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90940

909400

SUPERVISOR'S USE ONLY

NZQA

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.

Achievement

TOTAL 10

ASSESSOR'S USE ONLY

You may find the following formulae useful.

ASSESSOR'S USE ONLY

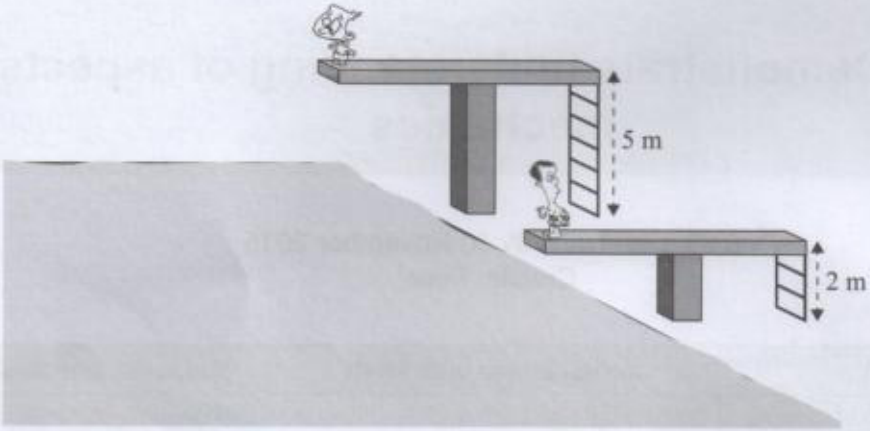
$$v = \frac{\Delta d}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t} \qquad F_{net} = ma \qquad P = \frac{F}{A} \qquad \Delta E_p = mg\Delta h$$

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

The value of g is given as 10 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.

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

$v = \frac{2}{0.6}$

$v = 3.33 \text{ ms}^{-1}$ (2 dp)

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

$W = F \times d$

$W = 480 \times 2$

$= 960 \text{ J}$

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

$g = 48 \times 10$

$g = 480 \text{ N}$

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's force is higher than Chris' and Ian also had to climb higher. Work is, when one energy transfer to another. Ian had to transfer more energy into climbing up the 5m ladder than Chris did, 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.

Ian, before he jumps have gravitational potential energy as well as support and gravity as he stands about to jump. He also has potential kinetic. As Ian is about to hit the water an energy acting on Ian is gravity, and kinetic energy acting upon him as well as friction as his body creates friction with the air. and waste energy of heat

$\Delta E_p = mg\Delta h$

$= 520 \times 5$

$\Delta E_p = 2600$

(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 what was calculated in part d as friction is when we calculate part d we don't take into consideration energy forces acting upon him that are slowing him down like friction. Friction He creates friction with the air which will slow him down //

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 measured in ~~N~~ Newtons, whereas weight is measured in kilograms. ~~Weight is~~ Newtons is how much ~~press~~ gravity ~~is~~ your body is exerting onto a point

