Class	Register Number	Name

南洋女子中学校

NANYANG GIRLS' HIGH SCHOOL
End-of-Year Examination 2014
Secondary Three

PHYSICS **1 hour 45 minutes**

Paper 2 Theory Paper **09:15 – 11:00**

Friday **03 October 2014**

Additional materials: Calculators may be used

READ THESE INSTRUCTIONS FIRST

Do not open this booklet until you are told to do so.
Write your name, register number and class in the spaces at the top of this page and on any separate answer paper used.

Section A (40 marks)
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

Section B (30 marks)
Answer **all** questions including questions **8, 9 and 10 *Either* or 10 *Or*.**
Write your answers in the spaces provided on the question paper.

At the end of the examination, circle **10 Either** or **10 Or** in the grid on the right to indicate which question you have answered.

INFORMATION FOR CANDIDATES
The intended number of marks is given in the brackets [ ] at the end of each question or part question. You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

Take gravitational field strength, g, to be 10 m s^{-2} or 10 N kg^{-1}.

Examiner's Use	
Paper 2	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10 Either	
10 Or	
Total	

Paper 1	

Overall
%

Section A
Answer **all** questions.

Write your answers in the spaces provided.

1 An experiment is set up to determine the diameter of a marble using two half-metre rules and 10 marbles as shown in Fig. 1.1. The total distance *d* across the 10 marbles is recorded and then divided by 10 to determine the diameter of one marble. The approximate diameter of one marble is slightly more than 1 cm.

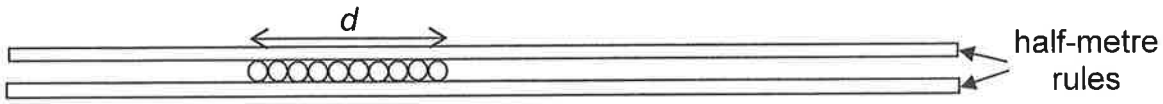

Fig. 1.1

(a) A second method uses a pair of vernier calipers to measure one marble to determine the diameter of a marble.
Explain the advantage of using the method with two half-metre rules and 10 marbles compared to the method using a pair of vernier calipers and one marble.

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..... [2]

(b) State the advantage of using at least 10 marbles in the method with two half-metre rules.

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..... [1]

2 Fig. 2.1 shows the speed-time graph for two cars in a race.
Car A accelerates steadily before braking.
Car B, started at the same time as car A, accelerates to 30 m s^{-1} but the car develops a fault and comes to a stop.

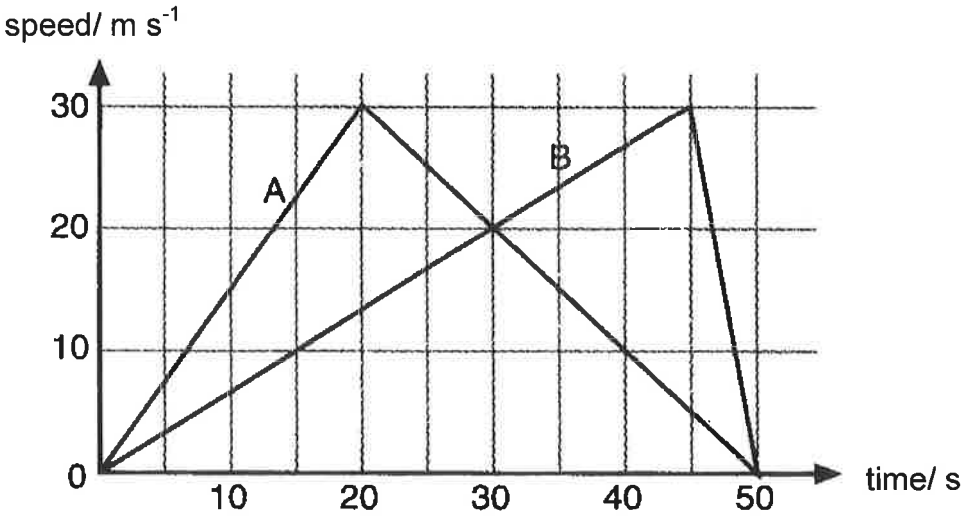

Fig. 2.1

(a) Calculate the acceleration of car A before the brakes are applied.

