2]

(c) The pressure exerted by the gas on the inner walls of the container and on the underside of the piston increases. [2]

A7 An experimental set-up shown in **Fig. A7.1** below is used to measure the specific latent heat of vaporisation of water. Water in a beaker is kept boiling by an immersion heater which is connected to the main supply through an energy meter. The following data are obtained from the experiment:

Power consumed by the heater in one hour = 0.128 kW

Initial reading of the electronic balance = 0.864 kg

Final reading of the electronic balance = 0.712 kg

Heat capacity of the beaker and the heater = 240 J $^{\circ}C^{-1}$

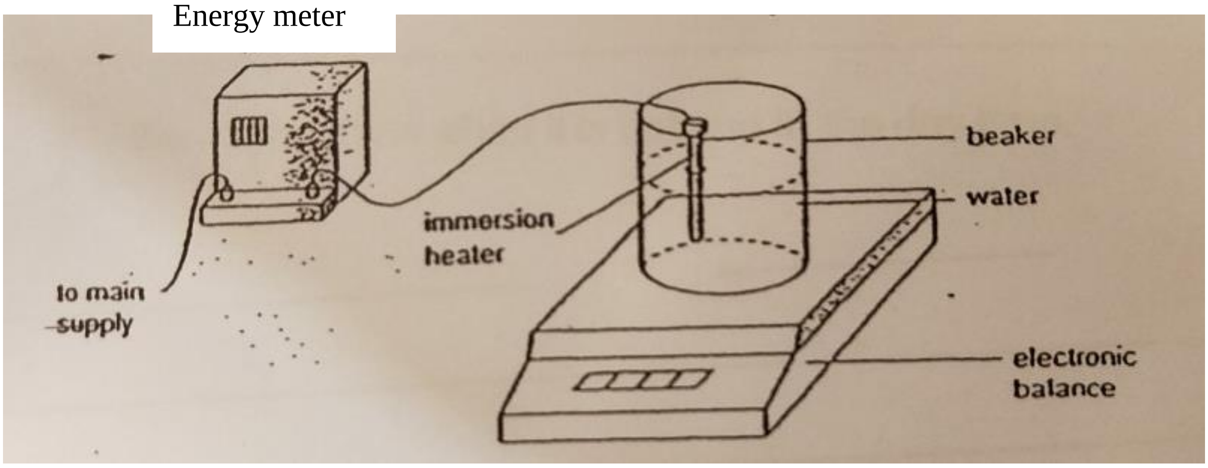

Fig. A7.1

(a) Before water starts to boil, the reading of the electronic balance decreases slowly with time. Calculate the specific latent heat of vaporization of water from the data obtained above. [2]

(b) If the experiment was repeated with a lid covering the beaker, would you expect the boiling point to be higher, equal or lower than the present set-up? Explain briefly. [2]

A8 An object with a height of 2.0 cm is placed 9.0 cm in front of a converging lens. The lens has a focal length of 3.0 cm. A sharp image is captured on a screen.

(a) By means of a scale diagram, find the image distance. [3]

(b) Where should the object be placed if the image required is to be the identical to that of the object? [1]

Section B [30 marks]

B9 When a traffic accident occurs, a proper investigation requires close inspection of the road and the surrounding area to find physical evidence in the forms of marks on the surface of the road. In a traffic accident, a driver knocked down a pedestrian on a rainy day, leaving a braking mark of length 30.0 m on the road. The police did a series of test on a rainy day and the results were as shown in **Fig. B9.1**. Assume that the car decelerated uniformly to a stop.

u / m s^{-1}	**s** / m	$\mathbf{u^2}$ / m^2 s^{-2}
10.0	25.0	
12.0	36.5	
14.0	49.3	
16.0	65.0	
18.0	81.0	
20.0	100.8	

Fig. B9.1

u : initial velocity

s : braking distance measured from the start of the use of brakes to the point when the car stops

The final velocity, initial velocity and displacement of the vehicle are related by the equation **"$v^2 = u^2 + 2as$"**, whereby **v** and **a** are the final velocity and acceleration of the car respectively.

