1

SUPERVISOR'S USE ONLY

90940

909400

NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

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

Level 1 Science, 2015

90940 Demonstrate understanding of aspects of mechanics

9.30 a.m. Tuesday 10 November 2015
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 2–15 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.

Low Excellence

TOTAL 20

ASSESSOR'S USE ONLY

You may find the following formulae useful.

ASSESSOR'S USE ONLY

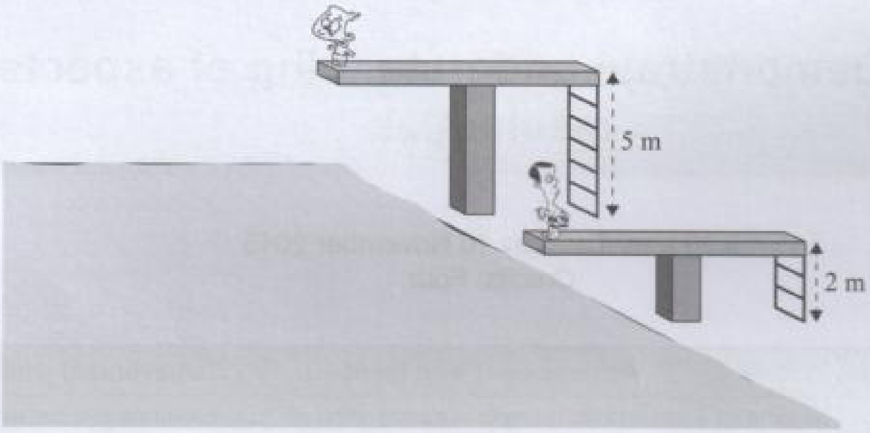
$$v=\frac{\Delta d}{\Delta t} \qquad a=\frac{\Delta v}{\Delta t} \qquad F_{\text{net}}=ma \qquad P=\frac{F}{A} \qquad \Delta E_p = mg\Delta h$$

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

The value of g is given as $10\ \text{m s}^{-2}$

QUESTION ONE: SWIMMING POOL

Chris and Ian were jumping off different platforms into a pool.



(a) It took Chris 0.60 s to reach the water once he had jumped from the 2 m platform.

Calculate his average speed.

$S = \frac{d}{t} = \frac{2}{0.6} = 3.33$ m/s

(b) How much work did Chris (48 kg) do when he climbed up the stairs to the 2 m platform?

~~W~~ $W = Fd$

$F = 48 \times 10 = 480$ N

$W = 480 \times 2 = 960$ J

ASSESSOR'S USE ONLY

(c) Ian's mass is 52 kg.

Why did Ian do more work climbing up the 5 m ladder compared to Chris climbing up the 2 m ladder?

No calculations are needed.

Ian did more work because ~~he had~~ to move a larger distance with more force. As the formula for work is F×d, Ian had both a larger force (520N) and a further distance (5m), therefore he did more work. //

(d) Ian jumps into the pool from the 5 m platform.

Calculate Ian's speed as he is about to hit the water (assuming conservation of energy).

In your answer you should:

- name the types of energy Ian has before he jumps, AND as he is about to hit the water
- calculate Ian's speed as he is about to hit the water.

At the top of the platform Ian's energy was stored as GPE, which equals mgh = 52×10×5 = 2600J. When he jump his energy is being converted into kenetic energy.

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

$2600 = \frac{1}{2}mv^2$

$2600 \div \frac{1}{2}m = v^2$

$v^2 = 100$

$v = 10 m/s$

When Ian is about to hit the water ~~t~~ all of the GPE has been converted into kinetic energy he is moving fastest at this point.

(e) Explain why Ian's actual speed as he is about to hit the water, is slower than that calculated in part (d).

ASSESSOR'S USE ONLY

Ian's actual speed is slower than calculated because realistically not all of the GPE he had at the top of the platform was converted into kinetic energy. Some of the energy was converted into heat and sound energy due to friction ~~and~~. ✓

1/ 3H

M6

ASSESSOR'S USE ONLY

QUESTION TWO: FORCES

The kererū (also known as New Zealand wood pigeon or kūkupa) is one of the largest pigeons in the world.

http://nzbirdsonline.org.nz/species/new-zealand-pigeon

(a) (i) Explain the difference between mass and weight.