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

Weight = ~~Ø~~ $\frac{.63}{10}$

$= 0.063\,kg$

(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

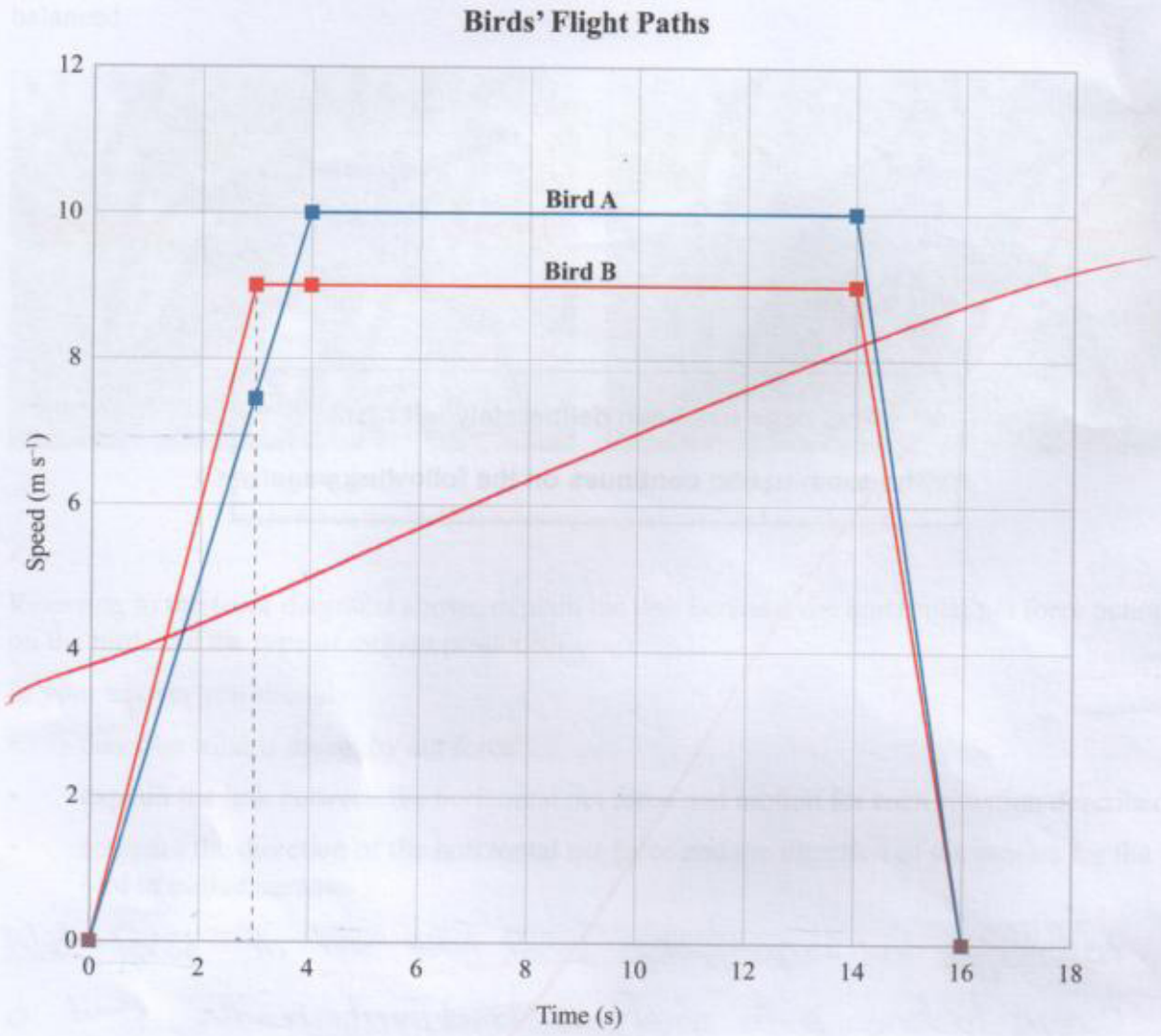
Referring to the force diagrams above, explain the link between the horizontal net force acting on the bird, and the type of motion produced.

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.

Net force is the total force acting upon an object at a time. When the bird is flying at a constant speed all horizontal forces are balanced (the net force being 0 or equal), however when the bird is slowing down the net force does not equal 0 or equal as the forces are unbalanced. When the bird is slowing down the force of pull is acting upon the bird causing it to slow down. When the bird is travelling at a constant speed and the bird is travelling forwards the horizontal net force will be equal or 0. When the bird is slowing down the bird will continue to go forwards but ~~slow~~ will be slowing down, however the horizontal net force arrow is pointing in the other direction as it is slowing the bird down.

(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 greater acceleration we can see this in the graph, as in the first 3 seconds Bird B has reached a speed of 9ms^{-1} whereas bird A has approx 7.25 ms^{-1} //

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

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

Show all working.

