Tick this box if you have NOT written in this booklet ☐

# NZQA
NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

**QUALIFY FOR THE FUTURE WORLD**
**KIA NOHO TAKATŪ KI TŌ ĀMUA AO!**

# Level 1 Science 2021

## 90940  Demonstrate understanding of aspects of mechanics

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

Check that this booklet has pages 2–11 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (░). This area may be cut off when the booklet is marked.

**YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.**

You may find the following formulae useful.

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

$$E_k = \frac{1}{2}mv^2 \qquad W = Fd \qquad g = 10 \text{ N kg}^{-1} \qquad P = \frac{W}{t}$$
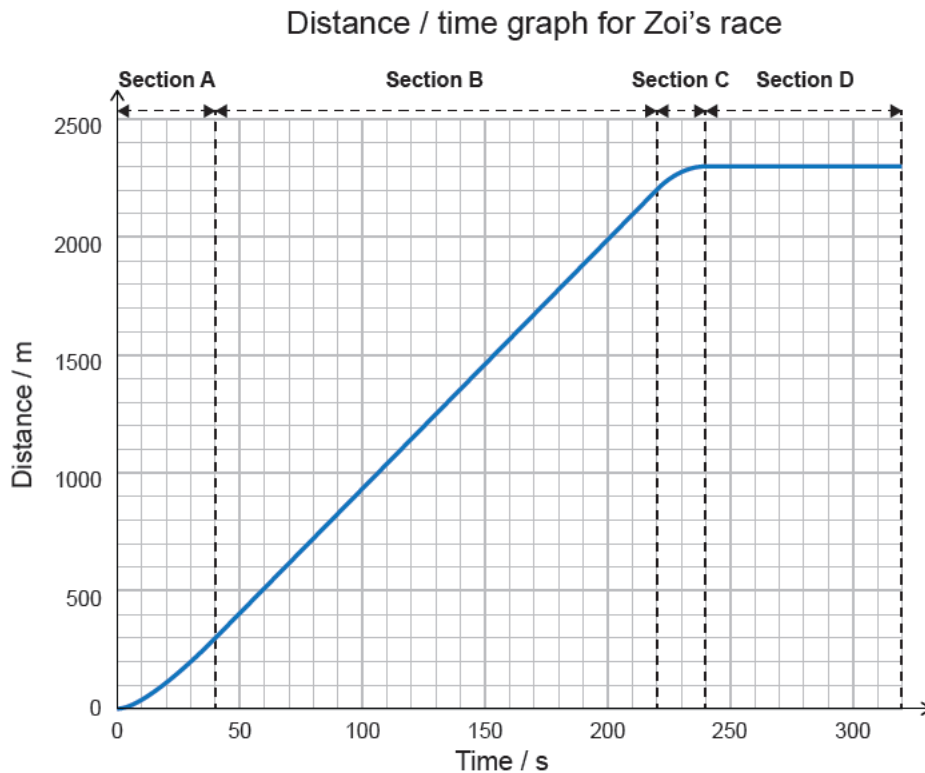
## QUESTION ONE: SNOWBOARDING

Zoi is snowboard racing in the mountains.

Source: www.odt.co nz/sport/winter-olympics/wanaka-snowboarder-misses-out-medal

The distance-time graph below shows Zoi's race.



Distance / time graph for Zoi's race

(a)  Describe the motion of Zoi in the four sections.

Section A: _____

Section B: _____

Section C: _____

Section D: _____

(b)     How long does Zoi's total journey take?

_____

(c)     Calculate the speed of Zoi in Section B.

_____

_____

_____

(d)     Another race is 3000 m long. Zoi averaged a speed of 5 m s$^{-1}$.

Calculate the time it would take her to finish the race.

_____

_____

_____

(e)     To get back to her car, Zoi wears snowshoes.

The surface area of one snowshoe is 0.15 m$^2$, and the surface area of one walking shoe is 0.03 m$^2$. Zoi has a weight of 570 N.

