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90940



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Level 1 Science 2022

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.

Make sure that you have Resource Booklet L1–SCIER.

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 2–16 in the correct order and that none of these pages is blank.

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

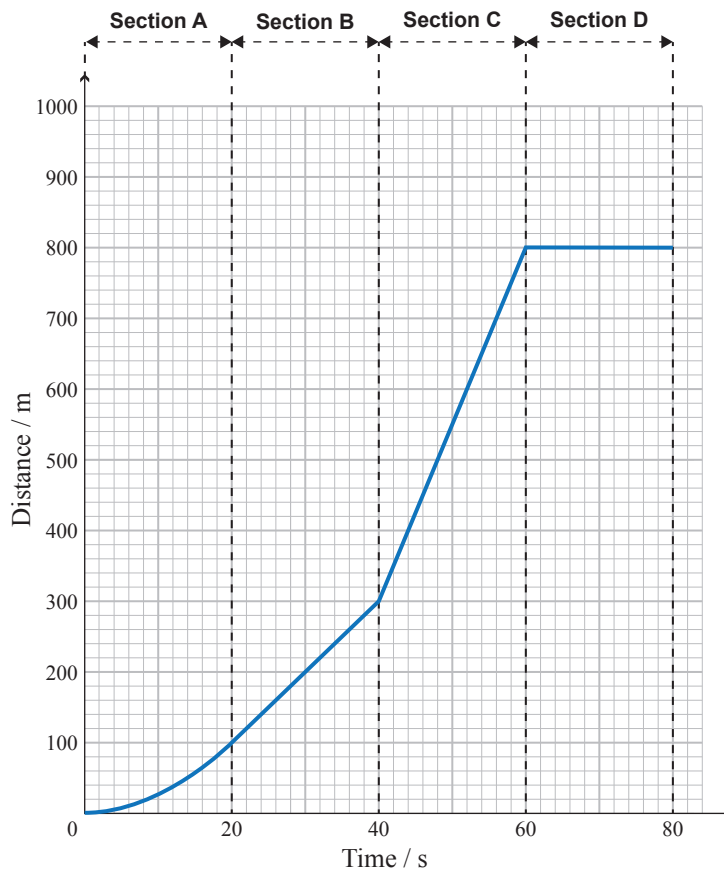
YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

QUESTION ONE: AMERICA'S CUP BOAT



Source: <https://resources.stuff.co.nz/content/dam/images/4/y/r/2/z/n/image.related.StuffLandscapeSixteenByNine.1420x800.220eds.png/1613834074445.jpg>

Below is a **distance-time** graph for an America's Cup boat sailing across the Waitematā Harbour.



