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NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
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SUPERVISOR'S USE ONLY

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.

Achievement

TOTAL 10

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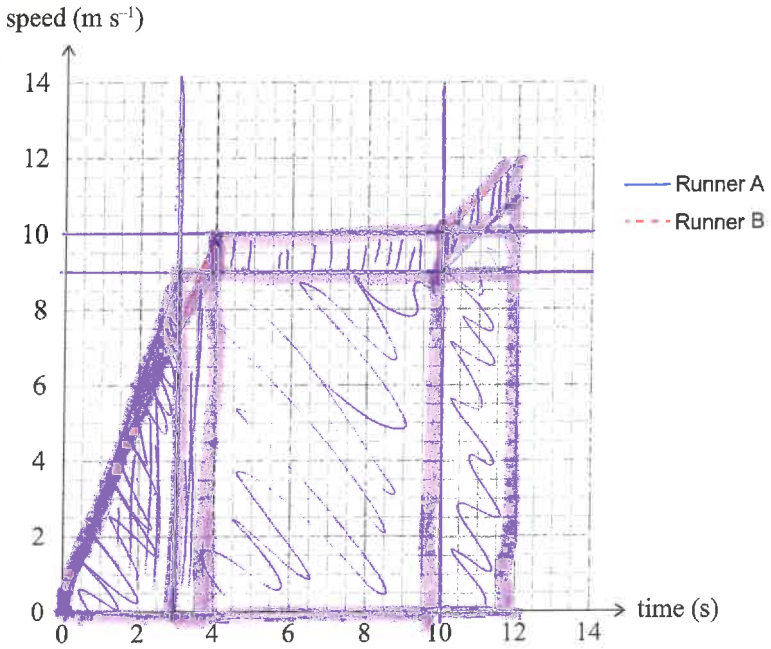
You may find the following formulae useful.

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

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

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.

Runner A has a ~~fastn~~ faster acceleration because they have a higher speed.

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

$a = \frac{\Delta v}{\Delta t}$ $3 - 0 = 3$

$9 \div 3 = 3$ $a = 3\ \text{ms}^{-2}$

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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.

B. V=10 $a = \frac{\Delta V}{\Delta t}$ $a = 10 \div 10 = 1\ ms^{-2}$

A. V = 9 $a = \frac{\Delta V}{\Delta t}$ $a = 9 \div 10 = 0.9\ ms^{-2}$

runner b is accelerating less at the start and more at the end.

runner A is accelerating more at the start and less at the end.

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

(B) $\frac{1}{2} \times 10 \times 4 = 20$

$6 \times 10 = 60$

$\frac{1}{2} \times 2 \times 2 = 2$

$2 \times 10 = 20$

$= 102$

runner b finishes first.

(A) $\frac{1}{2} \times 9 \times 3 = 13.5$

$7 \times 9 = 63$

$\frac{1}{2} \times 2 \times 2 = 2$

$9 \times 2 = 18$

$= 96.5$

(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.

P =

AE

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}.

