Class	Register Number	Name

南洋女子中学校

NANYANG GIRLS' HIGH SCHOOL
End-of-Year Examination 2020
Secondary Three

PHYSICS **1 hour 45 minutes**

Paper 2 Theory Paper **10:15 – 12:00**

Wednesday **14 October 2020**

No additional materials are required.

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.

Write in dark blue or black ink. You may use a pencil for any diagrams or graphs. Do not use correction fluid or tape.

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.
Question **11** has a choice of parts to answer: **11** ***Either*** or **11** ***Or*****.**
Write your answers in the spaces provided on the question paper.

At the end of the examination, **circle 11 Either** or **11 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.

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, as more marks are awarded for sound use of Physics than for correct answers.
The use of an approved scientific calculator is expected, where appropriate.

The acceleration due to gravity (or gravitational field strength) g is taken to be 10 m s^{-2} (or 10 N kg^{-1}) near the Earth's surface.

Examiner's Use	
Section A (40 marks)	
1	
2	
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6	
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8	
Section B (30 marks)	
9	
10	
11 Either	
11 Or	
Paper 2 (70 marks)	

Paper 1 (30 marks)	

Overall
%

This document consists of **19** printed pages and **1** blank page.

Setters: AJL & TPY **NANYANG GIRLS' HIGH SCHOOL**

Section A (40 marks)

Answer **all** questions.

1 Fig. 1.1 shows a thin flexible rod clamped to a table and a mass *M* attached to the rod at a distance *L* from the base of the rod. When the mass is displaced sideways slightly and then released, it oscillates between A and B.

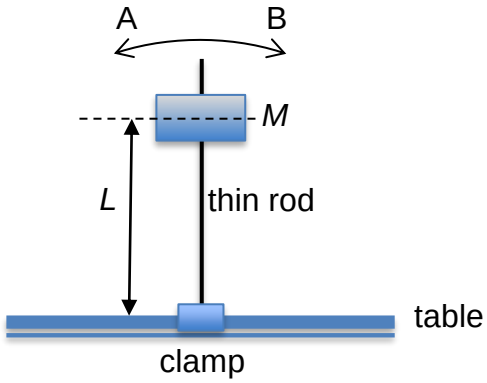

Fig. 1.1

A student measures the period of oscillations *T* for different values of the mass *M* and a fixed value of the length *L*.

(a) The student measures the time for 10 oscillations and divides this time by 10 to obtain the period *T*. Explain why this is a better method than measuring the time for one oscillation.

……

……

……[1]

(b) The student repeats the procedure in **(a)** another time and then calculates the average of the two periods. Explain the advantage of doing this.

……

……

……[1]

(c) Fig. 1.2 shows the graph of *T* against *M* plotted by the student.

