Science 1.1 AS 90940

GZ Science Resources

Demonstrate understanding of aspects of mechanics

WORKBOOK

Working to Excellence & NCEA Questions

CONTENTS

All NCEA answers can be found on S1.1 ppt

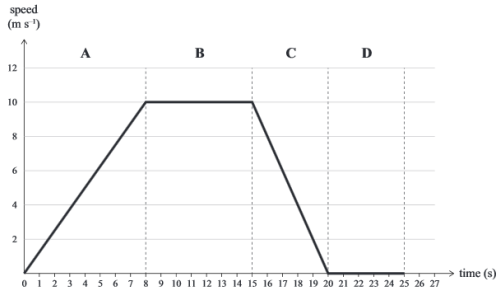
GZ Science Resources

Writing Excellence answers to Interpreting motion-time graphs questions

Interpreting motion-time graphs QUESTION

Question: Describe the motion of the runner through sections A, B, C, and D.
Your answers should include descriptions AND any relevant Calculations

A runner's speed is recorded for 25 seconds and graphed below.



$v = d/t$

v = velocity (ms^{-1})
d = distance (m)
t = time (s)

$a_{ave} = \Delta v/\Delta t$

a = acceleration (ms^{-2})
v = velocity (ms^{-1})
t = time (s)

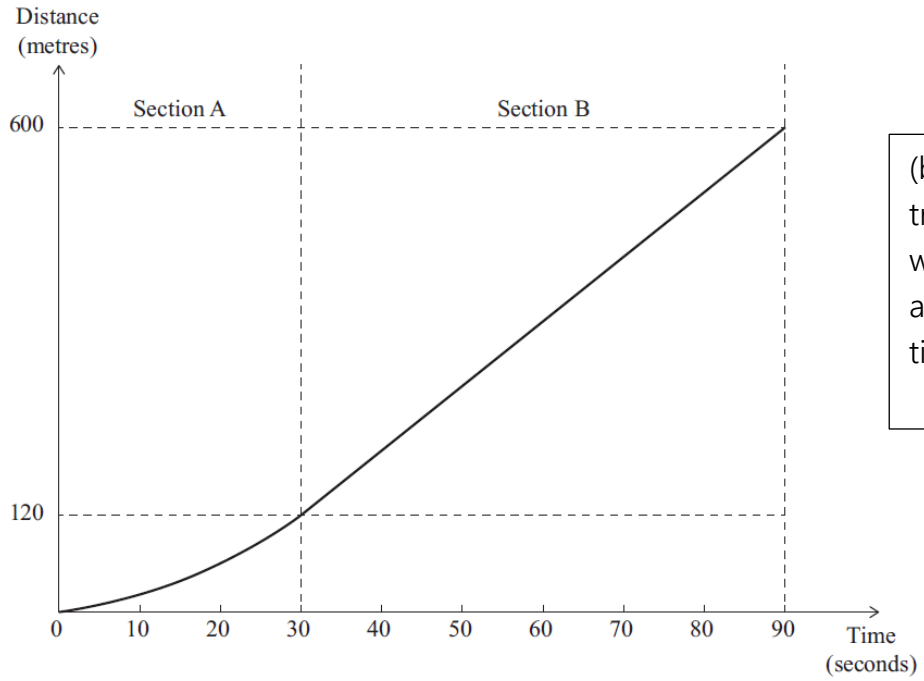
ANSWER

1. state the type of graph used (distance-time or speed-time graph)	
2. starting with section **A** describe the type of motion (stationary, constant speed or acceleration)	
3. state the starting speed and final speed, as well as total time taken (use correct units)	
4. calculate the motion in section A using either v = Δd/Δt or a = Δv/Δt Show working and use correct units	
5. next with section **B** describe the type of motion (stationary, constant speed or acceleration)	
6. state the starting speed and final speed, as well as total time taken (use correct units) – calculation not needed for stationary	
7. next with section **C** describe the type of motion (stationary, constant speed or acceleration)	
8. state the starting speed and final speed, as well as total time taken (use correct units)	
9. calculate the motion in section A using either v = Δd/Δt or a = Δv/Δt Show working and use correct units (make sure to use a – sign if acceleration negative)	
10. finally with section **D** describe the type of motion (stationary, constant speed or acceleration)	
11. state the starting speed and final speed, as well as total time taken (use correct units)	

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

NCEA Questions for Interpreting motion-time graphs (Part ONE)

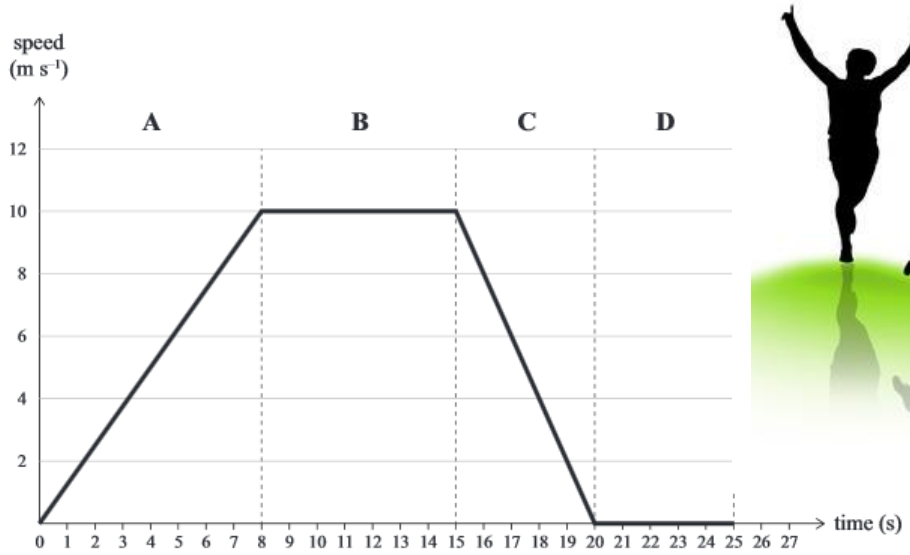
2012: 1a. A woman drives her tractor down a sandy beach to pick up her friend's boat. The distance-time graph below shows part of the journey. Use the information from the graph to calculate the average speed of the tractor during the 90 seconds.



(b) Describe the motion of the tractor in section B, and explain what this tells us about the forces acting on the tractor during this time.

2013: 1a. Describe the motion of the runner through sections A, B, C, and D. Your answers should include descriptions AND any relevant calculations

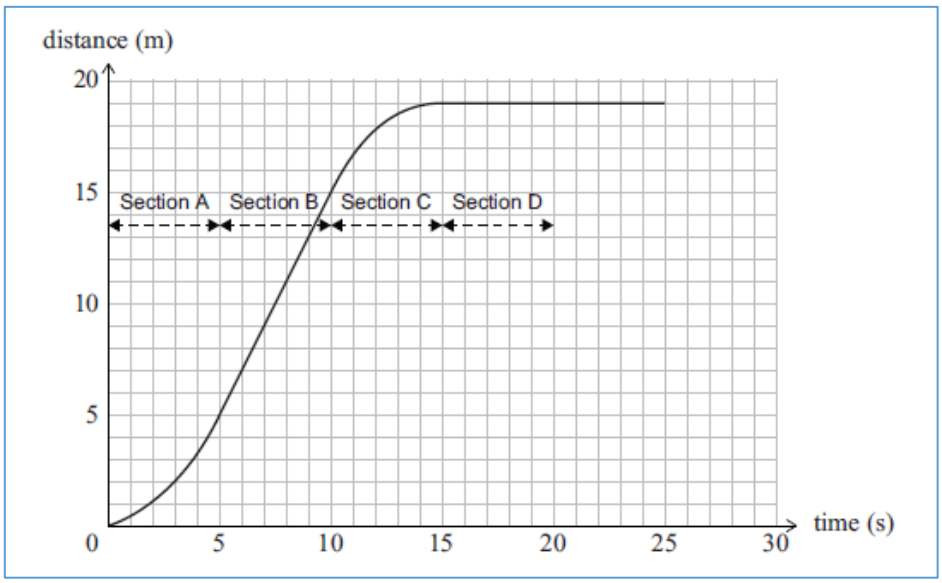
A runner's speed is recorded for 25 seconds and graphed below.



2014: 2a. A chair (15.0 kg) and footstool (15.0 kg) are shown beside. The chair has four legs in contact with the floor, whereas the base of the footstool does not have legs and is entirely in contact with the floor. (a) It took 6 seconds to push the footstool a distance of 8.0 m across a room.
Calculate the average speed of the footstool as it is pushed.

NCEA Questions for Interpreting motion-time graphs (Part TWO)

2014: 1a. The cyclist's journey was plotted on the distance / time graph below. Describe the motion of the cyclist in each of sections A,B,C and D.

