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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.

Achievement

TOTAL 09

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Annotated Exemplar

Achieved Exemplar 2016

Subject:	Science	Standard:	90940	Total score:	09

Q	Grade score	Annotation
1	A3	(a) Students described 3 of the 4 points correctly. (b) The right equation was used but this student read the wrong values off the graph. (c) Although the right equation was used the value for Pressure was substituted for the Force and the area (in centimetres squared instead of metres squared) was squared. It is not the value that is squared just the unit. (d) This student has realised that more force causes more pressure to be exerted.
2	N2	(a) Here the incorrect method was used. It should be the area under the graph. (b) The speeds in the two sections were identified correctly, however, for a constant speed the drag must equal the thrust force. (c) The weight force was calculated correctly as was the work done. The next step would be to calculate the power exerted. (d) This student did not understand that the force is lower as the distance is greater and the power greater as the time is less.
3	A4	(a) The correct definition for mass was given but not the definition for weight (b) The value for acceleration was calculated correctly however the unit was wrong (c) The correct formula was used. However the velocity was the quantity that was asked to be calculated using conservation of energy (d) In this question the change of speed was correctly stated for point 1. The rocket is falling so it is the weight force acting against air resistance

QUESTION ONE

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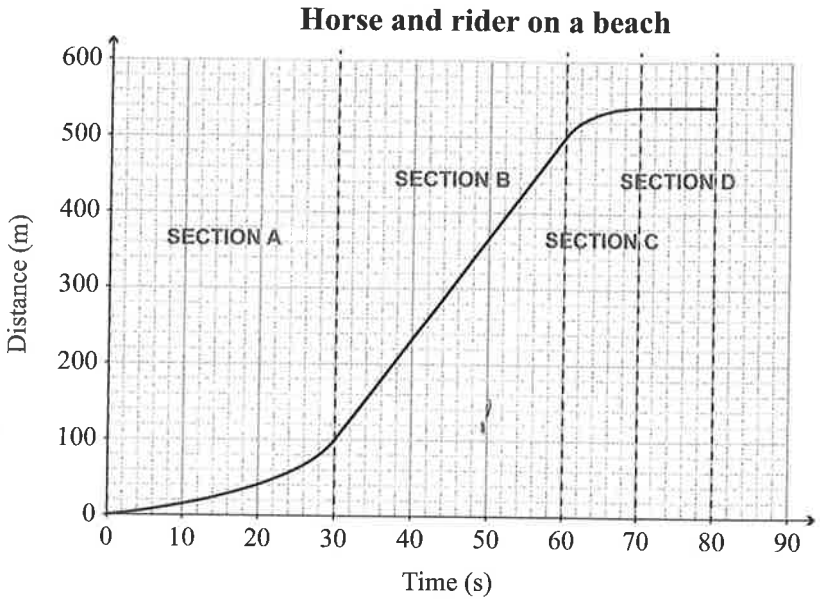
The graph below shows the motion of a horse and rider as they travel along a beach.



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

Section A: Accelerating

Section B: Constant Speed

Section C: Decelration

Section D: Constant speed

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

$V = \frac{d}{T}$

$V = \frac{500}{40}$

$V = 12.5 m/s$

(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.

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

$P = \frac{200155}{44^2}$

$P = 103.38\ kg$

$g = 10\ N\ kg^{-1}$

$g = 10338 \times 10$

$g = 1033.8\ N$

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

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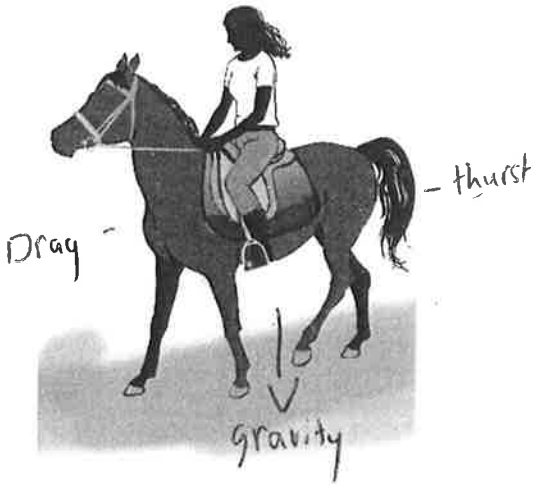

Explain why the horse's hooves sink further into the sand when the rider gets onto the horse.
In your answer you should consider the **pressure applied** and the **forces acting**.
(No calculations are necessary.)

