Class	Register Number	Name

南洋女子中学校

NANYANG GIRLS' HIGH SCHOOL

End-of-Year Examination 2012
Secondary Three

PHYSICS — **1 hour 45 minutes**

Paper 2 Theory Paper — **10:00 – 11:45**

Monday **15 October 2012**

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 **7, 8 and 9 *Either* or 9 *Or*.**
Write your answers in the spaces provided on the question paper.

At the end of the examination, circle **9 Either** or **9 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 the acceleration due to gravity, g, to be 10 m s^{-2} or 10 N kg^{-1}.

Examiner's Use	
Section A	
1	
2	
3	
4	
5	
6	
Section B	
7	
8	
9 Either	
9 Or	
Total	
70	

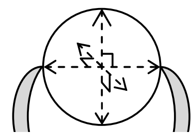
Section A
Answer **all** questions.

Write your answers in the spaces provided.

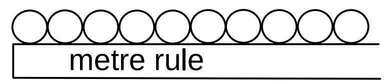
1 Three students set out to determine the average diameter of a marble using different methods.

Method 1
Student A uses a micrometer screw gauge to measure the widest part of the marble. The reading is 10.92 mm.

Method 2
Student B uses a pair of vernier callipers to measure widest part across 3 mutually perpendicular axis of one marble. The average of the 3 readings is 10.1 mm.



Method 3
Student C uses a ruler to measure the total length of 10 similar marbles arranged in a straight line. The total length is 10.1 cm and the average is 10.1 mm.



(a) State **one** advantage of **Method 1** over **Methods 2** and **3**.

…………………………………………………………………………………………

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

(b) Explain whether **Method 2** or **Method 3** is a more accurate method for determining the average diameter of the marble.

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

(c) The mass of the ten marbles used in **Method 3** is weighed and their volume is measured. The following results are recorded.

Mass = 17.7 g Volume = 6.9 cm^3

(i) Calculate the average weight of 1 marble.

Weight = ……………………….. [1]

(ii) Determine the average density of the marbles.

Density = ……………………….. [2]

2 In **Fig. 2**, a ball of mass 420 g enters a smooth ramp with velocity ***v*** and rolls up the ramp to reach a maximum vertical height of 3.6 m.

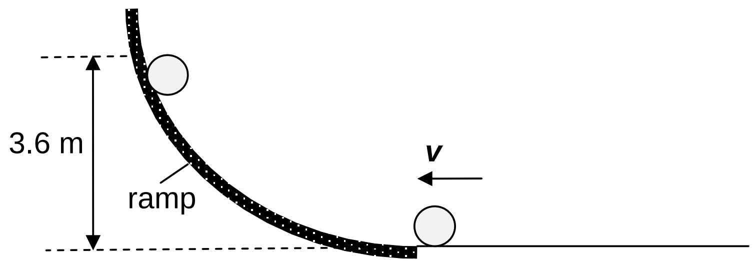

Fig. 2

(a) State the main energy change of the ball.

……………………………………………………………………………………………

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

(b) Calculate the work done by the ball in moving up the ramp.

Work done = ……………………….. [2]

(c) Calculate the velocity ***v*** of the ball as it enters the ramp.

Velocity = ……………………….. [2]

(d) State and explain whether the velocity ***v*** calculated in **(c)** is likely to be greater or less than the actual velocity of the ball when it entered the ramp.

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………………………………………………………………………………………………

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

3 (a) Define a vector quantity.

………………………………………………………………………………………………

………………………………………………………………………………………………

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

(b) State the condition under which a resultant vector may be determined by simple addition or subtraction of vectors.

………………………………………………………………………………………………

………………………………………………………………………………………………

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

(c) **Fig. 3** below shows a trap door **AB** of weight 150 N hinged at **A**. It is held open at an angle of 20º to the horizontal by a rope with a tension of 80 N. The rope is attached to **B** and makes an angle of 60º with the trap door at **B.**

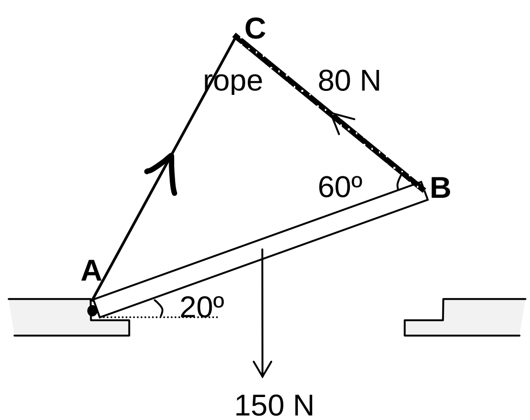

Fig. 3

(i) Using a scale diagram, determine the magnitude of the third force acting on the trap door.