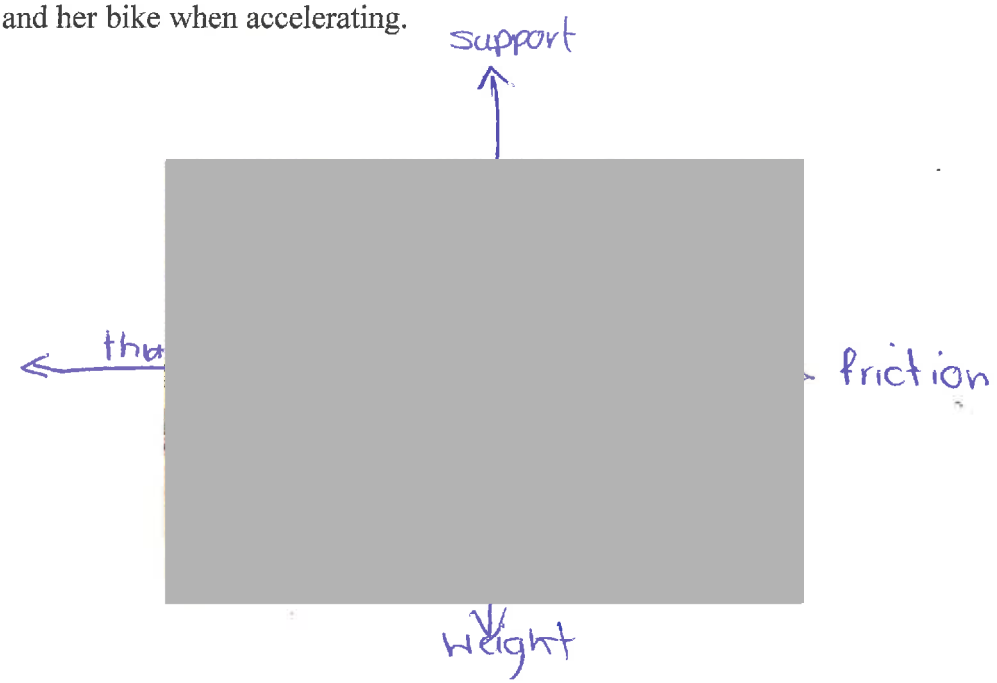
(a) Calculate the net force acting on the bike and rider when accelerating.

$F_{net} = ma$

$82 \times 0.80 = 65.6$ N

$F = 65.6$

(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**.

as she is accelerating, the thrust force is greater and the friction is less.
The weight and support force are ~~the~~ balanced because there is no net force.

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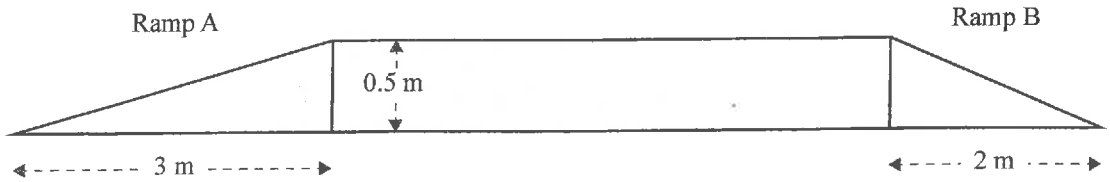
(c) Willow had to choose between two ramps to ride her bike to the top of an incline. It takes less time to use Ramp B.



(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.

ramp B would take more work as the ramp is ~~steep~~ steeper than A and A has more of a gradual rise and it is more spread and the work won't be as much.

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

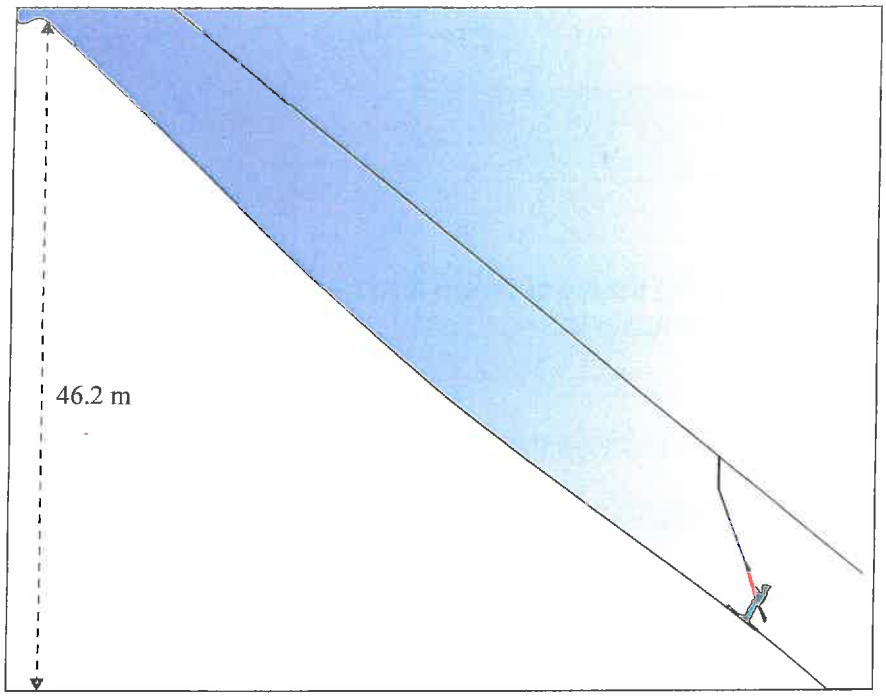
Calculations are not required.

