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NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

Level 1 Science, 2012

90940 Demonstrate understanding of aspects of mechanics

9.30 am Monday 19 November 2012
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of aspects of mechanics.	Demonstrate in-depth understanding of aspects of mechanics.	Demonstrate comprehensive understanding of aspects of mechanics.

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 attempt ALL the questions in this booklet.

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 2–12 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.

TOTAL

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You are advised to spend 60 minutes answering the questions in this booklet.

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You may find the following formulae useful.

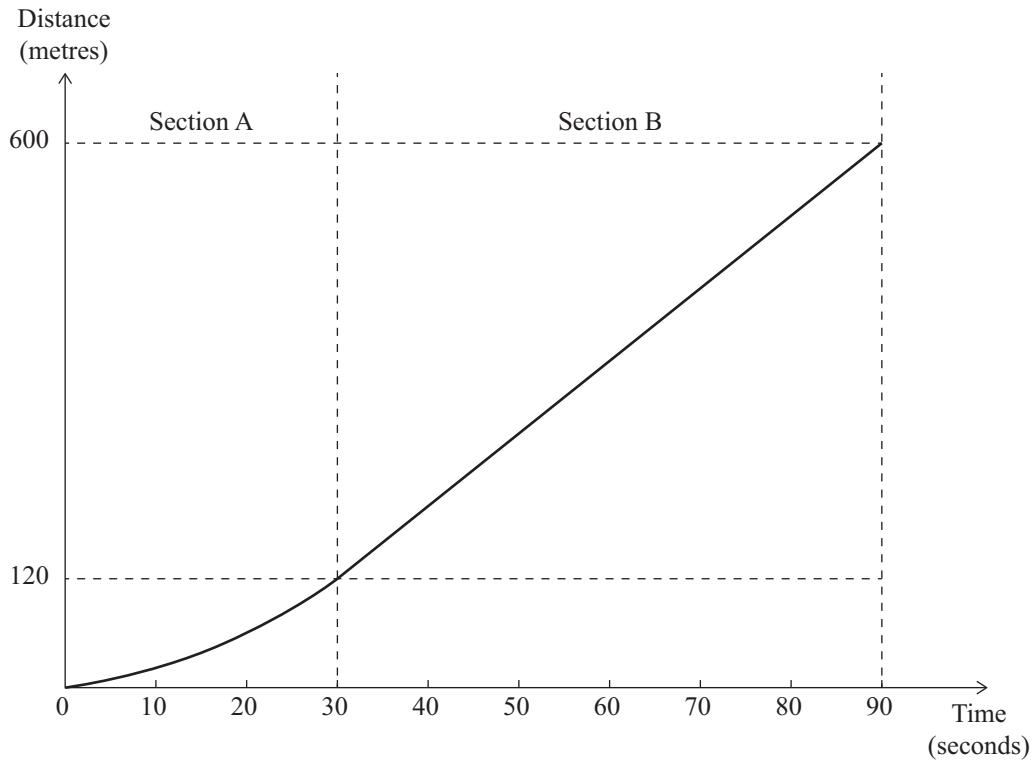
$$v = \frac{\Delta d}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t} \qquad F_{net} = ma \qquad P = \frac{F}{A}$$

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

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

QUESTION ONE: THE TRACTOR

A woman drives her tractor down a sandy beach to pick up her friend's boat. The distance-time graph below shows part of the journey.



(a) Use the information from the graph to calculate the **average speed** of the tractor during the 90 seconds.

average speed = _____ m s^{-1}

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(b) Describe the **motion** of the tractor in **section B**, and explain what this tells us about the forces acting on the tractor during this time.

(c) The total mass of the tractor and driver is 1660 kg.

Calculate the **speed** of the tractor at the **end** of section A, and then calculate the **net force** acting on the tractor during **section A** of the graph.

net force = _____ N

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(d) While on the sandy beach the woman sees a car (m = 1100 kg) that is stuck in the sand.

The photos below show the tread patterns of the tractor's rear tyre and the car's rear tyre.

tractor tread

car tread

Compare the different **treads** of the tractor tyre AND car tyre in terms of force, surface area and pressure applied.