(a) Complete the table by calculating the values of $\mathbf{u^2}$. [1]

(b) Plot a graph of $\mathbf{u^2}$ against ***s*** on the graph paper provided. The gradient of the graph corresponds to twice the deceleration of the car. Staple the graph paper containing your drawn graph to the back of this answer script. [4]

(c) **(i)** The speed limit is 50 km h^{-1}. Convert 50 km h^{-1} into m s^{-1}. [1]

(ii) With reference to **(c) (i)**, deduce the corresponding braking distance from your graph. [1]

(iii) With reference to your answer in **(c) (ii)**, determine if the driver was speeding before braking. [1]

(iv) How will the gradient of the graph change if the test is carried out on a dry day? Explain your answer. Assume that the reaction time of the driver remains unchanged. [2]

B10 A heat sink is a device to help remove heat from electronic parts. **Fig. B10.1** shows a heat sink typically placed above the computer chips. **Fig. B10.2** shows a thin layer of thermal paste being applied to the surfaces between the computer chips and the heat sink. This pasting is done as the surfaces may not be perfectly flat.

Fig. B10.1

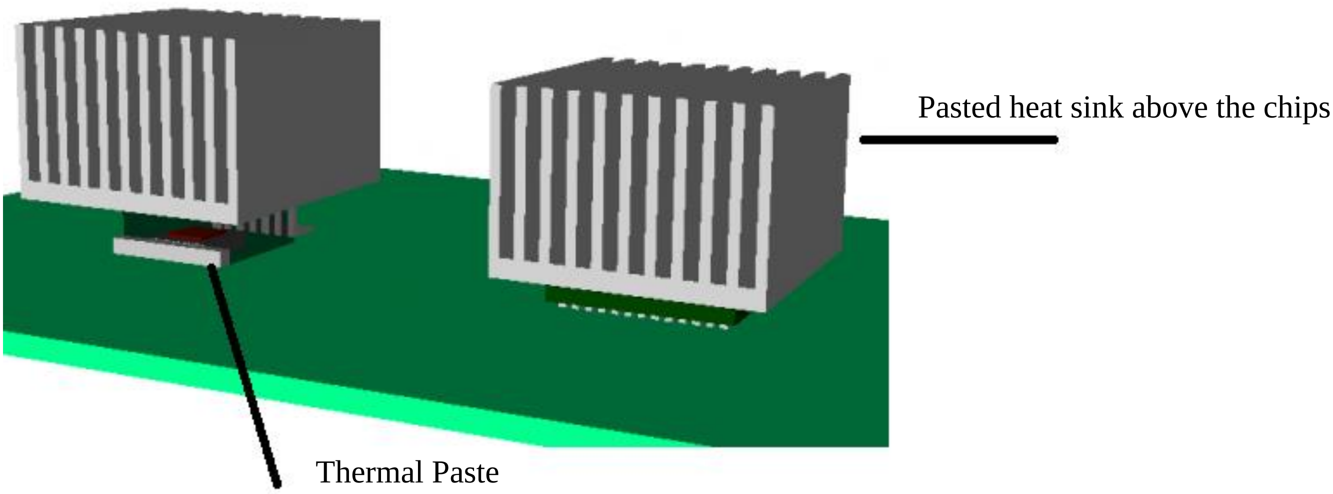

Fig. B10.2

(a) What is the purpose of the thermal paste and what property must it have? [2]

(b) Below are the features of the heat sink. [4]

1. Made of Aluminium
2. Black in colour.
3. Has many fins.
4. Air gaps between the fins.

Explain the purpose of each feature based on your knowledge of thermal heat transfer.

(c) Briefly describe the process of radiation and list the factors affecting it. [4]

B11 A monochromatic (single wavelength) light ray enters a semi-circular glass block at **Q** as shown in **Fig. B11.1** below.

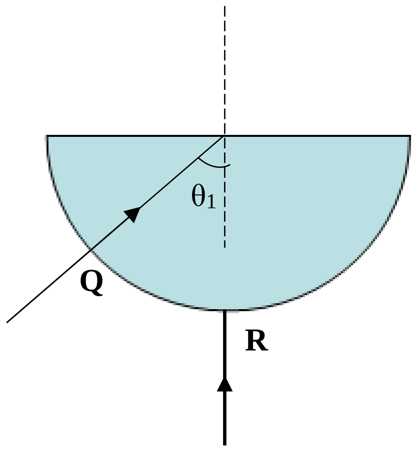

Fig. B11.1

Given that the refractive index of glass is 1.5.

(a) Explain why the light ray enters the block at **Q** without changing its direction. [2]

(b) Calculate the speed of the light ray in the glass. [2]

(c) Calculate the critical angle of the glass for the light. [2]

(d) Using your answer in **(c)**, state and explain if refraction or total internal reflection occurs at $\theta_1 = 60^\circ$. [3]

(e) Ray **R** enters the semi-circular glass block as shown. Complete the ray diagram in **Fig. B11.1** above. [1]

[END OF PAPER]