1

90940

909400

NZQA

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
KIA NOHO TAKATŪ KI TŌ ĀMUA AO!

SUPERVISOR'S USE ONLY

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.

Excellence

TOTAL 22

ASSESSOR'S USE ONLY

Excellence Exemplar

Subject:	Science	Standard:	90940	Total score:	22

Q	Grade score	Annotation
1	E8	(a) The motion of all 4 sections was described correctly. (b) The speed of the horse in Section B was calculated correctly. (c) The correct method was used to calculate the Weight This student has appreciated that you need to multiply the surface area of one hoof by 4. (d) This student answered this question correctly. The weight increases and so does the pressure as long as the surface area stays the same. There is some extra discussions that do not add to this answer.
2	M6	(a) The distance was calculated correctly. (b) A description of the net force and the effect on motion was given in both sections and these forces (thrust and drag) were named. (c) The work done and the power exerted were calculated correctly. (d) This student did not realise that the work done in both situations were the same and if the distances were different therefore the forces must be different. The same applies to the power. If the work done is the same and the time is less then the power exerted must be more.
3	E8	(a) A correct definition for mass and weight were given. (b) The acceleration was calculated correctly with the correct unit. (c) The velocity that the rocket would hit the ground was correctly calculated. There was a good discussion as to why this must be the maximum velocity although this was not required. (d) This question was answered very fully.

You may find the following formulae useful.

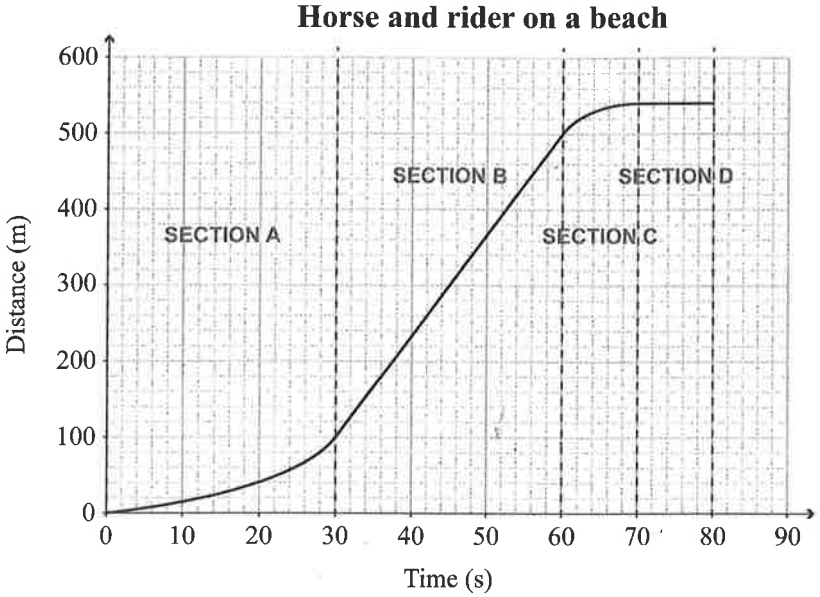
$$v = \frac{\Delta d}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t} \qquad F_{net} = ma \qquad P = \frac{F}{A} \qquad \Delta E_p = mg\Delta h$$

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

QUESTION ONE

ASSESSOR'S USE ONLY

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: ~~Acceleration~~ Acceleration

Section B: Constant speed

Section C: Deceleration

Section D: Stationary

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

$v = \frac{\Delta d}{\Delta t}$

$= \frac{400m}{30s}$

$= 13.3\ ms^{-1}$

(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.