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

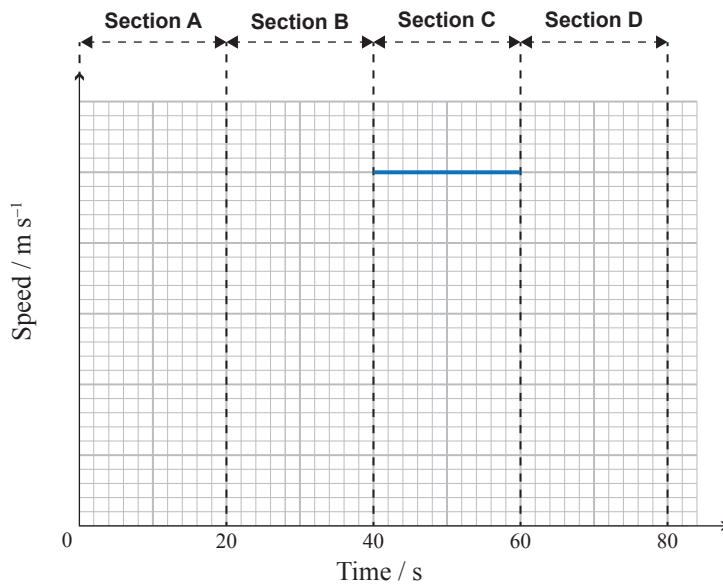
Section A: _____

Section B: _____

Section C: _____

Section D: _____

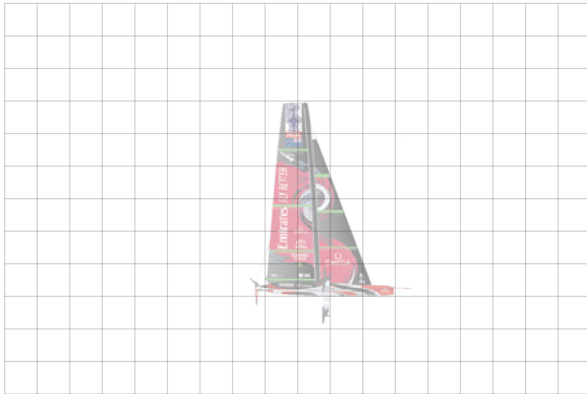
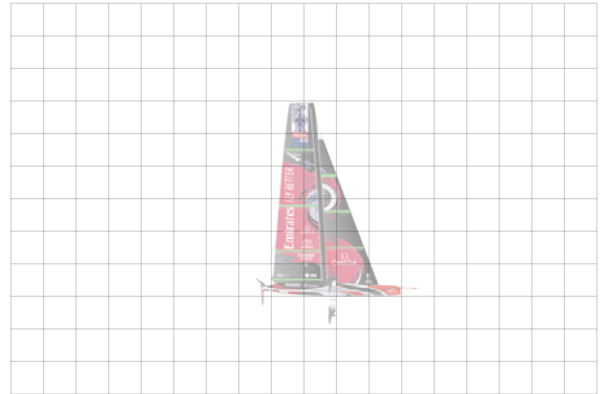
- (b) (i) On the axes below, sketch a speed-time graph for this journey.
Section C has been done for you.



*If you need to redraw
your response, use the
diagram on page 11.*

- (ii) Calculate the speed of the boat in Section B of the graph.
Show your working.

- (c) On the diagrams below, draw and label arrows to show the size and the direction of the horizontal and vertical forces acting on the boat for Section A and Section B of the boat's journey.

Section A**Section B**

Source: <https://www.sailingscuttlebutt.com/2021/02/02/americas-cup-designing-the-best-ac75/>

*If you need to redraw your response,
use the diagrams on page 11.*

- (d) Compare and contrast the forces acting in Section A with the forces acting in Section B.
You should consider:

- both the horizontal and vertical forces
- the size and direction of these forces
- the motion of the boat in both sections
- the net force in both sections.

QUESTION TWO: SANDBOARDING AT CAPE REINGA

Source: www.visitboi.co.nz/wp-content/uploads/2019/05/downhill.jpg

A sandhill has a vertical height of 25 m. Ariana and her sandboard have a mass of 55 kg.

- (a) Explain the difference between the mass and the weight of Ariana and her sandboard.

- (b) Ariana carries her sandboard to the top of a 25 m hill in 120 seconds.

- (i) Calculate the work done to climb this hill.

- (ii) Calculate the power that she uses to climb this hill.

- (iii) Explain how she could lower the power output required to climb to the top of the hill.

- (c) Ariana rides her sandboard from the top of the 25 m hill to the bottom.

- (i) Calculate the gravitational potential energy of Ariana and her sandboard at the top of the hill.

- (ii) Her speed at the bottom of the hill is 12 m s^{-1} .

Calculate the kinetic energy of Ariana and her sandboard at the bottom of the hill.

- (iii) Explain the differences between her gravitational potential energy at the top of the hill, and her kinetic energy at the bottom of the hill.

QUESTION THREE: STEEP HILLS

Source: <https://carfromjapan.com/wp-content/uploads/2019/02/2-30.jpg>

- (a) Identify what each of the letters represents in the following formula, including units used.

$$P = \frac{F}{A}$$

Letter	This letter represents the term:	Unit
<i>P</i>		
<i>F</i>		
<i>A</i>		

Cars need effective brakes when driving down a hill. A brake system in a car uses two pistons: a small piston with a small area and a large piston with a large area.



Source: https://res.cloudinary.com/yourmechanic/image/upload/dpr_auto,f_auto,q_auto/v1/article_images/2_How_to_Open_Your_Car_Hood_A_diagram_of_the_how_brakes_fluid_is_applied_when_the_pedal_is_pushed_down

(b) Braking causes the small piston to move with a force of 20 N. The small piston has an area of 0.008 m^2 .

