Class	Register Number	Name

南洋女子中学校

NANYANG GIRLS' HIGH SCHOOL

End-of-Year Examination 2011
Secondary Three

PHYSICS

Paper 2 Theory Paper **1 hour 45 minutes**

Monday **17 October 2011** **1000 - 1145**

Additional materials: Calculator can 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.

The gravitational field strength near Earth's surface, g = 10 N/kg

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

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Section A

Answer **all** questions.

Write your answers in the spaces provided.

1 **Fig. 1.1** shows the velocity-time graph of an object.

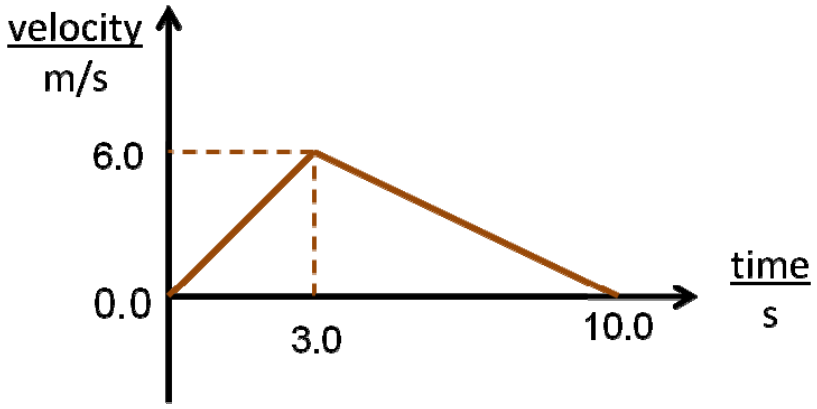


Fig. 1.1

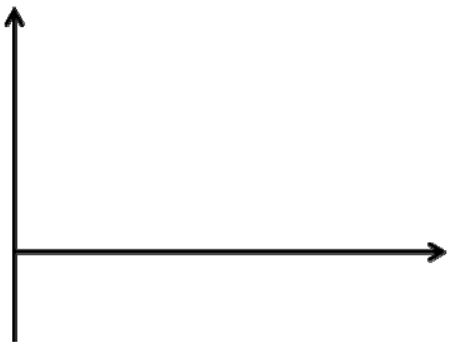
(a) Calculate the displacement of the object from t = 0.0 s to t = 3.0 s.

displacement = ... [1]

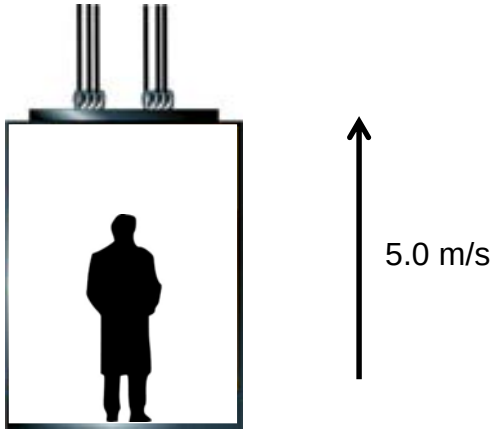
(b) Calculate the displacement of the object from t = 0.0 s to t = 10.0 s.

displacement = ... [1]

(c) Using the axes below, sketch the displacement-time graph for the object, labelling the axes, and other relevant information, clearly. [3]



2 A man is standing in a lift which is travelling upwards at a constant speed of 5.0 m/s. The mass of the man is 65 kg, while the mass of the lift is 435 kg.



(a) State the magnitude of the net force acting on the man. Explain your answer with reference to Newton's Laws of Motion.

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…… [2]

(b) In the space below, draw a free-body diagram of the forces acting on the man, clearly labelling each force and stating its magnitude.

[2]

(c) Suppose the lift is now travelling **downwards** at a constant speed of 10.0 m/s instead. State how the forces acting on the man as drawn in part **(b)** may change. Explain your reasoning clearly.

……

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…… [2]

3 **(a)** The diagram below shows the rest position (**Fig. 3.1**) and the displaced position (**Fig. 3.2**) of a toy. The toy **always** returns to its rest position after being displaced.

