For Supervisor's use only

1

90183

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

Level 1 Physics, 2005

90183 Demonstrate understanding of mechanics in one dimension

Credits: Five
9.30 am Tuesday 29 November 2005

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 2–10 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.

For Assessor's use only	**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 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)		

Assessor's use only

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

You may find the following formulae useful.

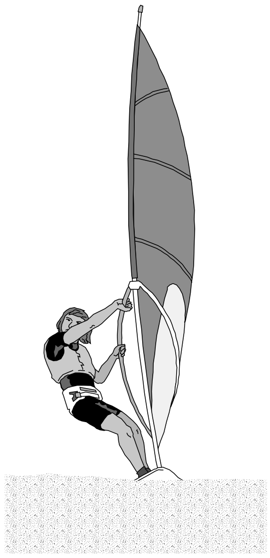
$$v = \frac{\Delta d}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t} \qquad F_{net} = ma \qquad P = \frac{F}{A}$$

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

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

QUESTION ONE: WIND SURFING

Windsurfing is a water sport that involves sailing over water on a board powered by wind acting on a single sail. The sail is connected to the board via a flexible joint.
Lee places his board on a flat surface on the beach and attaches the sail onto the board. He then tests the sail by standing on the board as shown in the diagram below right. The board exerts a pressure of **733 pascals** on the ground.



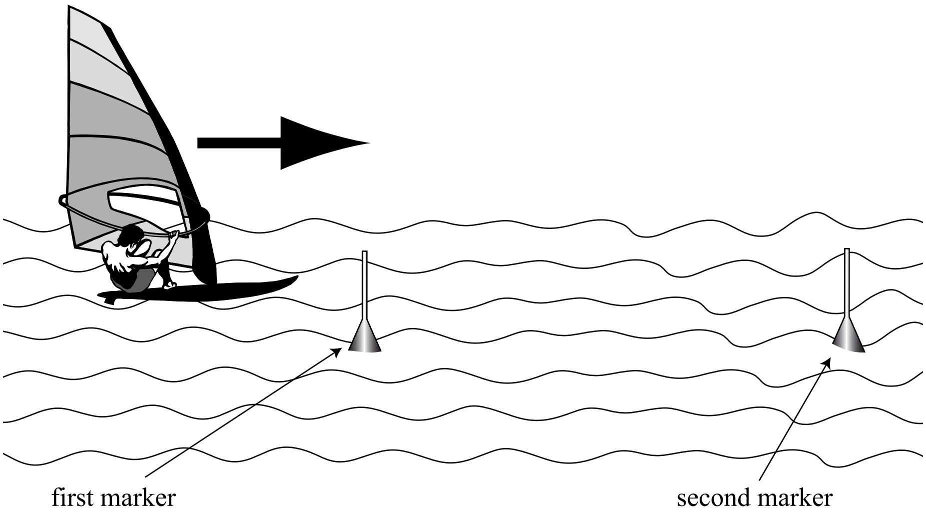
(a) Pascal is the unit of pressure. Explain what **'one pascal'** means.

(b) The combined mass of Lee, the board and the sail is **88 kg.** Calculate the **area** of the board **in contact** with the ground.

Area = ____________

Assessor's use only

Lee is now windsurfing on water. He accelerates from rest and moves along a straight line, passing two markers as shown in the diagram below.



(c) The length of the board is **2.8 m** and it takes **0.70 s** for the whole board to pass the first marker. Calculate the **average speed** of the board as it passes the first marker.

Average speed = ________________

(d) Lee is sailing along with an uniform acceleration. Lee takes **5.0 s** to go from the first marker to the second marker. The board takes **0.40 s** to completely pass the second marker.

