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Level 1 Science, 2018

90940 Demonstrate understanding of aspects of mechanics

9.30 a.m. Thursday 15 November 2018
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 2–11 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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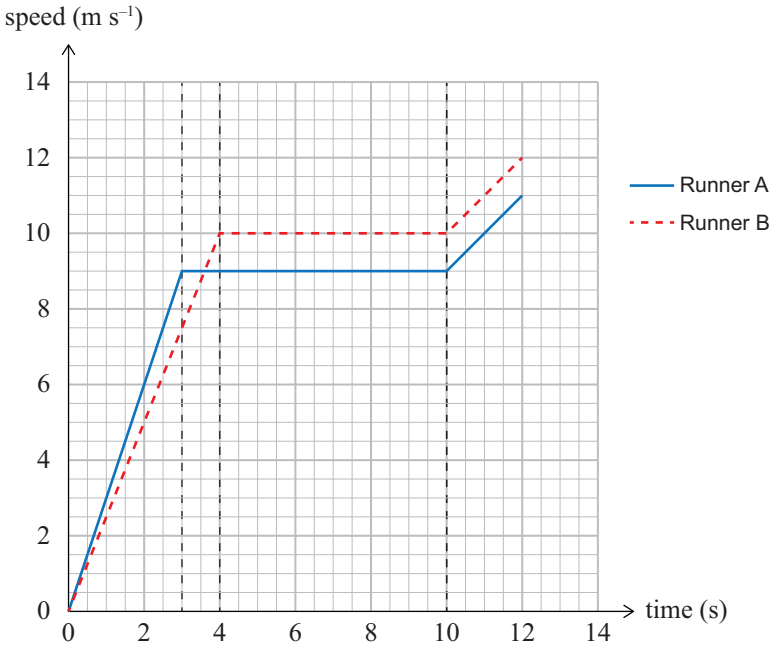
You may find the following formulae useful.

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

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

QUESTION ONE

The speed-time graph shows the motion of two runners in a 100 m race.



(a) From the graph, which runner has the greater acceleration in the first 3 seconds?
Explain your answer.
Calculations are not required.

(b) Using the graph, calculate Runner A's acceleration during the first 3 seconds.

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(c) (i) Use the information in the graph to compare the speed AND acceleration of Runner A and Runner B in the first 10 seconds.

(ii) Use the information in the graph and calculations to show which runner, Runner A or Runner B, finished the 100 m first.

(d) **Each** of Runner A's feet has a surface area of 200 cm^2 (0.0200 m^2), which sink into the track. Together, the feet exert a pressure of 13 000 Pa.

Calculate the **weight** of Runner A.

QUESTION TWO

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Willow and her mountain bike have a combined mass of 82 kg. She accelerates at the start of a race at 0.80 m s^{-2}.

(a) Calculate the net force acting on the bike and rider when accelerating.

(b) (i) Draw and label arrows on the diagram below to show ALL the forces acting on Willow and her bike when accelerating.

https://commons.wikimedia.org/w/index.php?curid=24096670

(ii) Explain the size of the forces involved when Willow and her bike are **accelerating**.

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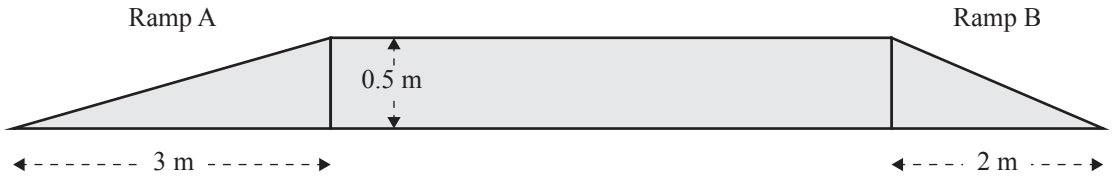
(c) Willow had to choose between two ramps to ride her bike to the top of an incline. It takes less time to use Ramp B.



(i) Is the **work** needed to get to the top of **Ramp A** more, less, or the same as the work needed to get to the top of Ramp B?

Explain your answer.

(ii) Explain how the two ramps differ in terms of the **force** and **power** needed to ride up them.

Calculations are not required.