Because pressure is measured in $P=\frac{F}{A}$ so the more force there is and area the pressure there is

Because pressure is measured in $P=\frac{F}{A}$ So if there is more force being applyied over an area then the horses hooves will sink further So when the girl Sat on the horse there was more force acting over over an area so the hooves Sank further into the ground. because there was more pressure

A3

QUESTION TWO

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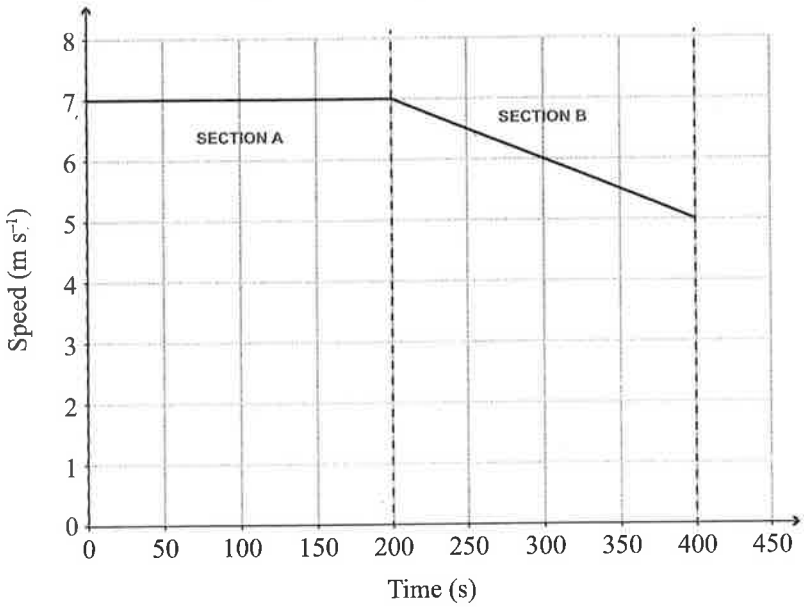
A harvester was working in a paddock.

photo.elsoar.com

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

Speed-time graph of a harvester



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

$a = \frac{V}{T}$

$a = 200$

$a = 0.035$

(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: The harvester was at constant speed so there where equal amounts of Thurst and drag acting upon the harvester but there was a little bit more thurst as it was not standing still as it was still moving forwards

Section B: The harvester was decceleratiny in speed so there was more drag then thurst acting on the harvester.

W=Pd

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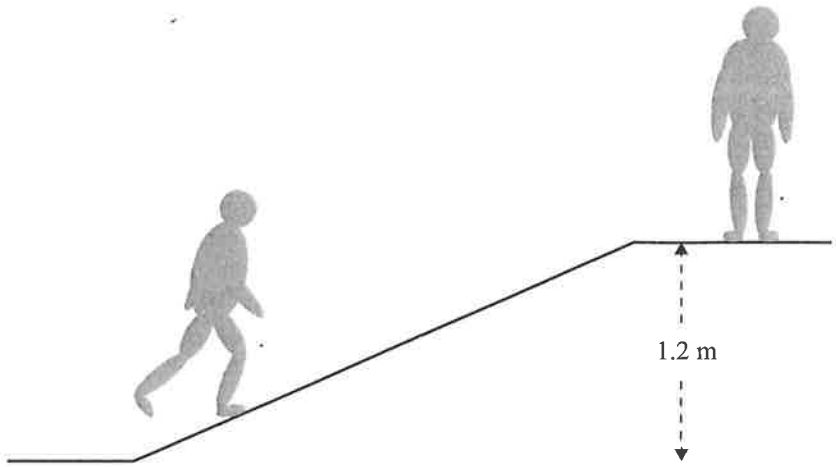
The harvested grain is stored in a shed with a ramp.

(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.

