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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, 2003

90183 Demonstrate understanding of motion in one dimension

Credits: Five
9.30 am Thursday 20 November 2003

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.

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Achievement Criteria		
Achievement	**Achievement with Merit**	**Achievement with Excellence**
Recall or describe phenomena, concepts or principles.	Describe or explain how phenomena, concepts, principles, or relationships are interrelated.	Explain or analyse phenomena in terms of concepts, principles, or relationships.
Solve problems with direction.	Solve problems by selection.	Solve problems requiring more than one step or the synthesis of information.
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.

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

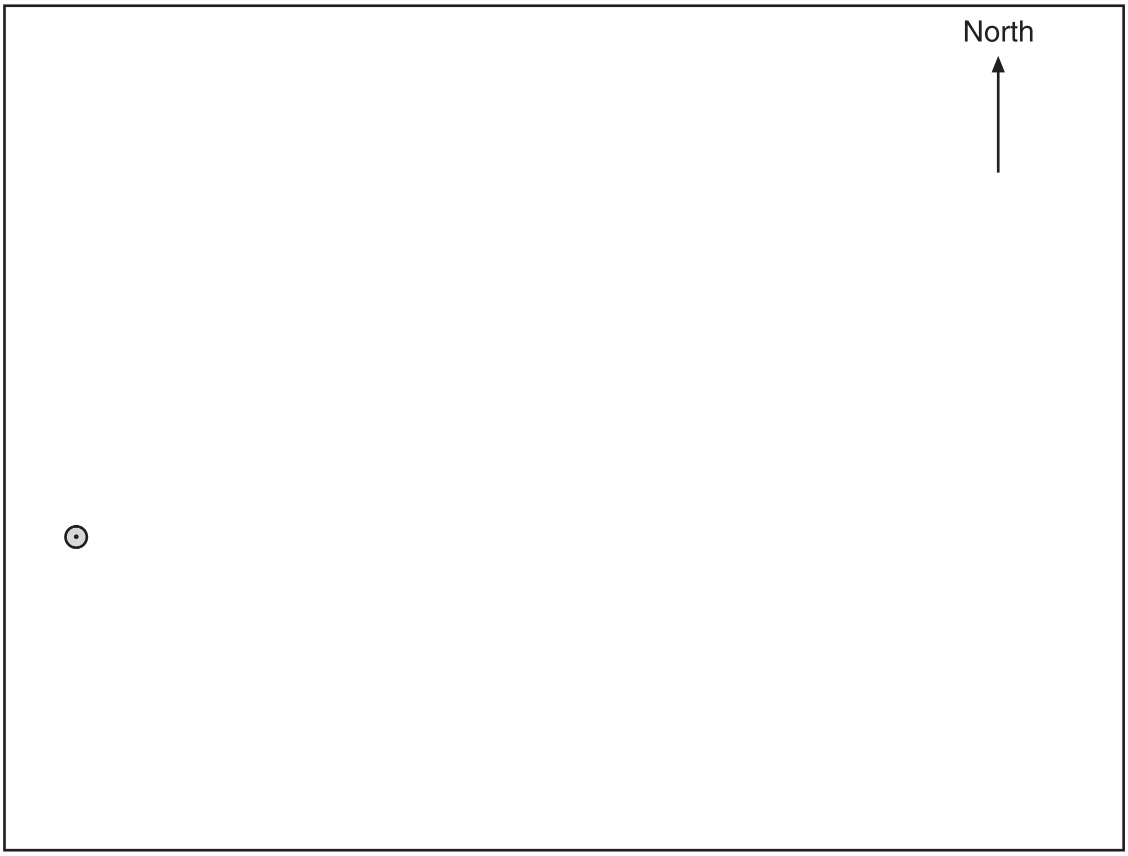
$$\Delta E_P = mg\Delta h \qquad E_K = \tfrac{1}{2}mv^2 \qquad W = Fd \qquad P = \frac{W}{t}$$

Where required, use $g = 10\ \text{N kg}^{-1}$ ($10\ \text{m s}^{-2}$)

QUESTION ONE: Motion and Motion Graphs

Tom and Hone are on a cycling trip. One morning they ride out from their campsite along the following route: 6.0 km north, 4.0 km east, 3.0 km south, 4.0 km east, 6.0 km south, 4.0 km east and 3.0 km north.

(a) In the box below, draw a careful **scale** (1 cm = 1 km) diagram that shows the route that they followed over the **seven** sections of their journey.
Start your diagram at the point indicated ⊙.



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(b) Calculate the **total** distance that Tom and Hone travelled.