Scale: ....

Magnitude of third force = ...[3]

(ii) Mark the position of the third force with an arrow on **Fig. 3**. Ignore the magnitude. [1]

4 (a) One of the Laws of Reflection states that the angle of incidence is equal to the angle of reflection (i.e. $i = r$). State the other Law of Reflection.

……………………………………………………………………………………………

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

(b) An object **R** is placed near to two mirrors $\mathbf{M_1}$ and $\mathbf{M_2}$ as shown in **Fig. 4.1**.

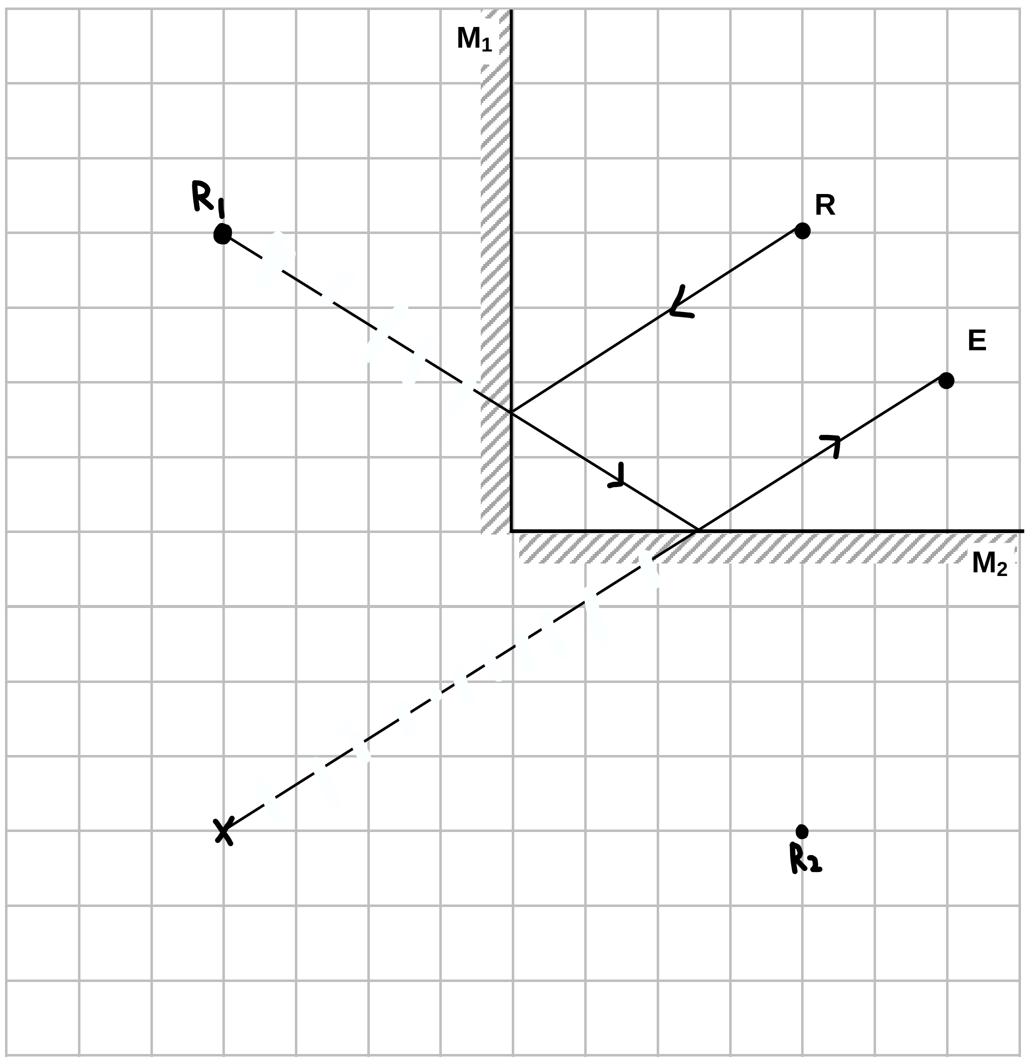

Fig. 4.1

(i) Mark the positions of **all** the images of the object **R** formed by these two mirrors with an **X** in the space provided in **Fig. 4.1**. [2]

(ii) A person stands at point **E** in **Fig. 4.1**, and looks at the image of the object **R** that is **the furthest distance away** from the object.