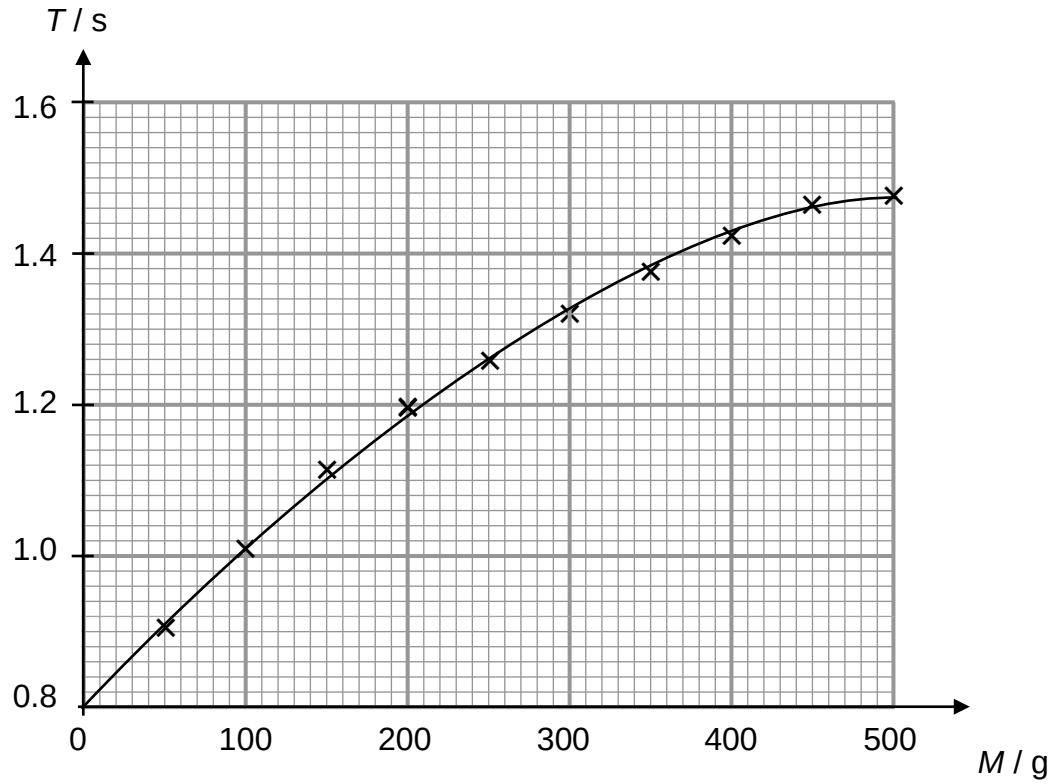

Fig. 1.2

The student has a hypothesis that the period *T* is directly proportional to the mass *M*.

Explain how **two** features of the graph in Fig. 1.2 support or does not support her hypothesis.

……

……

……

……

……[2]

2 A ball is projected vertically upwards with an initial velocity of 44.1 m s^{-1}.

(a) Calculate the time taken for the ball to reach its maximum height.

time taken = ……. [1]

(b) State an assumption you made in calculating part **(a)**.

……

……..….[1]

(c) Calculate the maximum height reached by the ball.

maximum height = ……..[2]

(d) Calculate the distance travelled by the ball during the first 6.0 s of its motion.

distance travelled = ……..[2]

3 A cyclist is travelling along a straight level road. She reaches a speed of 10 m s^{-1} by accelerating at 2.0 m s^{-2} for 3.0 s.

(a) Calculate the initial velocity of the cyclist, just before she starts accelerating.

velocity = ……..[2]

(b) The cyclist continues with the same acceleration for a further 2.5 s. Calculate the velocity 5.5 s after she started to accelerate.

velocity = ……..[1]

(c) Draw a velocity-time graph for the motion of the cyclist in this duration of 5.5 s using the axes provided in Fig. 3.1. [1]

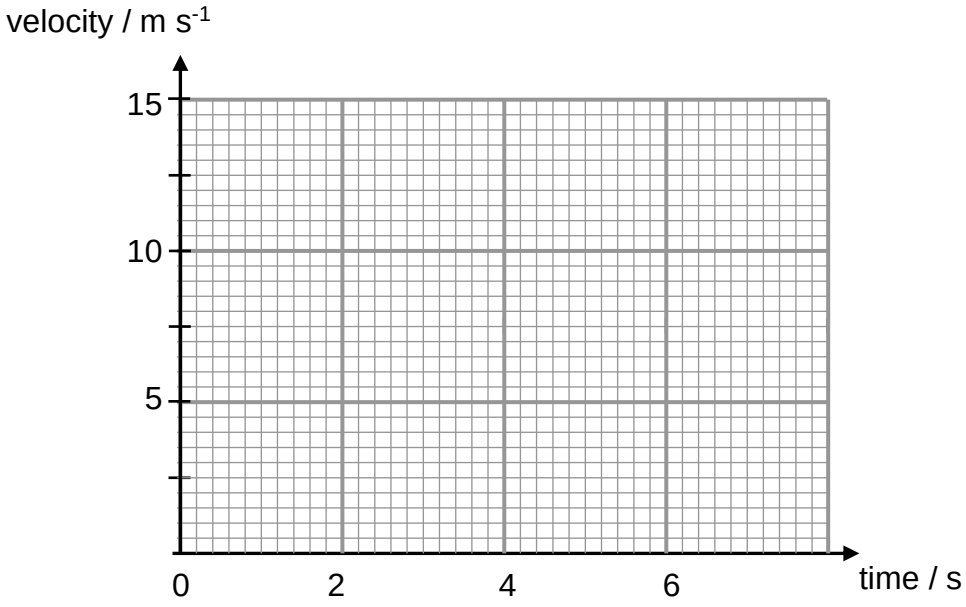

Fig. 3.1

(d) Calculate the distance travelled by the cyclist during this duration of 5.5 s.

distance = ……..[2]

4 A block B of mass 1.10 kg is connected by a string over a smooth pulley to a load M of mass 0.20 kg. B moves to the right on a smooth horizontal surface when it is pulled by M falling vertically as shown in Fig. 4.1.