~~The~~ Ramp A will need and have a lower ~~greater~~ work and acceleration force than ramp b because ramp b is steeper and it would take more effort and work to go up to the top. Ramp b will also have a lower acceleration because the work force will be higher. The power required will be higher on ramp B than ramp A.

A4

QUESTION THREE

ASSESSOR'S USE ONLY



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.

$W = fd$ → $13.42 \times 46.2 = 620\ J$

~~$62 \times 10 = 620$~~

~~620×46.2~~

$62 \times 10 = 620$

$F = \frac{W}{d}$ $620 \div 46.2 = 13.42$

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

8.75 minutes

Calculate the power needed to get Marama to the top.

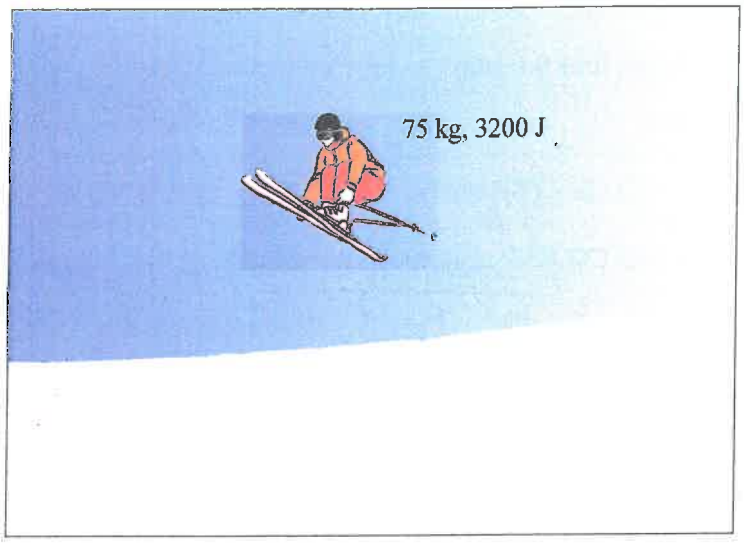
For this question, ignore friction.

$P = \frac{W}{t}$

$620 \div$ ~~525~~ $8.75 = 686\ W$

ASSESSOR'S USE ONLY

(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.

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(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.

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

Calculations are not required.

He won't sink as much as his weight is spread over a larger surface area. Before, he sunk in because he had a smaller surface area and his weight wasn't spread over a large surface.

N2

Annotated Exemplar Template

Subject	Science	***Standard***	90940	***Total score***	10

Q	***Grade score***	***Annotation***
1	A4	This candidate would have moved to a M5 if they had mentioned why they knew Runner A had a faster acceleration, for example, because the slope was steeper. In question 1 (ci) this candidate had enough evidence for Merit even though they had worked out the average acceleration over the whole 10 seconds instead of the first 3 or 4 seconds. This candidate used the area under the graph to calculate the total distance travelled, but again missed out the units.
2	A4	Question 2(a) was done well but units were missing. The vectors on the cyclist were well labelled and the sizes were appropriate. However, the candidate was unable to describe the consequence of these vectors. To get to the next level the candidate needed to state that the forces were unbalanced and hence the cyclist was accelerating. In the ramp question, even though this candidate could state that the power was greater going up ramp B, they did not state why correctly. It is because it took a shorter time to do the same amount of work as Ramp A. This would have enabled them to achieve a higher grade for this question.
3	N2	The grade score was hampered by this candidate not completing the question. Part (a) and (b) used the correct equations; however, this student did not put the correct numbers into them. In part (d) this candidate realised that wider skis had a larger surface area but could not explain that this would result in a lower pressure since the weight of the skier would stay the same