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.

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Merit

TOTAL 16

ASSESSOR'S USE ONLY

You may find the following formulae useful.

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

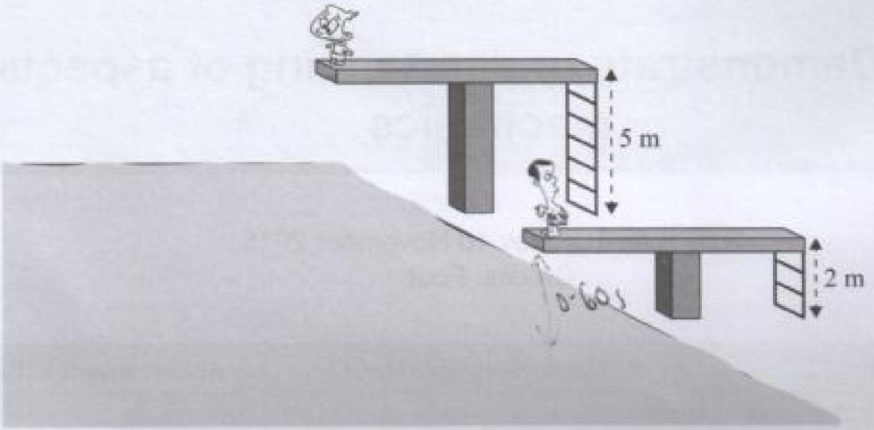
$$E_k = \frac{1}{2}mv^2 \qquad W = Fd \qquad g = 10\ \text{N kg}^{-1} \qquad P = \frac{W}{t}$$

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

ASSESSOR'S USE ONLY

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.

$v = \frac{d}{t}$ $\quad V = \frac{2m}{0.60}$ $\quad$ average speed = $3.33\ ms^{-1}$

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

F = mg $\quad$ W = Fd

F = 48 × 10 $\quad$ W = 480 × 2

F = 480 N $\quad$ W = 960 J

r.

(c) Ian's mass is 52 kg.

ASSESSOR'S USE ONLY

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.

Because Ian has a heavier mass and had to climb a higher distance. Since ~~[illegible]~~ work done is measured by W = Fd the bigger your weight force (520N) and the greater your distance (5m) the more work is exerted. //

(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.

~~Ian~~ ~~[illegible]~~ Energy cannot be destroyed or created only changed from one form to another.

~~[illegible]~~ ~~$E_K = \frac{1}{2}mv^2$~~ ~~$E_K = \frac{1}{2}(52)v^2$~~ ~~$E_K = 26v^2$~~

$\Delta E_p = mg\Delta h$ $\qquad$ $\Delta E_p = \Delta E_K$ + heat

$E_p = 52 \times 10 \times 5$ $\qquad$ $E_K = \frac{1}{2}mv^2$ $\qquad$ $2600 = 26v^2$

$E_p = 2600\,J$ $\qquad$ $\frac{2600}{26} = v^2$ $\qquad$ $v^2 = 100$ *

~~At Ian jumps [illegible]~~ At the top of the platform Ian has gravitational potential energy as he jumps he has kinetic energy as gravitational potential energy = kinetic energy then when he hits the water some of the energy is lost as sound. //

* $\sqrt{100} = v$

$v = 10ms^{-1}$

(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

Because some energy is lost as sound and heat so his speed will be slower before he hits the water.

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 amount of matter in an object measured in kg and weight is the downward force measured in N (Newtons).

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

F=mg

630g converted to kg = ~~0.63kg~~

0·063 kg

Weight = 0·063 × 10

= 0·63 N

(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.

Net force is the resulting force. In the first picture the bird is travelling at a constant speed meaning the forces are balanced. The horizontal forces of thrust and friction are equal so the bird travels at a constant speed and Fnet = 0.* In the second picture the bird is slowing down so friction is greater than thrust and the forces are unbalanced. Fnet force will equal Friction - Thrust. And there will be a larger force to the right.

* As the bird is neither accelerating or decelerating.