acceleration = ... [2]

(b) State the time when car A and car B have the same speed.

time = ... [1]

(c) Determine the distance between car A and car B at the time when both of them have the same speed.

distance = ... [3]

(d) State the time when car B catches up with car A.

time = ... [1]

3 Fig. 3.1 shows part of an arc made of stone.

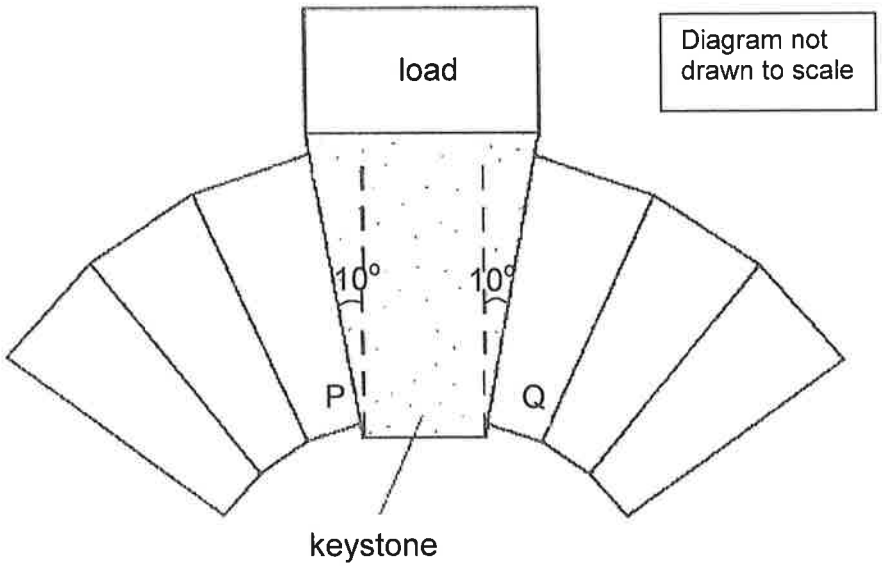

Fig. 3.1

The central stone is known as the keystone and has a weight of 100 N. The keystone is supporting a load of 500 N. The sides of the keystone make an angle of 10° to the vertical. The two stones P and Q, which are next to the keystone, exert forces at right angles to the sides of the keystone.

(a) On Fig. 3.1, draw and label arrows to show the following four forces.

W, the weight of the keystone
L, the force the load exerts on the keystone
X, the force stone P exerts on the keystone
Y, the force stone Q exerts on the keystone [4]

(b) By combining forces *W* and *L* into one force, draw a vector diagram (scale 1 cm : 200 N) to determine the value of force *Y*.

Magnitude of force Y = ... [3]

4 Fig. 4.1 shows a simple balancing toy placed on the tip of a finger. When the toy is displaced slightly, it is able to return to the position shown in Fig 4.1.

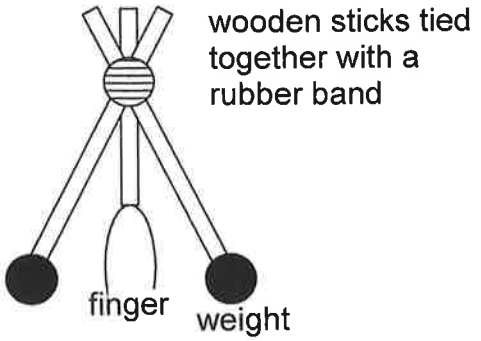

Fig. 4.1

(a) Define what is meant by the *centre of gravity* of an object.

.....

..... [1]

(b) On Fig. 4.1, mark with a 'X' a possible position of the centre of gravity of the toy. [1]

(c) The toy is now displaced slightly to the left as shown in Fig. 4.2.