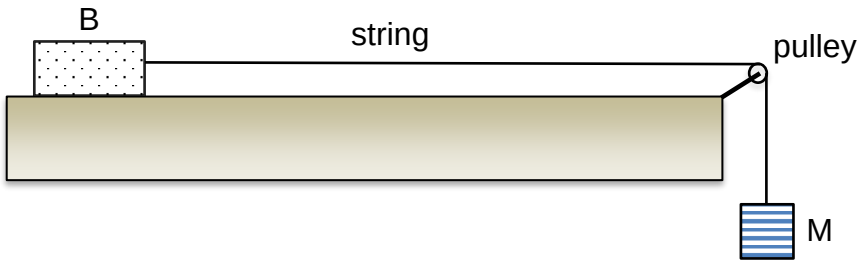

Fig. 4.1

(a) On Fig. 4.2 below, draw and label all the forces acting on the block B as it moves to the right in Fig. 4.1. [1]

Neglect air resistance.

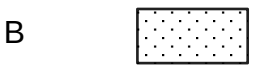

Fig. 4.2

(b) Calculate the magnitude of the acceleration experienced by B and M in Fig. 4.1.

acceleration = ……..[2]

(c) Calculate the tension in the string.

tension = ……..[1]

(d) Calculate the net force acting on the falling load M.

net force = ……..[1]

(e) As the block B accelerates to the right in Fig. 4.1, the string suddenly breaks. Describe and explain any change to the motion of B just after the string breaks.

……

……

……

……

……..….[2]

5 Fig. 5.1 shows a trolley used for lifting and transporting heavy boxes. The force to lift the box is derived from a downward force *F* at Y of the lifting bar XY. The centre of gravity of the lifting bar is at the pivot P.

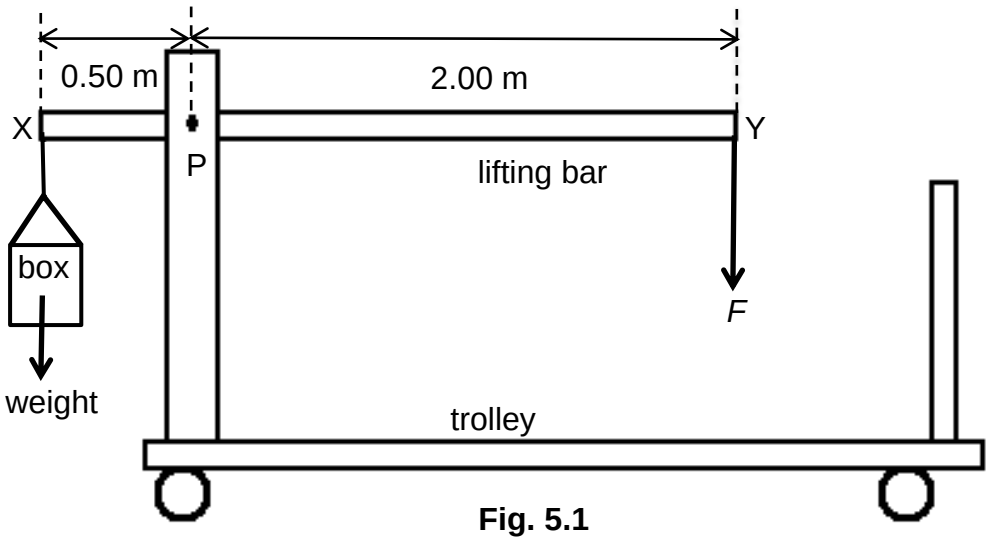

Fig. 5.1

(a) Suggest one advantage of pivoting the bar at the centre of gravity of the lifting bar XY.

……

……

……[1]

(b) Calculate the force *F* necessary to maintain the lifting bar in the position shown in Fig. 5.1, if the weight of the box and its contents is 500 N.

F = ……..[2]

(c) Explain the purpose of having PY longer than PX.

……

……

…….. [1]

6 A man stands with his back against a wall. Fig. 6.1 shows the maximum position the man can bend forward before toppling.