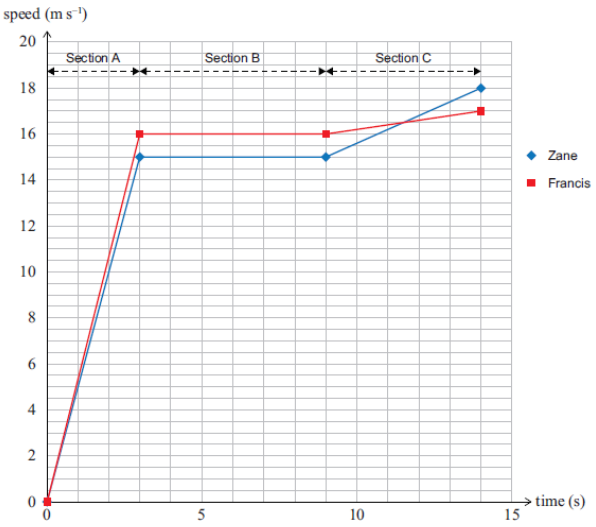


1b. Calculate the cyclists speed during section B.

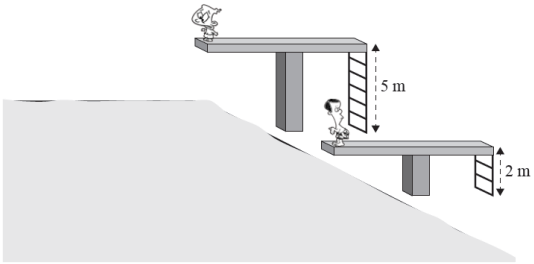
1c. what is the total distance covered from 5 to 15 seconds?

2014: 4. Two go-carts were racing on a track. A speed / time graph is shown below for each go-cart. Zane's graph is shown in blue, and Francis's in red.

(a) Calculate the acceleration of Zane in the first 3 seconds.

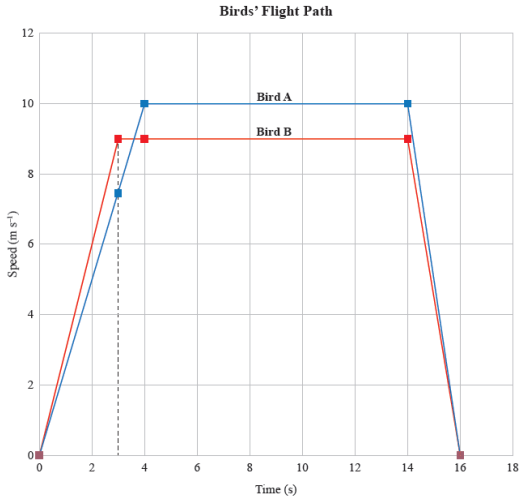


2015: 1a. Chris and Ian were jumping off different platforms into a pool. It took Chris 0.60 s to reach the water once he had jumped from the 2 m platform. Calculate his average speed.

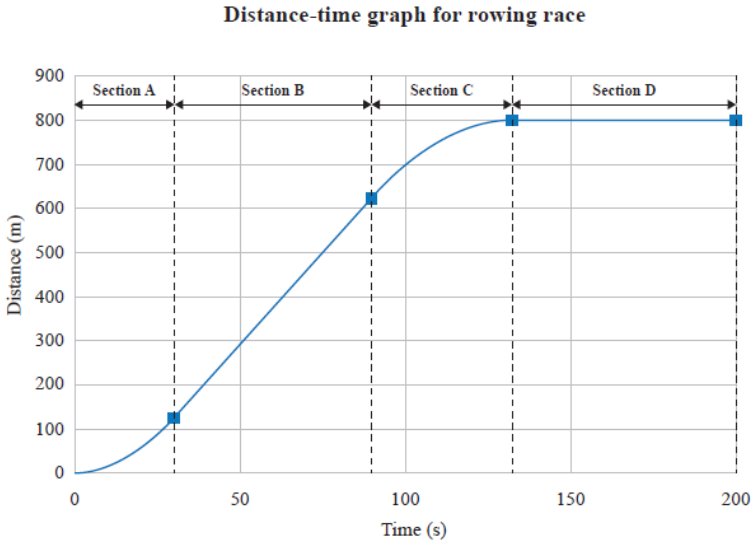


NCEA Questions for Interpreting motion-time graphs (Part THREE)

2015: 2c(i). The speed-time graph shows the flights of two birds. Use the graph to explain which bird has the greater acceleration in the first 3 seconds.



2015: 3a. The distance-time graph below shows the journey of a rowing boat in a race.
Describe the motion of the boat throughout the journey.
No calculations required.



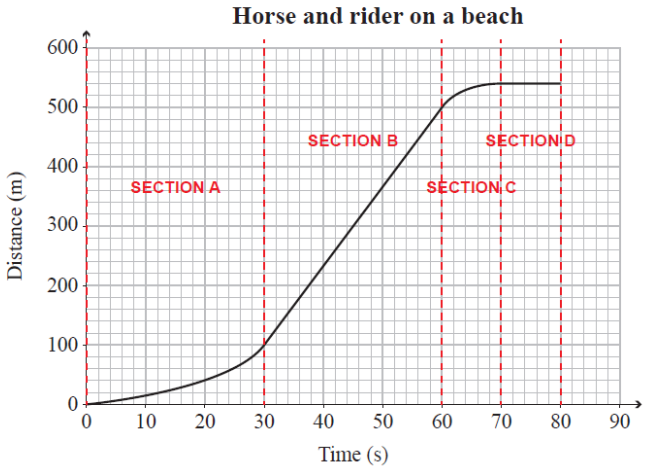
3b. During the first 30 s of the race, the rowers' speed changed from 0.0 m s^{-1} to 8.3 m s^{-1}.

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.

2016: The graph below shows the motion of a horse and rider as they travel along a beach.



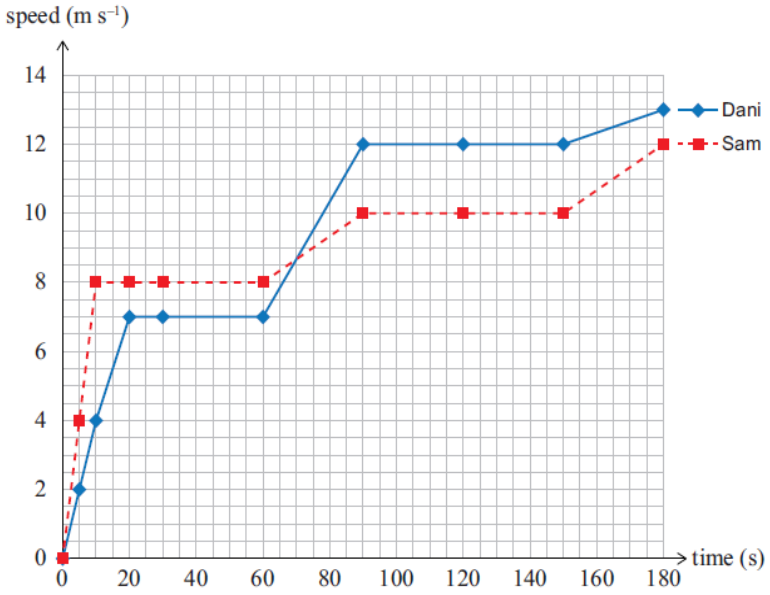
(a). Describe the motion of the horse and rider in each section of the graph.

(No calculations are required.)

NCEA Questions for Interpreting motion-time graphs (Part FOUR)

2017: 1a. Two horses, ridden by Dani and Sam, are racing against each other. The speed-time graph of their two horses is shown below.

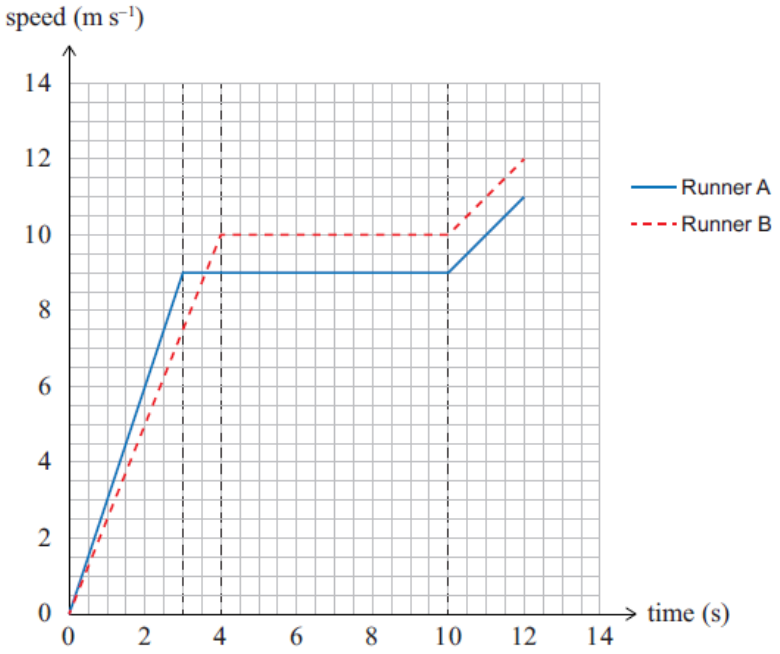
Use the information in the graph to compare the speed AND acceleration of Dani and Sam in the first 60 seconds.