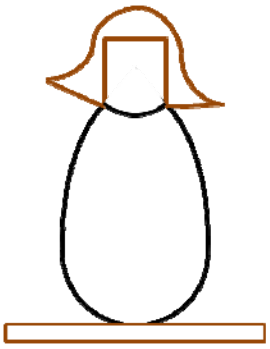

Fig. 3.1

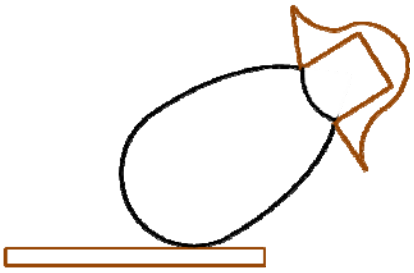

Fig. 3.2

(i) Mark, with a cross, the centre of gravity of the toy in **Fig. 3.2**. [1]

(ii) Describe what happens after the toy is released from the displaced position (**Fig. 3.2**). Explain your reasoning clearly.

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..... [3]

(b) Explain why the toy is able to stay at rest in the position shown in **Fig. 3.1**.

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[2]

4 **Fig. 4.1** shows a section of a roller coaster. The mass of the cart and its passengers is 400 kg. The speed of the cart at **L** is 20 m/s. Assume that the tracks are frictionless and do not do work on the cart.

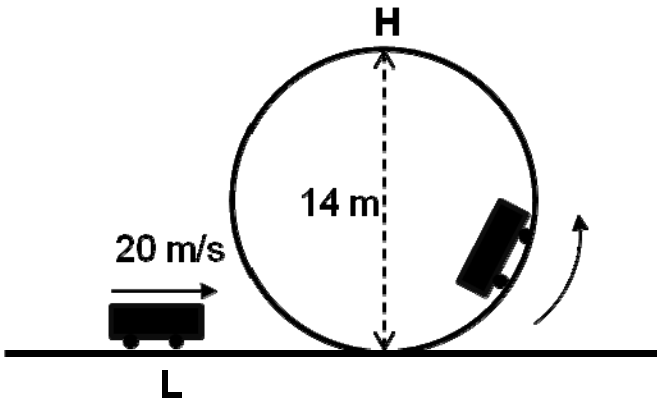

Fig. 4.1

(a) Calculate the gravitational potential energy gained by the cart when it travels from **L** to the highest point, **H**.

gravitational potential energy gained = ... [1]

(b) Calculate the kinetic energy of the cart when it reaches the highest point, **H**.

kinetic energy at **H** = ... [2]

(c) Calculate the speed of the cart at the highest point, **H**.

speed of cart at **H** = ... [2]

5 **Fig. 5.1** shows the **top view** of an arrangement where a plane mirror is used in a shop to observe a display counter behind a wall. **P** is the position of the observer's eye.