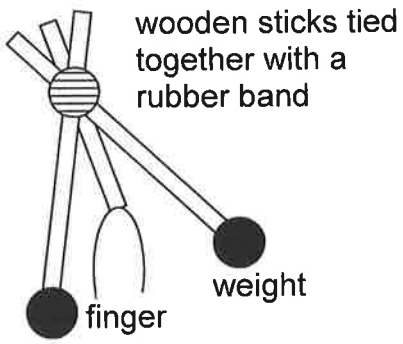

Fig. 4.2

Explain how it is able to return to its upright position as shown in Fig. 4.1.

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..... [2]

5 Fig. 5.1 below shows a simple mercury barometer constructed using a glass tube with a decreasing cross-sectional area upwards.

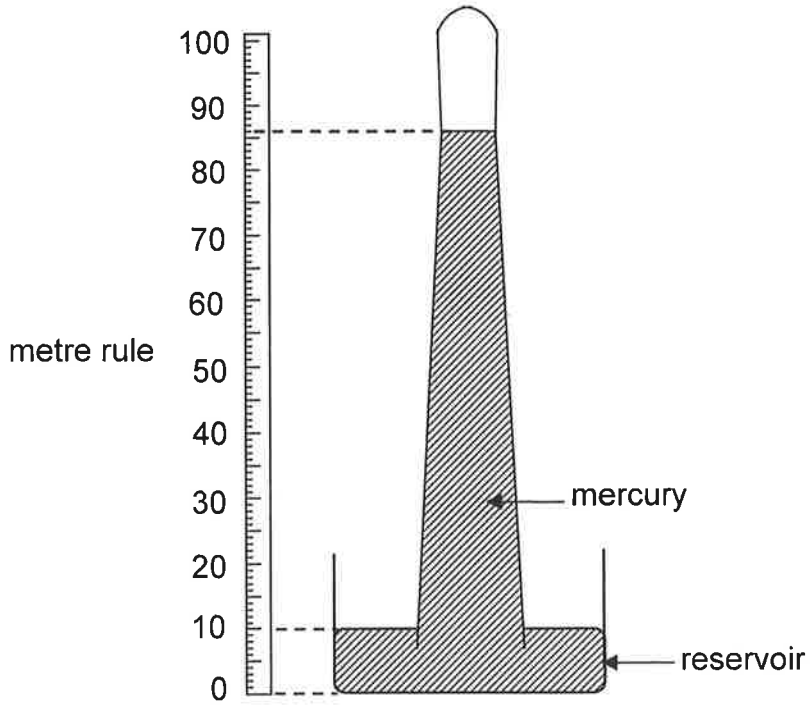

Fig. 5.1

(a) State the atmospheric pressure measured by the barometer in cm Hg.

atmospheric pressure = ...cm Hg [1]

(b) Mark on the barometer,

(i) a point Z where the pressure is zero,
(ii) a point M where the pressure is maximum,
(iii) a point P where the pressure is 30 cm Hg below atmospheric pressure.
[3]

(c) The barometer is taken to the peak of a mountain and the mercury level drops to the 70 cm mark.

Given that density of mercury is 13600 kg m^{-3} and density of air is 1.2 kg m^{-3}, calculate the height of this mountain.

mountain height = ... [2]

6 Fig. 6.1 below shows part of a roller coaster ride. Ignore the effect of air resistance and friction.

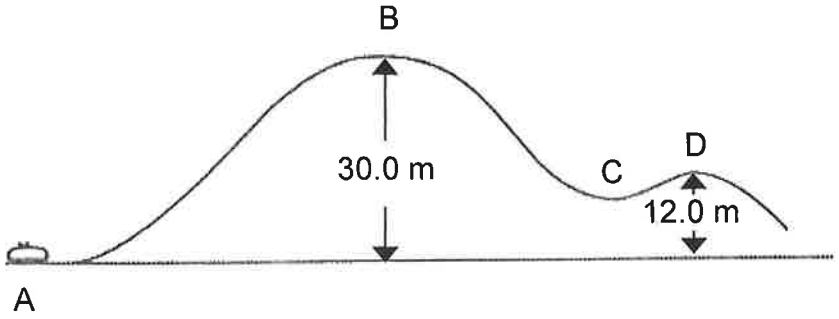

Fig. 6.1

The vehicle starts from rest at A and is hauled up to B by an electric motor. At point B, the motor is switched off and the speed of the vehicle is negligible. From B, the vehicle moves under gravity for the rest of the ride.