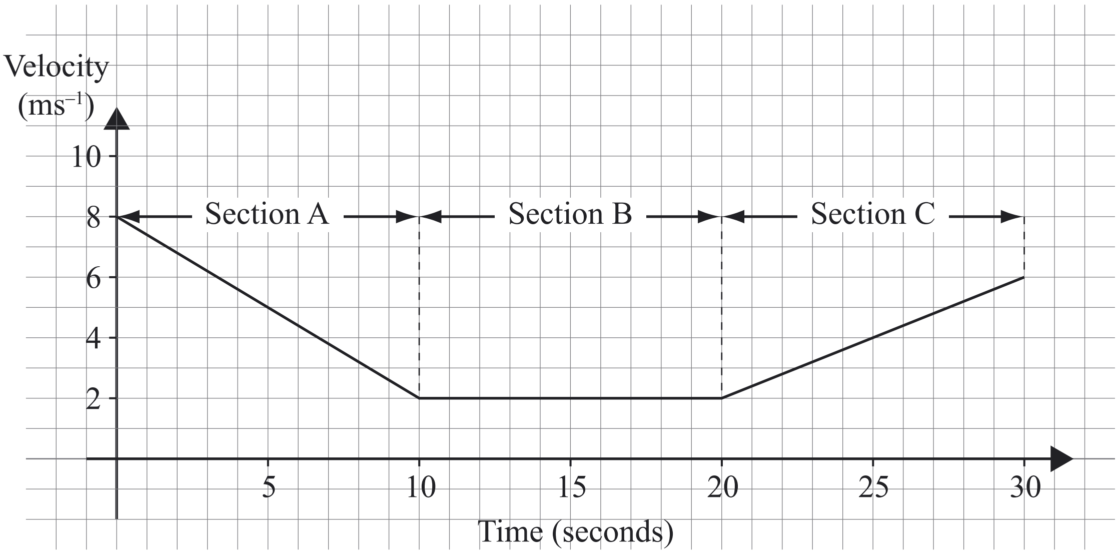
Calculate the **acceleration** of Lee and the board between the two markers.

Acceleration = ________________

QUESTION TWO: PLAIN SAILING

Assessor's use only

The velocity-time graph below shows the motion of Lee and the board a few minutes later.



(a) Calculate the **deceleration** during **section A** of the graph.

Deceleration = __________

(b) Calculate the **distance** travelled by Lee and the board during **section A** of the graph.

Distance = __________

(c) Describe in detail the motion of Lee and the board during **sections B** and **C** of the graph.

Section B

Section C

Assessor's use only

(d) Explain, **in terms** of the **forces** acting on Lee and the board, why the gradient of **Section B** of the graph is **zero.**

(e) On the diagram below, draw arrows (vectors) to show the relative **sizes** and **directions** of the forces acting in the **horizontal direction** on Lee and the board during **section C** of the graph**.**

Name the forces.

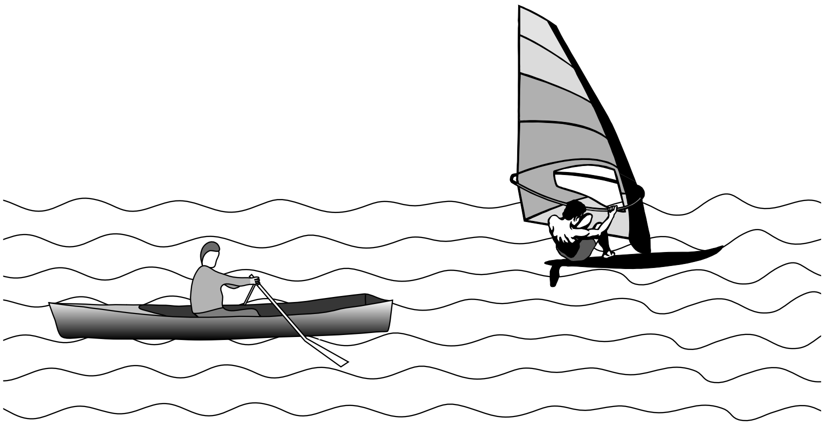
(f) Calculate the **size** of the **unbalanced force** acting on Lee, the board and the sail during **section C** of the graph. The combined mass of Lee, the board and the sail is **88 kg.**

Force = ________________

Assessor's use only

QUESTION THREE: FUN ON WATER

Lee is sailing to the right at a constant velocity of **3.5 ms^{-1}** and Manu is rowing a boat to the left at a constant velocity of **1.6 ms^{-1}** as shown in the diagram below.