QUESTION THREE

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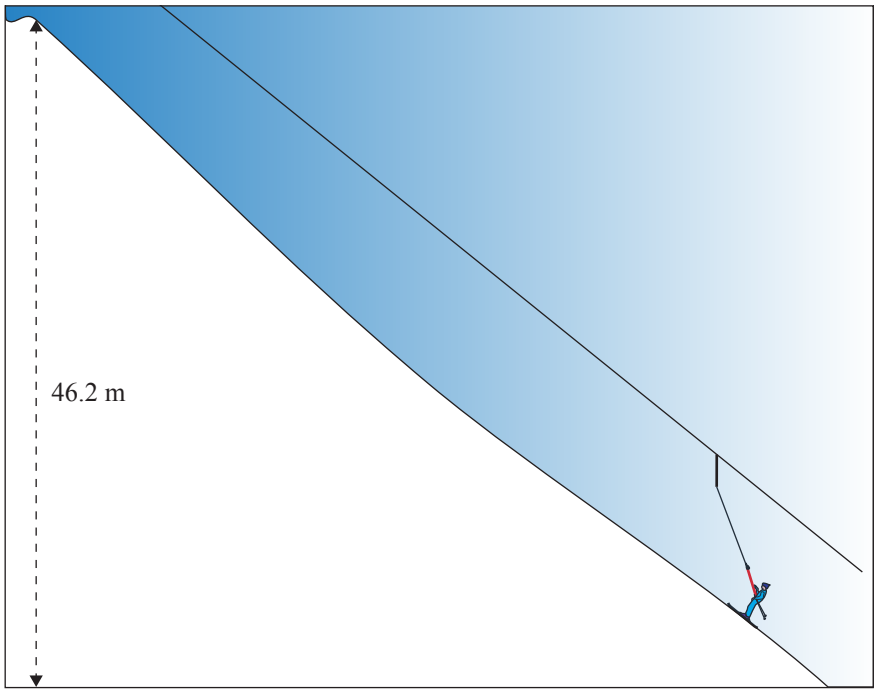

Marama is snow skiing and uses a ski tow to get to the top of the slope.

The ski tow pulls Marama up the slope to a height of 46.2 m. The combined mass of Marama and her ski gear is 62 kg.

(a) Calculate the work done for Marama to reach the top of the slope.

(b) It takes 525 s for the tow to pull Marama to the top of the slope.

Calculate the power needed to get Marama to the top.

For this question, ignore friction.

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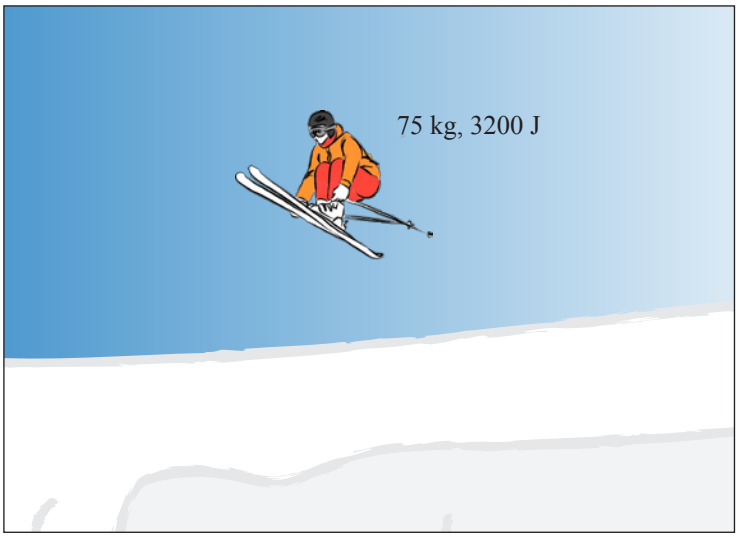
(c) Jake has a mass of 75 kg and is doing a jump.



He has 3200 J of gravitational potential energy at the top of his flight.

(i) Calculate his downward (vertical) speed just before he lands, assuming energy is conserved.

(ii) Explain why Jake's actual speed when he lands is slower than that calculated in part (i).

Question Three continues on the following page.

(d) Jake changes to his wide skis. The skis measure 10 cm in width compared with normal skis of 5 cm. Both sets of skis are the same length.

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Explain why Jake does not sink into the snow as much when he uses his wide skis.

Calculations are not required.

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

QUESTION NUMBER

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