$5 \times 5 = 25$

$\frac{1 \times 5}{2}$

$= 2.5$

$\frac{2 \times 5}{2}$

$= 5$

$25 \times 2.5 \times 5$

$= 312.5\text{m}$

$312.5 - 121.5$

$= 191\text{m}$

Bird A travelled 191m further than Bird B in the same time.

ASSESSOR'S USE ONLY

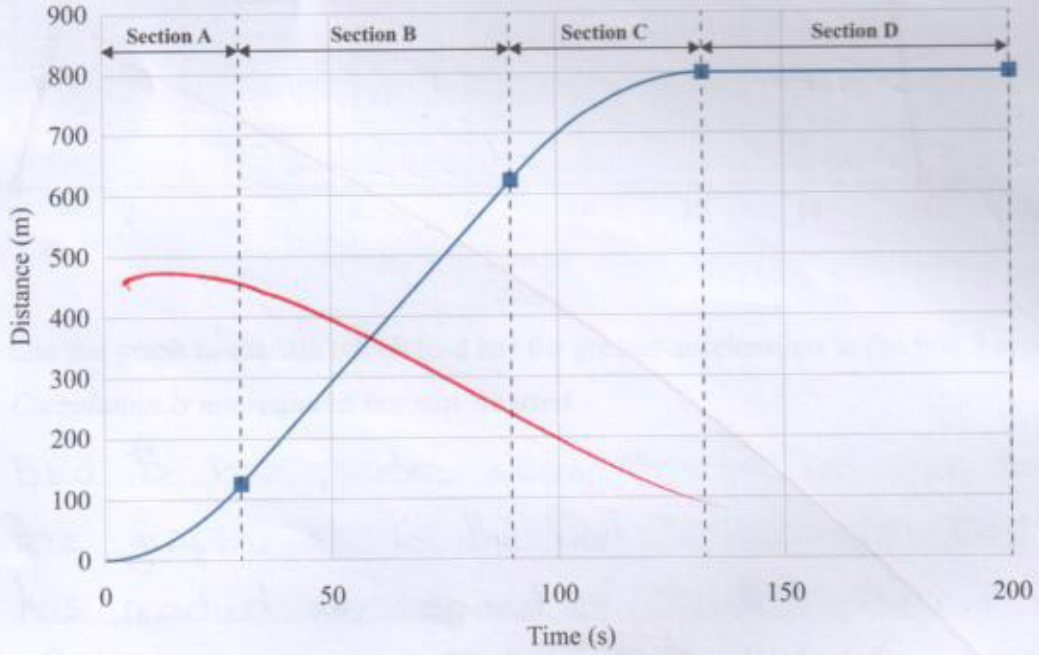
N1

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: Quick acceleration

Section B: Steady Speed

Section C: Decelerating

Section D: No movement

(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.

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

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

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

$= \frac{125}{30}$

$= 4.17$ ms

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

$a = \frac{4.17}{30}$

$a =$

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

$= \frac{8.3}{30}$

$= 0.27 \text{ ms}^{-1}$

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

Show your working.

$W = F \times d$

$W = 1400 \times 125$

$W = 175000 \text{ J}$

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

$g = 140 \times 10$

$= 1400 \text{ N}$

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

ASSESSOR'S USE ONLY

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.

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

$P = 18$

g = 10 N kg^{-1}

= 185 × 10

= 1850 N

Surface Area = 3 × 4

= 12 m^2

Pressure = 1850 × 12

= 22200 Pa

Pressure = Surface area × Force

(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.