(i) Show that the pressure of this piston is 2500 Pa.

(ii) The pressure is the same in all parts of the braking system. The large piston has an area of 0.04 m^2 .

Calculate the force applied by the large piston when braking occurs.



Source: <https://s3-eu-west-2.amazonaws.com/yps-assets/3006430ee743dd6ecb858327ca1cc38d.jpeg>

(c) A car is moving along a flat road at a speed of 20 m s^{-1} . It comes to a stop 4 seconds later.

(i) Calculate the acceleration of this car over these 4 seconds.

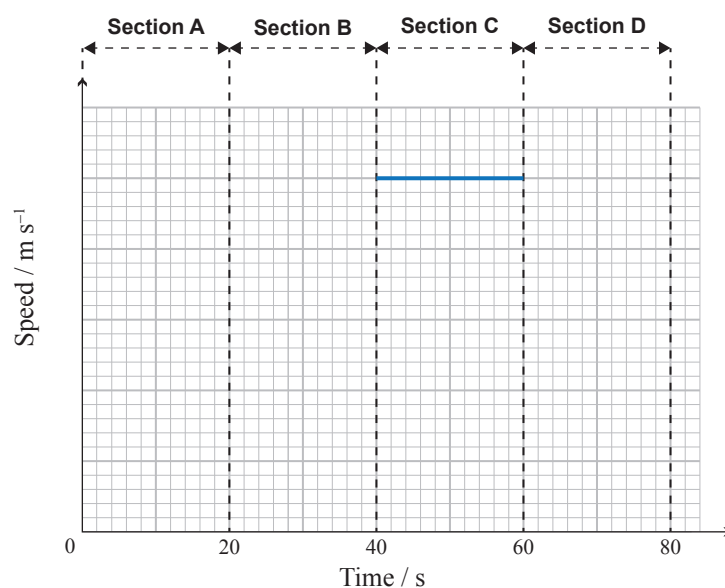
(ii) The car and driver have a mass of 1000 kg together.

Calculate the force required to stop the car.

(iii) Explain the direction of this force.

SPARE DIAGRAMS

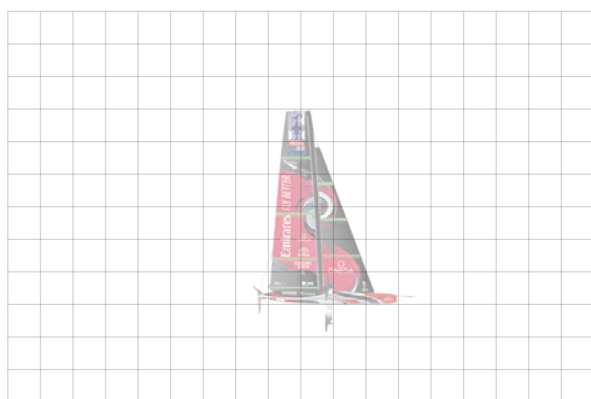
If you need to redraw your response to Question One (b)(i), use the diagram below. Make sure it is clear which answer you want marked.



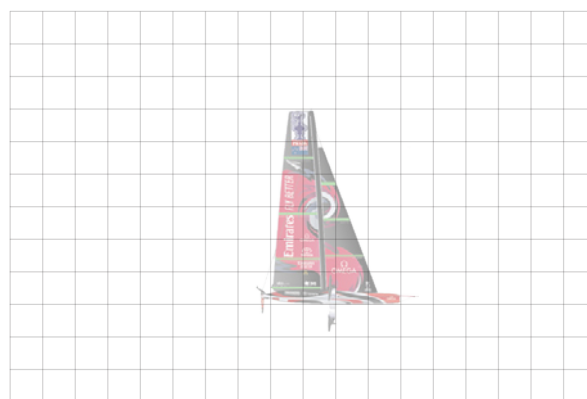
Source: <https://www.sailingscuttlebutt.com/2021/02/02/americas-cup-designing-the-best-ac75/>

If you need to redraw your response to Question One (c), use the diagrams below. Make sure it is clear which answer you want marked.

Section A



Section B



Source: <https://www.sailingscuttlebutt.com/2021/02/02/americas-cup-designing-the-best-ac75/>

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

**QUESTION
NUMBER**

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