2018: 1a. The speed-time graph shows the motion of two runners in a 100 m race.

From the graph, which runner has the greater acceleration in the first 3 seconds?

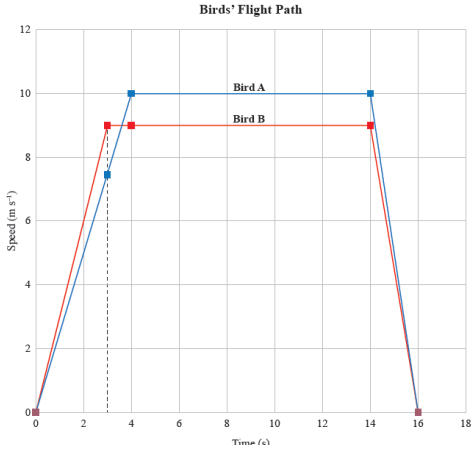
Explain your answer. Calculations are not required.



1b. Using the graph, calculate Runner A's acceleration during the first 3 seconds.

1c (i). Use the information in the graph to compare the speed AND acceleration of Runner A and Runner B in the first 10 seconds.

Writing Excellence answers to Distance in a speed-time graph questions

Distance in a speed-time graph QUESTION
Question: In 16 s, **Bird B** travelled 121.5 m. How much further did **Bird A** travel in the same time? *Show all working.* 

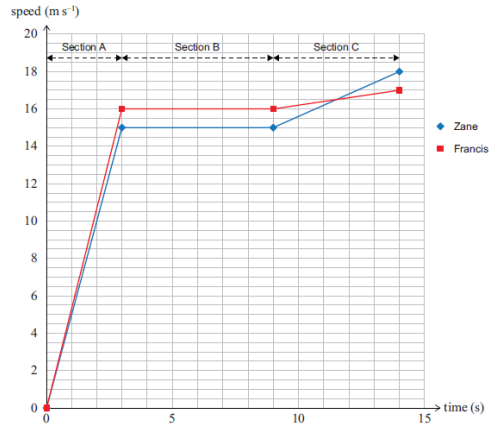
ANSWER	
1. divide the are under the graph (for bird A) in the **smallest number** of rectangles and triangles	
2. calculate the area for section **A** – a triangle Area = ½ base x height Or Distance = ½ v x t	
3. calculate the area for section **B** – a rectangle Area= base x height Or Distance = v x t	
4. calculate the area for section **C** – a triangle Area = ½ base x height Or Distance = ½ v x t	
5. **add all 3 sections** together and show working plus units	
6. subtract one distance from the other to show the **differences in distance**	
7. **compare** between the distances of both birds and state which has flown the furthest	

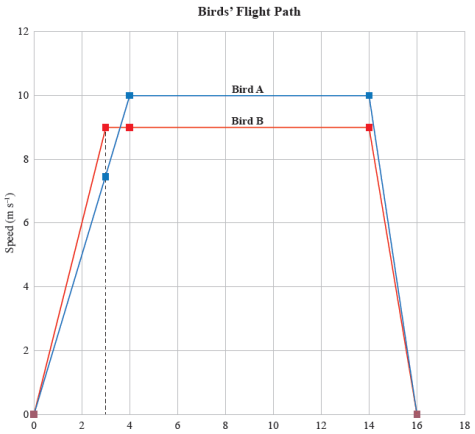
NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

NCEA Questions for Distance in a speed-time graph

2014: 4c. Explain which go-cart travelled 200 m around the track first.

In your answer you should: • use the information in the graph • show all working for the calculations • compare the distances travelled by Zane and Francis by the end of 14 s.

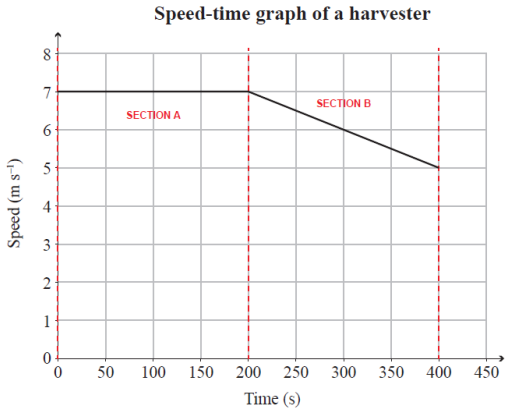


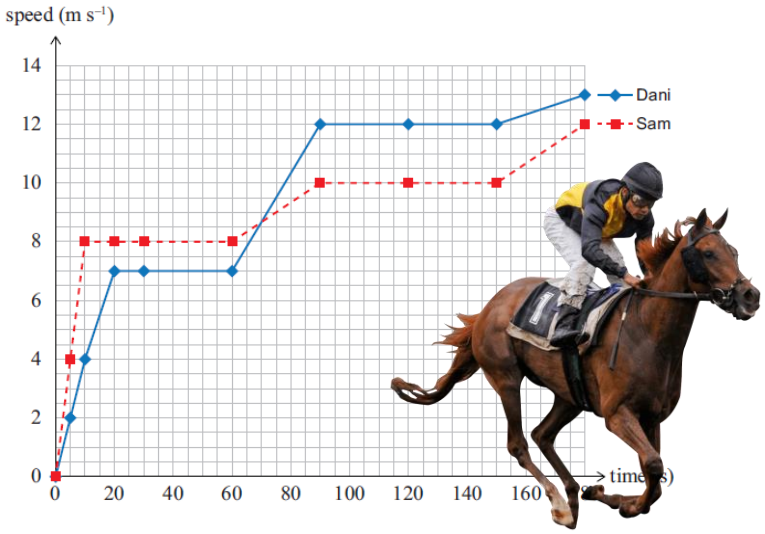


2015: 2c (ii). In 16 s, Bird B travelled 121.5 m. How much further did Bird A travel in the same time? *Show all working.*

2016: 2a. A harvester was working in a paddock. The speed-time graph shows the journey of the harvester.

Calculate the distance the harvester travelled in the first 200 seconds.





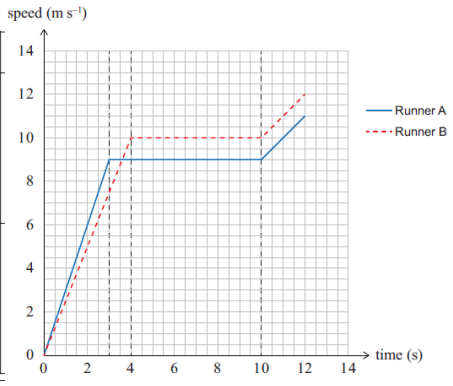
2017: 1d. After 90 s, Sam and his horse had travelled 710 m.

How much further had they travelled compared to Dani and her horse at this stage in the race?

Use the information in the graph and any necessary calculations to answer.

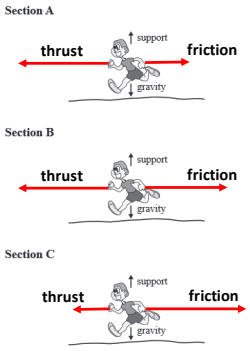
2018: 1c (ii). Use the information in the graph and calculations to show which runner, Runner A or Runner B, finished the 100 m first.

	Speed
A	First 3 s: $v = 4.5$ m s^{-1} **The rest: $v = 9$ m s^{-1}**
B	First 4 s: $v = 5$ m s^{-1} **The rest: $v = 10$ m s^{-1}**



Writing Excellence answers to Net Force questions

Net Force QUESTION
Question: Referring to your force diagrams in part (b), explain the link between the **net force** acting on the runner in sections A, B, and C of the graph, and the type of motion. In your answer you should: • describe what is meant by net force • explain the link between net force and motion for EACH section • compare the direction of the net force and the direction of the motion for EACH section.

