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MANA TOHU MĀTAURANGA O AOTEAROA

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Level 1 Physics, 2008

90183 Demonstrate understanding of mechanics in one dimension

Credits: Five
9.30 am Tuesday 25 November 2008

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should answer ALL the questions in this booklet.

For all numerical answers, full working must be shown. The answer should be given with an SI unit.

For all 'describe' or 'explain' questions, the answer should be in complete sentences.

Formulae you may find useful are given on page 2.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–9 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

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Achievement Criteria		
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Identify or describe aspects of phenomena, concepts or principles.	Give descriptions or explanations in terms of phenomena, concepts, principles and / or relationships.	Give explanations that show clear understanding in terms of phenomena, concepts, principles and / or relationships.
Solve straightforward problems	Solve problems.	Solve complex problems.
Overall Level of Performance (all criteria within a column are met)		

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You are advised to spend 50 minutes answering the questions in this booklet.

You may find the following formulae useful.

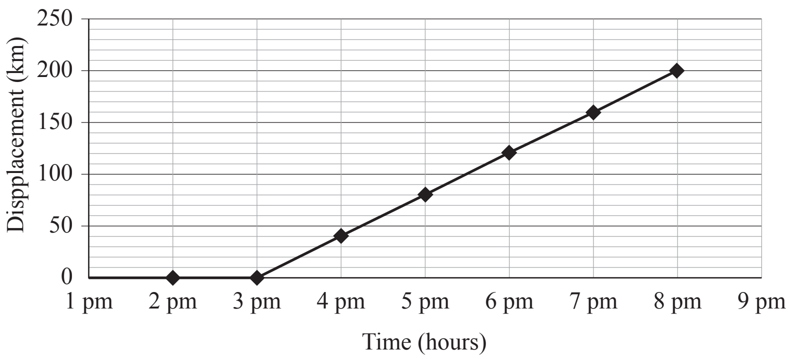
$v = \dfrac{\Delta d}{\Delta t}$	$a = \dfrac{\Delta v}{\Delta t}$	$F_{\text{net}} = ma$	$P = \dfrac{F}{A}$
$\Delta E_{\text{P}} = mg\Delta h$	$E_{\text{K}} = \dfrac{1}{2}mv^2$	$W = Fd$	$P = \dfrac{W}{t}$

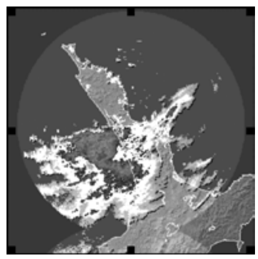
The value of g is given as 10 m s^{-2}.

QUESTION ONE: TRACKING STORMS

The photograph shows the image of a storm cloud over Auckland. The centre of the storm cloud is tracked by a radar over a period of time. The storm cloud is moving **east**. The graph below shows the displacement of the centre of the storm cloud against time.

Displacement of a storm cloud





(a) Describe what is meant by the term "displacement".

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(b) Describe the motion of the storm cloud shown in the above graph.

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(c) Use the graph to calculate the **average velocity** of the storm cloud from 1 pm to 8 pm, in km h^{-1}.

average velocity ______________

(d) During heavy rain, the gutter under the roof of a house begins to overflow onto the driveway. The gutter is **2.8 m** above the driveway and a **20 gram** mass of water leaves the gutter and hits the driveway. (For this question ignore the air friction.)

Calculate the **speed** at which the water hits the ground.

speed ______________

(e) The rain is falling from clouds, which are at a height of **3 km** above ground. Physics calculations predict that if the raindrops accelerate at **10 m s^{-2}**, they should hit the ground at about **250 m s^{-1}**. However, in reality, raindrops hit the ground at about **5 m s^{-1}**.

Explain why they hit the ground at a constant speed and much more slowly than predicted.

QUESTION TWO: LEARNING TO SKI

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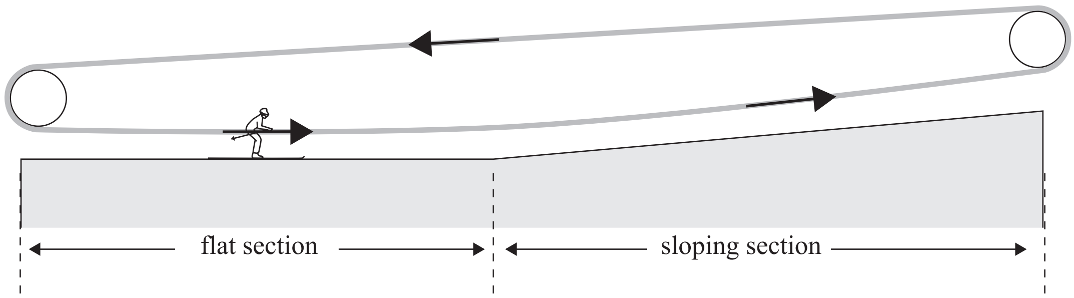
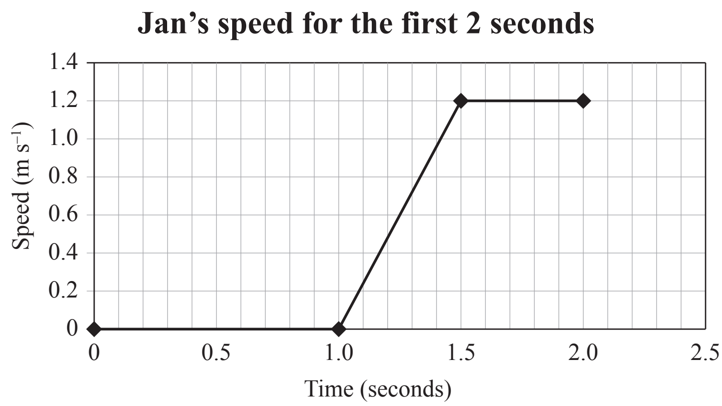
Beginner skiers often use a rope tow, which pulls them along and up a gentle slope. The rope is in the form of a loop, and an electric motor continuously moves the rope around.