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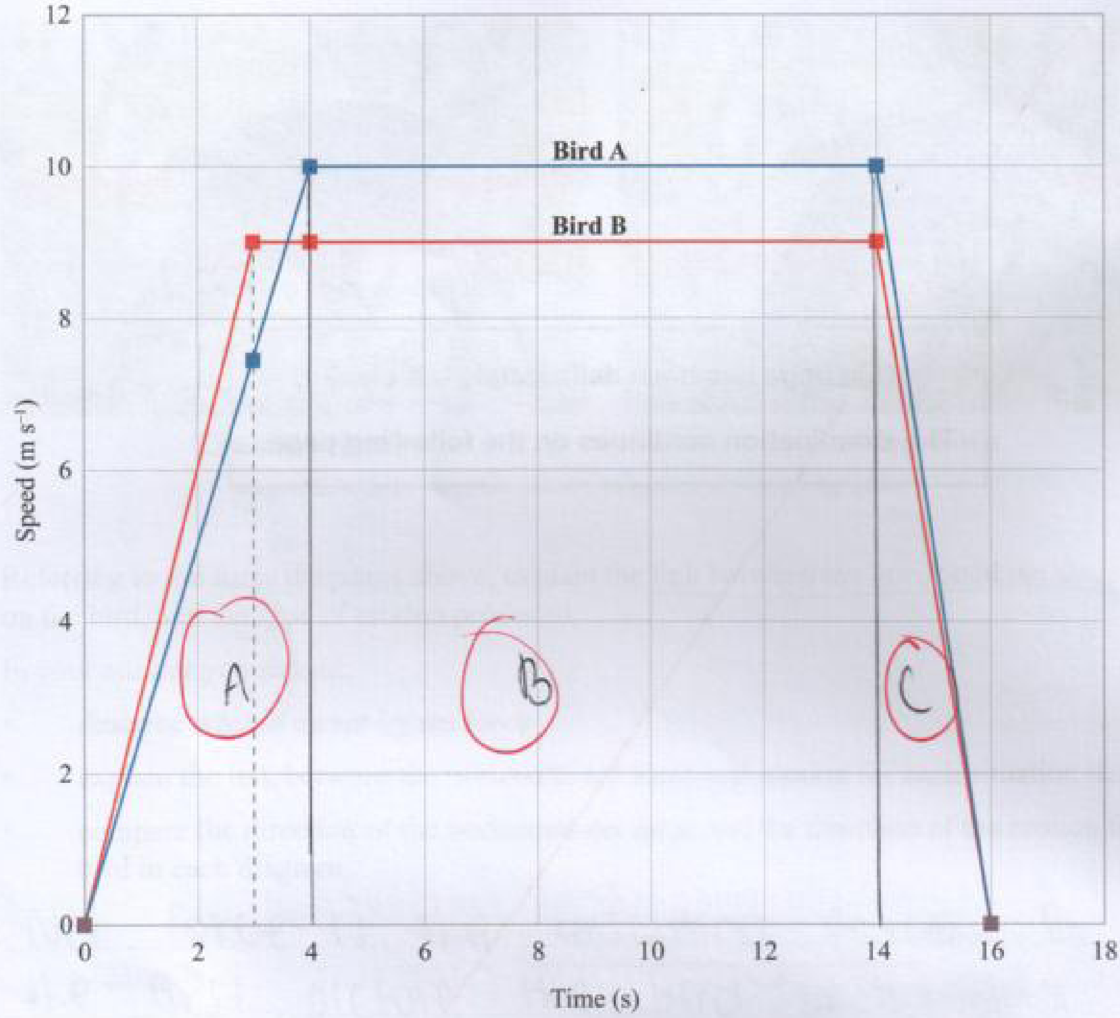
(c) The speed-time graph shows the flights of two birds.

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.

By looking at the graph we can see that ~~Bird~~ ~~on~~ Bird B has a steeper slope in the first 3 seconds so Bird B has a greater acceleration. ✓

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

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

Show all working.

Area under the graph of a speed-time ~~graph~~ graph = the distance.