The mass of the vehicle and the passengers is 480 kg. The electric motor takes 2.0 minutes to haul the vehicle and its passengers from A to B.

(a) Calculate

(i) the work done by the electric motor, and

work done by motor = ... [2]

(ii) the power of the motor.

power of motor = ... [1]

(b) Calculate the speed of the vehicle at point D.

speed of vehicle = ... [2]

7 **(a)** Fig. 7.1 below shows an object P in front of a plane mirror MN. Draw a cone of light on Fig. 7.1 to show how an eye at E sees an image of P in the mirror MN. Label this image P_0.

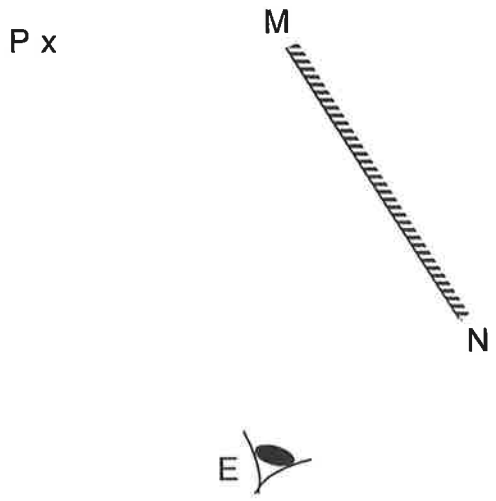

Fig. 7.1

[4]

(b) Pepper's ghost is an illusion technique used in theatre to create ghosts on stage using effects of reflection of light. It is named after John Henry Pepper, who popularized the effect.
Fig. 7.2 shows the common set-up used to create this effect and the path of a ray of light from the actor to the audience.

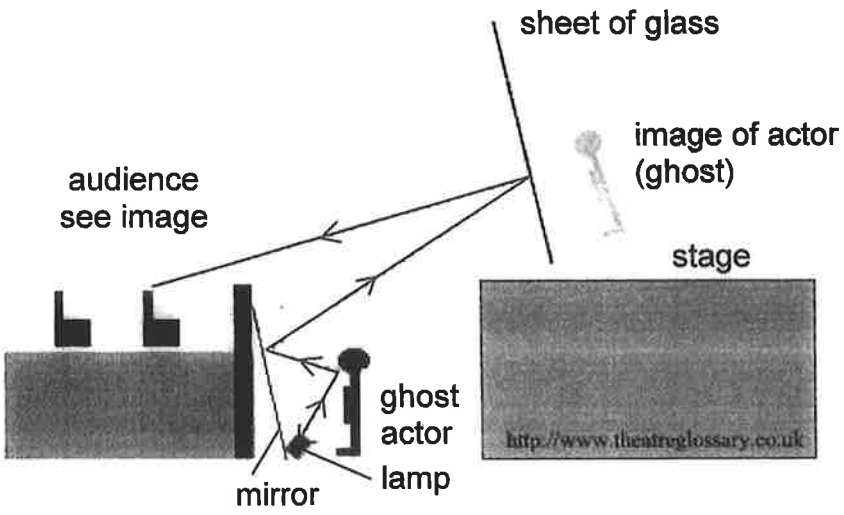

Fig. 7.2

(i) State **two** errors in the diagram and how they should be corrected.

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..... [2]

(ii) State if the "ghost" is a real or a virtual image. Explain your answer.

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..... [2]

Section B

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

Answer only **one** of the alternative questions in **Question 10**.

8 A flat equilateral triangular cardboard, of side 40.0 cm is supported vertically by a horizontal pin at its centre of gravity C as shown in Fig. 8.1. The cardboard can turn freely about the pin.