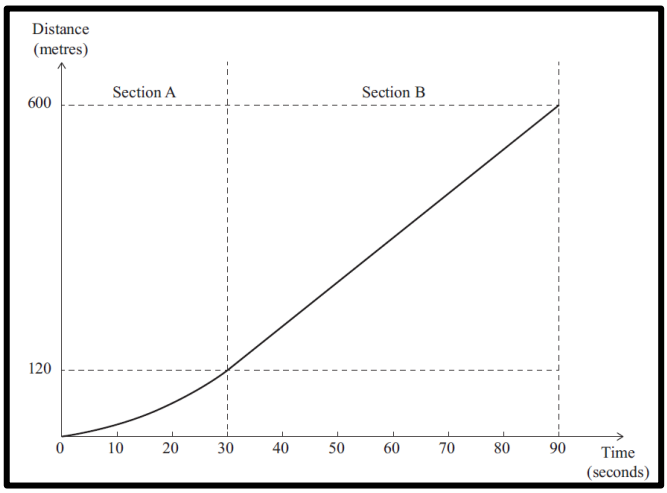


ANSWER	
1. give the **definition** for Net force	
2. link the **size** and **direction** of the forces (arrows) to the size of the Net force	
3. link the **Net force** to your example	
4. link Net force to **acceleration**	
5. link Net force to **deceleration**	
6. link Net force to **stationary** motion and **constant speed**	
7. discuss section **A** linked to Net force and the size of the forces name them)	
8. discuss section **B** linked to Net force and the size of the forces name them)	
9. discuss section **C** linked to Net force and the size of the forces name them)	

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

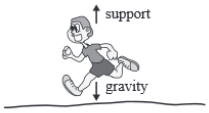
NCEA Questions for Net Force (Part ONE)

2012: The total mass of the tractor and driver is 1660 kg.
Calculate the speed of the tractor at the end of section A, and then calculate the net force acting on the tractor during section A of the graph.

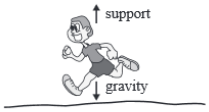


2013: 1b. On the diagrams below, draw and label the thrust and friction forces acting on the runner in sections A, B, and C.
In your answer you should:
•use arrows to show the directions of the thrust and friction forces
•beside each diagram, state if thrust is greater than friction, thrust is equal to friction,
Or if thrust is less than friction.
The gravity and support forces have been done for you

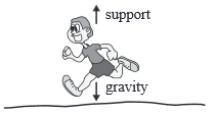
Section A



Section B



Section C

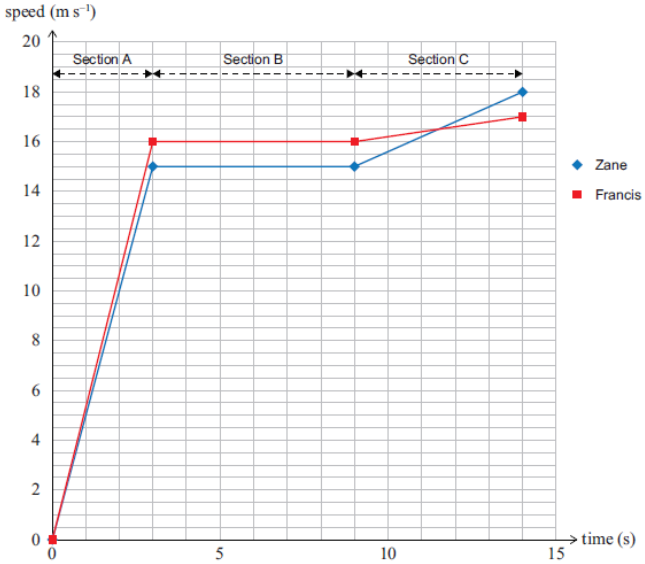


2013: 1c. Referring to your force diagrams in part (b), explain the link between the net force acting on the runner in sections A, B, and C of the graph, and the type of motion.
In your answer you should:
• describe what is meant by net force
• explain the link between net force and motion for EACH section
• compare the direction of the net force and the direction of the motion for EACH section.

2014: 4b (i). On the photo beside, draw and label ALL the forces acting on Zane's go-cart in Section B of the graph. The track is flat and horizontal. Ensure that your labels show the relative sizes of the forces.

NCEA Questions for Net Force (Part TWO)

2014: 4b (ii). Discuss the forces that are acting on Zane's go-cart to explain its motion in Section B of the graph.



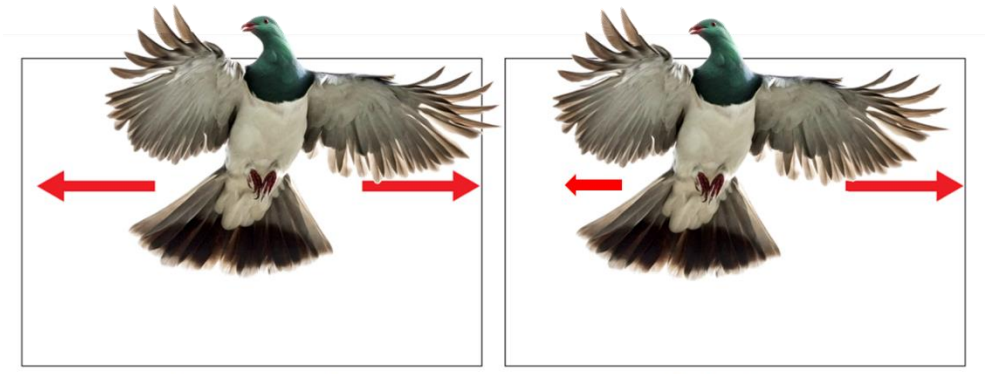
2015: 2b. The force diagrams below show another kererū flying at a constant speed, but then slowing down. Only horizontal forces are shown in these diagrams. Assume any other forces are balanced. Referring to the force diagrams of the kererū, explain the link between the horizontal net force acting on the bird, and the type of motion produced.

In your answer you should:

• describe what is meant by net force

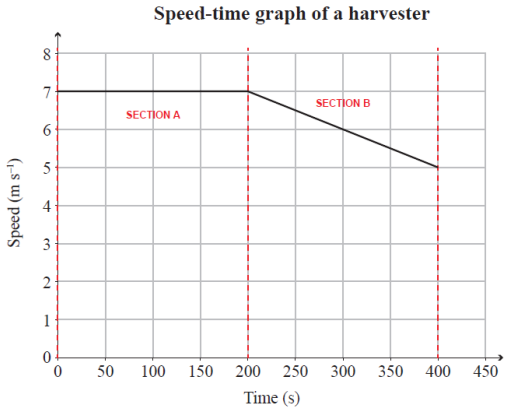
• explain the link between the horizontal net force and motion for each situation described

• compare the direction of the horizontal net force and the direction of the motion for the bird in each diagram.



Constant speed **Slowing down**

2016: 2b. 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.



NCEA Questions for Net Force (Part THREE)

2017: 3c. Referring to the force diagram below, explain the link between
the vertical net force acting on the container, and the type of motion produced,
while the container is being lowered.
In your answer, you should:
• describe what is meant by net force
• explain the link between the direction of the vertical net force and motion.

Force diagram

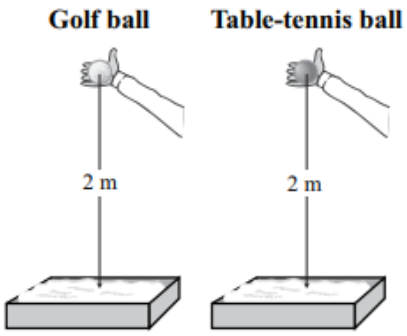
2018: 2a. Willow and her mountain bike have a combined mass of 82 kg. She accelerates at the start of a race at 0.80 m s^{-2}.

Calculate the net force acting on the bike and rider when accelerating.

2018: 2b (i). Draw and label arrows on the diagram below to show ALL the forces acting on Willow and her bike when accelerating.

2018: 2b (ii). Explain the size of the forces involved when Willow and her bike are accelerating.

NCEA Questions for Weight and Mass



2012: 3a. Some students wanted to investigate how craters form. They dropped two different balls – a golf ball (m = 0.046 kg) and a table-tennis ball (m = 0.003 kg), from a height of 2 m into a container filled with flour. (a) Calculate the weight of the golf ball.

2013: 3. A box in a warehouse has a mass of 2 500 kg. assuming $g=10ms^{-2}$

(a) Explain the difference between weight and mass.
(b) Calculate the weight of the box.