Distance = ____________ km

(c) The journey took them 2.0 hours. Use the formula $v = \frac{\Delta d}{\Delta t}$ to calculate their **average** speed in km h^{-1}.

Average speed = ___________ km h^{-1}

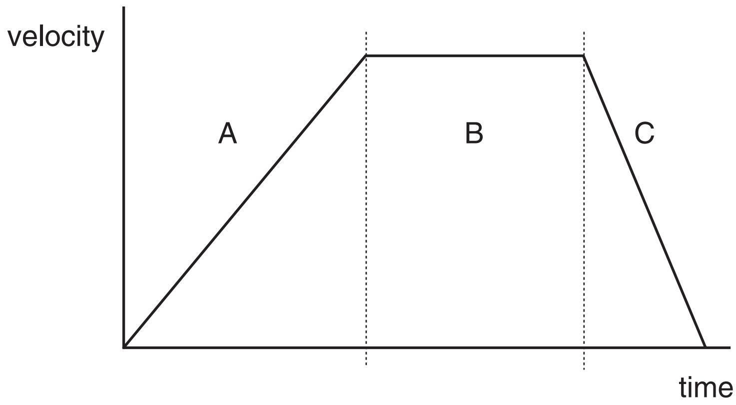
(d) Clearly explain the difference between the **distance** that they travelled and their **displacement** at the end of the journey.

(e) Calculate the boys' average **velocity** for the trip in m s^{-1}.

Average velocity = _______________ m s^{-1}

The boys' morning ride was on flat roads. In the afternoon they decide to return to the campsite by a different route that involves cycling up and down steep hills.

Graph 1: Velocity-time graph for part of Tom's return journey



(f) Describe briefly Tom's motion in:

(i) section A ______________________________

(ii) section B ______________________________

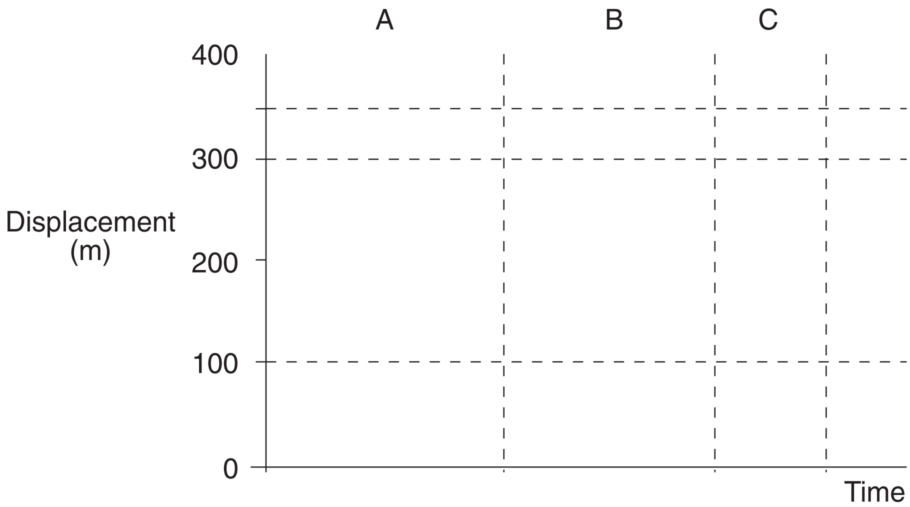
(iii) section C ______________________________

(g) Describe the **most likely** way in which the road slopes in section A of the journey.

Section A: ______________________________

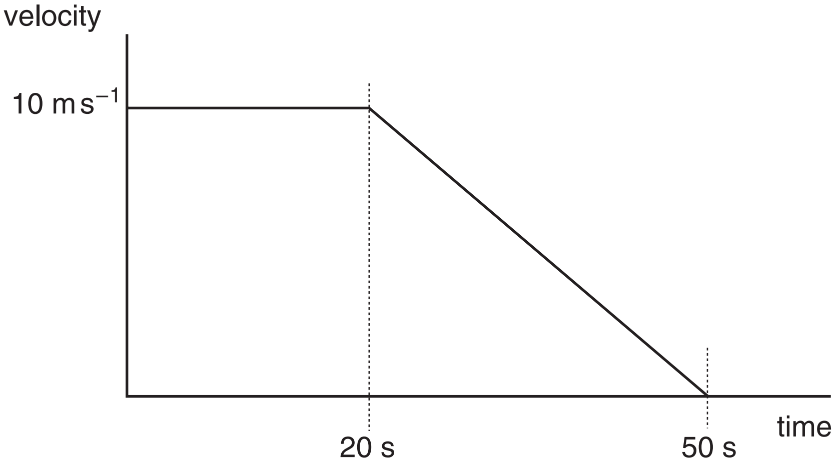
(h) In Section A, Tom cycles a distance of 100 m. In section B, he cycles a further 200 m and in section C he cycles a further 50 m. On the axes below, **sketch** the correctly **shaped** displacement-time graph for the three sections of Tom's journey that are illustrated by the velocity-time graph (Graph 1).

