1

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90940

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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.

Not Achieved

TOTAL 5

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m = mass
E_K = kinetic energy
W = work

You may find the following formulae useful.

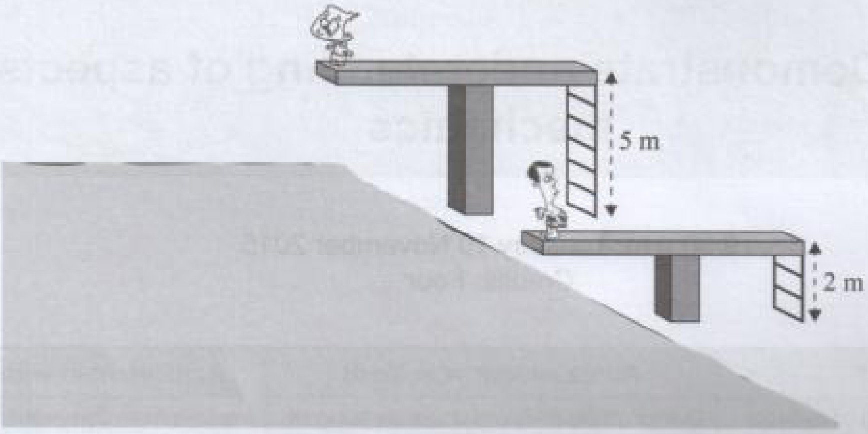
F m a

$v = \dfrac{\Delta d}{\Delta t}$ $\quad a = \dfrac{\Delta v}{\Delta t}$ $\quad F_{net} = ma$ $\quad P = \dfrac{F}{A}$ $\quad \Delta E_p = mg\Delta h$
$E_k = \dfrac{1}{2}mv^2$ $\quad W = Fd$ $\quad g = 10\ \text{N kg}^{-1}$ $\quad P = \dfrac{W}{t}$
The value of g is given as $10\ \text{m s}^{-2}$

g = gravity

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.

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

$V = \dfrac{2m}{0.60}$

$= 3.33' m/s$

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

~~W = Fd~~
~~W = 10 × 2m~~
~~= 20~~

mass = 48 kg
distance = 2 m
velocity = 3.33 m/s

$F_{net} = mg$
$F_{net} = 48kg \times 5.55 m/s^2$
$= 266.4 N$

$a = \dfrac{\Delta v}{\Delta t}$
$= \dfrac{3.33 m/s}{0.60}$
$a = 5.55 m/s^2$

W = Fd
$W = 266.4 N \times 5.55 m/s^2$
W = 1478.52 kJ

1.2

(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 climbing up the 5m ladder in comparison to Chris climbing up the 2m ladder because there was more mass involved and the distance was longer.

(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.

Kinetic energy, heat energy.

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

$V = \frac{5m}{1.5s}$

$= 3.33 m/s$

Ians speed as he is about to hit the water is: 3.33 m/s

m = 52 kg
d = 5 m

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

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lans actual speed as he is about to hit the water is slower than the calculated part in (d) because in comparison to the ~~weight~~ mass of chris (48kg) & the ~~speed~~ average speed of chris (3.33m/s) Ian should have had a higher speed because of his mass (52kg).

N2

QUESTION TWO: FORCES

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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. kg's/g

Mass is measured in ~~[illegible]~~ is

Weight is a force and is measured in N (Newtons). Weight has a force of 10.

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

630g × 10N = 6.3 kg

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(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.

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.

The two forces involved are Thrust and Pull. These two forces combined become a total force i.e net force.

there is a deceleration in the motion of the bird.