Section A : $\frac{1}{2}bh$
$= \frac{1}{2}(4 \times 10) = 20m$

Section B : $(14-4) \times 10 = 100m$

Section C : $\frac{1}{2}bh$
$= \frac{1}{2}(2 \times 10)$
$= 10m$

Bird A travelled $20m + 100m + 10m$
$= 130m$

$130m - 121.5m = 8.5m$

Bird A travelled 8.5m more than Bird B !/

ASSESSOR'S USE ONLY

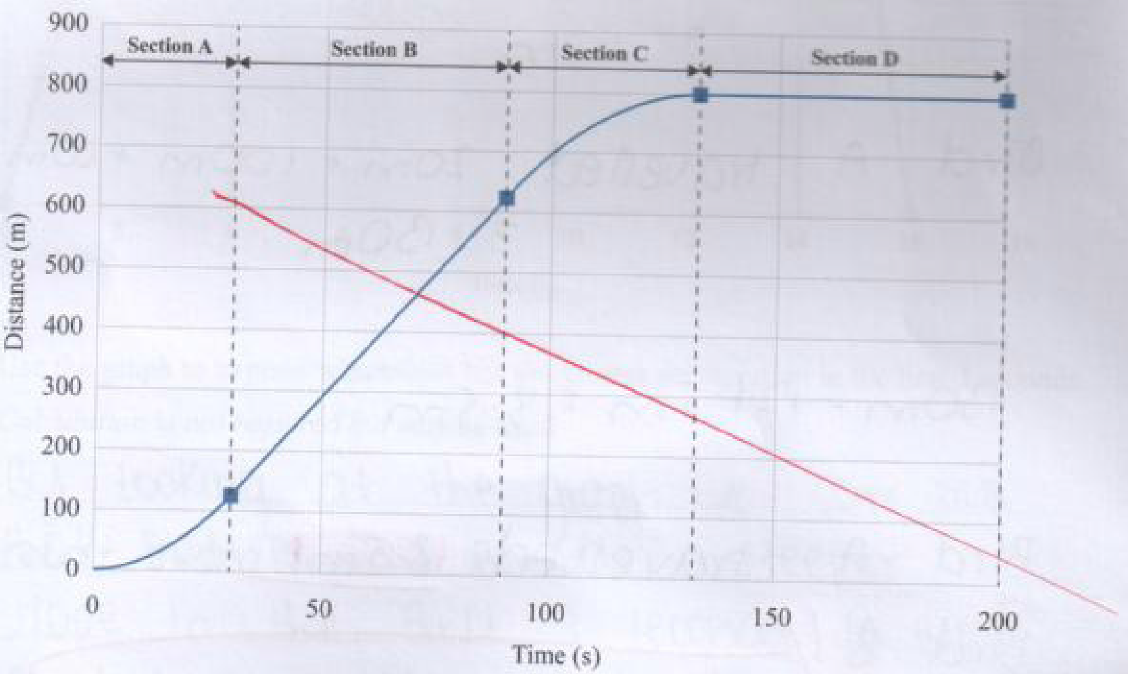
M5

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: Accelerating

Section B: constant speed

Section C: Decelerating

Section D: Stopped (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.

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

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

Show your working.

$W = Fd$ $F = mg$

$W = 1400 \times 125$ $F = 140 \times 10$

$W = 175000 J$ $F = 1400N$

ASSESSOR'S USE ONLY

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$W = Fd$ $F = mg$

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$W = 175000 J$ $F = 1400N$

Large Area → Smaller pressure
Small Area → Large pressure

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

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

~~Since Pressure is calculated by $P = \frac{F}{A}$ the smaller greater the area the greater the pressure~~

Since pressure is calculated by $P = \frac{F}{A}$ the smaller the area and the larger the force applied the greater the pressure. And the larger the area and the smaller force applied the smaller the pressure.
So since two people stand on the pontoon the greater the force applied over a small area so the larger the pressure meaning the pontoon will sink lower in the water when two people stand on it.

m5

Annotated Exemplar for Science level 1 AS 90940, 2015

Merit exemplar for Science Level 1 AS 90940, 2015		Total score	16
Q	**Grade score**	**Annotation**	
1	M6	The candidate has calculated work for Chris with correct unit Correctly calculated the speed for Ian just before he is to hit the water The candidate used W=F x d to explain the increased force and distance caused more work for Ian. In the explanation of losing energy as heat and sound the candidate failed to identify friction or air resistance as a cause of it.	
2	M5	The candidate has given the correct definition of the mass but failed to identify the weight is a force due to gravity. The candidate correctly explained the net forces in both situations. He has identified there will be a larger force to the right but did not link the opposing direction of the net force caused deceleration of the bird. The candidate has calculated the extra distance the bird A travelled correctly.	
3	M5	The candidate calculated pressure correctly with unit. He used formula and explained the greater force as people standing on the pontoon led to larger pressure. For Excellence, he needs to explain the factor of the unchanged surface area in this situation in relation to pressure.	