Graph 2: Displacement-time graph for part of Tom's journey



For a **different** part of the return journey, the following is a velocity-time graph for Hone.

Graph 3: Velocity-time graph for part of Hone's return journey



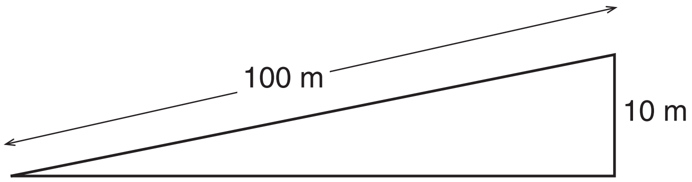
(i) One section of the velocity-time graph for Hone shows acceleration. Calculate the value of the acceleration in that section.

Acceleration = __________ m s^{-2}

(j) **Use the graph** to calculate the distance travelled by Hone in the last 30 seconds of the journey.

Distance = ____________ m

The following diagram (not to scale) is a profile (side view) of a hill up which the boys have to ride.



(k) Tom uses a constant force of 180 N to ride up the hill. Use the formula $W = Fd$ to calculate how much work he has done by the time he gets to the top. Give the correct unit with your answer.

Work done = ________ ________ (unit)

(l) If it took Tom 50 seconds to get to the top of the hill, calculate his power. Give the correct unit with your answer.

Power = ________ ________ (unit)

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QUESTION TWO: Forces, Energy and Vectors

(a) Tom and Hone have returned to their campsite and they decide to play some football. The football field is down the river from the campsite, so the boys need to row down the river (in the same direction as the current). Hone can row the boat at a speed of 2.0 m s^{-1}. The current in the river flows at 1.0 m s^{-1}.

Find the resultant speed of the boat down the river.

Working: ______________________________

Resultant speed = ______________ m s^{-1}

(b) A football has a mass of 0.42 kg. Tom kicks the ball with a force of 20 N. Assuming that friction with the air can be ignored, calculate the acceleration of the ball.

____

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Acceleration = __________ m s^{-2}

(c) Tom's kick sends the ball to a maximum height of 6.0 m above the ground. Use the formula $\Delta E_P = mg\Delta h$ to calculate the gravitational potential energy of the ball at this height. Give the correct unit with your answer.

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Gravitational potential energy = ________ _____ (unit)

(d) The ball then falls back towards the ground.

(i) In what form is the energy of the ball **just before** it lands on the ground?

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(ii) Assuming that friction with the air can be ignored, calculate the velocity of the ball just before it hits the ground.

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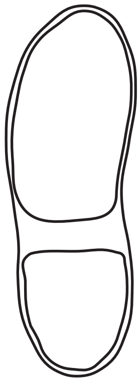
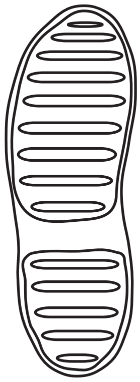
Velocity = __________ m s^{-1}

(e) Tom is wearing smooth-soled shoes and Hone is wearing shoes with moulded soles that have ridges on them. The diagram below shows the pattern of the soles of their shoes.



Tom's shoe



Hone's shoe

Each boy has a mass of 60 kg and their shoes are the same size.

(i) Carefully explain why Hone exerts more pressure on the hard surface of the field where they are playing.

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(ii) Calculate Hone's weight. Give the correct unit with your answer.

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Weight = ____________ ______ (unit)

(iii) The total area of the ridges on Hone's shoes is 16 cm^2 (1.6×10^{-3} m^2). Calculate the pressure that Hone exerts on the ground. Give the correct unit with your answer.

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Pressure = ______________________ ______ (unit)

(f) The boys stop playing football because they notice a skydiver coming to land on the field.

A skydiver accelerates when she first jumps out of the aeroplane. Before landing, she opens a parachute that slows her down to a safe constant speed of fall.

(i) State the **name** given to the constant speed that the skydiver attains.

___

(ii) Clearly explain, in terms of the forces acting on the skydiver, why she is travelling at a **constant** speed as she approaches the ground.

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

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