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

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

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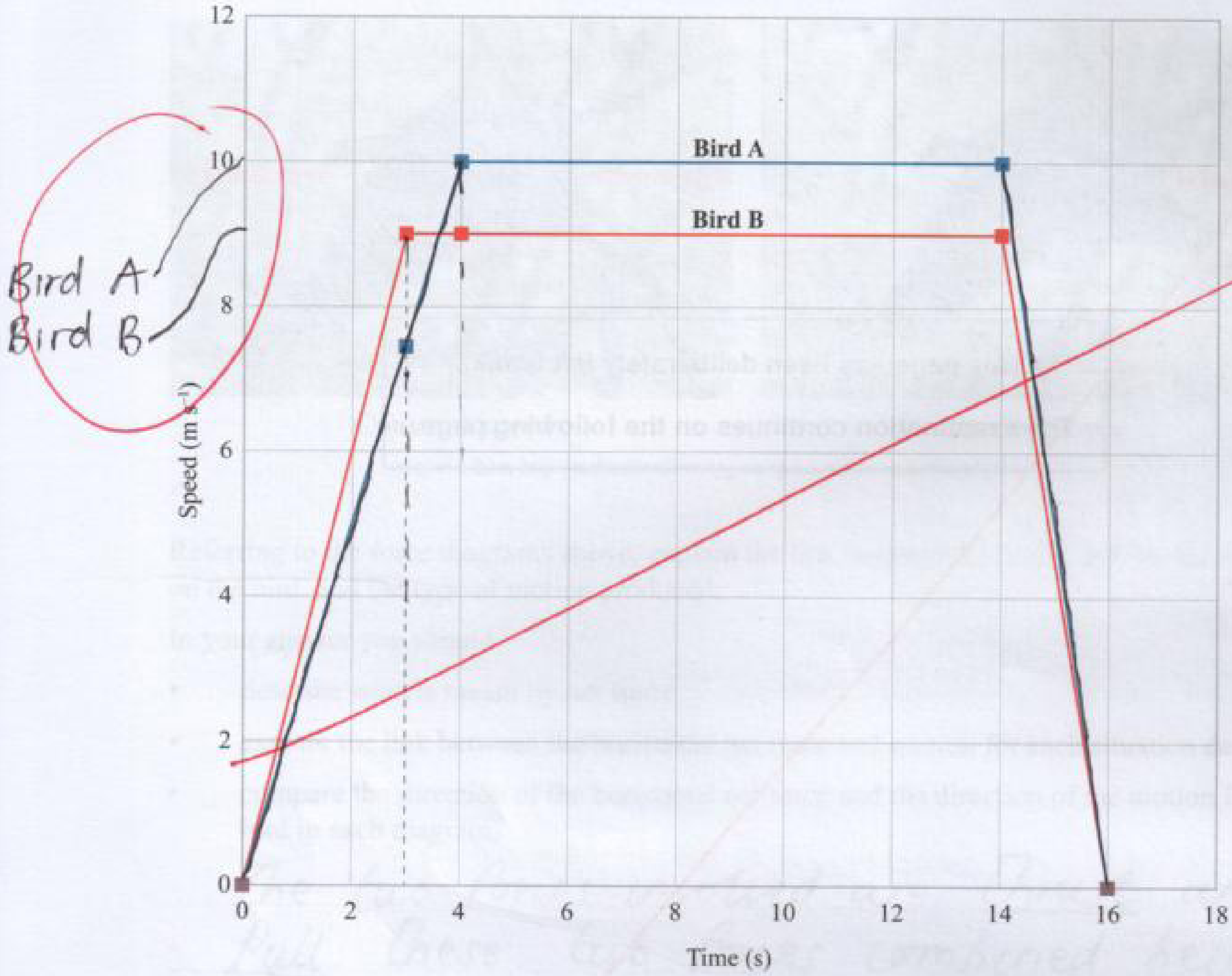
Birds' Flight Paths



(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 the greater acceleration in the first 3 seconds reaching a speed of 9m/s whereas Bird A is slower and reaches a speed of about 7.5 m/s in three seconds.

Bird A | Section A

$a = \frac{\Delta v}{\Delta t}$ $\frac{10}{4} = 2.5 m/s^2$ } Bird B

~~Section~~ Section B

$\frac{10}{10} = 1 m/s^2$

Section C $a =$

$\frac{10}{2} = 5$

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

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

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

Show all working.

Bird B
$t = 16s$
$d = 121.5m$
$v = 7.59 m/s$
$a = 0.47 m/s^2$

Bird A =
$v = 8.5 \times 16$
$d = ?$
$t = 16s$
$a = 8.5 m/s^2$

$d = vt$
$d = 8.5 \times 16$
$= 136m$

$136 - 121.5m = 14.5m$

Bird A travelled ~~14.5m~~ 136m ~~further~~ in ~~than~~ ~~for~~ 16s which is 14.5m further than what Bird B travelled in the same time.