Use this comparison to explain why the car gets stuck in the sand, BUT the tractor does not.

QUESTION TWO: 100 METRE RACE

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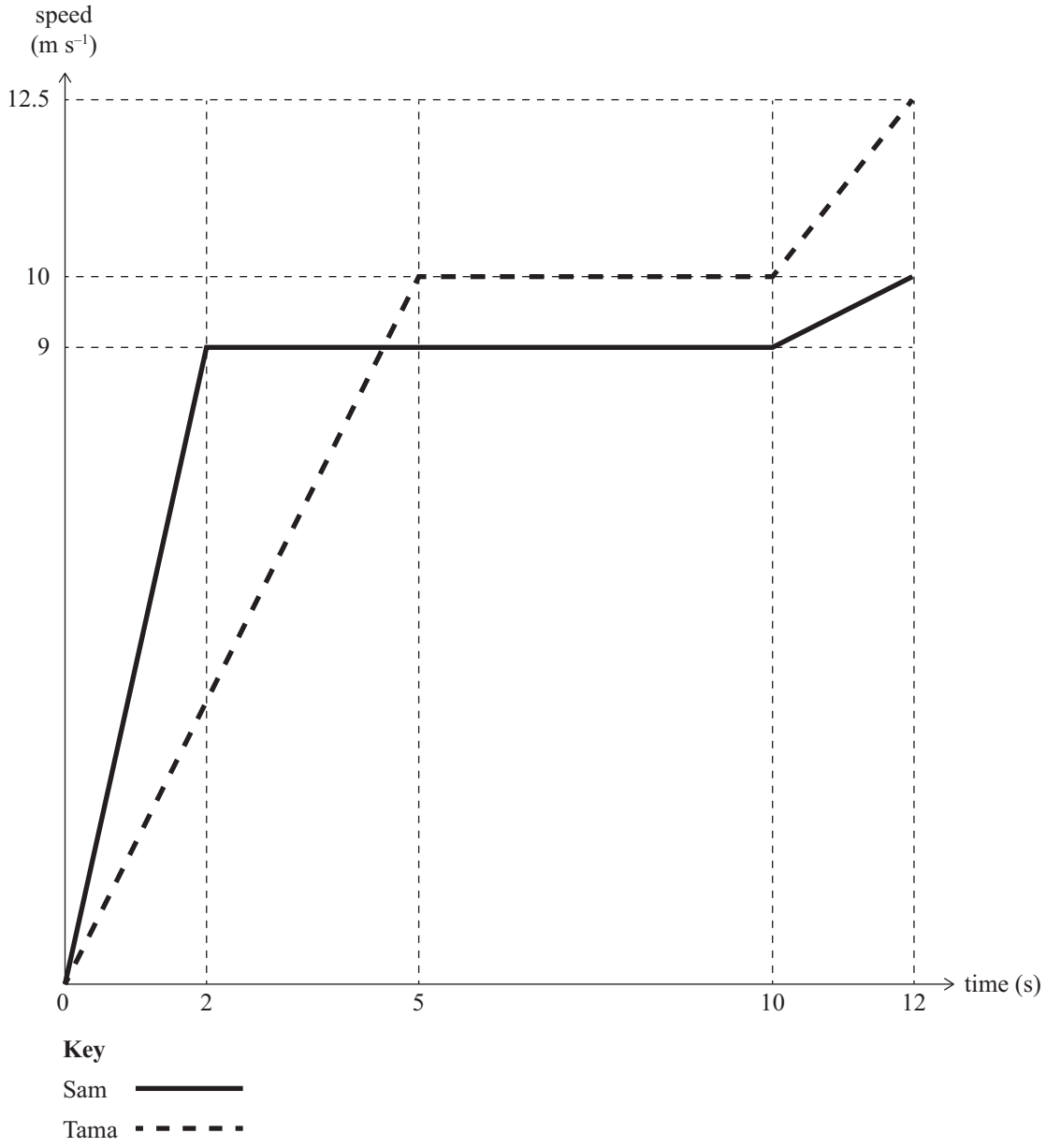
On athletics day, two friends compete in the same 100 metre race. The speed-time graphs for 12 seconds of their race are shown below.