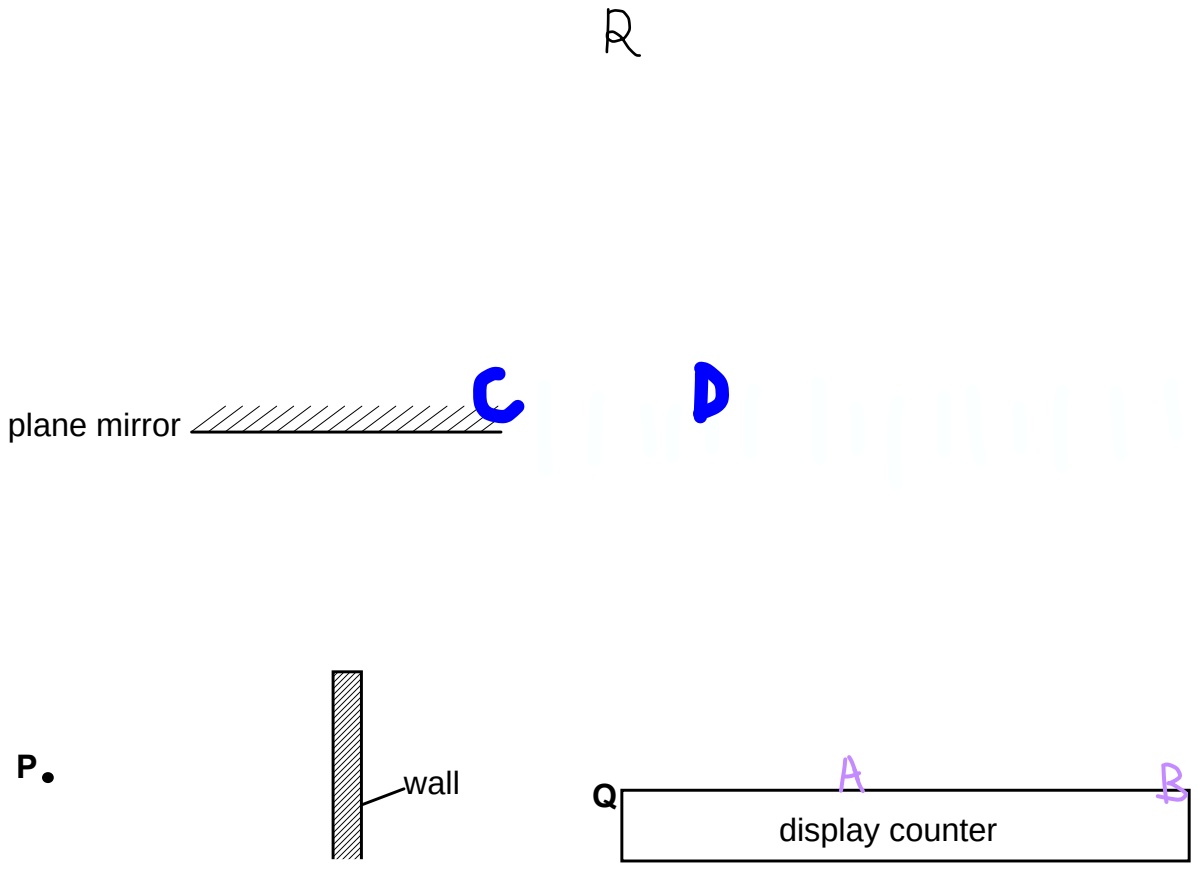

Fig. 5.1

(a) The corner **Q** of the display counter can be seen at **P** via the plane mirror. By drawing **just one incident light ray** from **Q**, show the path of the reflected light that reaches **P**. Locate and label the image of **Q** in the mirror with the letter **R**.

[2]

(b) On **Fig. 5.1** above, draw light rays accurately to show how much of the display counter **cannot** be seen from **P**. Label the part of the counter that **cannot** be seen with **AB**. [2]

(c) The plane mirror has to be extended in order for the whole display counter to be seen from **P**. By drawing light rays on **Fig. 5.1**, indicate the minimum extended length of mirror required to do this. Label this mirror extension with **CD**.

[2]

6 **(a)** State two conditions for **total internal reflection** to occur.

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…… [2]

(b) **Fig. 6.1** shows the refraction of a light ray passing from liquid **X** to air.

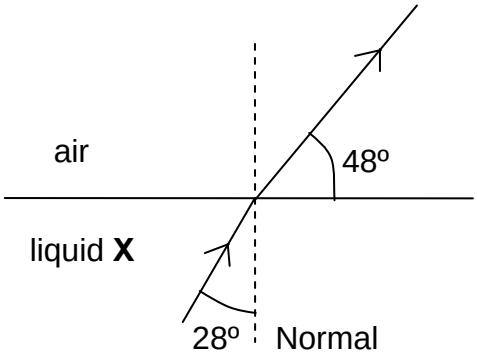

Fig. 6.1

(i) Calculate the refractive index of the liquid **X**.

refractive index = …….. [2]

(ii) Calculate the critical angle for the liquid **X**.

critical angle = …….. [2]

(iii) Suggest one reason why the refracted light is dimmer than the incident light.

……

…… [1]

7 **Fig. 7.1** below shows a converging lens and the image of an object formed on a screen (drawn to scale). The image is the **same size** as the object but inverted.