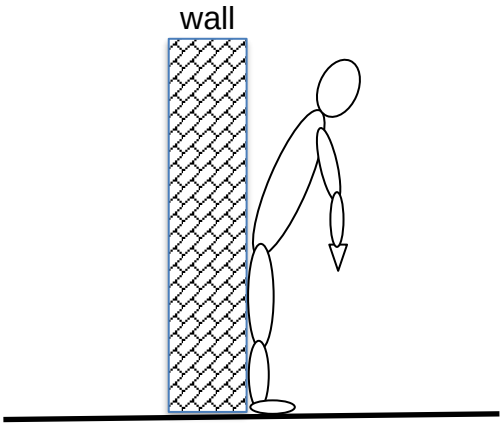

Fig. 6.1

(a) On Fig. 6.1, use a small cross to mark the position of the centre of gravity of the man. [1]

(b) If his heels are against the wall, explain why he will topple when he tries to touch his toes.

……

……

……

…… [2]

7 Fig. 7.1 shows a J-shaped tube containing 10.0 cm^3 of gas trapped in arm A and arm B is opened to the atmosphere. The density of mercury is 1.36 x 10^4 kg m^{-3}.

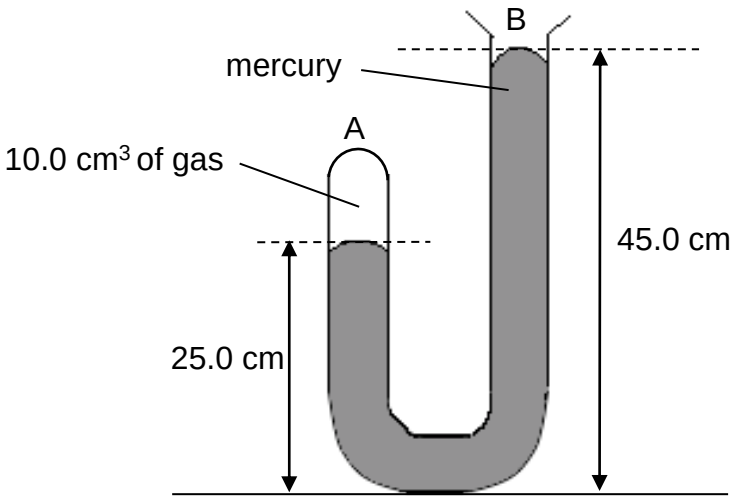

Fig. 7.1

(a) If the atmospheric pressure is 76.0 cm Hg, calculate

(i) the atmospheric pressure in pascal.

atmospheric pressure = ……..[1]

(ii) the gas pressure in cm Hg.

gas pressure = ……..[2]

(b) Mark a cross and label a suitable distance on Fig. 7.1. to indicate a point in the mercury where the pressure is 5.0 cm Hg less than the gas pressure. [2]

(c) Mercury is removed from this tube such that the mercury level at arm B dropped till the mercury levels in both arms are at the same level.

(i) State the gas pressure in cm Hg.

gas pressure = ……..[1]

(ii) Calculate the new volume of the gas.

volume = ……..[1]

8 A ball bearing of mass 200 g is released from rest at C and rolls down a smooth track which has a circular loop as shown in Fig. 8.1.