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

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

$$200155\ Pa = \frac{ma}{A} \qquad (F = ma)$$

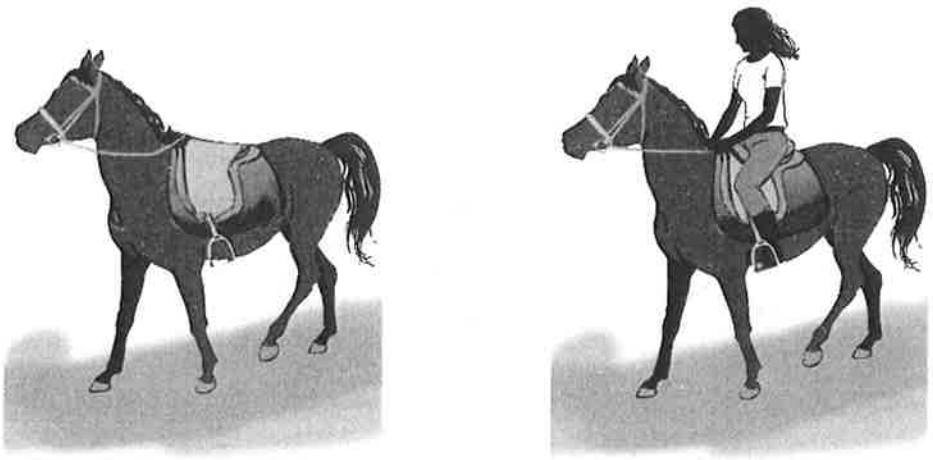
$$200155\ Pa = \frac{m \times 10 ms^{-2}}{0.0044 m^2 \times 4}$$

$$3522.728 = m \times 10 ms^{-2}$$

$$F = 3522.728\ N$$

In science, weight is measure the ~~force~~ force on an object and causes by the effect of gravity. Like ~~force~~ force, it is measure in newton (N). Therefore the weight of the house is 3522.728 N

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



Explain why the horse's hooses 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.)

~~Pressure~~ The amount of pressure depends on the ~~force acted~~ surface area of an object and the force that applied on that area. As if the force that applied on that area increase, ~~the~~ and the surface area remains unchange, the pressure increase. As if the surface area of the object increase ~~area~~ and the force that ~~is~~ applied on that area remains unchange, the pressure decrease. The surface area of the horse's hooves remain unchange but the force that applied on it increase as the mass increase when the rider gets onto the house. Therefore there will be more force concentrated on the ~~is~~ small ~~area of feet~~ surface area and the pressure applied on the sand will be more, and it gives a better grip to the sand ~~as~~ as the result the horse's hooves sink further into the sand when the rider gets onto the ~~house~~ horse.

E8

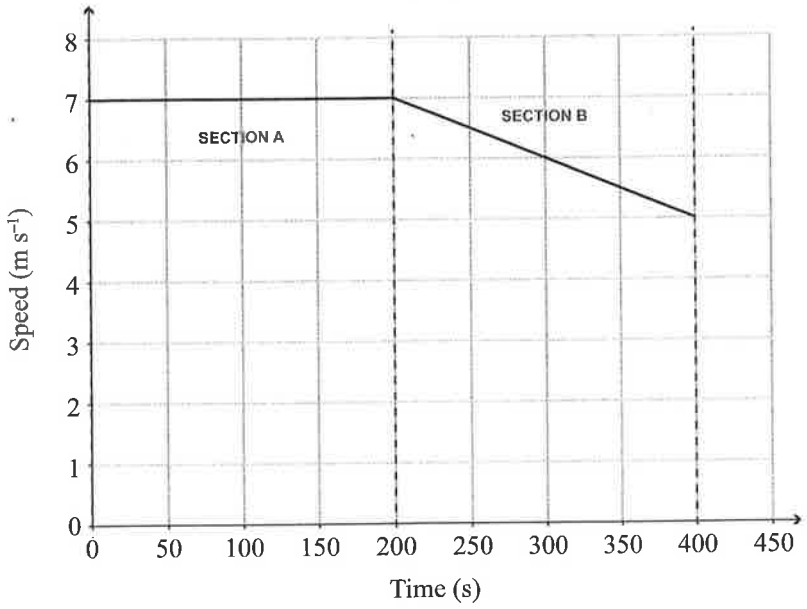
QUESTION TWO

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.