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Merit

TOTAL 16

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You may find the following formulae useful. $F = mg$ ~~where g is 10 kg⁻¹~~

ASSESSOR'S USE ONLY

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

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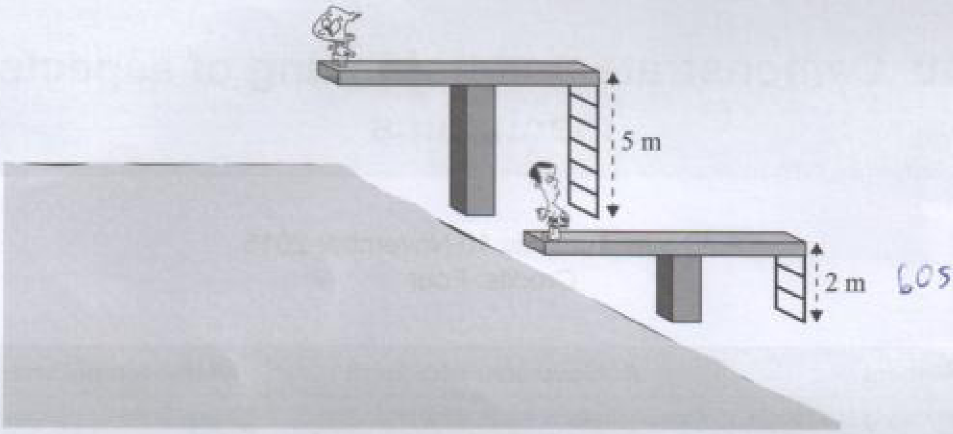
The value of g is given as $10\ \mathrm{m\ s^{-2}}$

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.

$v = \frac{d}{t}$ $\quad v = \frac{2.0}{0.60}$ $\quad = 3.\dot{3}$ s

~~it took~~ Chris' average speed was 3.3 seconds

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

$f = mg$ $\quad W = Fd$

$f = 48 \times 10$ $\quad W = 480 \times 2$

$F = 480$N $\quad = 960$J

the work done by chris was 960J

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.

because ian has both a bigger mass 520N compared to 480N and thefore force and ian also he covered/climbed a much larger distance than Chris, 2 m compared with 5 m, ian ~~clim~~ climbs over doubble what chris did, all of this resulting in a bigger number and there fore a ~~bt~~ larger amount of work done.

(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.

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

Distance 5 m
mass 52kg
weight 520 N

$\Delta E_p = mg\Delta h$

$E_p = 520 \times 5$

2600

before ian Jumps he has gravatational potential energy, this energy is 2600 J

once ian Jumps this is converted into kenetic energy

$\frac{48}{52} = \frac{12}{13}$

$\frac{s}{58}$ know Chris' speed

(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

because Ian will lose energy through friction (a force that always opposes motion) and as a result of friction small amounts of heat and ~~of~~ sound

M5

QUESTION TWO: FORCES

ASSESSOR'S USE ONLY

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 ~~amou~~ amount of matter or 'stuff' in side an object, your mass stays the same no matter where you are ie. earth, moon, still same mass but ~~your~~ weight is the force of gravity acting apon an object, this is different dependin ~~of~~ on where you are ie. moon less weight than earth

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

$630g = 0.630kg \qquad F = mg$

$F = 0.630 \times 10$

$= 6.3N$

the weight of a kererū is 6.3N

ASSESSOR'S USE ONLY

(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.

net force is the total sum of force acting upon an object ~~on~~ at any given time.

