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NZQA
NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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SUPERVISOR'S USE ONLY

Level 1 Science, 2011

90940 Demonstrate understanding of aspects of mechanics

9.30 am Monday 21 November 2011
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.

Show ALL working.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–13 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 may find the following formulae useful.

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

$$\Delta E_{\text{p}} = mg\Delta h \qquad E_{\text{k}} = \frac{1}{2}mv^2 \qquad W = Fd \qquad P = \frac{W}{t}$$

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

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

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QUESTION ONE: PARACHUTING

A parachutist of mass 75 kg jumps from a plane at a height of 4 000 m above sea level.

(a) The parachutist falls through a distance of 2 400 m during the first 60 seconds. Calculate the average speed of the parachutist during this time.

Average speed = _____ m s^{-1}

http://riverdaughter.files.wordpress.com/2009/07/free-fall1.jpg

(b) Explain the vertical motion of the parachutist **just after** she jumps out of the plane (before the parachute opens).

In your answer you should:

- draw and label the vertical force(s) acting on the parachutist and show their relative sizes on the image to the right
- describe the net vertical force and state whether the force(s) are balanced or unbalanced
- describe the vertical motion of the parachutist
- explain how the net vertical force affects the vertical motion.

(c) After the 60 seconds, the parachutist pulls the cord and opens her parachute.

http://www.wallpaper-free.eu/wallpapers/parachute/parachute001_1400x1050.jpg

Explain how the parachute **reduces** the speed of the parachutist when it is just opened.

In your answer you should consider:

- how the motion of the parachutist changes when the parachute is opened
- the effect of the size of the parachute on the motion
- the effect of the parachute on the net vertical force.

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QUESTION TWO: RUNNING

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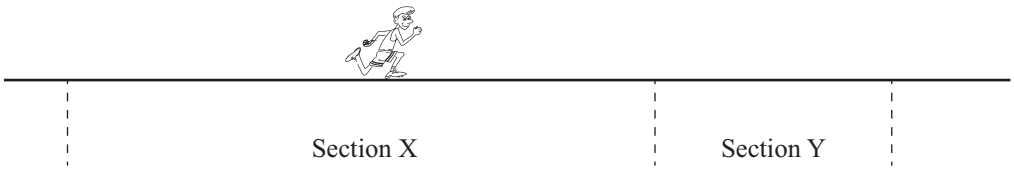

A boy runs along a track, as shown above.

During section X, he runs with a **constant speed** of 2 m s^{-1} for 15 seconds.

During section Y, he runs with a **constant acceleration** of 0.2 m s^{-2}.

(a) Calculate the net force acting on the boy (mass 60 kg) during **section Y**.

Give an appropriate unit with your answer.

Net force acting on the boy during section Y = _____ (_____)
unit

(b) The boy runs 12.5 m during section Y in 5 seconds.

Calculate the power required by the boy to produce the constant acceleration of 0.2 m s^{-2} in 5 seconds during section Y.

Give an appropriate unit with your answer.

Power required by the boy during section Y = _____ (_____)
unit

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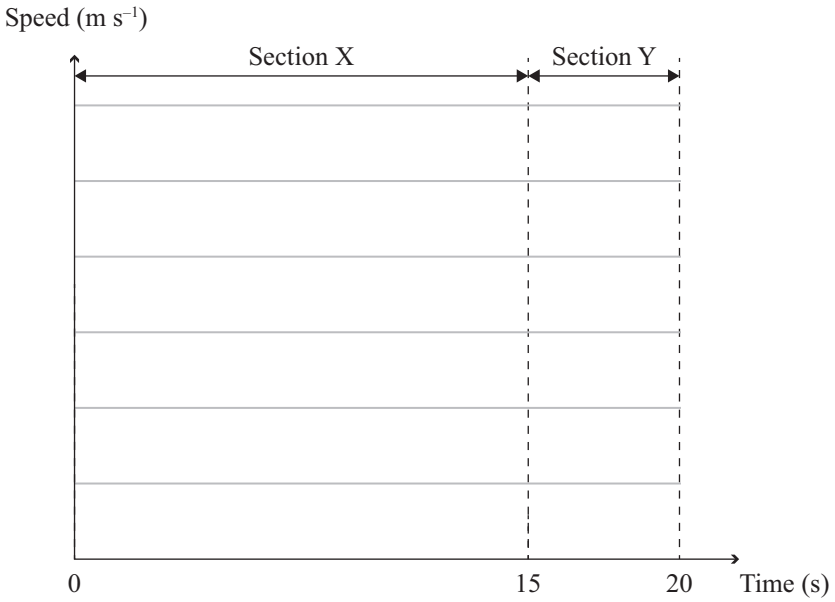
(c) (i) Calculate the speed of the boy as he reaches the end of section Y.