Mass is the measurement of how much matter something has, whereas weight is a measurement of force exerted by mass multiplied by gravity. Weight changes across planets, mass is universal.

(ii) Calculate the weight of a kererū that has a mass of 630 g.

$F = ma$

$F = 0.630 \times 10$

~~Fta~~ Force/Weight = ~~6.3 N~~ 6.3N

(b) The force diagrams below show another kererū flying at a constant speed, but then slowing down. Only horizontal forces are shown in these diagrams. Assume any other forces are balanced.

ASSESSOR'S USE ONLY

Constant speed **Slowing down**

adapted from http://nzbirdsonline.org.nz/species/new-zealand-pigeon

Referring to the force diagrams above, explain the link between the horizontal net force acting on the bird, and the type of motion produced.

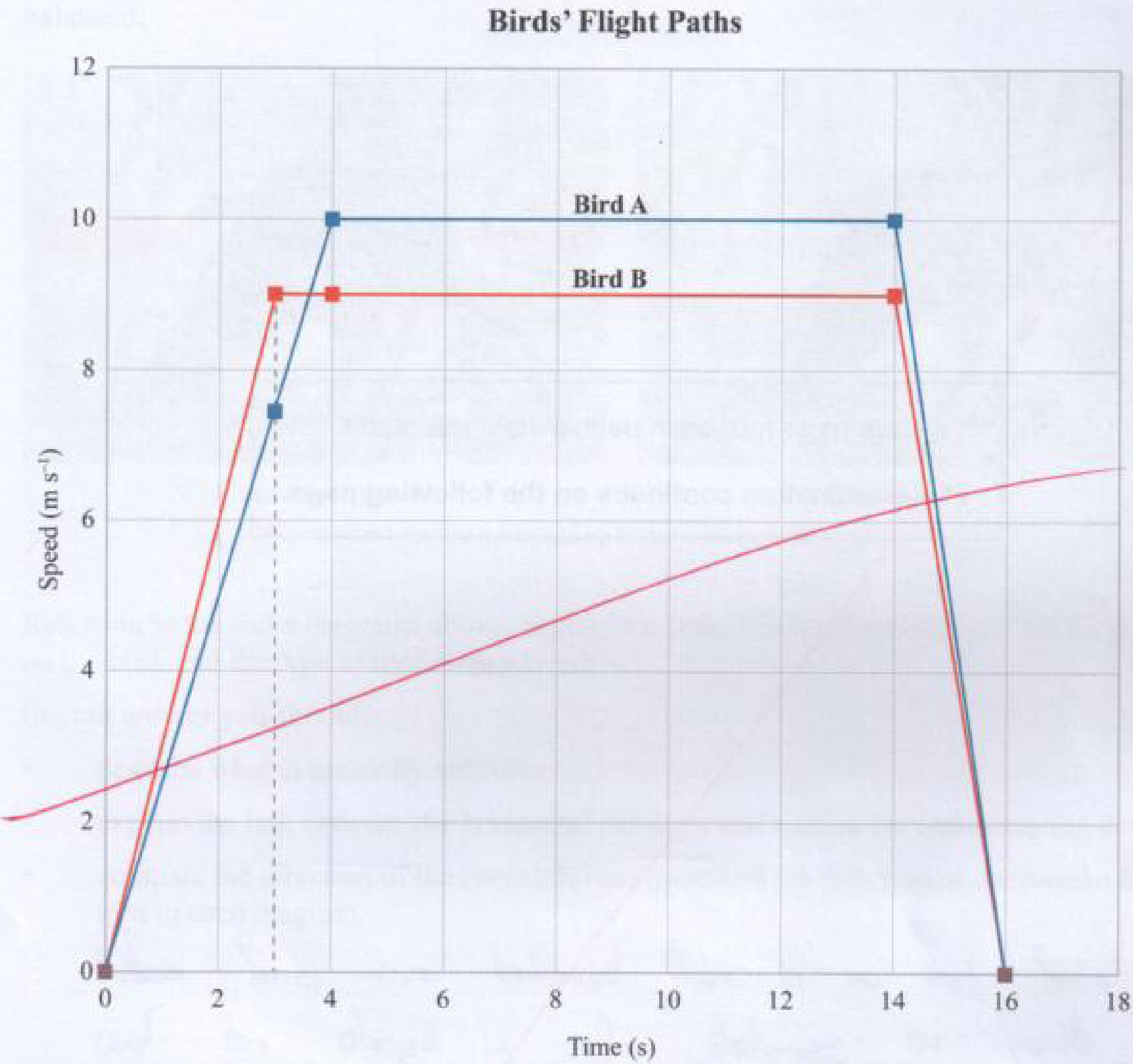
In your answer you should:

- describe what is meant by net force
- explain the link between the horizontal net force and motion for each situation described
- compare the direction of the horizontal net force and the direction of the motion for the bird in each diagram.

When forces are balanced there is no net force and an object is either stationary or travels at a constant speed. Net force is the amount of extra force there is in one direction, this causes movement either accelleration or decelleration. The horizontal forces acting on the first diagram are balanced so the bird is moving at a constant speed. However the second ~~diag~~ diagram shows unbalanced horizontal forces, indicating there ~~is~~ is a net force. In this case the drag force is greater than the thrust force, so the net force is against forward movement causing the bird to decellerate. //

ASSESSOR'S USE ONLY

(c) The speed-time graph shows the flights of two birds.



(i) Use the graph to explain which bird has the greater acceleration in the first 3 seconds.

Calculation is not required but may be used.

Bird B has a faster acceleration in the first 3 seconds.

$a = \frac{\Delta v}{\Delta t} = \frac{9}{3} = \cancel{3 m/s/s}\ 3 m s^{-2}$ – Bird B

$a = \frac{\Delta v}{\Delta t} = \frac{7.5}{3} = 2.5 m s^{-2}$ – Bird A

(ii) In 16 s, **Bird B** travelled 121.5 m.

How much further did **Bird A** travel in the same time?

Show all working.