When the 2 people stand on the pontoon it will sink lower as ~~there is more~~ pontoon has a higher mass, this will make it heavier. There is more pressure exerted on the pontoon, so it will sink lower. The water wont be able to withstand the amount of pressure being exerted on the pontoon therefore it sinks lower. //

A4

Annotated Exemplar for Science level 1 AS 90940, 2015

Achieved exemplar for Science Level 1 AS 90940, 2015		Total score	10
Q	**Grade score**	**Annotation**	
1	M5	The candidate has calculated the average speed and work for Chris. Correctly identified Ian used more force and climbed higher (distance) so he has to transfer more energy because when energy is transferred work is done. The candidate has calculated gravitational potential energy but failed to give the correct unit. The candidate has identified friction slowing Ian down but did not link it to energy loss.	
2	N1	The candidate has failed to give the correct definition for mass and weight The candidate used the wrong formula to calculate weight even though he has converted gram to kilogram correctly. The candidate correctly described net force. The candidate compared the speeds of the birds at the end of 3 seconds but failed to compare the change in the same time period. The candidate incorrectly calculated the distance for bird A.	
3	A4	The candidate correctly named the motion for all the sections of the boat. Correctly calculated the average acceleration. The candidate has used wrong acceleration to calculate force therefore the wrong work done. The candidate calculated force and area correctly but used the wrong formula for pressure. The candidate identified a higher mass when people stood on the pontoon but did not continue to explain it is the bigger force (due to the increased mass) caused by more pressure.	

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TOTAL 10

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You may find the following formulae useful.

ASSESSOR'S USE ONLY

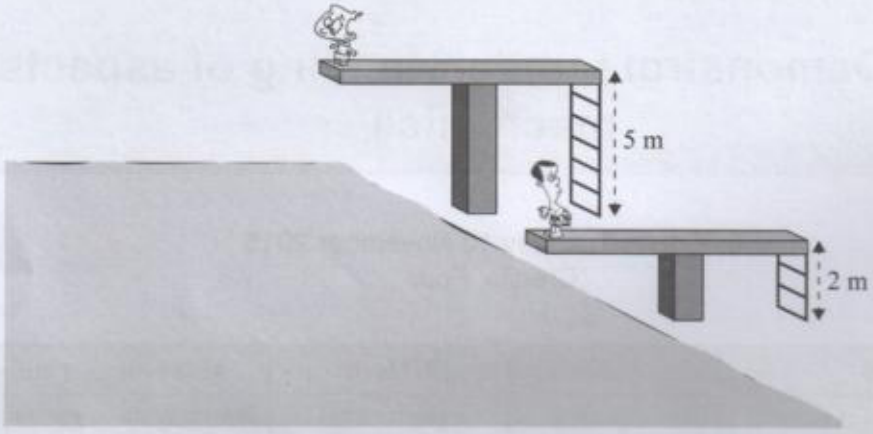
$$v = \frac{\Delta d}{\Delta t} \qquad a = \frac{\Delta v}{\Delta t} \qquad F_{net} = ma \qquad P = \frac{F}{A} \qquad \Delta E_p = mg\Delta h$$

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

The value of g is given as 10 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.

$v = \frac{\Delta d}{\Delta t}$ $\frac{2}{0.6} = 3.33 \text{ ms}^{-1}$

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

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

Chris weighs 480N (10 × 48)

$W = 480 \times 2$

$W = 960$

Chris worked 960J to climb the stairs

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.

Automatically Ian's mass is bigger than chris's which means he has more of weight force. Then he has to climb 5m which is bigger than 2m which required more energy to climb. //

(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's has the energy of thermal energy meaning he has heat in his body which is released every time he works. Then when jumps ~~off the~~ board / platform he then has potential & kinetic ~~kinetic~~ energy, which is energy that has energy before he hits water while falling. //

Ian's speed is unknown because there are no time to calculate from how long he fell before touching water. It is required for calculation for the formula $v=\frac{d}{t}$ & I can only do $v=\frac{5}{\Delta t}$. So unknown. //

(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

Air resistance? Yeah, because as soon as he makes contact with water it slows him down instantly. //

A3

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.