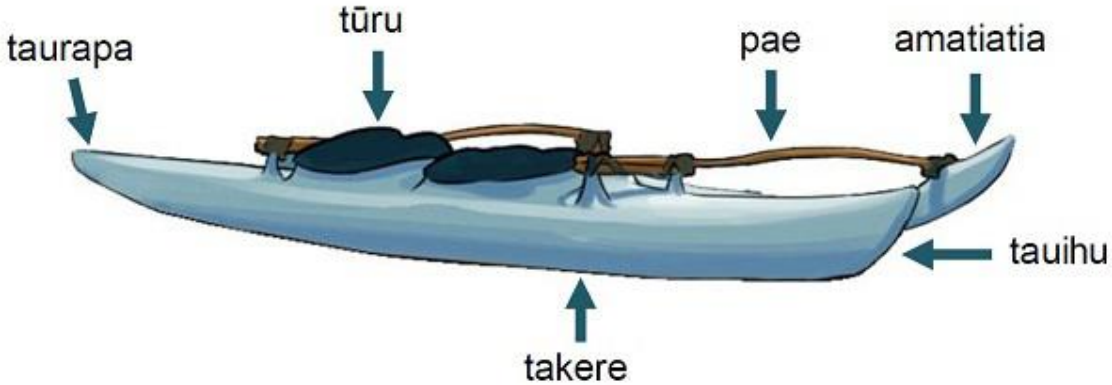
2015: 2a(i). The kererū (also known as New Zealand wood pigeon or kūkupa) is one of the largest pigeons in the world.
Explain the difference between mass and weight.
2a (ii). Calculate the weight of a kererū that has a mass of 630 g.

2016: 3a. 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.

2017: 2a. A lightweight waka ama (outrigger canoe) has a mass of 9.90 kg.

(a) What is the difference between mass and weight?
Use the waka ama as an example, and include a calculation for weight.



Writing Excellence answers to Pressure questions

Pressure QUESTION
Question: Q 1: The chair (15.0 kg) has four legs in contact with the floor, whereas the base of the footstool (15.0 kg) does not have legs and is entirely in contact with the floor. The area of each chair leg in contact with the floor is 0.001 m^2. Calculate the pressure that the chair (mass 15.0 kg) exerts on the carpet. In your answer you must determine: • the area of the chair legs in contact with the floor • the weight force of the chair • the pressure acting on the carpet. A person sat on the chair and then sat on the footstool for the same period of time. They noticed that the chair legs left deeper marks in the carpet than the footstool did, although both the chair and footstool have the same mass. Explain these differences in terms of pressure, force, and surface area.

	ANSWER
1. calculate the **surface area** of the chair (remember units and multiply by number of legs)	
2. calculate the **weight** of the chair $F_w = m \times g$	
3. calculate the **pressure** of the chair with units $P = F/A$ (some questions may ask you to calculate 2 objects)	
4. state the **surface area** of both and compare	
5. state the **weight** of both and compare	
6. explain the $P = F / A$ *in words*	
7. **link pressure** to the situation in the question	

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

NCEA Questions for Pressure (Part ONE)

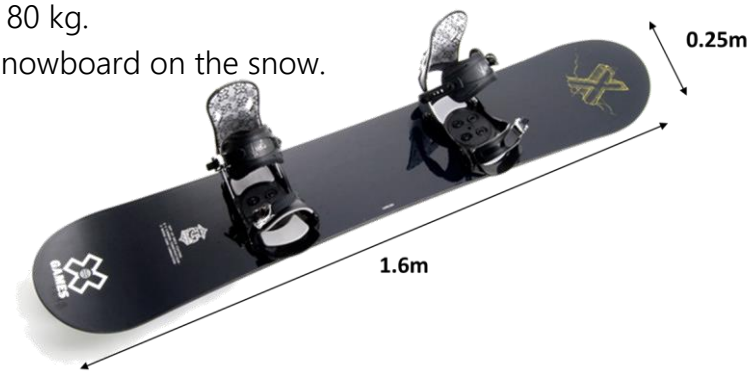
2012: 1. While on the sandy beach the woman sees a car (*m* = 1100 kg) that is stuck in the sand. The photos below show the tread patterns of the tractor's rear tyre and the car's rear tyre.

tractor tread

car tread

1d. Compare the different treads of the tractor tyre AND car tyre in terms of force, surface area and pressure applied. Use this comparison to explain why the car gets stuck in the sand, BUT the tractor does not.

2013: 4. A family decides to spend a day at a snow field. The father hires a snowboard for himself and a pair of skis for his daughter. Assume the snowboard and skis are rectangular in shape.
The father and snowboard have a combined mass of 80 kg.
(a) Calculate the pressure exerted by the father and snowboard on the snow.
Your answer should include:
• an area calculation
• a calculation of the pressure.



2013: 4b. The father notices that his daughter on her skis has sunk further into the snow than he has on his snowboard. The father and snowboard have a combined mass of 80 kg. The daughter and the skis have a combined mass of 58 kg. Explain why the daughter on her skis sinks further into the snow than her father on his snowboard.
In your answer you should:
• calculate the pressure exerted by the daughter and her skis on the snow
• compare the pressure exerted by the daughter and father (from part (a)) on the snow
• explain the difference in pressure in terms of force AND area
• explain how pressure relates to how far the person will sink in the snow.

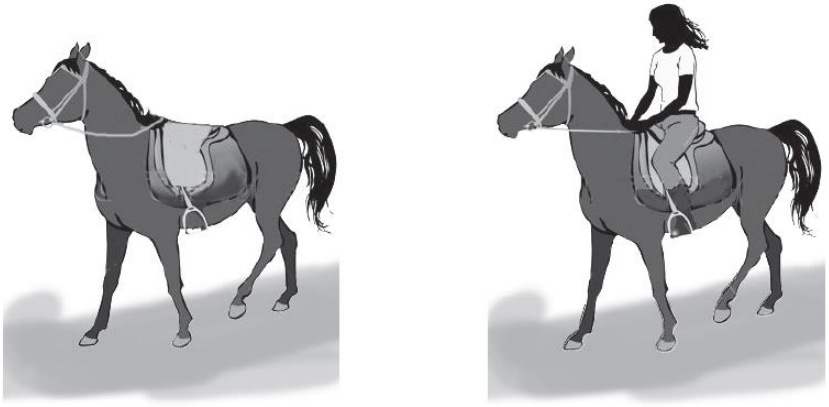
2014: 2c. A chair (15.0 kg) and footstool (15.0 kg) are shown below. The chair has four legs in contact with the floor, whereas the base of the footstool does not have legs and is entirely in contact with the floor. The area of each chair leg in contact with the floor is 0.001 m^2. Calculate the pressure that the chair (mass 15.0 kg) exerts on the carpet.
In your answer you must determine:
• the area of the chair legs in contact with the floor
• the weight force of the chair
• the pressure acting on the carpet.

NCEA Questions for Pressure (Part TWO)

2014: 2d. The chair has four legs in contact with the floor, whereas the base of the footstool does not have legs and is entirely in contact with the floor. A person sat on the chair and then sat on the footstool for the same period of time. They noticed that the chair legs left deeper marks in the carpet than the footstool did, although both the chair and footstool have the same mass.
Explain these differences in terms of pressure, force, and surface area.

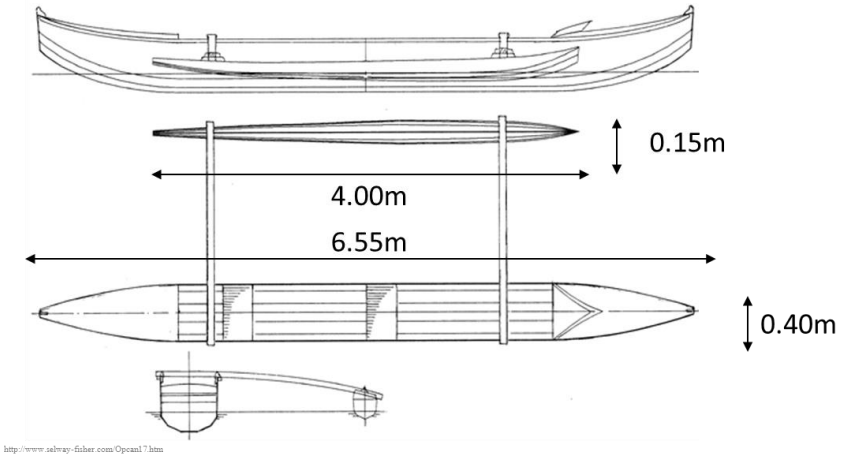
2015: 1c. Each of the horse's hooves has a surface area of 44 cm^2 (0.0044 m^2) and sinks into the sand when the horse stops. The hooves exert a pressure of 200155 Pa.
Calculate the weight of the horse.

2015: 1d. The rider walks beside the horse and then gets onto the horse. Explain why the horse's hooves 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.)