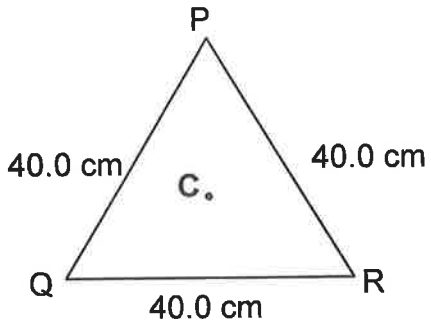

Fig. 8.1

(a) State the two conditions for the triangular cardboard to remain at rest as shown in Fig. 8.1.

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.....[2]

(b) Fig. 8.2 shows two forces being applied to the triangular cardboard.

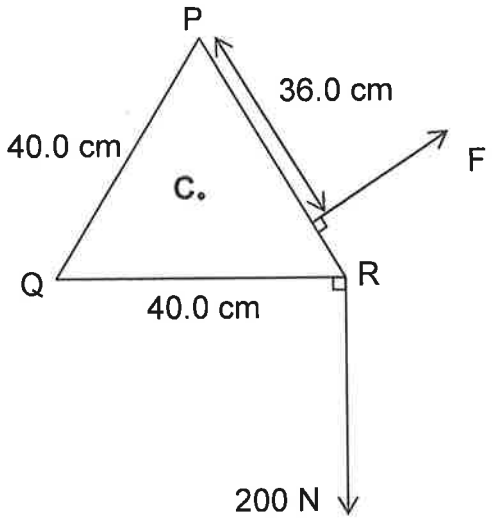

Fig. 8.2

The 200 N force is applied at point R perpendicular to side QR.
Another force F is acting perpendicular to side PR, 36.0 cm from point P.

(i) Calculate the moment of the 200 N force about the centre C.

moment = ... [2]

(ii) Calculate the value of the force F that will keep the cardboard stationary.

force F = ... [2]

(iii) The force F is removed. On Fig. 8.3,

(1) mark out how another force of 200 N can be applied at point P so that the cardboard does not turn, and

(2) label clearly the angle this 200 N force makes with side PQ.

[2]

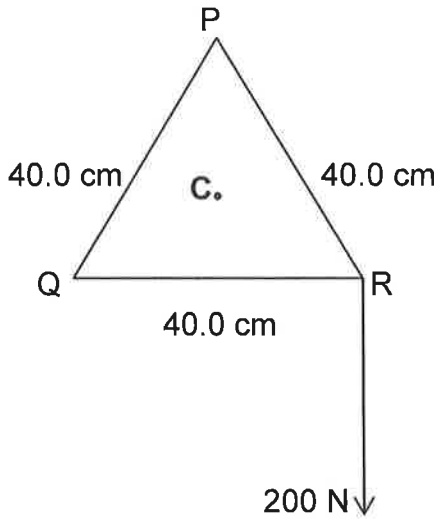

Fig. 8.3

(c) The triangular cardboard is removed from the pin and placed on a table. State **two** reasons why it is more stable when it is placed flat on the table than when it is placed on the table in a vertical position.

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.....[2]

9 Fig. 9 below shows a piece of glass being lifted by a suction cup.

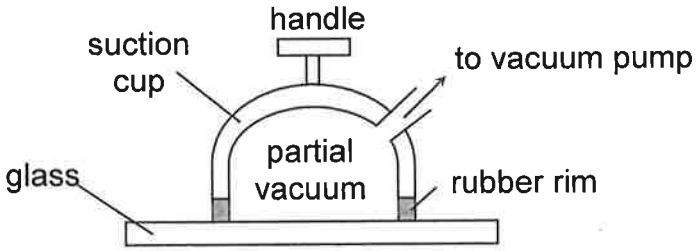

Fig. 9

Air is removed from the cup by a vacuum pump and a partial vacuum is created inside the cup. Atmospheric pressure outside pushes the glass on to the cup. The area of the glass covered by the cup is 0.00250 m^2 and the pressure inside the cup is at 60 000 Pa.