$g = 10N\,kg^{-1}$

$85 \times 10 = 850N$

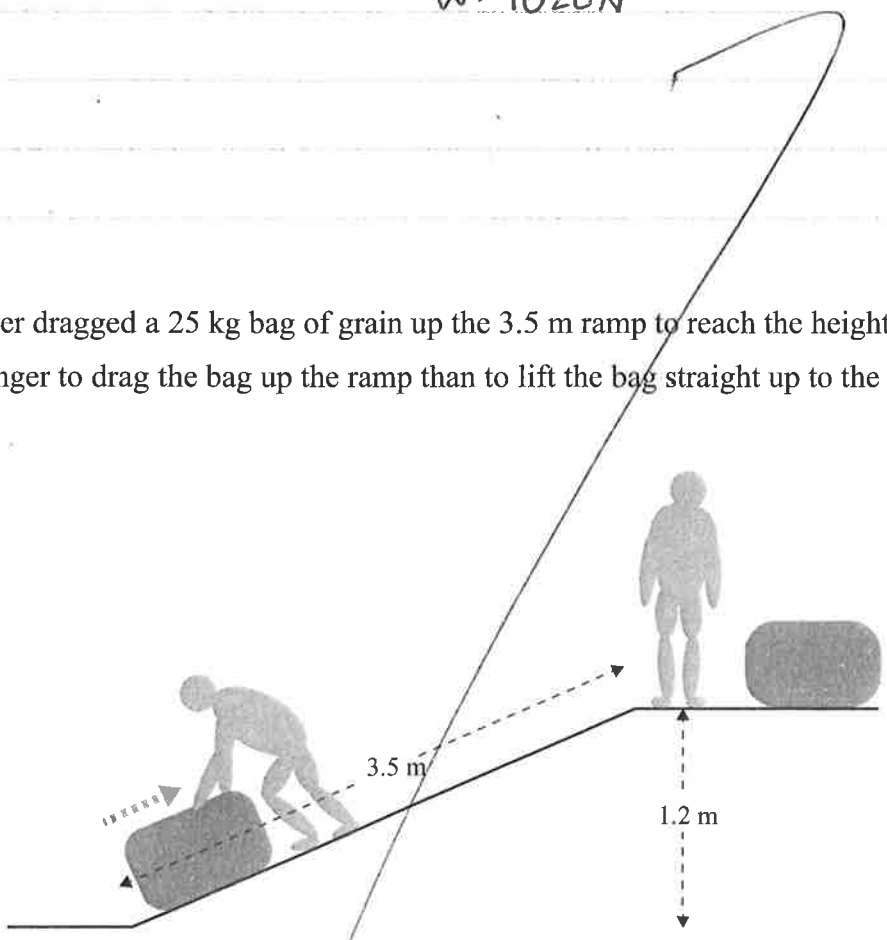
$W = Fd$

$W = 850 \times 1.2$

$W = 1020N$

(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.

Because force is measured in F=ma
So if he picked up the bag of grain
Straight up (Vertically) there would be more mass over
area so making it harder to pick up vertically
and requiring more forces then if he dragged it.

(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.)

less power is required when
lifting the box vertically because he has a shorter
distance he has to lift it to meaning he
has to use less power because when he has
to drag the box he has to drag it for longer
meaning he is using more energy. (lifting it requires
him to lift it to 1.2m) (pushing it requires him to
push it for 3.5m)

N2

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.

mass = is the amount of matter in an object or person.

weight = the amount of ~~mass~~ quantity in an object or person.

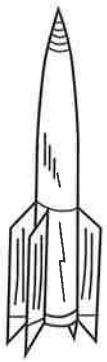
(b) The rocket was fired vertically. It left the launch pad and after 1.2 s was travelling at 20 m s^{-1}.

Calculate the rocket's acceleration.

$a = \frac{v}{t}$

$a = \frac{20}{1.2}$

$a = 16.7 ms^{-1}$



(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)?

$E_K = \frac{1}{2}mv^2$

$E_K = \frac{1}{2} \times 26.0 \times 20^2$

$E_K = 5200$ M/S

(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.

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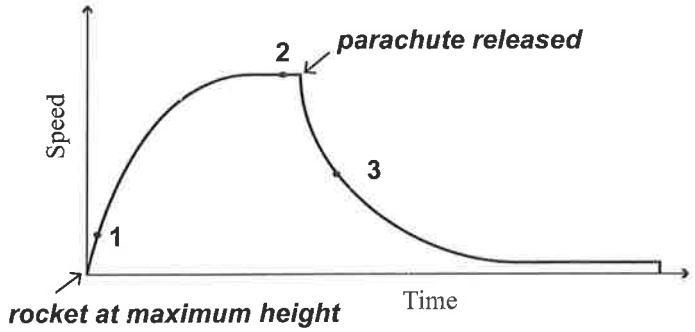
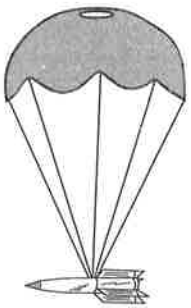
The graph below shows the speed-time graph of the rocket **falling from its maximum height** back to ground. Just after point **2**, a parachute is released.





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.

At point 1 the rocket was accelerating and the forces where unbalanced as there was a lot more thurst then drag. At point 2 the forces where balanced as there was equal amounts of thurst and drag. At point 3 the forces where unbalanced as there was more drag then thrust making the rocket slowly decend down. The air particals was acting as friction as the rocket was falling making it slow down faster.

A4