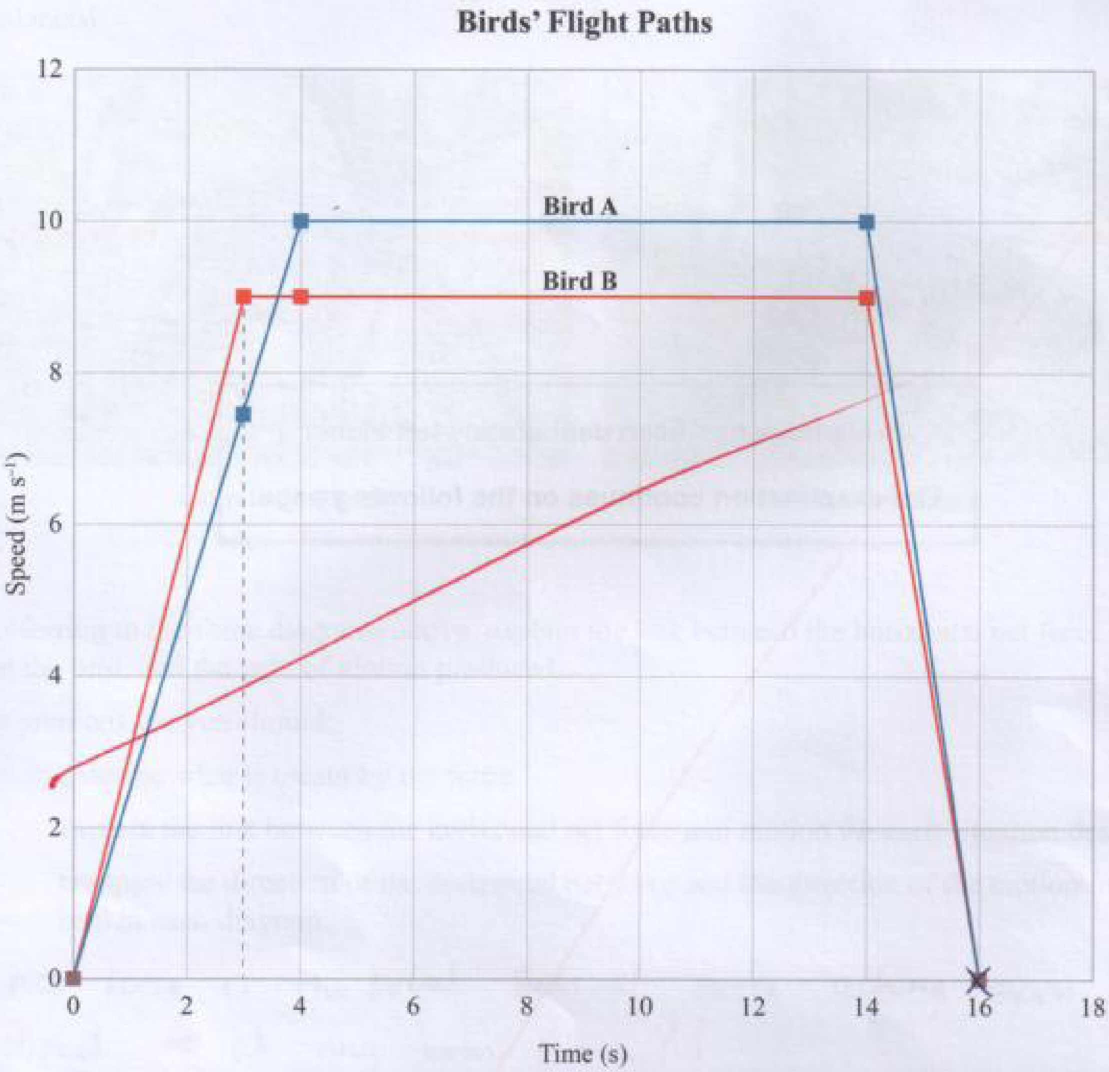
in the first diagram the bird is flying at a constant speed, this means that the forces are balanced * and this means that there would be no net force as it would = 0 for example 20← - →20 =0 the forces are balanced

* the thrust force is the same as the air resistance force

but in the ~~2nd~~ 2nd diagram the forces are un balanced. ~~and~~ because the bird is slowing down. the air resistance force is greater than the thrust, this would result in a net force being x(→) greater of resistance force.

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.

$a = \frac{9}{2.5} = 3.6 m s^{-2}$

A

$a = \frac{10}{4} = \cancel{2.5 m s^{-2}}$

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

bird B has the greatest acceleration in the first 3 seconds this is shown on the graph by bird B having a slightly steeper gradient compared to bird A.

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

ASSESSOR'S USE ONLY

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

Show all working.