(a) From the graph, who has the greater acceleration in the first 2 seconds?

Give a reason with your answer.

No calculation is required.

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(b) Sam accelerates for the first 2 seconds of the race.

During this time, he covers a distance of 9 m. His mass is 60 kg.

Using the graph, calculate Sam's **acceleration** during the first 2 seconds, AND then calculate the **work done** to cover the distance of 9 m.

work done = _____ J

(c) (i) Use the information in the graph to compare the speed AND acceleration of Sam and Tama in the **first 10 seconds.**

Sam's speed and acceleration: _____

Tama's speed and acceleration: _____

Comparison of Sam and Tama: _____

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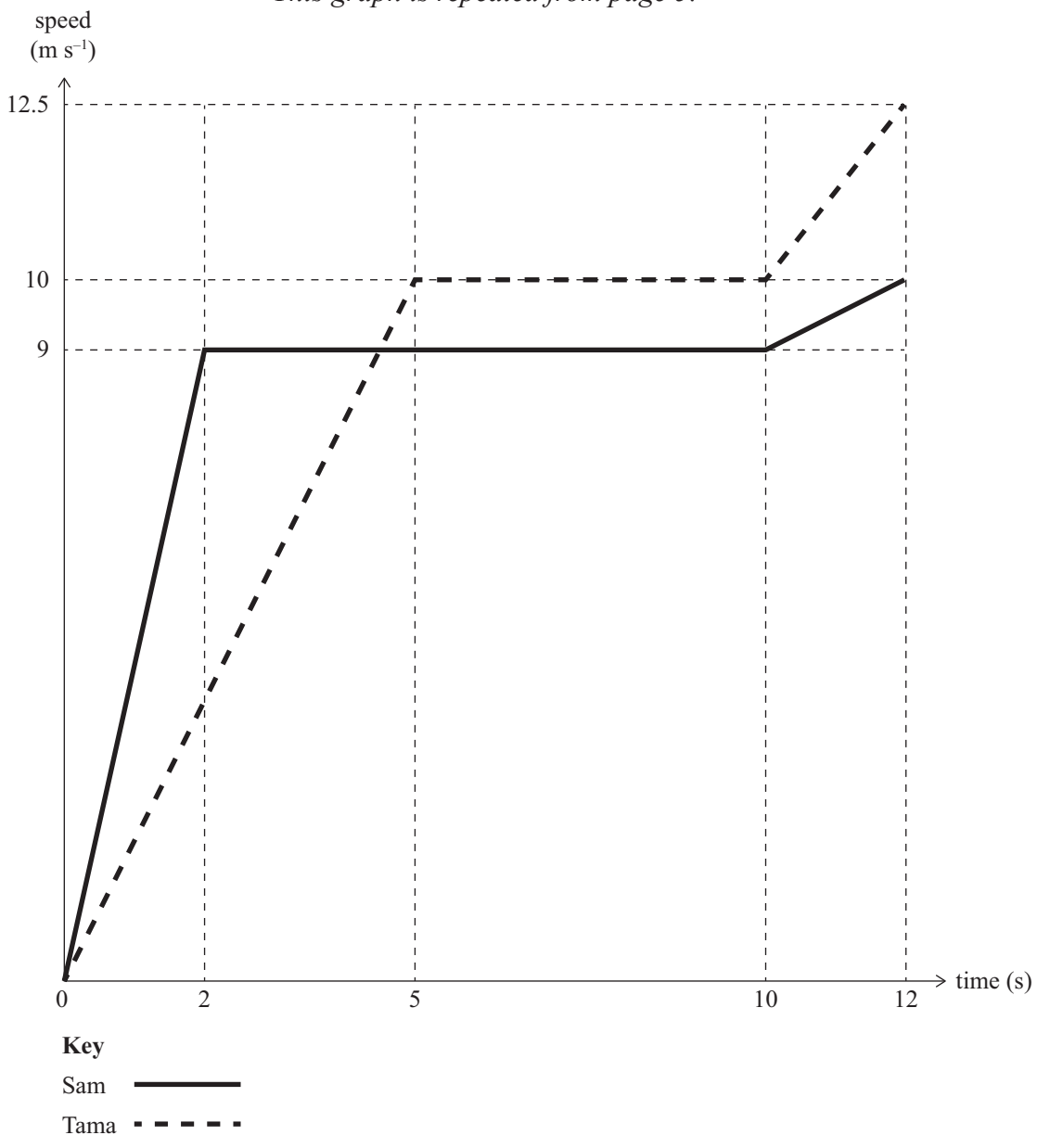
(ii) At 12 seconds, one of the runners has finished the 100 metre race.