The simplified diagram below shows the motion of the loop.



Jan is learning to ski. She stands by the rope, grabs it, and starts to move along the flat section of the snow. The graph below shows her journey for the first two seconds.



(a) Describe her motion during the first two seconds of her journey.

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(b) The combined mass of Jan and her ski gear is **80 kg**.

Use the information given in the graph to calculate the initial resultant force on Jan as she begins to move.

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force ___

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(c) Along the flat section, Jan moves at a steady speed of **1.2 m s^{-1}**.

State the **size** of the resultant force acting on Jan. Explain your answer.

Size ____________________

Explanation ____________________

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____

(d) From the graph, calculate the **distance** Jan travels during the first **two** seconds.

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____

____

distance ____________________

(e) Jan is moving up the slope at a steady speed of **1.2 m s^{-1}**. The length of the sloped section is **75 m**.

Calculate the time it takes for Jan to get to the top of the slope.

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____

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time ____________________

(f) As she moves up the slope at **1.2 m s^{-1}**, her friend Susan comes down the slope towards her at a speed of **6.5 m s^{-1}**.

Calculate the **size** and **direction** of Susan's velocity relative to Jan.

____

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size ____________ direction ____________________

The rope pulls Jan up the slope through a vertical height of **3.8 m**. The time of travel is **1.5 minutes**. The combined mass of Jan and her ski gear is **80 kg**.

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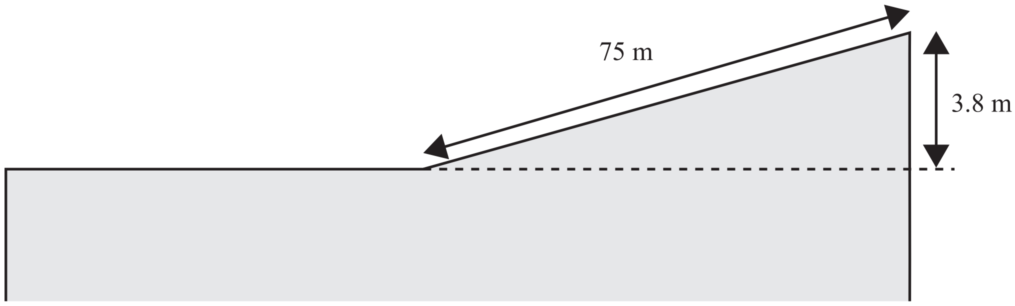

(g) Calculate the **power** provided by the electric motor to pull Jan to the top of the slope. (For this question ignore the friction.)

power ______________

(h) At the top of the slope, Jan throws a hard snowball straight up in the air.

Describe the change that occurs in the **velocity** of the snowball while it is moving in an upward motion to its maximum height. Explain your answer. (Ignore air friction.)

Description ______________

Explanation ______________

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QUESTION THREE: FEELING CONFIDENT

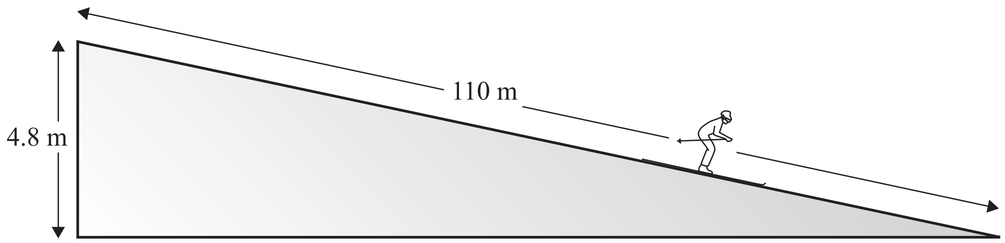
Jan moves to a rope tow for skilled skiers. At the top of the tow, Jan walks onto a flat area. Then she skis freely down a slope in a straight line. At the bottom of the slope, her speed is **6.0 m s^{-1}**. The combined mass of Jan and her ski gear is **80 kg**.

(a) Show that Jan's **kinetic energy** at the bottom of the slope is **1.44 kJ**.

(b) The kinetic energy gained by Jan at the bottom of the slope does not equal the potential energy she has lost.

Explain why they are **not equal**.

The distance Jan travelled on the slope is **110 m**, and during her descent, she drops down through a vertical height of **4.8 m**. At the bottom of the slope, her kinetic energy is **1.44 kJ**. The combined mass of Jan and her ski gear is **80 kg**.



(c) Calculate the average **frictional force** on Jan as she skis down the slope.

force ______________

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The length of **each** of Jan's skis is **1.60 m**, and its average width is **0.10 m**. The combined mass of Jan and her ski gear is **80 kg**.

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http://cdn.overstock.com/images/products/L10216583.jpg

(d) Jan is standing upright on both of her skis.

Calculate the pressure that Jan's skis exert on the snow.

pressure

(e) At the bottom of the slope, Jan meets her friend Ron. Ron is standing on both feet and wearing tramping boots, and Jan is standing on both feet and wearing skis. Jan weighs slightly more than Ron.

Explain which person sinks deeper into the soft snow.

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www.ruoutside.com/tundra-boot.html

Person

Explanation

**Extra paper for continuation of answers if required.
Clearly number the question.**

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Question number