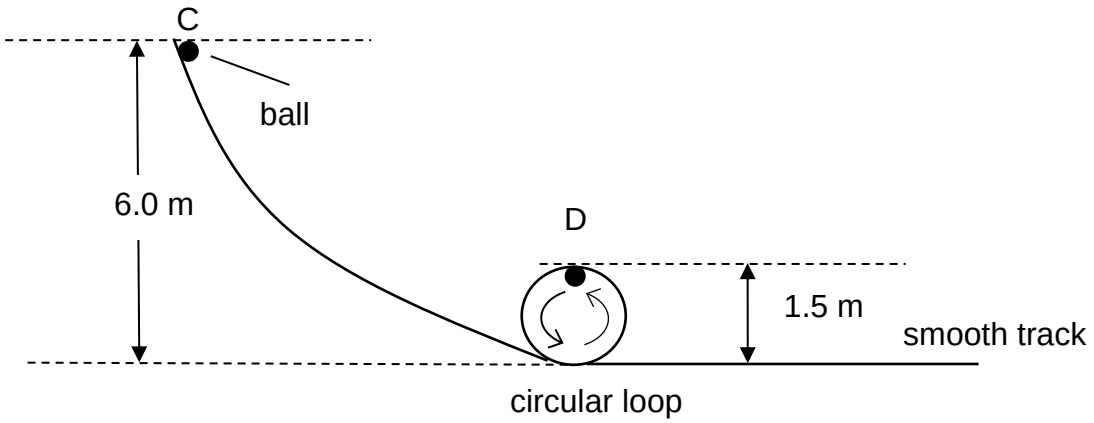

Fig. 8.1

The ball bearing rolls down the track, goes round the circular loop and continues to move along the horizontal part of the track on the right.

(a) Calculate the kinetic energy of the ball bearing at position D.

kinetic energy = ……..[2]

(b) Calculate the speed of the ball bearing at D.

speed = ……..[1]

Section B (30 marks)

Answer questions **9, 10** and **only one of the alternative questions** in Question **11**.

9 This year, space agencies from the United Arab Emirates (UAE), China and the United States have planned missions to send rovers to Mars to look for additional signs of past life and potentially pave the way to - someday - step foot on its surface. They hope to take advantage of this period of time in July when the Earth and Mars are nearest: 55 million kilometres apart. The journey will take about six months.

The UAE's *Hope Probe* was launched on July 20 and China's Tianwen-1 mission launched its Mars probe on July 23. The US *Mars 2020* was launched on July 30.

[Adapted from: *https://www.straitstimes.com/world/europe/china-us-uae-take-positions-in-a-trio-of-mars-missions-in-the-starting-blocks*]

(a) (i) Suggest why "this period of time in July" was chosen by the space agencies to launch their rovers to go to Mars.

……..

……..

…… [1]

(ii) Estimate the average speed of a rover's journey from Earth to Mars in km h^{-1}.

average speed = ……..[2]

Consider a landing module descending vertically towards the surface of a planet X. The rocket engine of the module is fired to slow down the module.

(b) On Fig. 9.1 draw and label the forces acting on the landing module when the rocket engine is fired. Neglect air resistance. [2]

Fig. 9.1

Fig. 9.2 shows how the acceleration *a* of the landing module varies with time *t*. The sign convention is upwards is positive.

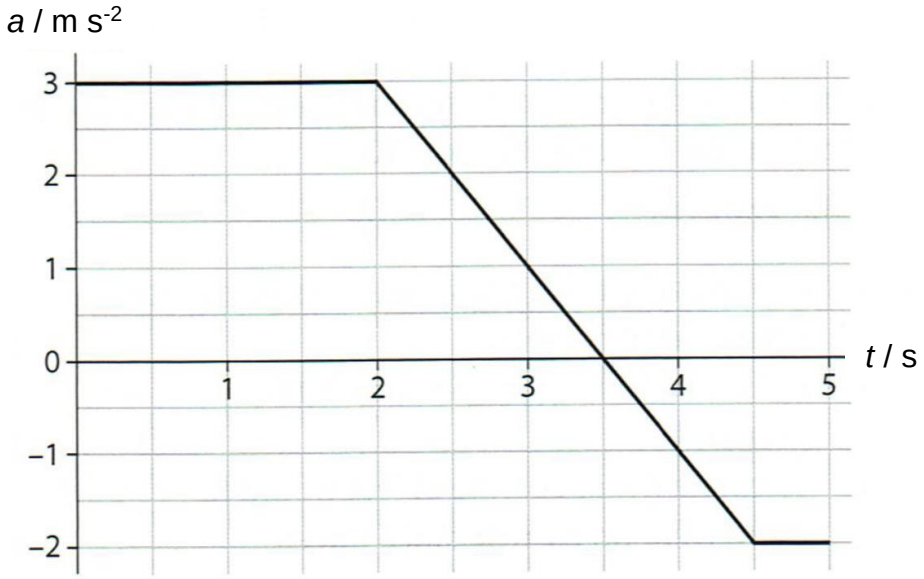

Fig. 9.2

The initial velocity of the module is – 9.0 m s^{-1} at time *t* = 0 s.
From time *t* = 0 s, the engine is fired in order to slow down the module. Then the engine is switched off at *t* = 4.5 s and the module lands at *t* = 5.0 s.