Use the information in the graph and any necessary calculations to show which runner, Sam or Tama, finished at 12 seconds.

This graph is repeated from page 5.



QUESTION THREE: CRATERS

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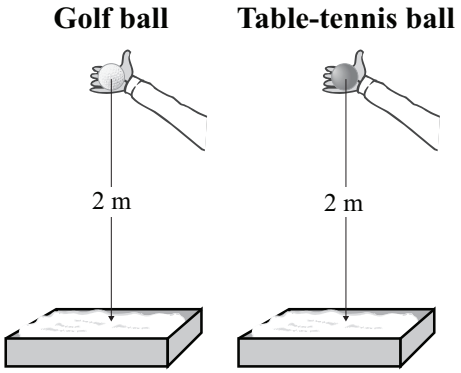
Some students wanted to investigate how craters form.

They dropped two different balls – a golf ball (m = 0.046 kg) and a table-tennis ball (m = 0.003 kg), from a height of 2 m into a container filled with flour.



(a) Calculate the **weight** of the golf ball.

weight = _____ N

(b) The image shows an example of a crater produced by the golf ball.

The students found that the golf ball **always** produced a deeper crater than the table-tennis ball.

Explain why the golf ball produces a deeper crater than the table-tennis ball, even though the balls are the **same size and shape**, and dropped from the **same height**.

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http://juliebeane.blogspot.com/2011/04/projects-and-baseball.html

(c) Assuming conservation of energy calculate the speed of the **golf ball** when it hits the flour.

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speed = _____ m s^{-1}

Question Four is on the next page.

QUESTION FOUR: RAMPS

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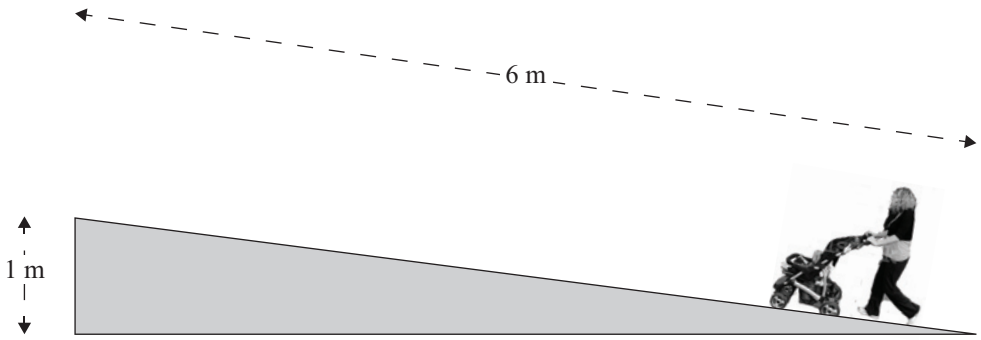
A woman pushes a child in a buggy up a ramp as shown below. The woman pushes the buggy up the ramp with a force of 100 N.



(a) Calculate the **work done** to push the buggy and child up the ramp.

work done = _____ J

(b) The energy gained by the buggy and child (m = 55 kg) at the top of the ramp does not equal the work done.

Explain why these two values are not equal.

In your answer you should:

- name the type of energy the buggy has, when it reaches the top of the ramp
- calculate the difference between the work done and the energy at the top of the ramp
- explain where the "missing" energy has gone and why this occurs.

(c) Explain, in terms of force and energy, why it is **easier** to push the buggy and child up a ramp **than** to lift it straight up.

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Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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