½b×h between 0-4sec 20m travelled

" 4-14 sec 140m "

" 14-16 sec 10 m "

Bird A travelled 170m in 16s

bird A travelled 48.5m further than bird B in the same time

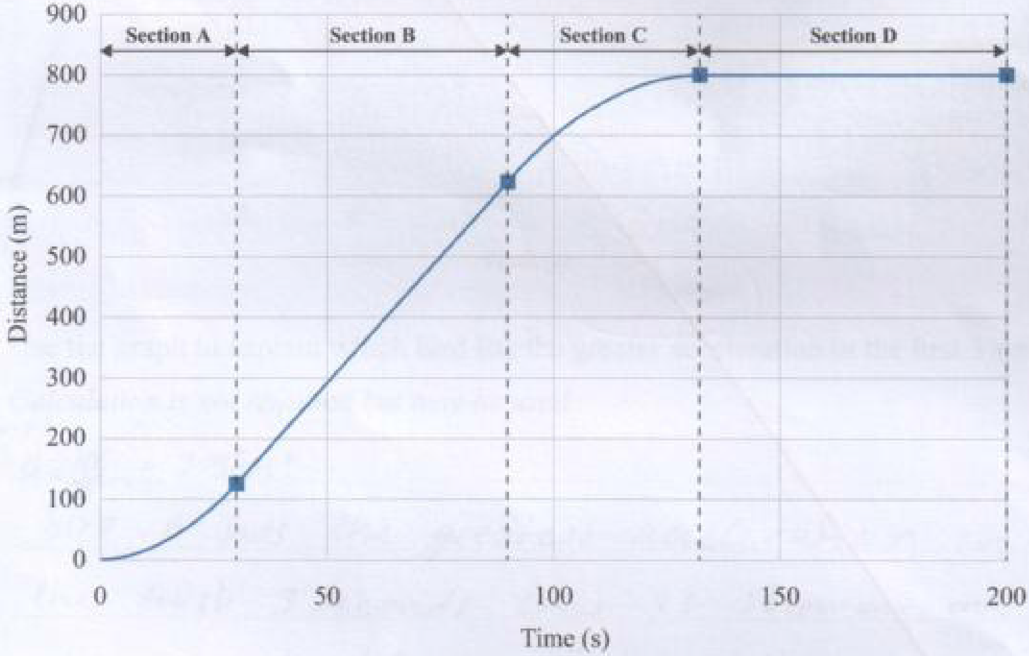
m6

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



ASSESSOR'S USE ONLY

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

No calculations required.

Section A: the boat is accelerating

Section B: the boat is accelerating at a constant speed.

Section C: the boat is decelerating

Section D: the boat is stationary out time increaces

(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.

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

the boats average acceleration over the first 30s ~~ts~~ was 0.3 ms^{-2}

$a = \frac{8.3}{30} = 0.276$

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

Show your working.

$W = F \times d$

$F = mg$
$140g \times 10 = 1400N$

1400×125

17 5000J

the work done by the boat was 175000J

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.

$3 \times 4 = 12$ m area of 12 m² $P = \frac{F}{A}$

$F = mg$ $P = \frac{1850}{12}$

$F = 185 \times 10$

1850 N $= 154.1666667$

$= 154$ pa

the pressure exerted by the pontoon on the water is 154 pa

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

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 the area is still the same the combined mass/weight of the two people and the pontoon is now greater and therefore the pressure the pontoon exerts is also greater resulting in the pontoon sinking further into the water than it would with out the aditional mass/weight

ASSESSOR'S USE ONLY

M5

Annotated Exemplar for Science level 1 AS 90940, 2015

Merit exemplar for Science Level 1 AS 90940, 2015		Total score	16
Q	**Grade score**	**Annotation**	
1	M5	The candidate has calculated work for Chris and gravitational potential energy for Ian with correct units. The candidate explained that increased force and distance caused more work but did not explain the direct proportional relationship between force, distance and work. In the explanation of losing energy through friction (heat and sound as a result of friction) the candidate failed to identify where the friction is from, and where the heat and sound is from.	
2	M6	The candidate has given the definition of the mass and weight and compared the difference between mass and weight. Correctly calculated weight force with correct conversion of the unit. The candidate compared the forces which lead to a net force causing the bird to slow down. However, it is not clearly indicated that the net force is opposing the motion of the bird which causes it to slow down. The candidate has made a mistake in calculating the time therefore the distance for the bird A between 4 to 14 seconds.	
3	M5	The candidate correctly calculated pressure but gave the unit wrongly. The candidate tried to link the relationship between pressure, mass/force and surface area. However, the broken link between the mass and weight force resulted a merit grade. For Excellence, he needs to explain the increased mass when people were standing on the pontoon led to the increased weight force. While pressure is directly proportional to force, with the increased weight force and same surface area, the pressure increased.	