Source: www.piratesofpowder.com/best-snowshoes/

Calculate the pressure on the snow for:

One snowshoe: _____

One walking shoe: _____

Explain why using snowshoes makes it easier to walk in the soft snow.

_____

_____

_____

_____

**QUESTION TWO: CAVING**



www.doc.govt.nz/globalassets/images/places/nelson-tasman/harwoods-hole/harwoods-hole-1200.jpg

Pete and Manaia have decided to climb down a rope into a cave. Pete and his climbing equipment have a mass of 80 kg.

(a) (i) Calculate the weight of Pete and his climbing equipment.

_____

_____

(ii) Using Pete as an example, explain the difference between mass and weight.

_____

_____

_____

_____

(b) When Manaia is 100 metres from the bottom of the cave, her 1 kg torch falls out of her backpack.

(i) Calculate the gravitational potential energy the torch has 100 m above the ground.

_____

_____

_____

(ii) What type of energy does the torch gain as it falls?

_____

(iii) Calculate the maximum speed at which her torch will hit the ground.
(Air resistance can be ignored.)

_____

_____

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(c)  To get out of the cave, they need to climb up a 170 m rope.

Pete, mass 80 kg, takes 2200 seconds.

Manaia, mass 75 kg, takes 2000 seconds.

(i)  Calculate the work done by both Pete and Manaia.

_____

_____

_____

_____

(ii)  Calculate the power output by both Pete and Manaia.

_____

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(iii)  Explain who does more work, and also who uses more power.

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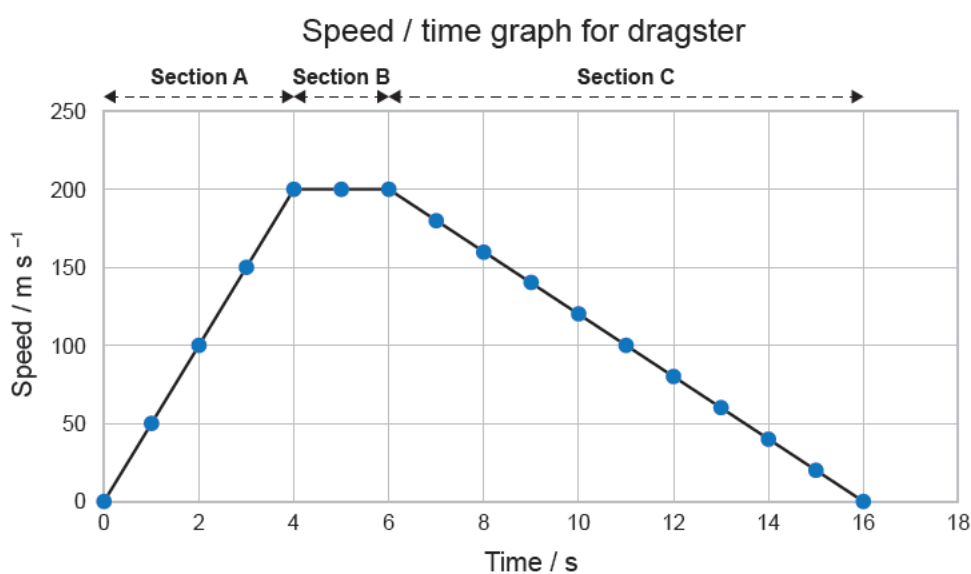
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## QUESTION THREE: DRAGSTERS



Source: www.classicandsportscar.com/classifieds/motorsport/race-cars/dragsters/1964-fuller-roberts-starlite-iii-top-fuel-dragster/9306628

Dragsters are designed to travel short distances very quickly.

Below is a speed/time graph of a dragster.



(a)   What is the maximum speed of the dragster?

_____ m s$^{-1}$

(b)   (i)   Using the graph, show the acceleration of the dragster in the first 4 seconds is 50 m s$^{-2}$.