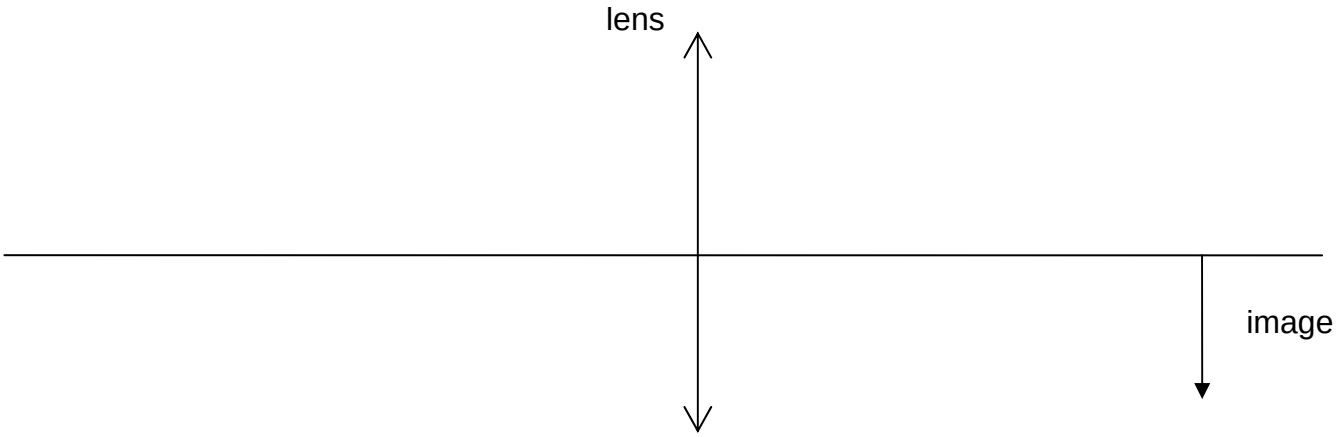

Fig. 7.1

(a) Determine the position of the object and draw 2 light rays to show how the image is formed from the object.
Label the object with the letter **O**. [3]

(b) Hence or otherwise, determine the focal length of the lens.

focal length = …….. [1]

(c) The object is moved further away (to the **left**) from the lens. The screen is shifted to form a sharp image again. Describe any change(s) to the image.

……

……

…… [1]

Section B

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

The last question is in the form of **either/or** and only **one** of the alternatives should be attempted. Each question carries **ten** marks.

8 Jane is driving a car and travelling at 17 m/s as she approaches a traffic junction with a width of 10 m.

At the instant when the car was 25 m from the start of the junction, the traffic light changed from green to amber. **Fig. 8.1** shows the position of Jane's car at that instant.

Jane can either step on the brakes such that she may stop before the junction, or step on the accelerator so that she may pass the junction before the light turns red.

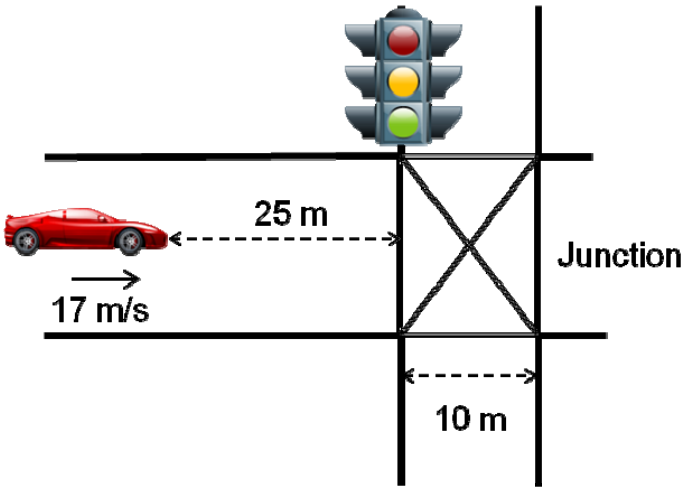

Fig. 8.1

Assume that Jane's reaction time is negligible.

(a) Suppose Jane decides to step on the **accelerator**. Jane's car engine provides a constant acceleration of 2.0 m/s^2.

(i) Calculate the speed of the car 1.0 s after the instant shown in **Fig. 8.1**.

speed of car = ... [2]

(ii) Calculate the distance travelled by the car in this 1.0 s.

distance travelled = ... [1]

(iii) It is known that the duration of the amber light is 1.0 s, after which, it turns red. Based on your answer in **(a) (i)** and **(a) (ii)**, comment on whether it is wise for Jane to step on the accelerator.

.....

