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Level 1 Science, 2016

90940 Demonstrate understanding of aspects of mechanics

9.30 a.m. Monday 14 November 2016
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 2–12 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.

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You may find the following formulae useful.

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

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

QUESTION ONE

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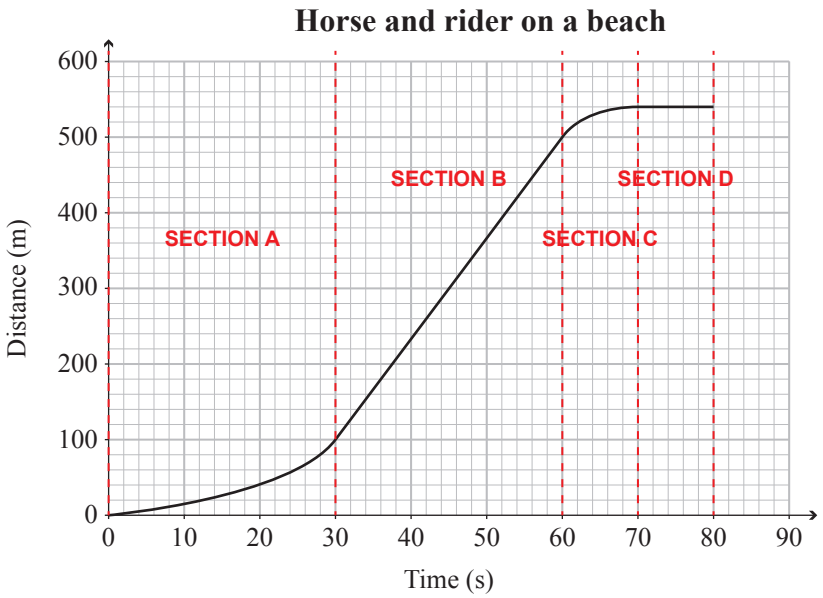
The graph below shows the motion of a horse and rider as they travel along a beach.



(a) Describe the motion of the horse and rider in each section of the graph.
(No calculations are required.)

Section A: _____

Section B: _____

Section C: _____

Section D: _____

(b) Calculate the speed of the horse and rider in Section B of the graph.

_____

_____

_____

_____

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(c) **Each** of the horse's hooves has a surface area of 44 cm^2 (0.0044 m^2) and sinks into the sand when the horse stops. The hooves exert a pressure of 200155 Pa.

Calculate the weight of the horse.

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(d) The rider walks beside the horse and then gets onto the horse.

Explain why the horse's hooves sink further into the sand when the rider gets onto the horse.
In your answer you should consider the **pressure applied** and the **forces acting**.
(No calculations are necessary.)

QUESTION TWO

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A harvester was working in a paddock.

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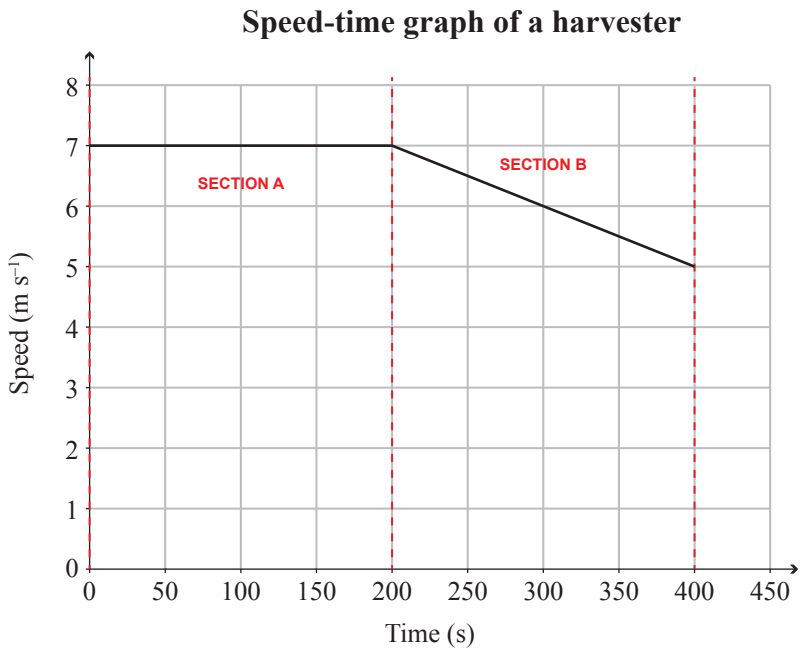
The speed-time graph shows the journey of the harvester.



(a) Calculate the distance the harvester travelled in the first 200 seconds.

(b) Explain how the **forces** acting on the harvester result in the motion shown in the graph (no calculations are needed).

Include reference to the **net force**.