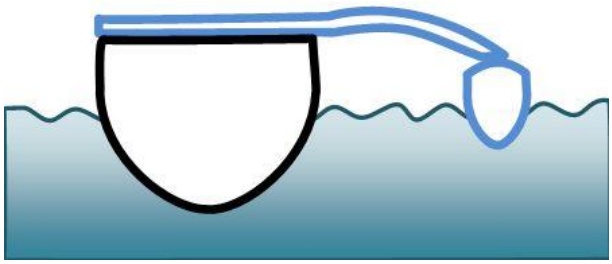
NCEA Questions for Pressure (Part THREE)

2017: 2b. A sketch of the waka ama hulls is shown below right.
(b) Calculate the pressure exerted by the waka ama (both hulls) on the water.
Your answer should include:
• an area calculation (assume both waka ama hulls are rectangular in shape, and the measurements above show the area in contact with the water)
• a calculation of the pressure. (A lightweight waka ama has a mass of 9.90 kg.)



2017: 2c. The waka ama sinks further into the water when a 67 kg paddler sits in it.
Explain why the waka ama sinks further into the water when the paddler sits in it.
Use calculations to support your answer.

Cross-section of a waka with a round hull



2018: 1d. Each of Runner A's feet has a surface area of 200 cm^2 (0.0200 m^2), which sink into the track. Together, the feet exert a pressure of 13 000 Pa.

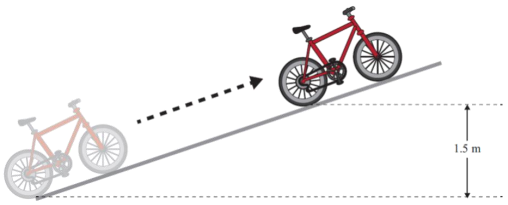
Calculate the weight of Runner A.

2018: 3d. Jake changes to his wide skis. The skis measure 10 cm in width compared with normal skis of 5 cm. Both sets of skis are the same length.

Explain why Jake does not sink into the snow as much when he uses his wide skis.

Calculations are not required.

Writing Excellence answers to Work and Power questions

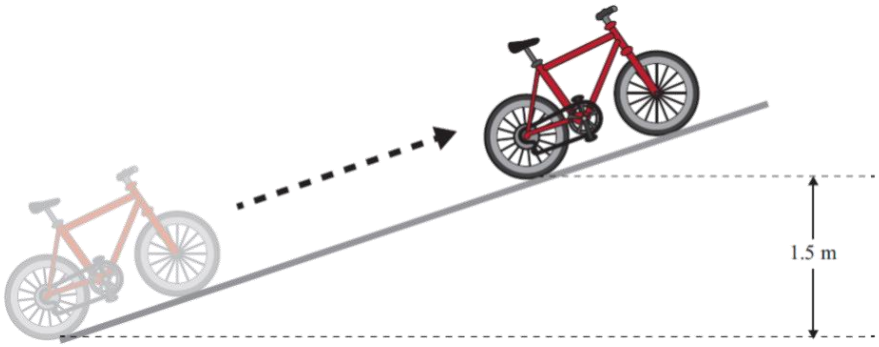
Work and Power QUESTION	
Question: A bike with a mass of 20 kg is lifted onto a shelf that is 1.5 metres high. It takes 3 seconds to lift the bike. Calculate the power required to lift the bike onto the shelf. Before you calculate the power, you will need to: • determine the weight force of the bike • calculate the work done in lifting the bike.  A person pushed the same bike up a ramp that it was also at a height of 1.5m. It then took them a longer time to do this than lifting the bike. Explain whether the power needed to push the bike up the ramp is more or less than when it is lifted straight up to the same height. Refer to force and energy.	
ANSWER	
1. calculate the **weight** (force) of the object (bike) with units $F_w = m \times g$	
2. calculate the **work done** by the bike with units $W = F \times d$	
3. calculate the **power** required to lift the object (bike) with units $P = W / t$	
4. link the same height above ground to same work required	
5. link the same work done to the same amount of energy gained	
6. explain the ***W = F x d*** *in words* comparing the differences in F and d in both situations – with both equalling the same work done.	
7. Compare the power required in both situations by explaining $P = W / t$ *in words*	

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

NCEA Questions for Work and Power (Part ONE)

2013: 3. A box in a warehouse has a mass of 2 500 kg.
A forklift lifts the box 4 metres straight up so it can be placed on a shelf. It takes 5 seconds to lift the box at a constant rate.
(c) Calculate the work done to lift the box to the height of 4 m, and then calculate the power needed by the forklift to lift it to this height.
(d) Find the average speed of the box as it moves up to the 4 m high shelf.
(e) Explain how the power needed to lift the box would be affected if the box was lifted at twice the speed.
In your answer you should consider how increased speed affects the time taken.

2014: 1c. A bike with a mass of 20 kg is lifted onto a shelf that is 1.5 metres high. It takes 3 seconds to lift the bike. Calculate the power required to lift the bike onto the shelf.
Before you calculate the power, you will need to:
• determine the weight force of the bike
• calculate the work done in lifting the bike.



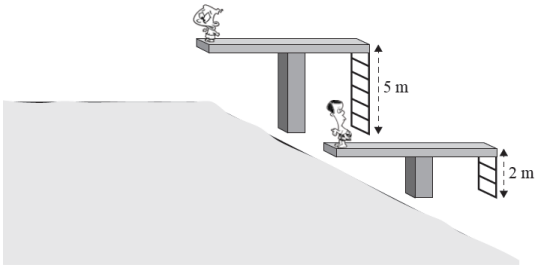
2014: 1d. A person pushed the same bike up a ramp that it was also at a height of 1.5m. It then took them a longer time to do this than lifting the bike. Explain whether the power needed to push the bike up the ramp is more or less than when it is lifted straight up to the same height. Refer to force and energy.

2014: 3a. During the construction of a building, a long beam was lifted into place using a crane. Calculate the work done in lifting the beam with a weight of 6000 N through a distance of 50 m.

2014: 3b. Explain why there is no work being done when the beam is hanging in the air without moving.

2015: 1b. How much work did Chris (48 kg) do when he climbed up the stairs to the 2 m platform?

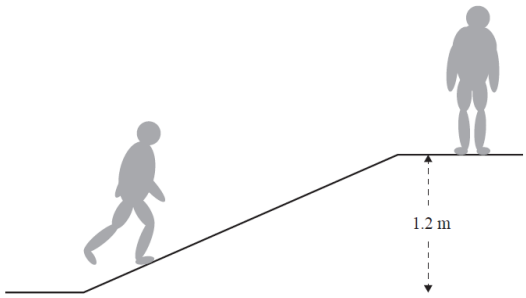
1c. Ian's mass is 52 kg.
Why did Ian do more work climbing up the 5 m ladder compared to Chris climbing up the 2 m ladder?



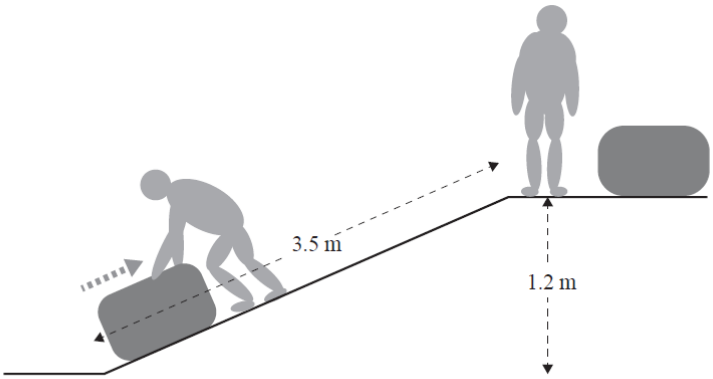
NCEA Questions for Work and Power (Part TWO)

2016: 2c. The harvested grain is stored in a shed with a ramp.

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.

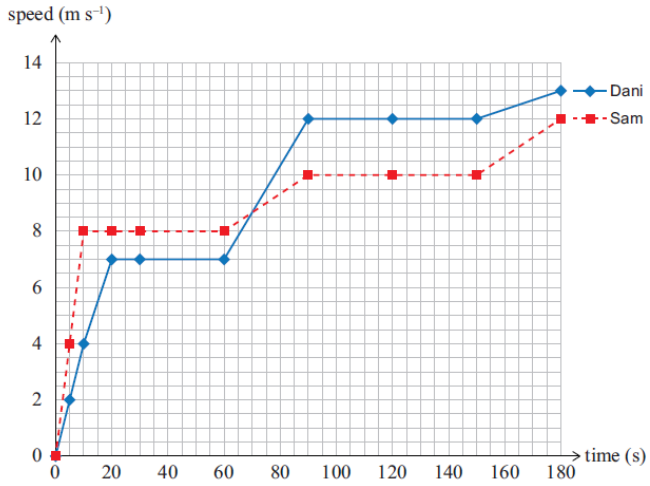


2016: 2d. The worker dragged a 25 kg bag of grain up the 3.5 m ramp to reach the height of 1.2 m. It took longer to drag the bag up the ramp than to lift the bag straight up to the top of the ramp.
(i) Explain why the force needed to drag the bag of grain up the ramp to the top is less than the force needed to lift the bag straight up (vertically). Ignore friction.