$v = \frac{\Delta d}{\Delta t}$

$\Delta d = v \times \Delta t$

$= 7\ m\ s^{-1} \times 200\ s$

$= 1400\ m$

SSOR'S ONLY

ASSESSOR'S USE ONLY

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

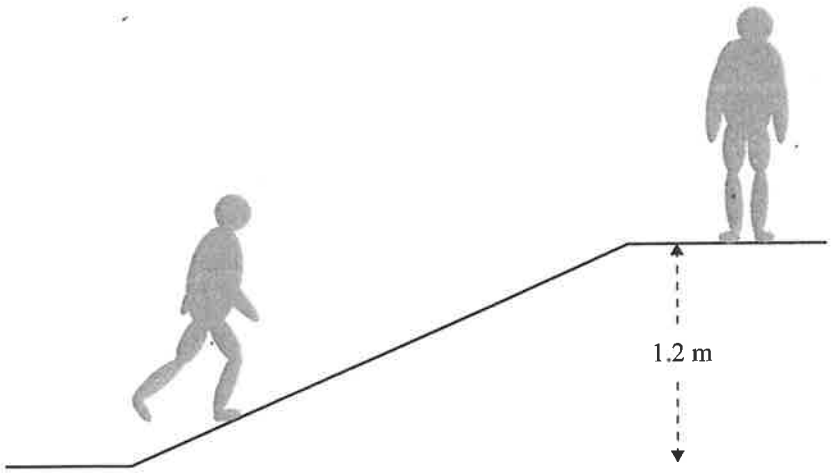
Include reference to the **net force**.

Section A: The time ~~is~~ is increasing to the right but the speed does not change which mean the harvester is moving at a constant speed. The forces that are acting on the oppsite site are balanced because they are the same size which mean the ~~two~~ thrust force equals to to friction force and they cancel each ~~other~~ other out. Therefore there will be no net force.

Section B: Net force is the resultant force of mutiple forces interact. If the forces are pointing at an ~~oppo~~ opposite direction, ~~it~~ the forces subtract and giving a smaller net force (or zero net force) The net force of the ~~harvester~~ harvester is pointing to the opposite direction to the direction of motion which mean the the ~~friction force do~~ thrust force is less than the friction force. ~~Therefore~~ Therefore, the ~~harv~~ harvester decelerates and shows on the graph as ~~it~~ slowing its speed down from ~~7~~ 7 ms^{-1} to 5 ms^{-1}.

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.

$W = Fd$

$= (85\ kg \times 10 ms^{-2}) \times 1.2m$

$= 1020\ J$

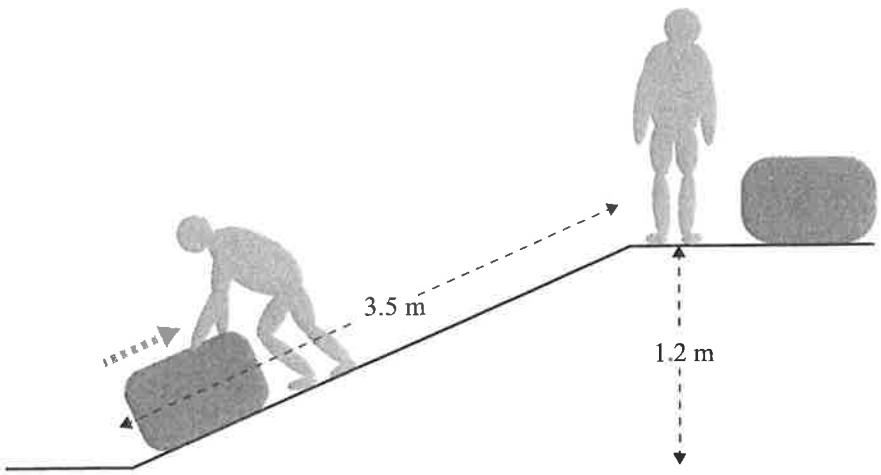
$P = \frac{W}{t}$

$= \frac{1020\ J}{8\ s}$

$= 127.5\ watt$

(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.



(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.

The amount of work done to drag the bag of grain up the ramp is The amount of work depends on the force on the object and the distance the object travelled. Work = Force x Distance. As either force of object or the distance increase, the work increases. The force needed to drag the bag of grain up the ramp to the top is less because it allows less force applied on the bag over a greater time / distance as the acceleration of the bag graining up the ramp is less than lift the bag straight up due to the Earth's gravity ($10 ms^{-2}$)

(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.)