Draw the paths of a light rays travelling from object **R** to the person **E** that allow this person to see this image. [2]

(iii) A third mirror $\mathbf{M_3}$ is placed near the object **R** as shown in **Fig 4.2**.

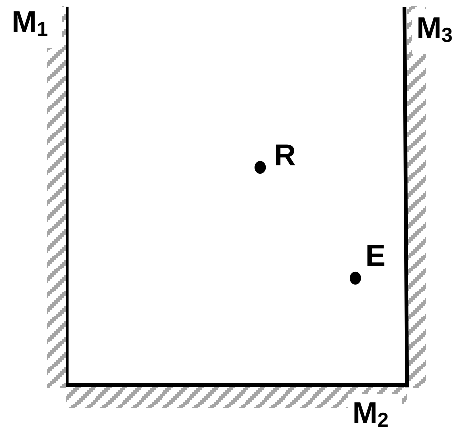

Fig. 4.2

State the total number of images that will be formed of object **R** due to this arrangement of mirrors.

Number of images = ………………………… [1]

5 **Fig. 5.1** shows a ray of light passing through a lens.

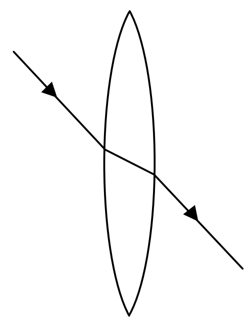

Fig. 5.1

(a) State the name of this type of lens.

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

(b) Explain why light rays change direction as they enter the lens.

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

………………………………………………………………………………………

……………………………………………………………………………………. [2]

(c) **Fig. 5.2** shows a word seen through a lens. **Fig. 5.3** shows the same word without the lens.

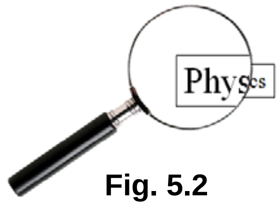

Fig. 5.2

Fig. 5.3

(i) State two properties of the image seen through the lens.

1. ……………………………… 2. ……………………………….. [2]

(ii) On **Fig. 5.4**, sketch a ray diagram to show how the image in **Fig. 5.2** was formed by the lens (the object **O** represents the word "Physics"). Mark clearly the principal focus, **F** of the lens and the image, **I** formed.

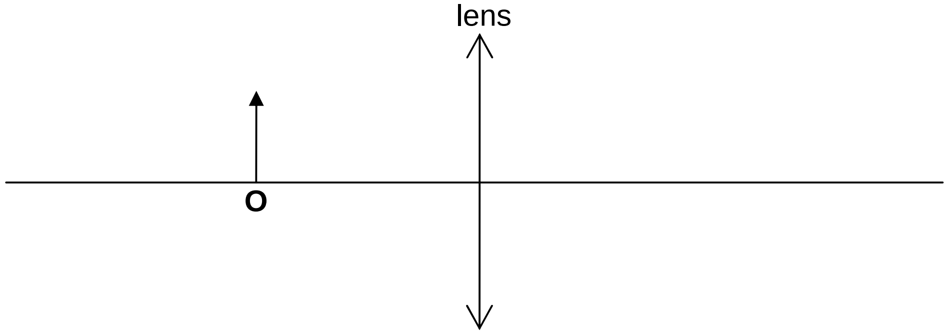

Fig. 5.4

[3]

6 **Fig. 6.1** shows a train of water waves produced by a straight vibrator in a ripple tank experiment. The vibrator has a frequency of 10 Hz. The waves travel from **Region A** to **Region B** across the boundary **XY** as shown. The two regions are of different depths.

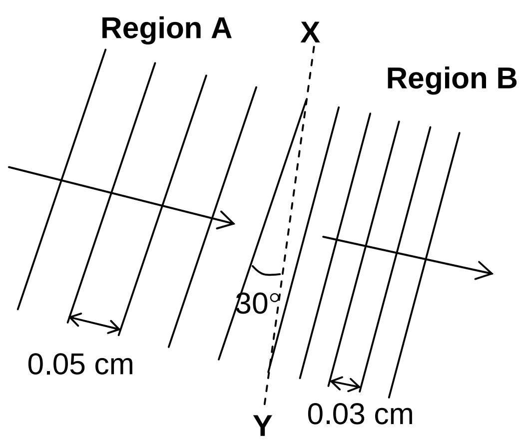

Fig. 6.1

(a) State which region is deeper.