(a) Determine the **velocity** of Lee as seen by Manu from his boat.

Velocity = ____________

(b) Manu has a mass of **70 kg.** Calculate his **kinetic energy**.

Kinetic energy = ____________

Lee now sails back to the beach to get a larger sail. He sails towards the beach at a constant speed of **1.2 ms^{-1}**. As he approaches the sandy beach, the front of the board drags along the sand for **0.70 m** before stopping. The combined mass of Lee, the board and the sail is **88 kg**.

(c) Using the idea of conservation of energy, calculate the **size** of the average force exerted by the sand on the board.

Force = ____________

Assessor's use only

(d) State the **direction** of the force in (c).

(e) Lee lifts the sail through a vertical distance of **1.1 m**. The mass of the sail is **5.6 kg** and the power used to lift the sail is **34.2 watts**.

Calculate the time taken to lift the sail through the vertical distance of **1.1 m**.

Time = ____________

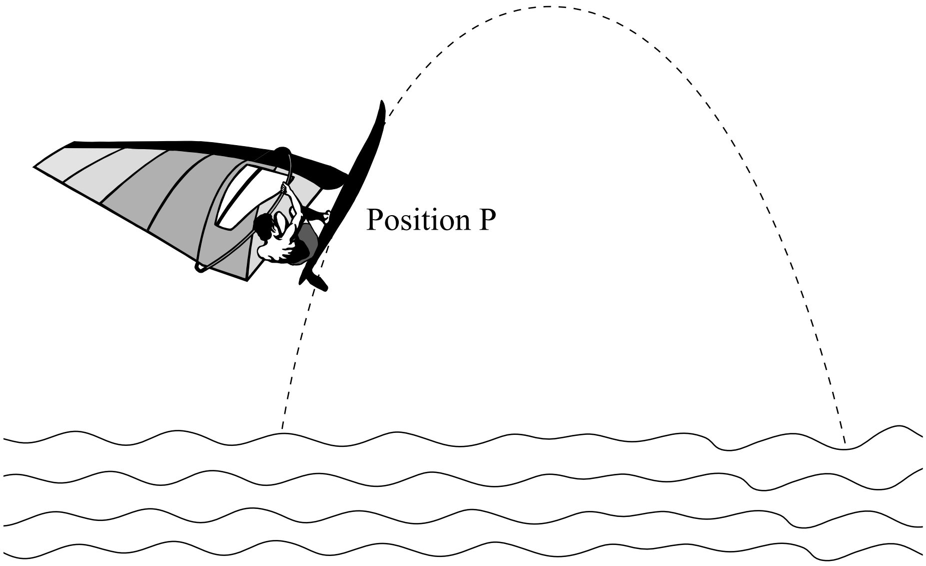
(f) Describe what **'one watt'** means.

(g) Lee now holds the sail above his head and walks towards his car. Explain why **no work** is done by Lee on the sail during this time. Ignore the air friction.

Assessor's use only

QUESTION FOUR: TRICKY SAILING

Lee is now back on the water sailing. A big wave throws Lee, the board and the sail up in the air as shown in the diagram below.



(a) State the **direction of the largest force** acting on him when he is at the position P, shown in the above diagram.

___

(b) The combined mass of Lee, the board and the new sail is **91 kg**. Lee, the board and the sail have a kinetic energy of **728 J** at the position P, shown in the above diagram. Calculate the speed of Lee, the board and the new sail at the above position P.

___

___

___

___

Speed = ___

Assessor's use only

(c) The combined mass of Lee, the board and the new sail is **91 kg**. The maximum vertical distance Lee, the board and the sail travels is **1.3 m.** This information can be used to calculate the **speed** with which he leaves the water.

Explain the physical principle that can be used to calculate the **speed** with which he leaves the water. State any assumptions you have made. **(You are not required to calculate the speed.)**

(d) The **calculated** value of Lee's vertical speed when he lands back on the water is 5.1 ms^{-1}. Explain why the **actual** vertical speed when he lands back on the water, is less than the calculated value.

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

Assessor's use only

Question number