Weight is mass multiplied by gravity & is measured in newtons. Mass is force measured in kilograms. //

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

Mass x Gravity or Force = weight

mg = N

630 ÷ 10 = 6.3kg

~~630x10=6300N~~ 6.3 x 10 = 630N //

(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.

Net force means which way the object is going towards with total force. Example 500N going left, 300N going right. Net force is 200N to the left.

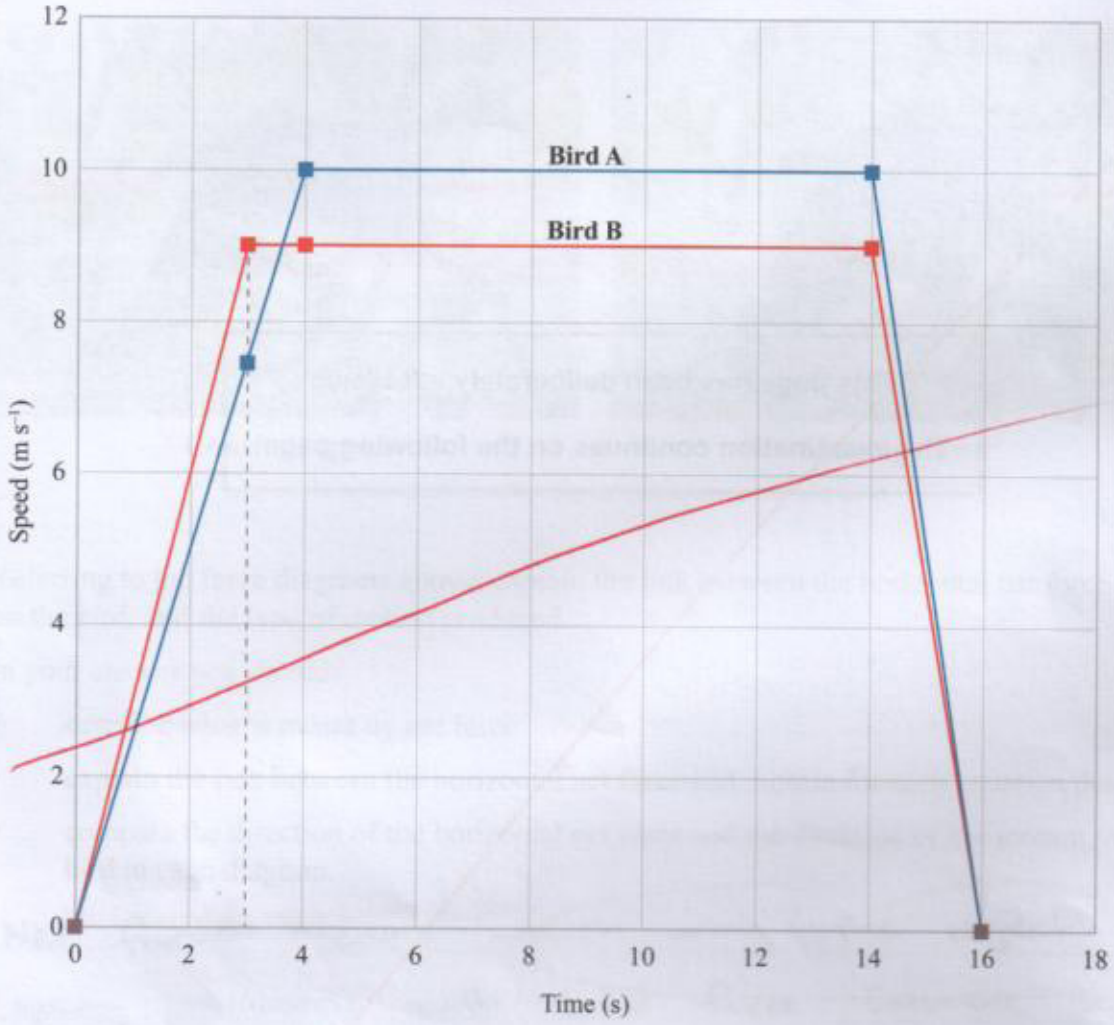
The horizontal net force shows us where the object is going either way left or right only just like the example above. It links with motion because yet again it helps to shows us which way an object is going & if the object is going at a balanced or unbalanced way. When the bird is at constant speed the forces are all equal this means that the forces are balanced. When the bird