Region .... is deeper. [1]

(b) Determine the speeds of the water waves in **Region A** and in **Region B.**

Speed in **Region A** =..................................,

Speed in **Region B** = ...[2]

(c) Calculate the angle of refraction for the water waves.

Angle of refraction = …………………………. [2]

(d) State the change that will be observed in a train of plane water waves as it travels across a tilted ripple tank with water of increasing depth as shown in **Fig.6.2**.

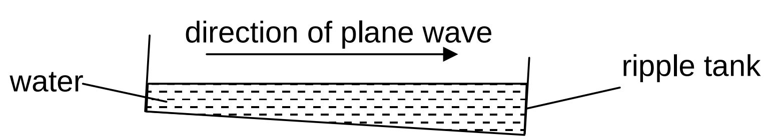

Fig. 6.2

…………………………………………………………………………………………

……………………………………………………………………………………… [1]

(e) State one difference in the wave properties of water waves and sound waves.

…………………………………………………………………………………………

…………………………………………………………………………………………

……………………………………………………………………………………… [1]

Section B

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

Question **9** is in the form of either/or and only **one** of the alternatives should be attempted.

7 A ball of mass 0.40 kg in thrown vertically upwards on planet X which has negligible amount of atmosphere. **Fig. 7** shows the variation of the velocity ***v*** of this ball with time ***t*** for the first 1.0 s of its motion.

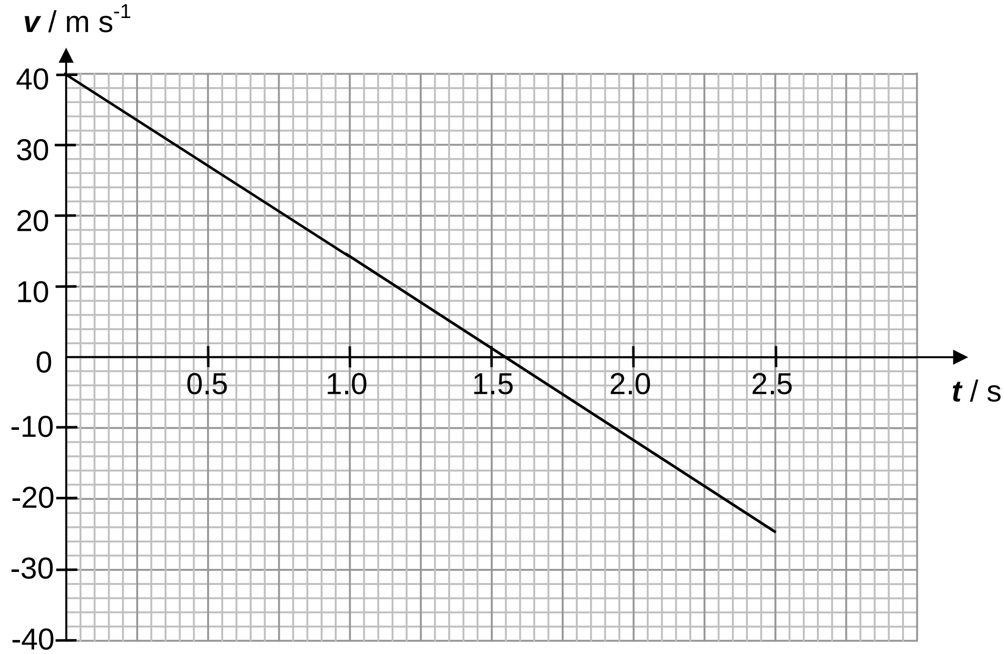

Fig. 7

(a) State what is meant by ***velocity***.

……………………………………………………………………………………………

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

(b) Calculate the vertical distance covered by the ball in the first 1.0 s of its motion.

distance = ……………………….. [2]

(c) Complete the graph in **Fig. 7** to show the variation of the velocity ***v*** of the ball with time ***t*** between ***t*** = 1.0 s and ***t*** = 2.5 s. [2]

(d) State the time when the ball is at its highest point above the ground.

time = ……………………….. [1]

(e) Calculate the gravitational acceleration on planet X.

Gravitational acceleration = ……………………….. [2]

(f) State and explain clearly one change to the completed graph in **Fig. 7**, if the ball is thrown vertically upwards on **Earth** with the same initial velocity.