_____

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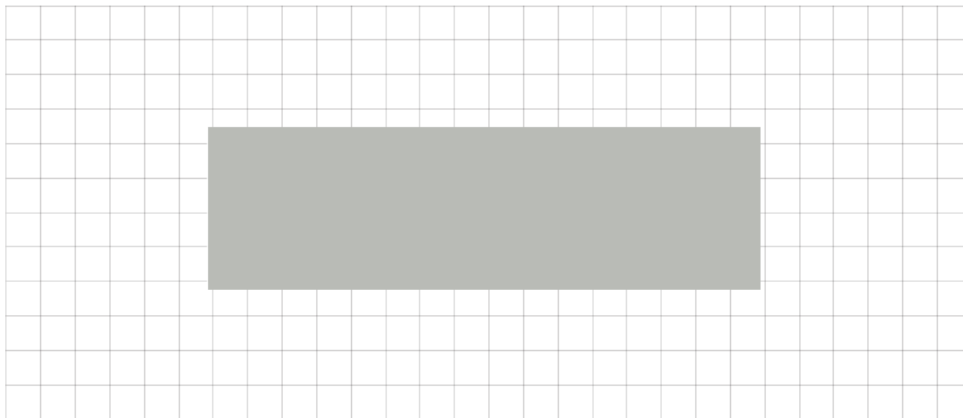
(ii)   The mass of the dragster is 1050 kg.

Calculate the net force required to accelerate the dragster at 50 m s$^{-2}$.

_____

_____

(iii) On the diagram below, draw and label arrows to show the size and direction of the vertical and horizontal forces on the dragster as it accelerates in Section A.
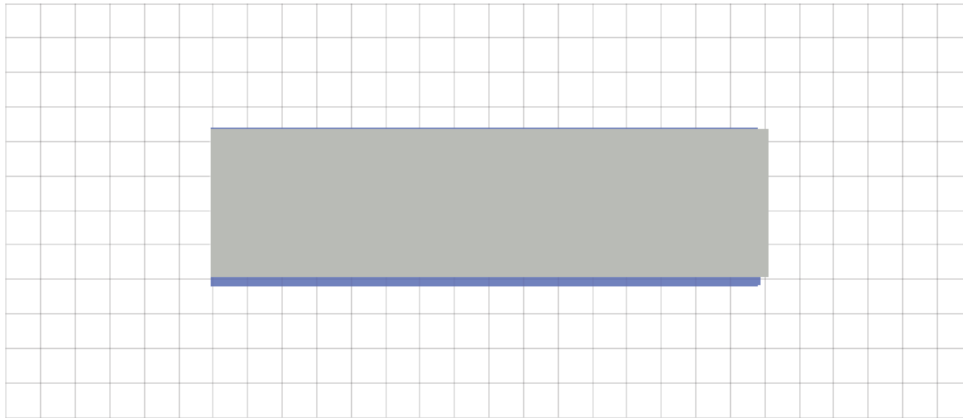
(iv) On the diagram below, draw and label arrows to show the size and direction of the vertical and horizontal forces on the dragster as it decelerates in Section C.
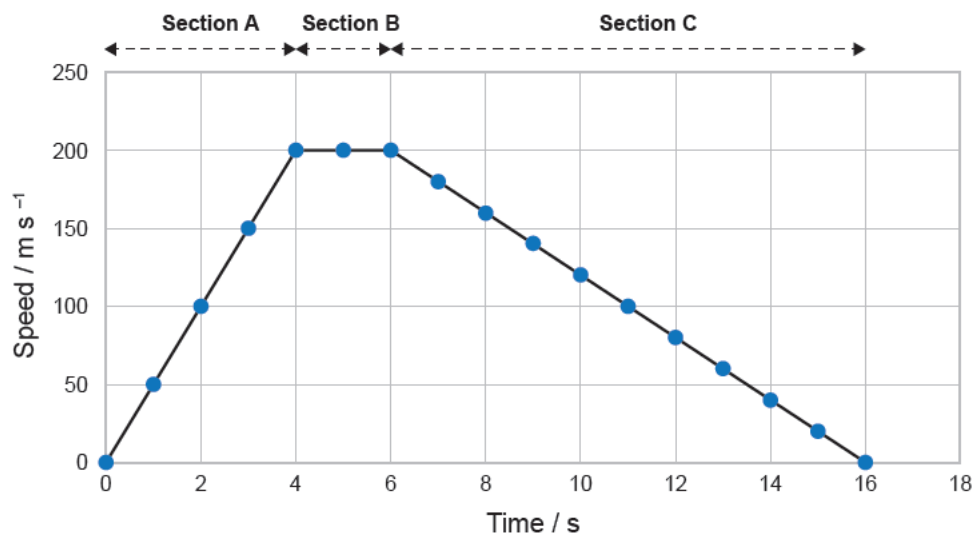
(c)   Dragsters use a parachute to slow them down.
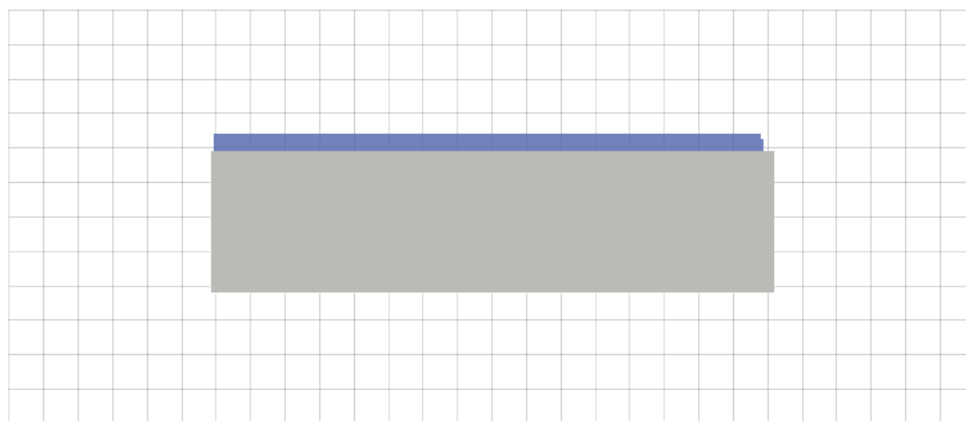


