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90183

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Level 1 Physics, 2004

90183 Demonstrate understanding of mechanics in one dimension

Credits: Five
9.30 am Thursday 18 November 2004

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 pages provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–11 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.

Achievement Criteria	*For Assessor's use only*	
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 concise 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)		

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

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You may find the following formulae useful.

$$v = \frac{\Delta d}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t} \qquad F_{net} = ma \qquad P = \frac{F}{A}$$

$$\Delta E_P = mg\Delta h \qquad E_K = \frac{1}{2}mv^2 \qquad W = Fd \qquad P = \frac{W}{t}$$

The value of g is given as 10 ms^{-2}

QUESTION ONE: TRIP TO THE SKI FIELD

At a ski resort, a mini-bus transports passengers between the car park and the ski centre. The bus starts from the car park and travels **north** to the ski centre, drops off the passengers and returns to the car park. The velocity–time graph for the the bus journey is given below.

(a) The time taken by the bus to travel from the car park to the ski centre is **200 seconds**. From the graph, calculate the **distance** travelled by the bus from the car park to the ski centre.

Distance = ___________

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(b) From the graph, show that the acceleration of the bus during section A of its journey is **0.20 ms**$^{-2}$.

(c) The mass of the bus is **2250 kg**. The combined mass of the driver and the passengers is **800 kg**. Calculate the force required to produce the acceleration of **0.20 ms**$^{-2}$, during section A of its journey.

Force =

After unloading the passengers at the ski centre, the bus now travels back to the car park with some tourists.

(d) Explain why the second part of the graph is drawn below the time axis.

(e) Describe the motion of the bus during **section B** of its journey.

(f) The unbalanced force acting on the bus during **section C** of its journey is **342 N**. Calculate the **combined mass** of the bus, the driver and its passengers.

Combined mass =

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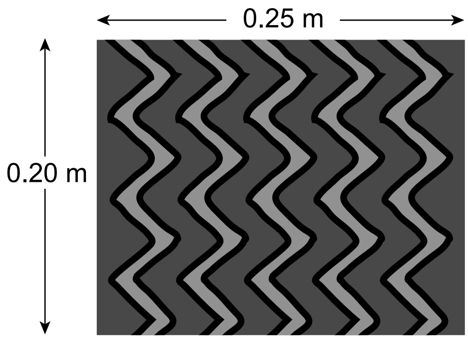
The empty bus is now parked in the car park. The diagram below shows the part of a front tyre which is resting on the road. Only 60% of the area shown below is in contact with the ground, due to the grooved surface of the tyre. The force exerted by this front tyre on the road is **6048 N.**

(g) Calculate the pressure exerted by this **front** tyre on the road. Give the correct unit with your answer.



Pressure = ______________________ (unit)

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QUESTION TWO: OPENING CELEBRATIONS

To celebrate the opening of the ski season, a hot air balloon is being sent up in the air with a skydiver in it. The balloon rises up in the air and then stays **stationary** at a certain height from the ground.

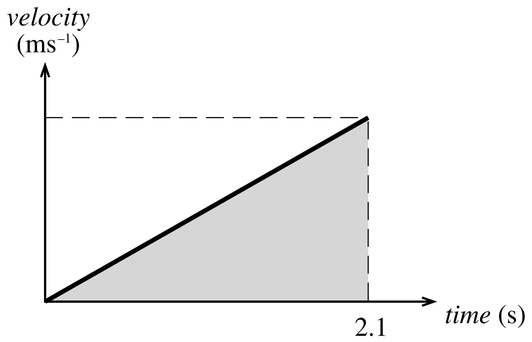
(a) On the diagram on the right, draw arrows to show the relative **sizes** and **directions** of forces acting on the balloon when it is stationary. Label the forces.

When the balloon is **21 m** above the ground, the skydiver accidentally drops a water bottle. The bottle accelerates uniformly as it falls to the ground. It takes **2.1** seconds for the bottle to reach the ground.

(b) Calculate the **average speed** of the bottle as it falls.

Average speed = ______________________

(c) Use the graph below to show that the **final velocity (v)** of the bottle just before it hits the ground is approximately **20 ms⁻¹**.



(d) The mass of the bottle (with its contents) is **0.73 kg**.