..... [1]

(b) Suppose that at the instant shown in **Fig. 8.1**, Jane decides to step on the **brakes**. The brakes on Jane's car provide a constant deceleration of 7.0 m/s^2.

(i) Calculate the distance travelled from the instant the traffic light turned amber until Jane's car comes to a complete stop.

distance travelled = ... [2]

(ii) Comment on whether it is wise for Jane to step on the brakes.

.....

..... [1]

(c) In real life, Jane's reaction time is 0.5 s. Jane decides to step on the **brakes**.

(i) Calculate the distance travelled from the instant the traffic light turned amber until Jane's car comes to a complete stop again, taking into account Jane's reaction time.

distance travelled in real life = ... [2]

(ii) Suggest one precaution Jane could have taken when driving such that she would not be caught in a situation whereby she can neither stop in time nor accelerate past a traffic junction in time.

.....

..... [1]

9 Two students are playing on a swing. Student A is sitting on the swing, while student B pulls the swing back as far as she can, as shown in **Fig. 9.1**. The rope makes an angle **θ** to the vertical.

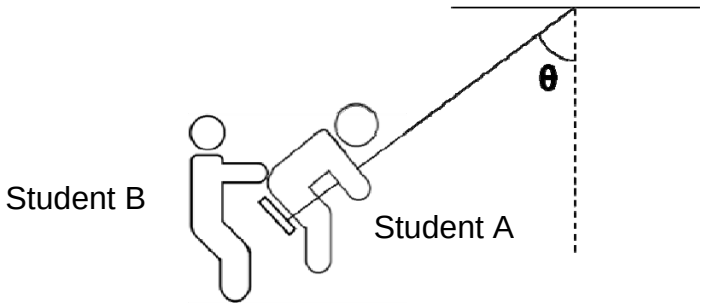

Fig. 9.1

The mass of student A is 50 kg. Neglect the mass of the swing. The pulling force, **F**, that student B generates by pulling is 700 N, and is directed **horizontally backwards**.

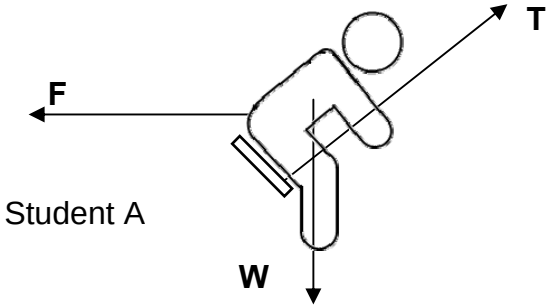

Fig. 9.2

Fig. 9.2 shows the pulling force **F**, tension in the rope **T**, and the weight **W** acting on student A. At the instant shown in **Fig. 9.2**, student A is in a state of equilibrium.

(a) Using any suitable method, determine the tension in the rope **T** and the angle the rope makes with the vertical, **θ** (See **Fig. 9.1**). [4]

tension **T** = ……

angle **θ** = ……

(b) Now Student B releases Student A, so that Student A swings forward on the swing.

(i) Assuming that all other forces remain constant, state the magnitude and direction of the net force acting on Student A at the moment she is released by Student B.

magnitude of net force = ... [1]

direction of net force = ... [1]

(ii) Hence, calculate the magnitude of the initial acceleration of Student A.

acceleration = ... [2]

(c) Before Student B releases Student A, Student B was also in a state of equilibrium.

Fig. 9.3 shows 3 of the forces acting on Student B. Complete the diagram by drawing an arrow(s) to show the **direction** of any other force(s) acting on Student B. State the **magnitude** of this other force(s). [2]

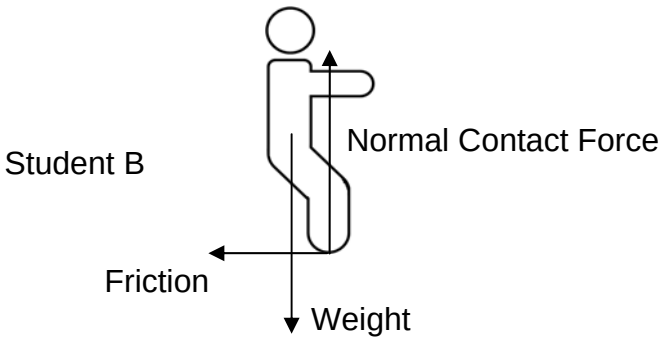

Fig. 9.3

10 EITHER

Students in Singapore have to undergo a fitness test every year. One test item for the girls is the inclined pull up.