(c) (i) Use Fig. 9.2. to calculate the velocity of the landing module at *t* = 2.0 s.

velocity = ……..[2]

(ii) Deduce the magnitude of the acceleration of free fall on this planet X.

magnitude of acceleration of free fall = ……..[1]

(iii) The mass of the landing module is 250 kg. Assume its mass remains constant during its descent onto the surface of the planet.

Determine the force exerted by the engine on the module at t = 1.0 s.

force = ……..[2]

10 Fig. 10.1 (not drawn to scale) shows an eye looking through a hole drilled at the 40.0 cm mark of a metre rule. The eye sees the image of a section of the metre rule in a reflective window on the wall.

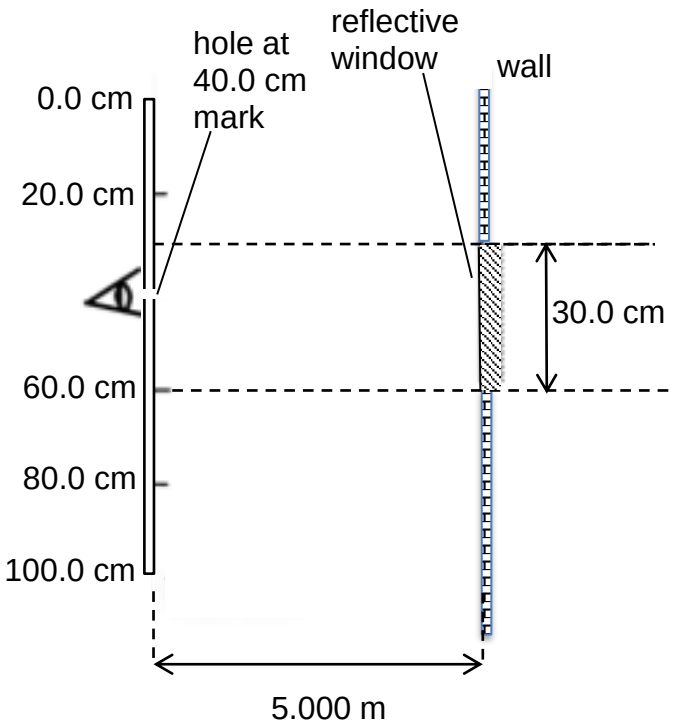

Fig. 10.1

(a) State three properties of the image formed in a plane mirror.

……

……

……[2]

(b) On Fig. 10.1, a section of the metre rule can be seen by the eye through the hole.

(i) Draw the image of the metre rule formed by the reflective window. [1]

(ii) Locate the highest point of the image that the eye can see and label it A'. [1]

(iii) Locate the point on the metre rule that corresponds to the image A' and label it A. [1]

(iv) Draw a light ray from A to show how the eye can see its image A'. [2]

(c) Determine the length of the image of the rule that can be seen by the eye through the hole.

length = ……..[2]

(d) Determine the horizontal distance from the eye to the image of the rule.

horizontal distance = ……..[1]

11 EITHER

Fig. 11.1 shows a man pulling an ice block of 100 kg with a pair of metal tongs with a force *F* at an angle of 40º from the horizontal.

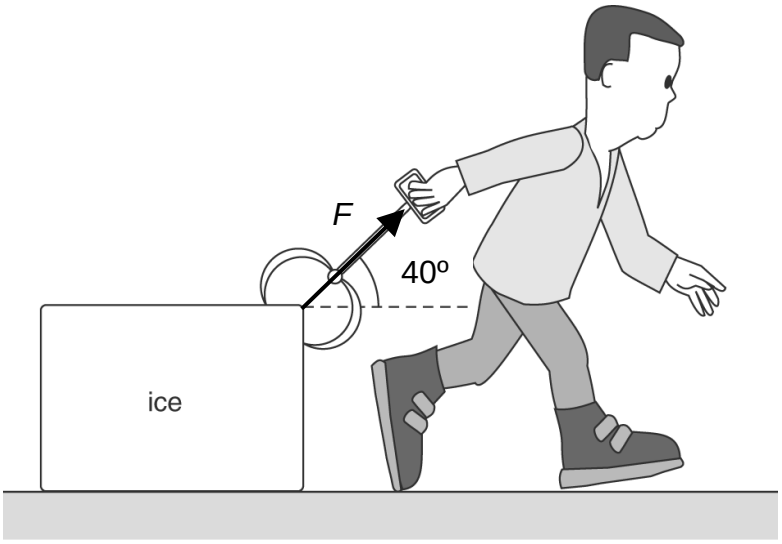

Fig. 11.1

(a) The man observes that "*although it is hard to pull the ice block initially, it becomes easier to pull it after a while.*"

Explain his observations.