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………

…………………………………………………………………………………………[2]

8 (a) Two blocks A and B with masses 5.0 kg and 15.0 kg respectively, are stacked on a smooth floor. The blocks move from rest to the left with an acceleration of 2.5 m s^{-2} when a constant horizontal force, F of 50.0 N, is exerted on block B as shown in **Fig 8.1.**

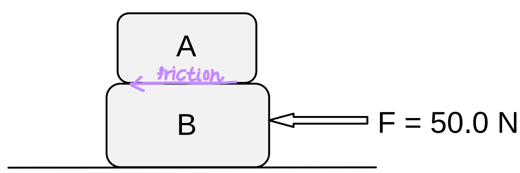

Fig. 8.1

(i) Mark on **Fig 8.1**, the direction of the frictional force acting on block A and calculate its magnitude.

Frictional force = ……………………….. [2]

(ii) On the free body diagram of block B shown in **Fig. 8.2**, mark and label **all** the forces acting on block B. The force F has been marked for you. [3]

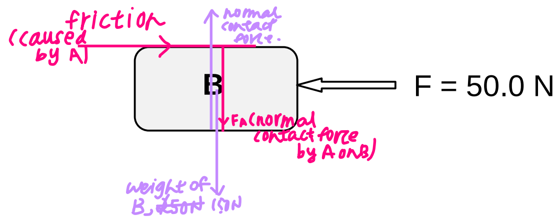

Fig. 8.2

(iii) Calculate the magnitude of the force acting on block B by the floor.

$NCF = F_A + W$
$= 10\times5 + 10\times15$
$= 200$

force = ………………………. [2]

(b) A wooden block X is supported by a string **S** from the ceiling. Another string **T** is fixed to the bottom of it as shown in **Fig 8.3**.

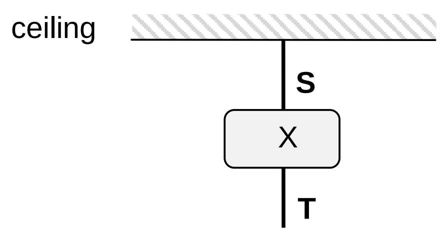

Fig. 8.3

(i) State Newton's First Law of Motion.

An object will remain at rest or travel in a straight line at constant velocity unless a resultant force acts on it.

…………………………………………………………………………………

………………………………………………………………………………… [1]

(ii) State and explain which string (**S** or **T**) will break if you give a sudden downwards jerk to string **T**.

String T will break because the inertia of the block will resists against the sudden jerk, thus resulting in string t to break instead of string s

…………………………………………………………………………………

…………………………………………………………………………………

………………………………………………………………………………… [2]

9 EITHER

(a) State the two conditions necessary for an object to be at equilibrium.

There are no net moments acting on the object and there are no net forces acting on the object at any point of the object

....[2]

(b) **Fig. 9.1** shows a non-uniform metre rule that is pivoted freely at the 50.0 cm mark.

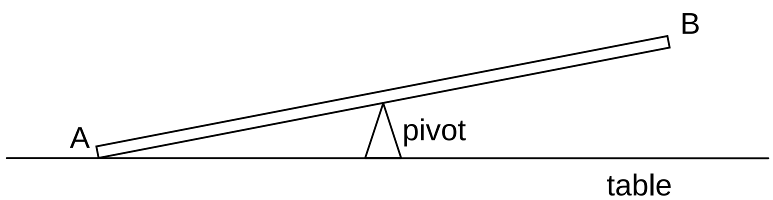

Fig. 9.1

Given a small amount of plasticine, state and explain how you would use the plasticine to balance the rule horizontally.

Place the plasticine on B. By doing so, the sum of clockwise moments would be increased so that it would be equal to the sum of anticlockwise moments, resulting in the rule being balanced

....[2]

(c) **Fig. 9.2.1** shows the side view of a structure that is formed by a uniform disc of diameter 60.0 cm soldered onto a uniform rod of length 100.0 cm. An axle **XY** is poked through the centre of both the disc and the rod.

In the plan view (viewed from the top) of the structure shown in **Fig 9.2.2**, two forces, each of 55 N act in opposite directions at right angles to the rod. A rope is attached tangential to the disc to prevent it from turning.