Power = $\frac{\text{work}}{\text{time}}$ As the amount of work increases, the power increases and as the time decrease, the power increases. The amount of work done to drag the bag of the bag of grain to the top of the ramp is less than the bag is lifted straight up to the top of the ramp and it also took a longer time. When it is the smaller amount of work done over a greater time, the power needed to drag the bag of grain to the top of the ramp is less than the power needed when the bag is lifted straight up.

M6

QUESTION THREE

ASSESSOR USE ONLY

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

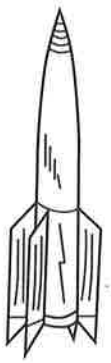
(a) Explain the difference between mass and weight.

The mass is measured of the amount of matter on an object and it is ~~not~~ measured by kilogram (kg). It does not change if the object changes its location. The difference between mass and weight is the weight is measured of the force that applied on an object and it causes by the effect of gravity. Weight is measured in newton (N) like force.

(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.

$$a = \frac{\Delta v}{\Delta t}$$
$$= \frac{20 ms^{-1}}{1.2 s}$$
$$= 16.7 ms^{-2}$$



(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)?

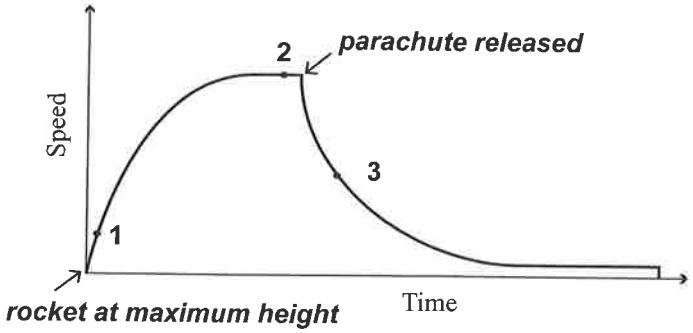
$$\Delta E_p = E_K = 1950 J$$
$$E_K = \frac{1}{2} m v^2$$
$$1950 J = \frac{1}{2} \times 2.6 kg \times v^2$$
$$v^2 = 1500$$
$$v = 38.7 ms^{-2}$$

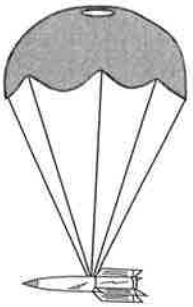
The maximum speed it could reach just before ~~hitting~~ hitting the ground will be 38.7 ms^{-2} (no friction). But in reality, some kinetic energy will be 'lost' as friction ~~force~~ causes some of the energy converted into heat and sound energy when the ~~rocket~~ rocket is falling. Therefore the maximum speed it could reach just before hitting the ground in reality will be less than 38.7 ms^{-2}.

ASSESSOR'S USE ONLY

(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.

When an object falls, there are two forces are acting on it which is weight force that causes by the effect of Earth's gravity on the object's mass and acts downward of the object, and the friction force that causes by air resistance and acts upward of the object. As the rocket falls though the air, the air resistance is due to the Earth's gravity ($10\ ms^{-2}$) as the weight force is much greater than friction force which is very low so the rocket accelerates at point 1. As the rocket kept falling, the air resistance increases because air resistance is the result of collisions of the object's leading surface with air molecule so the more air molecules are colliding with the surface area of rocket, the greater air resistance. As the result the net force between the weight force and friction force gets small. The rocket is still accelerate and the forces are unbalanced. Eventually, the weight force that acting downward is balanced by the upward force of air resistance (friction force) and the rocket

E8

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

QUESTION NUMBER

ASSESSOR USE ONLY

is falling at a constant speed (no acceleration) which is called terminal velocity ~~The amount of air resistance depends~~ at point 2. The amount of air resistance ~~is~~ depends on the falling speed of the object and the surface area of the object. When the parachute is released after point 2, the surface area ~~of the rocket and parachute~~ that ~~collides~~ collides with air ~~molecule~~ molecule increase. ~~There forces~~ Therefore, Therefore the friction force is now greater than the weight force ~~which is~~ and the forces are unbalanced. As the result the ~~rocket~~ rocket decelerates with the parachute at point 3.

90940