http://markjrebilas.com/blog/fast-cars-high-winds-and-the-best-save-i-ever-shot-nhra-vegas/

Using the graph below, compare the size and direction of the net force in Section A with Section C.
(No calculations are required.)



_____

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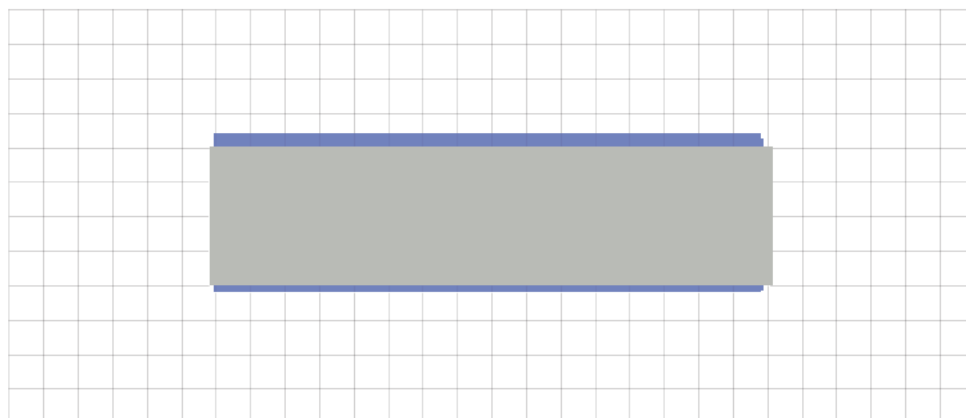
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## SPARE DIAGRAMS

If you need to redraw your response to Question Three (b)(iii), use the diagram below. Make sure it is clear which answer you want marked.

If you need to redraw your response to Question Three (b)(iv), use the diagram below. Make sure it is clear which answer you want marked.

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

QUESTION
NUMBER

| QUESTION NUMBER | |
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**Write the question number(s) if applicable.**