……

……

……

……

……[2]

(b) Assume the friction between the ground and the ice is 150 N and the ice block moves along the ground with a uniform speed.

On Fig. 11.2, draw and label all the forces acting on the ice block. [2]

Fig. 11.2

(c) Draw a vector triangle (not to scale) to show the vector addition of all the forces acting on this ice block. Label *F* and the value of any known force(s) and angle(s). Vertical forces can be combined into one force and labeled *V*. [2]

(d) Hence or otherwise, determine the force *F* exerted on the ice block (at 40º from the horizontal as shown in Fig. 11.1) needed to pull the ice block with a uniform speed.

F = ……..[2]

(e) Assume the mass of the ice block and the friction do not change. Suggest a method to reduce the magnitude of the force *F* needed to pull the ice block with a uniform speed. Explain how you arrive at your answer.

……

……

……

……..….[2]

11 OR

Luggage is loaded onto an aircraft using a ramp. Fig. 11.3 shows a luggage placed on a flat 4-wheeled cart being pulled up a smooth ramp at a constant speed by a rope attached to a motorised winch.

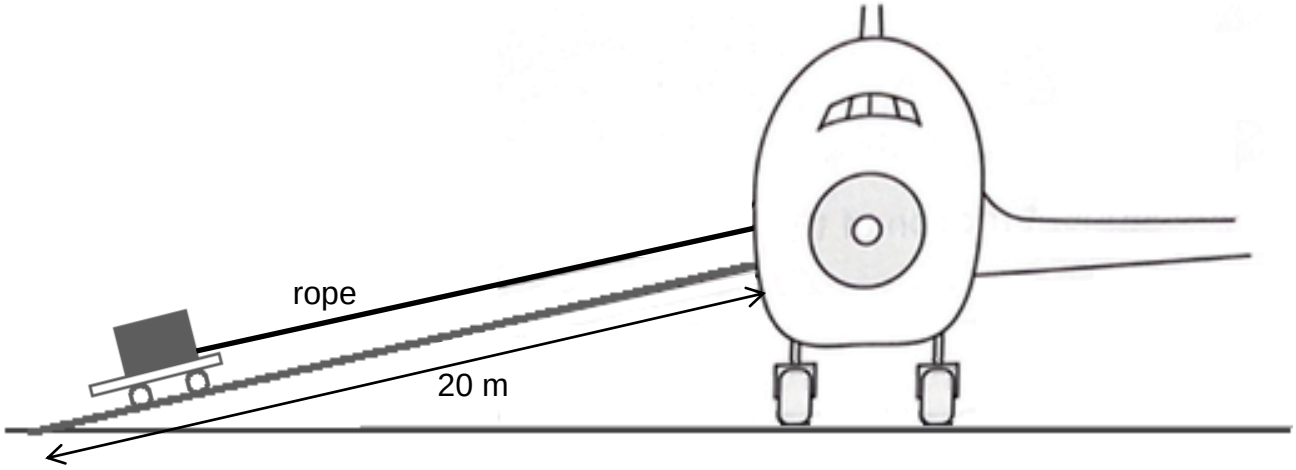

Fig. 11.3

(a) State the resultant force acting on the luggage along the ramp.

resultant force = ……..[1]

(b) The tension in the rope is 120 N when the motorised winch is used to pull the luggage up a 20 m smooth ramp at a constant speed. The ramp rises 1.0 m vertically for every 4.0 m of its length.

(i) Calculate the work done by the motorised winch in moving the luggage up into the aircraft.

work done by the winch = ……..[2]

(ii) State the change in the potential energy of the luggage when it moves from the bottom to the top of the ramp.

change in potential energy = ……..[1]

(iii) Calculate the weight of the luggage.

the weight of the luggage = ……..[2]

(c) The 150 W motorized winch pulls the luggage up the 20 m ramp in 20 s.

.

(i) Determine the useful output power developed by the motorized winch.

power = ……..[2]

(ii) Calculate the efficiency of the motorized winch.

efficiency = ……..[2]

End of Paper

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