2d (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.)

2017: 1b. Sam's horse accelerates for the first 10 s of the race AND covers a distance of 40 m. Sam and his horse have a total mass 308 kg.
(b) Use the acceleration to calculate the work that Sam and his horse have done in the first 40 m.

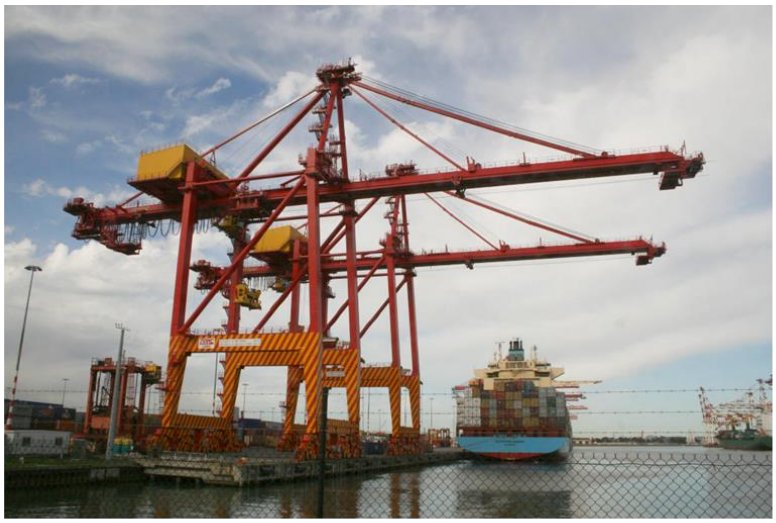


1c. Explain the effect on work AND power if a new, heavier jockey was on Sam's horse, which had the same speed and acceleration over the race.

Calculations are not required.

NCEA Questions for Work and Power (Part THREE)

2017: 3a. The crane shown below lifted a container 30 m in 15 s.
The weight of the container is 60 000 N.



https://commons.wikimedia.org/wiki/File:Melbourne--swanston-dock-container-crane.jpg

(i) Calculate the work done by the crane in lifting the container 30 m.

(ii) Calculate the power of the crane while lifting the container 30 m in 15 s.

3b. Explain what work is being done on the container when it is hanging in the air without moving.

2018: 2c. Willow had to choose between two ramps to ride her bike to the top of an incline. It takes less time to use Ramp B.

(i) Is the work needed to get to the top of Ramp A more, less, or the same as the work needed to get to the top of Ramp B?

Explain your answer.

(ii) Explain how the two ramps differ in terms of the force and power needed to ride up them.

Calculations are not required.

2018: 3a. Marama is snow skiing and uses a ski tow to get to the top of the slope.
The ski tow pulls Marama up the slope to a height of 46.2 m. The combined mass of Marama and her ski gear is 62 kg.
(a) Calculate the work done for Marama to reach the top of the slope.

2018: 3b. It takes 525 s for the tow to pull Marama to the top of the slope.
Calculate the power needed to get Marama to the top. For this question, ignore friction.

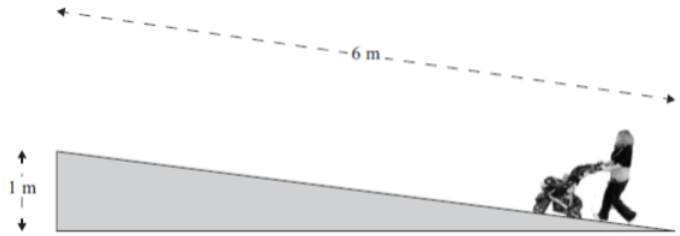
Writing Excellence answers to Conservation of Energy questions

Conservation of Energy QUESTION	
Question: A crane was lifting wood. The cable broke, and 150 kg of wood fell 12 m to the ground below. The wood had 15 000 J of kinetic energy just before it landed on the ground below. This was different from the amount of energy the wood had when it was hanging from the crane. Explain why there is a difference in the energy the wood had when it was hanging from the crane compared to just before it hit the ground. In your answer you should: • name the type of energy the wood had when it was hanging from the crane • calculate how much energy the wood had when it was hanging from the crane • calculate the difference between the kinetic energy of the wood just before hitting the ground and the energy the wood had when it was hanging from the crane • justify the difference in energy of the wood when it was hanging from the crane and then just before it hit the ground.	
ANSWER	
1. link the type of energy to the position at maximum height and minimum speed (velocity)	
2. link the type of energy to the position at minimum height and maximum speed (velocity)	
3. calculate the potential energy at maximum height $\Delta E_p = mg\Delta h$	
4. compare the Difference between E_P and E_K (you may have to calculate E_k in some questions)	
5. link the difference in energy to other types of energy due to friction.	
Conservation of Energy QUESTION	
Question: 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.	
ANSWER	
1. compare energy types at maximum and minimum height	
2. state the assumption about the conservation of energy	
3. state $E_p = E_k$	
4. rearrange equation to make v^2 the focus (cancel m on both sides)	
5. calculate v	

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

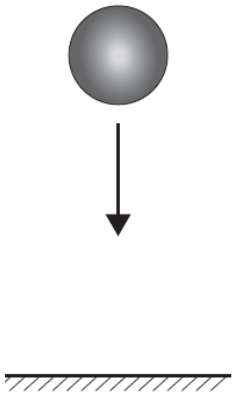
NCEA Questions for Conservation of Energy (Part ONE)

2012: 4a. A woman pushes a child in a buggy up a ramp as shown below with a force of 100N.
Calculate the work done to push the buggy and child up the ramp



4b. The energy gained by the buggy and child (m = 55 kg) at the top of the ramp does not equal the work done. Explain why these two values are not equal.
In your answer you should:
• name the type of energy the buggy has, when it reaches the top of the ramp
• calculate the difference between the work done and the energy at the top of the ramp
• explain where the "missing" energy has gone and why this occurs.

2013: 2a. In a classroom experiment, a ball is dropped onto the floor.
Before the ball is dropped, it is not moving, and has only gravitational potential energy (*E*p). As the ball falls, the gravitational potential energy is converted into kinetic energy (*E*k).
The ball has a mass of 100 grams.
(a) Complete the labels for the diagram below to show the energy changes as the ball is dropped.
Assume that the gravitational potential energy is changed only into kinetic energy.



At the top: $E_p = 0.2$ J $E_k = 0$ J

Halfway: $E_p =$ _____ $E_k =$ _____

Just before it hits the floor: $E_p =$ _____ $E_k =$ _____

2b: The teacher tells the students that the ball will be travelling at 2 m s^{-1} just before it hits the floor.
The students are asked to predict the speed of the ball halfway down from three options:
Option 1: The speed is less than 1 m s^{-1}.
Option 2: The speed is equal to 1 m s^{-1}.
Option 3: The speed is greater than 1 m s^{-1}.
State the correct option, explain your answer, and support your answer using energy calculations.
(The ball has a mass of 100 grams.)

NCEA Questions for Conservation of Energy (Part TWO)

2015: 1d. 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.
1e: Explain why Ian's actual speed as he is about to hit the water, is slower than that calculated in part (d).

2016: 3c. A small rocket has a mass of 2.60 kg and a weight of 26.0 N. The rocket had gained 1950 J of potential energy at its maximum height. It then fell back to the ground.

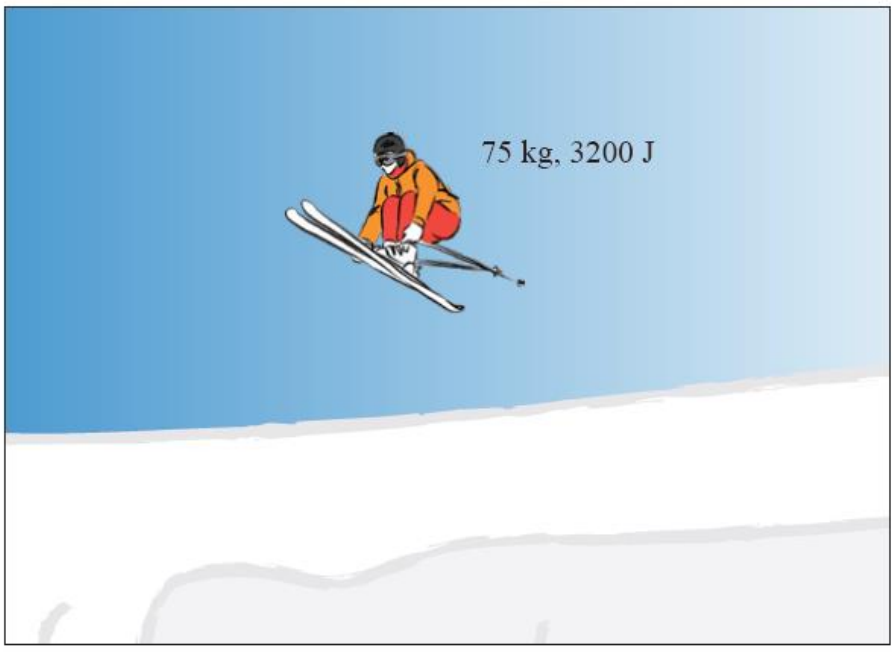
What was the maximum speed it could reach just before hitting the ground (assuming energy is conserved)?