Consider a girl doing an inclined pull up. **Fig. 10.1** shows the girl in the starting position and the forces acting on her.

It is given that the weight of the girl is 485 N and it acts at a horizontal distance of 0.85 m away from her feet, as indicated in **Fig. 10.1**. ***R*** is the force exerted by the floor on the girl's feet. The pulling force acting on her hands is ***F*** and it acts at a **perpendicular distance** of 1.35 m from her feet.

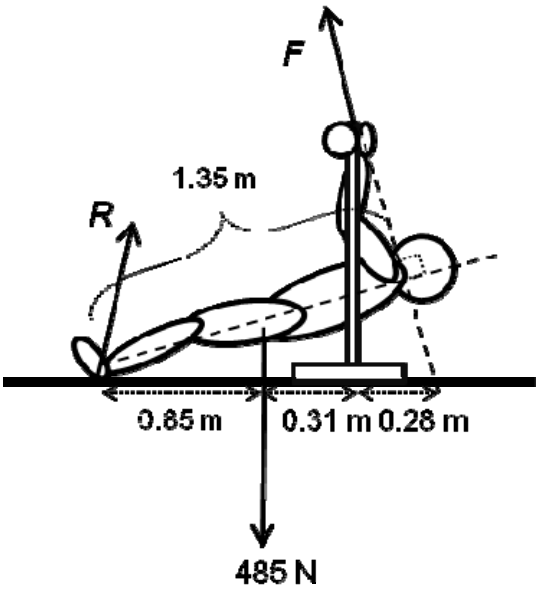

Fig. 10.1

(a) (i) State the moment due to ***R*** about the girls' feet.

moment due to ***R*** = ... [1]

(ii) By taking moments about the girls' feet, calculate the force, ***F***, required for the girl to just lift herself from this starting position.

F = ... [2]

It is known that boys above fifteen years of age will have to do the vertical pull up.

Fig. 10.2 shows the starting and ending positions for a vertical pull up for boys and **Fig. 10.3** shows the starting and ending positions for an inclined pull-up for girls.

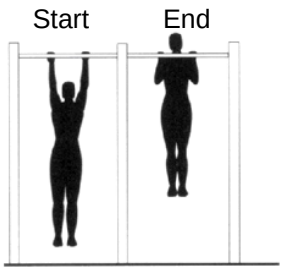

Fig. 10.2

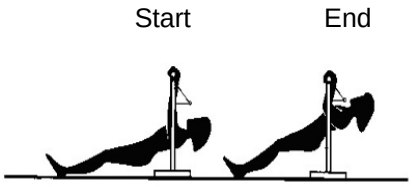

Fig. 10.3

(b) Based on your answer in part **(a) (ii)**, give a reason why it is easier to do an inclined pull up compared to a vertical pull up.

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.....

.....

..... [1]

(c) It is believed that doing one vertical pull up is more tiring than doing one inclined pull up.

(i) Calculate the gravitational potential energy gained by the girl in part **(a)** when she does one inclined pull up (**Fig. 10.3**), given that her centre of gravity rises by 0.12 m.

potential energy gained for one inclined pull up = ... [2]

(ii) It is given that the gravitational potential energy gained by the same girl if she were to do one vertical pull up is 121 J.

Based on your answer in part **(c) (i)**, comment on whether you agree that it is more tiring to do one pull up compared to one inclined pull up.

.....

.....

..... [1]

(d) In real life, the efficiency of a person's muscles is about 20%. This means that only 20% of the total energy used by the person goes into increasing the potential energy of the person during an inclined pull up.

(i) With reference to part **(c) (i)**, calculate the total energy used by the girl to do one inclined pull up in real life.

total energy used for one inclined pull up = ... [2]

(ii) Suggest what happens to the other 80% of the energy used by the girl.