Calculate the **kinetic energy** of the bottle just before it hits the ground.

Kinetic energy = ______________________

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The balloon now rises further up in the air. When the balloon is at a safe height from the ground, the skydiver jumps out from the basket.

(e) In terms of the forces acting on the skydiver, explain why she accelerates **immediately** after jumping.

(f) In terms of the forces acting on the skydiver, explain why she reaches a **uniform velocity** after a short time of fall. (The parachute is still unopened.)

When the skydiver opens her parachute, the upward force opposing her downward motion at a particular instant during her fall is **1300 N**. The combined mass of the skydiver and the parachute is **95 kg.**

(g) Calculate the **deceleration** of her fall at this instant.

Deceleration = ______________

(h) After landing, the skydiver uses a pair of snowshoes to walk in the snow, as shown in the photograph. The snowshoes are many times larger than normal shoes. Explain why it is easier to walk on snow wearing snowshoes rather than ordinary shoes.

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QUESTION THREE: FUN ON THE SNOW

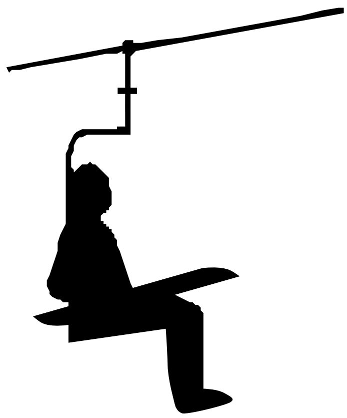
On the way to the ski lifts, Linda drags Moana on a sledge to the ski lifts along a **horizontal** path with a constant force of **21 newtons** over a distance of **28 metres** in **15 seconds**.

(a) Show that the **work** done by Linda to drag Moana to the ski lifts is 588 J.

(b) Calculate the **power** exerted by Linda to drag Moana to the ski lifts.

Power =

Moana now sits on the chairlift as shown in the diagram. The combined mass of Moana and her snow board is **88 kg.**



(c) Calculate the force provided by the seat to support Moana and her snow board. State the **direction** of this force.

Force =

Direction =

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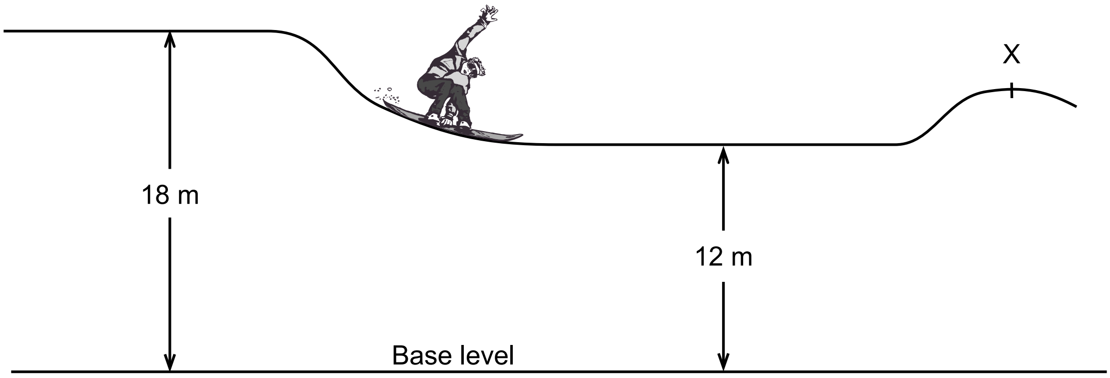
The chairlift carries Moana from the base to the ski slope, which is **18 m** above the base level as shown in the diagram below. Her mass is **85 kg**.

(d) Calculate her gain in **gravitational potential energy** at this height.

Gravitational Potential Energy =

Moana now snowboards down the slope and she levels off onto the flat section.
The flat section is **12 m** from the base level. Assume that the energy loss due to friction down the slope is zero.



(e) Calculate her speed at the bottom of the slope as she **begins** to level off onto the flat section.

Speed =

(f) On the flat section of the slope, Moana slows herself down by turning her feet so the snow board is almost at **right angles** to the direction of her motion. Then she goes **up** a small hill and stops at the point X in the diagram above. Explain what happened to her kinetic energy.