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Level 1 Science, 2019

90940 Demonstrate understanding of aspects of mechanics

9.30 a.m. Thursday 14 November 2019
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 and clearly number the question.

Check that this booklet has pages 2–8 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

ASSESSOR'S USE ONLY

You may find the following formulae useful.

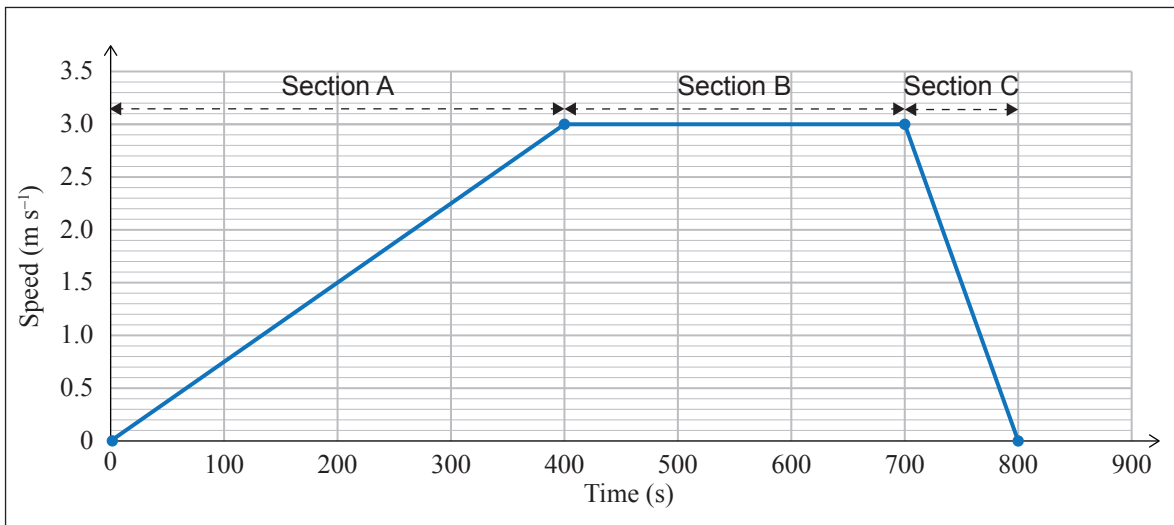
$$v = \frac{\Delta d}{\Delta t} \quad a = \frac{\Delta v}{\Delta t} \quad F_{\text{net}} = ma \quad P = \frac{F}{A} \quad \Delta E_p = mg\Delta h$$

$$E_k = \frac{1}{2}mv^2 \quad W = Fd \quad g = 10 \text{ N kg}^{-1} \quad P = \frac{W}{t}$$

QUESTION ONE

A boat travels across a lake to the start of a walking track. The graph below shows the boat's journey.

Boat Journey



- (a) Describe the motion of the boat during each section of the journey.

Section A: _____

Section B: _____

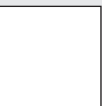
Section C: _____

- (b) Calculate the acceleration of the boat in the first 400 seconds.

acceleration = _____ m s^{-2}

- (c) Explain the acceleration and motion of the boat shown in Section B of the graph by discussing the horizontal forces acting on the boat.

- (d) Show that the total distance travelled by the boat is 1650 m.



QUESTION TWO

An adult and a child's feet sink into soft sand. The footprints are the same depth. The child's footprints cover a smaller area than the adult's.



- (a) Pressure is defined as the force exerted divided by the surface contact area.

Using this pressure definition, explain how it applies to the adult standing in the sand.

The surface area of one of the adult's footprints is 200 cm^2 (0.0200 m^2), and the surface area of one of the child's footprints is 150 cm^2 (0.0150 m^2). The adult has a weight of 690 N .

- (b) Show the total pressure the adult exerts on the sand is $17\,250 \text{ Pa}$.

- (c) Explain how the footprints are the same depth, although the mass of the child is smaller. In your answer include a discussion of pressure, surface area, and mass.

- (d) Both the adult's and the child's footprints are the same depth.

Calculate the mass of the child.

- (e) The adult's weight force does 21 J of work on the sand.

Calculate the distance the adult's feet sink into the sand.

QUESTION THREE

<https://medium.com/@rohicks/whuffo-you-jump-out-of-that-plane-14a70d0c4dc6>

A parachutist with total mass of 63 kg jumps from a plane.

- (a) Show that the parachutist's gravitational potential energy when the plane is 3500 m above sea level is 2 205 000 J.

- (b) The parachutist falls a distance of 450 m during the first 9.49 seconds.

Calculate the average speed of the parachutist during this time.

- (c) Explain the vertical motion of the parachutist immediately after jumping out of the plane (before the parachute opens).

In your answer you should:

- describe the vertical motion of the parachutist
- describe the net vertical force, and state whether the force(s) are balanced or unbalanced
- explain how the net vertical force affects the vertical motion.

- (d) During the 450 m fall, the parachutist's gravitational potential energy was reduced by 283 500 J. Calculate the parachutist's downward speed (vertical) at 450 m, assuming energy is conserved.