Pg 4 for more

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

ASSESSOR'S USE ONLY

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 greater acceleration in the first 3 seconds. This is because he reachs at approx $9ms^{-1}$ from $0ms^{-1}$ in the first 3 seconds whereas for Bird A he reaches at approx $7.50ms^{-1}$ from $0ms^{-1}$ at the first 3 seconds. $9ms^{-1}$ is bigger than $7.5ms^{-1}$ so bird B wins.

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

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

Show all working.

ASSESSOR'S USE ONLY

$d = vx +$

~~About 2 x 20m~~ 20m

$10ms^{-1} \times 10s = 100m$

~~approx $9ms^{-1}$ x approx 3.5 seconds = 31.5m~~

$100 + 20 + 31.5 = 151.5m$ //

Bird A had to travel around 20m more than Bird B at the same time. //

A3

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

No calculations required.

Section A: acceleration ~~or increase distance~~

Section B: constant speed ~~or increase distance~~

Section C: decelerating

Section D: stationery

ASSESSOR'S USE ONLY

(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.

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

$\frac{8.3}{30} = 0.27$ (2dp) ms^{-2}

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

Show your working.

Gravity x mass = Force Force x distance = Work

Gravity = 10g

~~[illegible]~~ 140 x 10 = 1400 N

1400 x 125 = 175000J work done.

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

ASSESSOR'S USE ONLY

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.

$3 \times 4 = 12 m^2$

$A = 12 m^2$

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

$F = 185 \times 10 = 1850 N$

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

$P = 154.16$ (2dp)

(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.

Because the area of the pontoon is small. Smaller area pressure increases, vice versa. If more ~~weir~~ mass is put on the pontoon it will sink because pressure it being pushed on water which doesn't support objects with small areas very well. Example when someone pin drops in a pool they sink. When someone lies on their back which increases area water supports them. //

A4

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

QUESTION NUMBER

ASSESSOR'S USE ONLY

2b is slowing down the forces are all unbalanced this because friction or air resistance is playing more of a force than thrust or acceleration, this now shows us that the ~~horizontal net force~~ should be going to the ~~left~~ right or slowly going to the left.

Seen -

Annotated Exemplar for Science level 1 AS 90940, 2015

Achieved exemplar for Science Level 1 AS 90940, 2015		Total score	10
Q	**Grade score**	**Annotation**	
1	A3	The candidate has correctly calculated the average speed and work for Chris. Correctly identified that Ian has more weight force and requires more energy (therefore more work) The candidate has failed to identify the correct energy before Ian jumps and is about to hit the water. The candidate is unsure if air resistance is the reason for Ian slowing down in the air but going on to explain the slowing is after contacting the water.	
2	A3	The candidate has failed to give the correct definition for the mass and weight The candidate failed to convert the mass correctly which led to incorrect weight calculation. The candidate correctly explained the forces are balanced while the bird is at a constant speed and forces are unbalanced when slowing down. The candidate has explained the higher acceleration is due to the higher change in speed for bird B (from 0 to 9 ms^{-1}) than bird A (from 0 to 7.5 ms^{-1}) in the same time period. The candidate correctly calculated two sections of the distance for bird A.	
3	A4	The candidate correctly named the motion for all the sections of the boat and correctly calculated the average acceleration The candidate has used the wrong acceleration to calculate force and work. The candidate calculated pressure correctly and identified the pressure as the reason for the pontoon to sink.	