(a) Using a simple mercury barometer, the atmospheric pressure is found to be 75.0 cm Hg. Determine the atmospheric pressure in Pa.
(The density of mercury is 13 600 kg/m^3.)

atmospheric pressure = ... [2]

(b) Calculate the greatest weight of glass that can be lifted with this cup.

greatest weight that can be lifted = ...[2]

(c) Explain the function of the rubber rim.

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..... [2]

(d) If the same method is used for lifting glass at a higher altitude, explain if the suction cup would be able to lift a heavier or lighter piece of glass.

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..... [2]

(e) State and explain one modification that would allow the suction cup to lift a heavier piece of glass, assuming that the atmospheric pressure remains unchanged at 75.0 cm Hg.

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..... [2]

10 EITHER

Figure 10.1 shows a car, with mass 2.0×10^3 kg, moving to the right, with a forward force and a resistive force (includes friction between the car and the ground and air resistance) acting on it.

Figure 10.2 shows the variation of the forward and resistive forces with time.

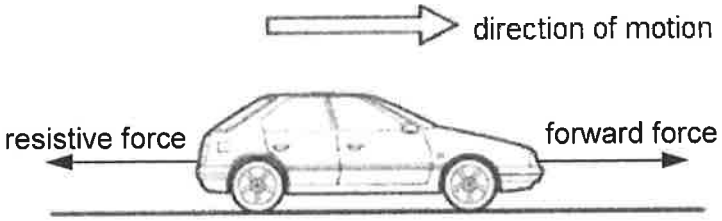

Fig. 10.1

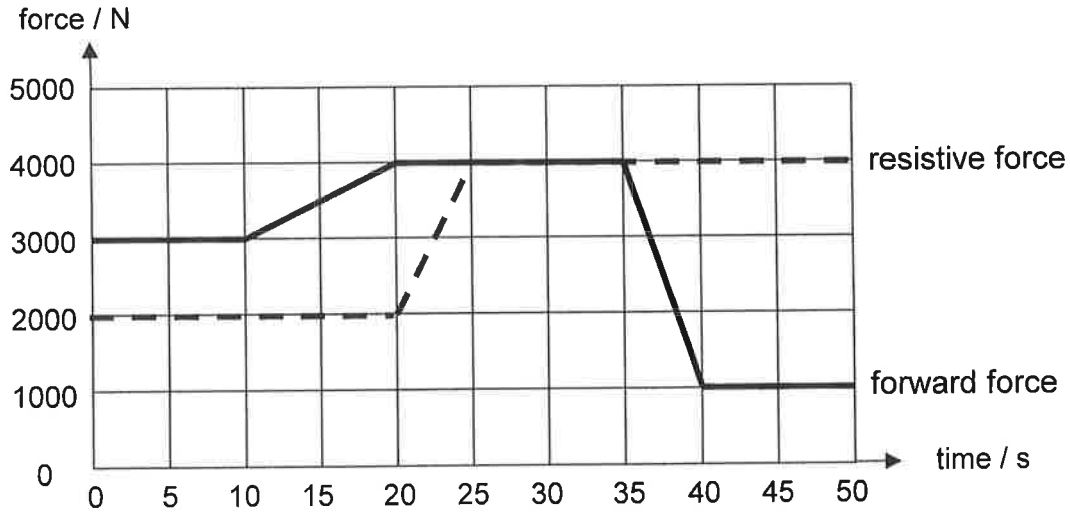

Fig. 10.2

(a) The car is observed to move faster from t = 0 s to t = 10 s.

(i) Calculate the acceleration of the car in the first 10 seconds.

acceleration = ... [2]

(ii) If the velocity of the car at t = 10 s is 25 m s^{-1}, find its initial velocity.

initial velocity = ... [2]

(b) Describe how the velocity of the car changes between t = 25 s and t = 35 s. Explain how you arrive at your answer.

.....

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.....[2]

(c) Describe the motion of the car from t = 40 s to t = 50 s.

.....

.....[1]

(d) **(i)** State **two** other forces acting on the car shown in Fig. 10.1.