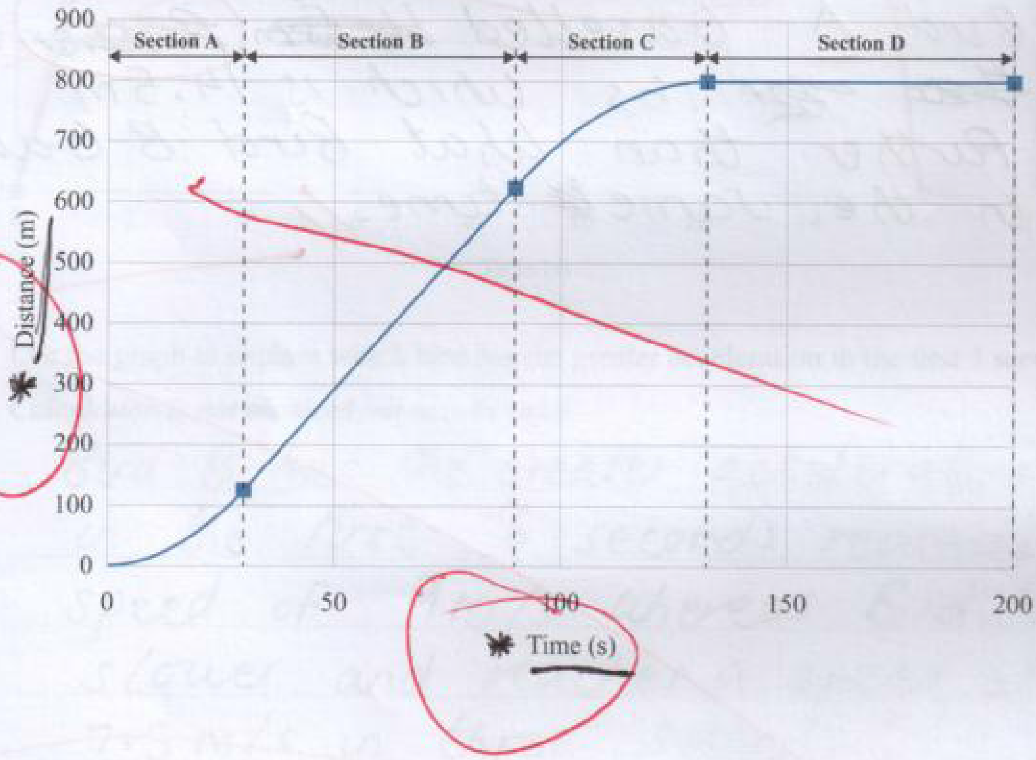
N1

QUESTION THREE: ROWING

http://www4.pictures.zimbio.com/gi/Zoe+Stevenson+Samsung+World+Cup+Sydney+T5PIDwyWCo8l.jpg

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

Distance-time graph for rowing race



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

$F_{net} = ma$
$W = Fd$

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

No calculations required.

Section A: Accelerating

Section B: Constant acceleration

Section C: Accelerating

Section D: Constant speed

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(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.

t = 30s
V = 8.3m/s
d = 125m
m = 140

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

$= \frac{0 + 30s}{0.0 + 8.3}$

$= \frac{30}{8.3s} = 3.61 m/s^2$

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

Show your working.

a = 3.61 m/s^2
d = 125m
m = 140

$F_{net} = ma$
$= 140 \times 3.61 m/s^2$
505.4 N

$W = Fd$
$W = 505.4N \times 125m$
$W = 63175 J$

F. / 0 .

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

W = Fd

F = ?
A = 24 m²

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.

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

mass = 185 kg

A = 24 m²

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

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

The pressure exerted from the two people will encourage the Pontoon to sink lower. //

N2

Annotated Exemplar for Science level 1 AS 90940, 2015

exemplar for Science Level 1 AS 90940, 2015			Total score	05
Q	**Grade score**	**Annotation**		
1	N2	The candidate has calculated the average speed correctly Correctly identified Ian has more mass and covered a longer distance.		
2	N1	The candidate correctly described net force as the combined force.		
3	N2	The candidate correctly used formula but made an error in calculating the average acceleration The candidate then used wrong acceleration to calculate force and work done. (This has been awarded a point with the follow on error.) The candidate identified that pressure caused the pontoon to sink lower.		