Speed at the end of section Y = _____ m s^{-1}

(ii) Use this and the other information provided in the question to complete the speed / time graph below.

On your graph, you should:

- label the speed values on the vertical axis
- draw a line on the graph to show the speeds for section X **and** section Y.



If you need to redraw this graph, use the grid on page 12.

QUESTION THREE: ROPE CLIMBING

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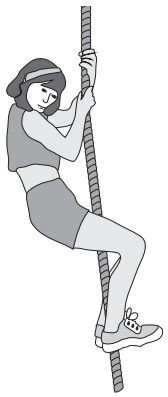

A girl of mass 60 kg uses 5 100 J of energy when she climbs a vertical rope.

(a) Calculate the maximum height it would be possible for the girl to reach.

(b) In reality, the girl reaches a height of only 8 m.

Explain why the **energy** used by the girl during the climb does **not** equal the work she does to reach the vertical height of 8 m.

In your answer you should:

- name the type of energy the girl has when she is 8 m above the ground
- calculate the work done to reach a height of 8 m above the ground
- calculate the difference between the work done and the energy used by the girl
- explain where the "missing" energy has gone, and why this occurs.

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QUESTION FOUR: FOOTBALL BOOTS

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Boot **without** studs.

Boot **with** studs.

A student of mass 40 kg uses the football boots shown above.

ONE boot **without** studs has a surface area of 165 cm^2 (0.0165 m^2) in **contact** with the ground.

ONE boot **with** six studs has a surface area of only 6 cm^2 (0.0006 m^2) in **contact** with the ground.

(a) Calculate the pressure exerted if the student stands on ONE foot on a **hard surface**, for the boot **without** studs AND for the boot **with** studs.

Give an appropriate unit with your answers.

(i) Without studs: _____

_____

_____

Pressure exerted by ONE foot for the boot **without** studs = _____ (_____)
unit

(ii) With studs: _____

_____

_____

Pressure exerted by ONE foot for the boot **with** studs = _____ (_____)
unit

(b) Discuss the **advantage** gained by the student when running on a **soft grass** football field while wearing the boots with studs **compared** to wearing boots of the same size without studs.

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In your answer you should:

- compare the pressure exerted on the ground by the boot with the studs AND the boot without studs
- explain the relationship between surface area and pressure exerted
- explain how the difference in pressures would help the student run on a softer surface like grass.

If you need to redraw the graph from Question Two (c), draw it on the grid below. Make sure it is clear which graph you want marked.

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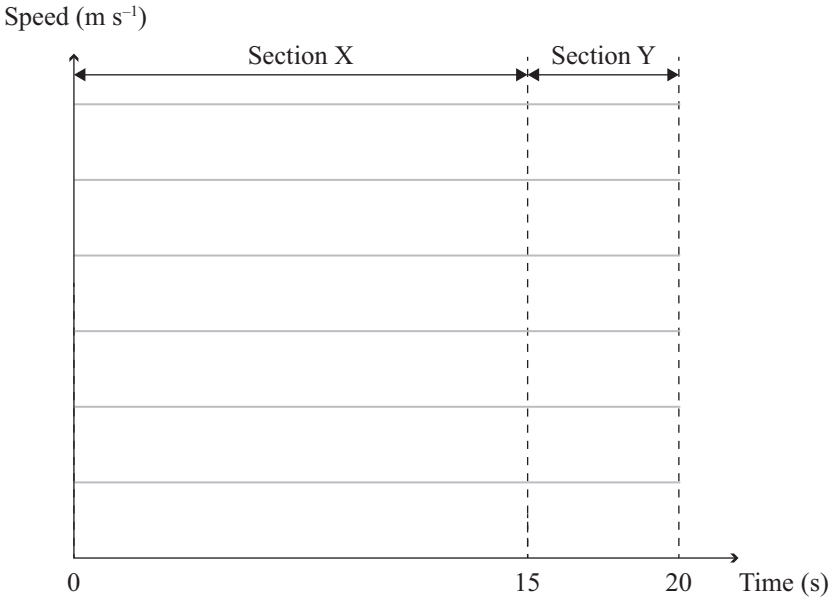

Extra space if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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