2 x 10 = 20m
10 x 10 = 100m
2 x 10 = + 20m
140m in 16s

ASSESSOR'S USE ONLY

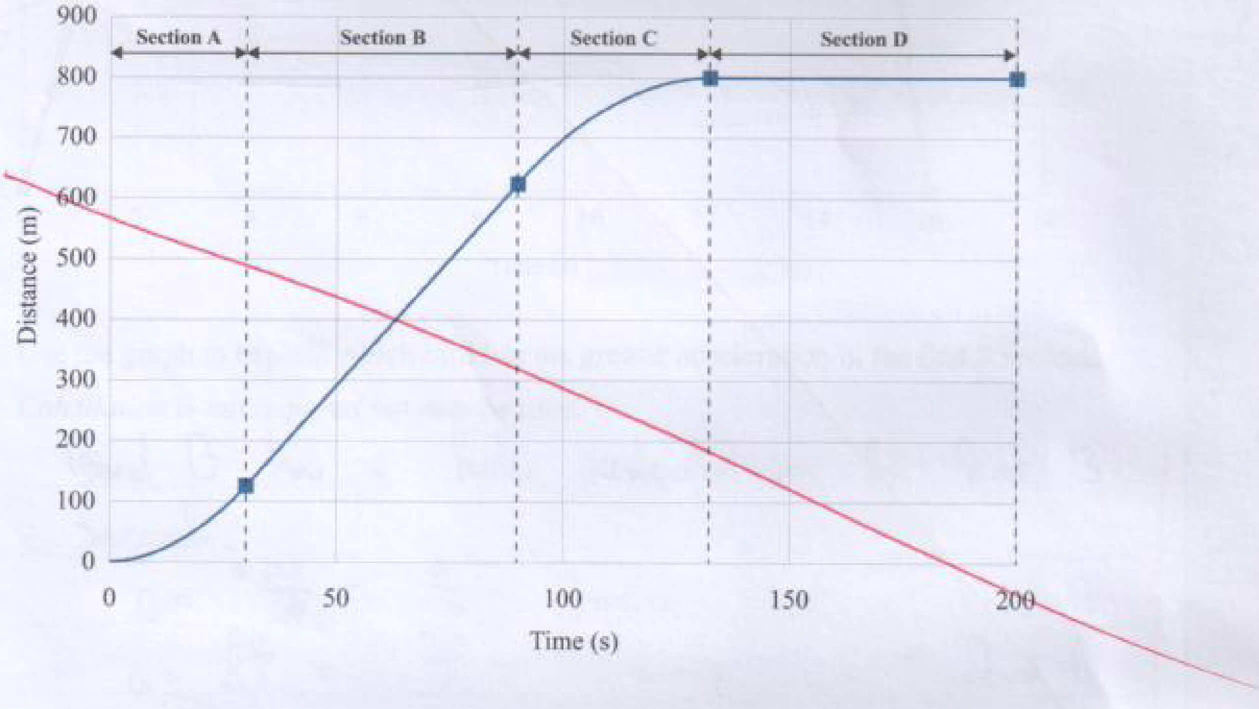
M6

QUESTION THREE: ROWING

http://www4.pictures.zimbio.com/gi/Zoe+Stevenson+Samsung+World+Cup+Sydney+T5PlDwyWCo8l.jpg

The distance-time graph below shows the journey of a rowing boat in a race.

Distance-time graph for rowing race



ASSESSOR'S USE ONLY

(a) Describe the motion of the boat throughout the journey.

No calculations required.

Section A: Boat is accelerating

Section B: Boat is travelling at a constant speed.

Section C: Boat is decellerating

Section D: Boat is stationary

(b) During the first 30 s of the race, the rowers' speed changed from 0.0 m s^{-1} to 8.3 m s^{-1}. During this time they covered 125 m. The total mass of the rowers and the boat is 140 kg.

(i) Calculate the boat's **average acceleration** during the first 30 seconds.

Show your working.

$a = \frac{\Delta v}{\Delta t} = \frac{8.3}{30} = 0.28 = 0.3 ms^{-2}$

(ii) Calculate the **work done** to cover the distance of 125 m.

Show your working.

$W = Fd$

$F_{net} = ma = 140 \times \cancel{0.28}\ 0.3 = 42N$

$W = 42 \times 125 = 5250 J$

ASSESSOR'S USE ONLY

(c) Two people rowed out to a pontoon floating in the water.

The pontoon has a mass of 185 kg. The dimensions of the pontoon are shown in the photo above.

(i) Use surface area and force to calculate the pressure exerted by the pontoon on the water.

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

$F = ma = 185 \times 10 = 1850\,N$

$A = 3 \times 4 = 12\,m^2$

$P = \frac{1850}{12} = \cancel{154.7\,Pa}\ 155\,Pa$

(ii) The two people then climb onto the pontoon and stand on it.

ASSESSOR'S USE ONLY

Explain why the pontoon will sink lower in the water when the people stand on it.

The pontoon will sink lower into the water because more pressure is being exerted onto the water. Pressure = F/A. The force is increasing because the two people are adding weight force, however the area is staying the same, this means that more force is being exerted on the same area. The water requires more support force to keep the pontoon afloat, therefore the the pontoon sinks lower until the support force = the weight force. More pressure is created on the same area when two people stand on the pontoon.

A1L E8

Annotated Exemplar for Science level 1 AS 90940, 2015

Excellence exemplar for Science Level 1 AS 90940, 2015		Total score	20
Q	**Grade score**	**Annotation**	
1	M6	The candidate has calculated work for Chris and used “work is Fxd” to link the relationship between work, force and distance in the explanation of why Ian had done more work. The candidate has correctly calculated Ian’s speed as he is about to hit the water. The explanation as to why his actual speed is slower lacked in-depth discussion of how the friction occurred, and why this led to the loss of speed.	
2	M6	The candidate explained the difference between mass and weight and correctly calculated weight force with correct conversion of the unit. In discussion of the horizontal net forces in the two situations, the candidate used appropriate language to fully explain how a net force is produced and how it causes different motions. E.g. the net force opposing the motion of the bird which causes it to slow down. For an E grade overall, the student needs to correctly calculate the extra distance that bird A travelled compared to bird B.	
3	E8	The candidate correctly calculated pressure with the correct unit. The candidate used pressure formula to link the relationship between pressure, force and surface area. The candidate fully explained the increased weight force and the same area led to an increased pressure which causes the pontoon to sink lower.	