.....

.....[1]

(ii) Explain why the forces in **(i)** do not affect the car's motion.

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.....[1]

(iii) Suggest a scenario whereby the forces in **(i)** affect the car's motion.

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.....[1]

10 OR

(a) State two conditions under which total internal reflection will occur.

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.....[2]

(b) **(i)** The refractive index of diamond is 2.42. Calculate the critical angle for diamond.

critical angle for diamond = ...[1]

(ii) Fig. 10.3 is a **scaled** diagram showing the path of a monochromatic ray of light entering a diamond at boundary AB until it is incident on BC.

Complete the path of the ray until it emerges from the diamond.
Show clearly labelled working done to determine the path of the ray.
At each incident boundary, mark the angle of incidence and angle of refraction or reflection.

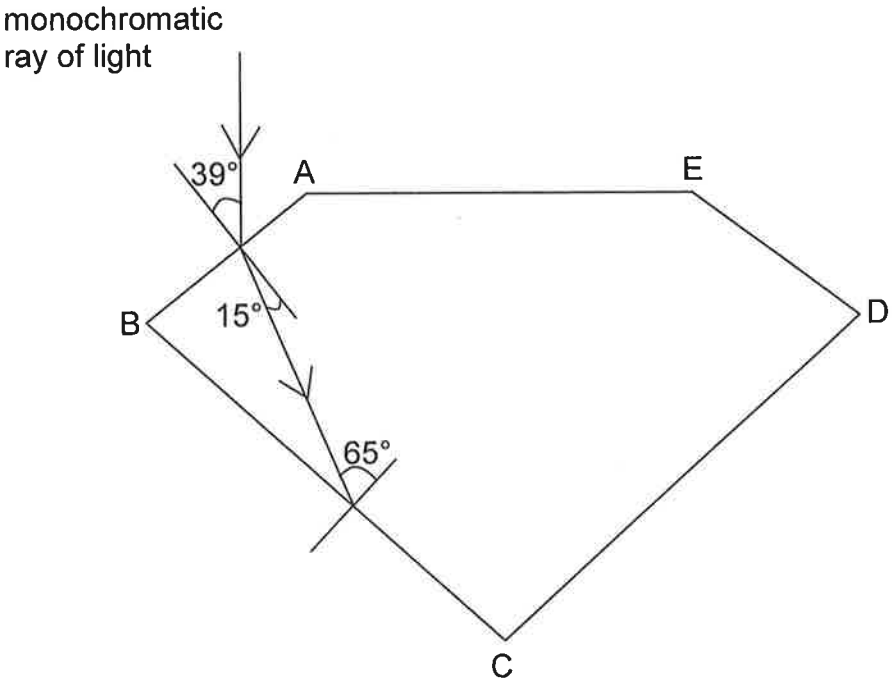
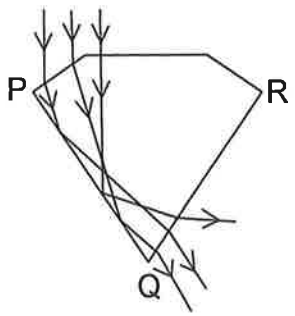


Fig. 10.3

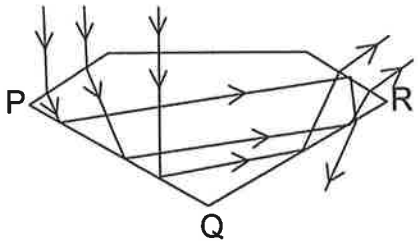
[4]

(iii) Fig. 10.4 a and Fig. 10.4 b below shows the cross-section of 2 diamond cuts where the pavilions PQR of the diamonds are too shallow or too deep.



too deep pavilion

Fig. 10.4 a



too shallow pavilion

Fig. 10.4 b

Explain why these two cuts do not make the diamonds sparkle as much as the diamond in part **(ii)**.

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.....[1]

(c) While glass can look very similar to diamond, explain why it does not sparkle as much.

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.....[2]

End of Paper

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