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Section A:

Section B:

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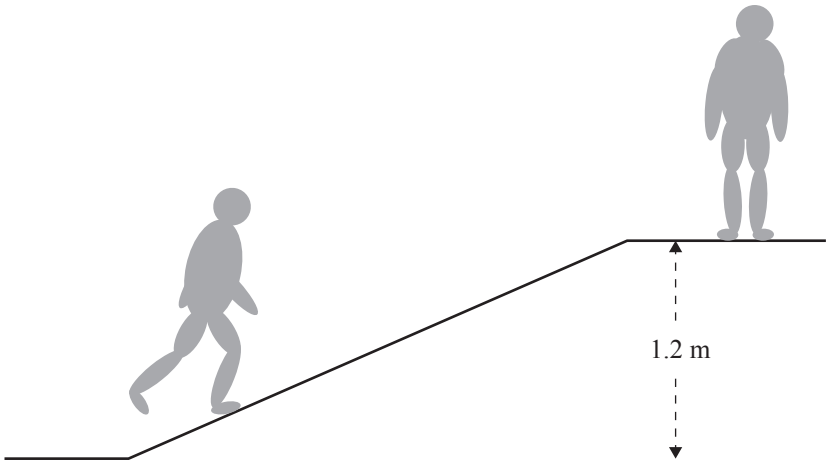
The harvested grain is stored in a shed with a ramp.

(c) An 85 kg worker climbed to the top of the ramp, a height of 1.2 m. This took 8 seconds.

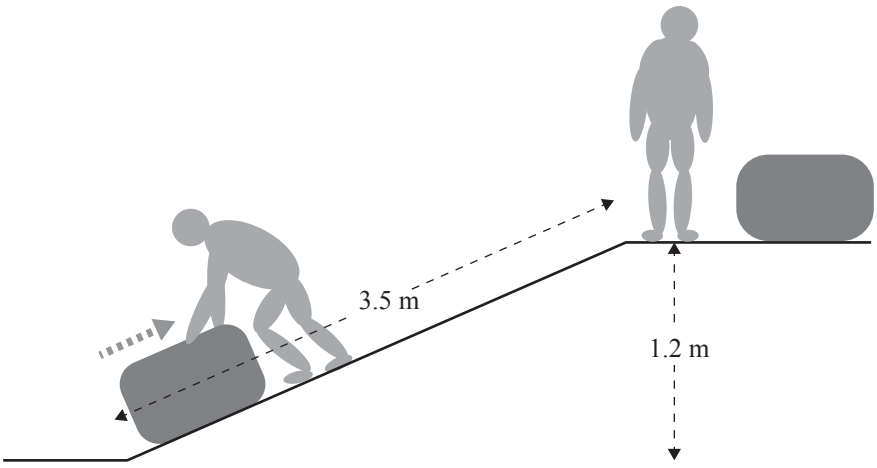


Calculate the **work** done by the worker to get to the top of the ramp and therefore the **power** exerted.

Include units.

(d) The worker dragged a 25 kg bag of grain up the 3.5 m ramp to reach the height of 1.2 m.

It took longer to drag the bag up the ramp than to lift the bag straight up to the top of the ramp.



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(i) Explain why the **force** needed to drag the bag of grain up the ramp to the top is less than the force needed to lift the bag straight up (vertically). Ignore friction.

(ii) Explain whether the **power** needed to drag the bag of grain to the top of the ramp is more or less than the power needed when the bag is lifted straight up (vertically) to the top of the ramp.

(No calculation is required.)

QUESTION THREE

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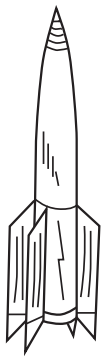
A small rocket has a mass of 2.60 kg and a weight of 26.0 N.

(a) Explain the difference between mass and weight.

(b) The rocket was fired vertically. It left the launch pad and after 1.2 s was travelling at 20 m s^{-1}.

Calculate the rocket's acceleration.



(c) The rocket had gained 1950 J of potential energy at its maximum height. It then fell back to the ground.

What was the maximum speed it could reach just before hitting the ground (assuming energy is conserved)?

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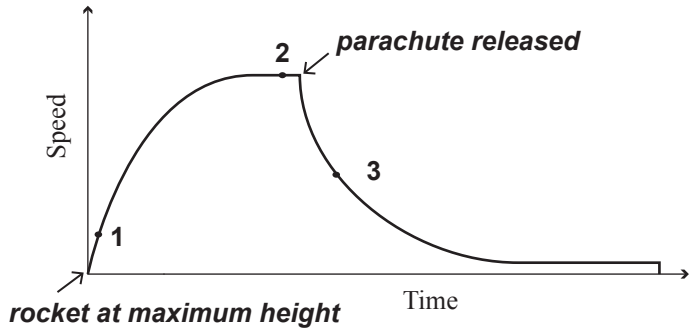
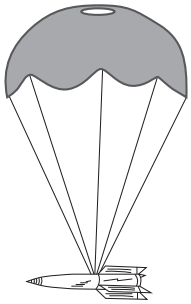
(d) The rocket was fired again. After it reached its maximum height, it began to fall back to the ground. As it fell, a parachute was released.

The graph below shows the speed-time graph of the rocket **falling from its maximum height** back to ground. Just after point **2**, a parachute is released.





Discuss the change in speed at points **1**, **2**, and **3** as the rocket falls to the ground.

In your answer you should:

- describe the forces involved, and whether they are unbalanced or balanced
- explain what is causing the change in speed
- describe the frictional forces acting as the rocket falls.

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

QUESTION NUMBER

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