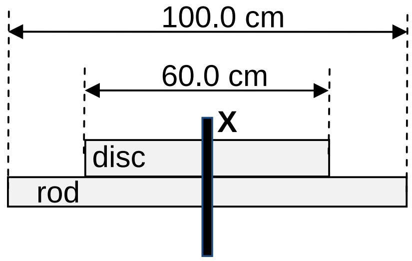

Fig. 9.2.1 (side view)

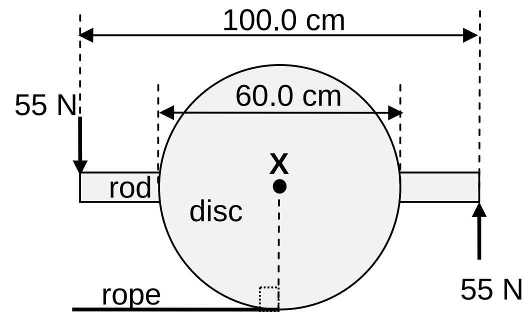

Fig. 9.2.2 (plan view)

(i) Calculate the net moment produced by the two 55 N forces about the axle **XY**.

2(55N×50cm) = 5500 Ncm

Net moments = ……………………………….. [2]

(ii) Calculate the tension in the rope.

T×30cm = 5500 Ncm
T = 5500/30
= 180

Tension = ……………………….. [2]

(iii) If the rope is no longer held tangential to the disc as shown in **Fig 9.2.3**, state and explain the change to the tension in the rope required to prevent the disc from turning.

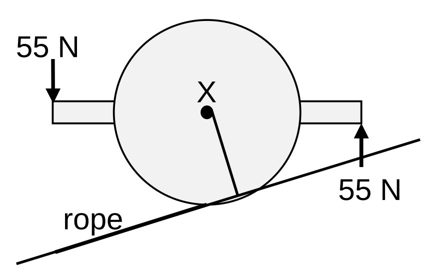

Fig. 9.2.3 (plan view)

The tension in the rope is increased such that the perpendicular distance from the pivot would be shorter such that the force required to stop the pivot would be lesser

………………………………………………………………………………….. [2]

9 OR

(a) Define critical angle.

Critical angle is the angle whereby when light ray pass through a denser to less dense medium, the angle of refraction is exactly 90 degrees

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

(b) Given that the refractive index of diamond is 2.4, calculate the critical angle of diamond.

$n_g \sin c = 1 \sin 90^\circ$

$\sin c = \frac{1}{2.4}$

$c = \sin^{-1}\left(\frac{1}{2.4}\right) =$

critical angle = ………………………… [1]

(c) A ray of light is incident on a diamond at point **O** as shown in **Fig. 9.3** below. The angle of incidence is 30°.

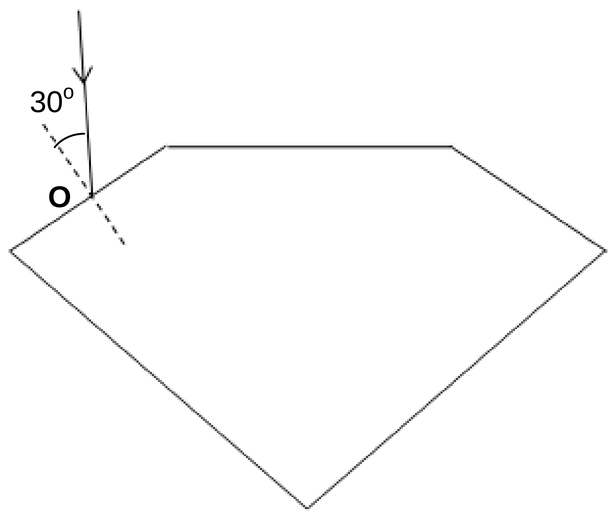

Fig 9.3

(i) Calculate the angle of refraction of the light ray after it is refracted at point **O**.

Angle of refraction = ………………………… [2]

(ii) Hence, on **Fig. 9.3**, construct the path of the light ray in the diamond after refraction at point **O**. [1]

(iii) Extend the ray that you constructed in **(ii)** until it meets another surface. Determine if the ray is refracted or totally internally reflected, and construct the path of the light ray accordingly. [2]

(iv) The light ray eventually emerges from the diamond. Describe and explain how the intensity of the light ray changes as it enters the diamond until after it exits the diamond.

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…………………………………………………………………………………..

…………………………………………………………………………………..

…………………………………………………………………………………..

………………………………………………………………………………... [2]

(v) Explain why some facets of a diamond may appear to be coloured even though it is placed under white light.

…………………………………………………………………………………..

…………………………………………………………………………………..

………………………………………………………………………………... [1]

End of paper