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[1]

10 OR

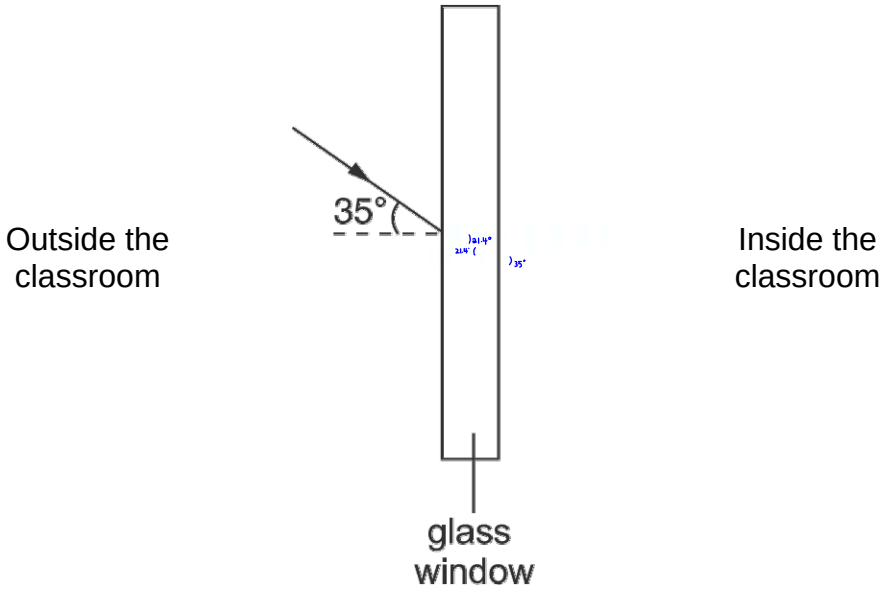


Fig. 10.4

(a) The diagram shows a light ray incident on the glass of the window (side view) of a classroom. It makes an angle of 35° with the normal.
The refractive index of the glass is 1.57.

(i) Calculate the angle of refraction for the light ray entering the glass.

angle of refraction = …….. [2]

(ii) Complete the ray diagram in **Fig. 10.4** by drawing the path of the light ray in the glass window and emerging into the classroom. [2]

(iii) A student inside the classroom sees an object outside the classroom through the window. Suggest any difference in what she sees of the object **with and without the piece of glass** in the window.

……

……

…… [1]

(b) The Next Generation Nationwide Broadband Network (Next Gen NBN) is Singapore's all-fibre, ultra-high-speed broadband network, that is capable of delivering speeds of 1Gbps and above, to all homes, offices and schools to offer pervasive connectivity around Singapore.

Optical fibre network technology is used for this new network. Optical fibre cables are thin strands of glass, about the thickness of a human hair, that permit the transmission of data using light over longer distances and at higher connection speeds of 1 Gbps and above.

[Adapted from: http://www.opennet.com.sg/consumers/next-generation-national-broadband-network-ngnbn/ Retrieved on 22 Aug 2011]

(i) Suggest a reason why optical fibres used for the Next Gen NBN can transmit information at much higher speed, compared to copper wires.

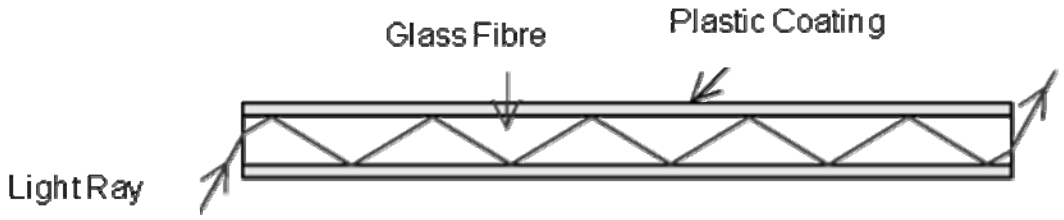
……

…… [1]

(ii) State the type of energy transmitted in

1. optical fibres : ……
2. copper wires: …… [2]

In an optical fibre, the strand of glass is coated with a layer of plastic. This allows light to travel through a long fibre through thousands of reflections, even if the fibre is bent.



[From: http://www.gcsescience.com/pwav35.htm Retrieved on 22 Aug 2011]

(iii) Name the physical phenomenon that allows light to travel through the long fibre.

…… [1]

(iv) Compare the refractive index of the glass fibre with that of the plastic coating.

……

…… [1]

End of Paper