2017: 3d. The crane was lifting another container and the cable broke. The 6500 kg container fell 15 m to the ground below. The container had 970 000 J of kinetic energy just before it hit the ground.

Calculate the energy the container had before the cable broke. AND
Explain why there is a difference in the energy of the container when it was hanging from the crane compared to just before it hit the ground.

2018: 3c. Jake has a mass of 75 kg and is doing a jump. He has 3200 J of gravitational potential energy at the top of his flight.

(i) Calculate his downward (vertical) speed just before he lands, assuming energy is conserved.



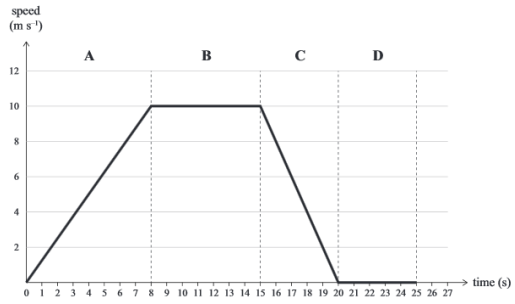
2018: 3c. (ii) Explain why Jake's actual speed when he lands is slower than that calculated in part (i).

Writing Excellence answers to Interpreting motion-time graphs questions

Interpreting motion-time graphs QUESTION

Question: Describe the motion of the runner through sections A, B, C, and D.
Your answers should include descriptions AND any relevant Calculations

A runner's speed is recorded for 25 seconds and graphed below.



$v = d/t$

v = velocity (ms^{-1})
d = distance (m)
t = time (s)

$a_{ave} = \Delta v/\Delta t$

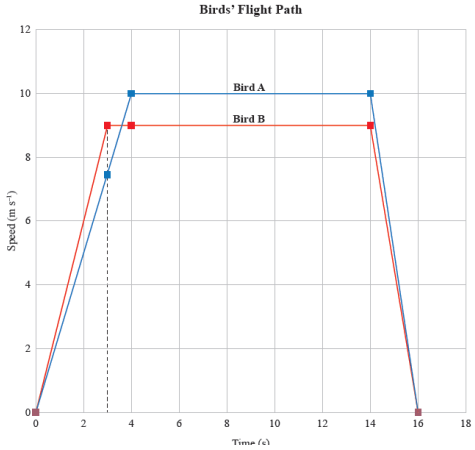
a = acceleration (ms^{-2})
v = velocity (ms^{-1})
t = time (s)

ANSWER

1. state the type of graph used (distance-time or speed-time graph)	This graph is a **speed-time** graph
2. starting with section **A** describe the type of motion (stationary, constant speed or acceleration)	Section **A** shows **acceleration** - the runner is accelerating
3. state the starting speed and final speed, as well as total time taken (use correct units)	Accelerating at a constant rate from 0 m s^{-1} to 10 m s^{-1} in 8 seconds.
4. calculate the motion in section A using either v = Δd/Δt or a = Δv/Δt Show working and use correct units	a = Δv/Δt a = 10 m s^{-1} / 8 seconds. **a = 1.25 m s^{-2}**
5. next with section **B** describe the type of motion (stationary, constant speed or acceleration)	Section **B** shows **constant speed** - the runner is travelling at a constant speed
6. state the starting speed and final speed, as well as total time taken (use correct units) – calculation not needed for stationary	Constant speed of 10 m s^{-1} for 7 seconds. Δv = 0 m s^{-1} **So a = 0 m s^{-2}**
7. next with section **C** describe the type of motion (stationary, constant speed or acceleration)	Section **C** shows **deceleration** (negative acceleration)
8. state the starting speed and final speed, as well as total time taken (use correct units)	Decelerating from 10 m s^{-1} to 0 m s^{-1} at a constant rate for 5 seconds.
9. calculate the motion in section A using either v = Δd/Δt or a = Δv/Δt Show working and use correct units (make sure to use a – sign if acceleration negative)	a = Δv/Δt Δv = 0 m s^{-1} - 10 m s^{-1} Δt = 20s-15s a = -10 m s^{-1} / 5 seconds. **a = –2 m s^{-2}**
10. finally with section **D** describe the type of motion (stationary, constant speed or acceleration)	Section **D** shows the runner is **Stationary**
11. state the starting speed and final speed, as well as total time taken (use correct units)	(constant speed of 0 m s^{-1}) for 5 seconds.

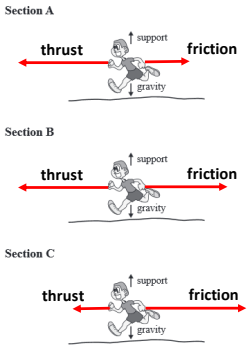
NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

Writing Excellence answers to Distance in a speed-time graph questions

Distance in a speed-time graph QUESTION	
Question: In 16 s, **Bird B** travelled 121.5 m. How much further did **Bird A** travel in the same time? *Show all working.*	
ANSWER	
1. divide the are under the graph (for bird A) in the **smallest number** of rectangles and triangles	(A) 0 – 4 s: (B) 4 – 14 s: (C) 14 – 16 s:
2. calculate the area for section **A** – a triangle Area = ½ base x height Or Distance = ½ v x t	d = ½ x 4 x 10 = 20m
3. calculate the area for section **B** – a rectangle Area= base x height Or Distance = v x t	d = 10 x 10 =100m
4. calculate the area for section **C** – a triangle Area = ½ base x height Or Distance = ½ v x t	d = ½ x 2 x 10 = 10m
5. **add all 3 sections** together and show working plus units	20m + 100m + 10m Total distance = 130 m
6. subtract one distance from the other to show the **differences in distance**	(Bird A 130 – Bird B 121.5 = 8.50 m)
7. **compare** between the distances of both birds and state which has flown the furthest	So Bird A has flown 8.50 m further than Bird B.

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

Writing Excellence answers to Net Force questions

Net Force QUESTION	
Question: Referring to your force diagrams in part (b), explain the link between the **net force** acting on the runner in sections A, B, and C of the graph, and the type of motion. In your answer you should: • describe what is meant by net force • explain the link between net force and motion for EACH section • compare the direction of the net force and the direction of the motion for EACH section.	

ANSWER	
1. give the **definition** for Net force	A net force is the resultant force when multiple (more than one) forces interact. (are acting on the same object)
2. link the **size** and **direction** of the forces (arrows) to the size of the Net force	If the forces are pointing in the same direction, the forces add, giving a larger net force. If the forces are in opposite direction, the forces subtract, giving a smaller net force (including a zero net force).
3. link the **Net force** to your example	Net forces determine whether the runner is accelerating, decelerating or maintaining constant speed.
4. link Net force to **acceleration**	If the net force is pointing in the same direction as the direction of motion, the object accelerates
5. link Net force to **deceleration**	If the net force is pointing in the opposite direction to the direction of motion, the object decelerates.
6. link Net force to **stationary** motion and **constant speed**	If there is no net force, the object maintains constant speed or is stationary.
7. discuss section **A** linked to Net force and the size of the forces name them)	The runner is accelerating. This is because there is a net force pointing forwards. This occurs when the thrust force is greater than friction.
8. discuss section **B** linked to Net force and the size of the forces name them)	The runner has constant speed. This is because there is no overall net force. This occurs when the thrust force is equal to friction.
9. discuss section **C** linked to Net force and the size of the forces name them)	The runner is decelerating. This is because there is a net force pointing in the opposite direction to the motion.

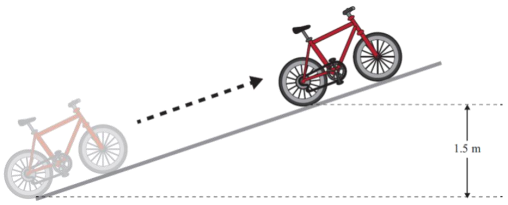
NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

Writing Excellence answers to Pressure questions

Pressure QUESTION	
Question: Q 1: The chair (15.0 kg) has four legs in contact with the floor, whereas the base of the footstool (15.0 kg) does not have legs and is entirely in contact with the floor. The area of each chair leg in contact with the floor is 0.001 m^2. Calculate the pressure that the chair (mass 15.0 kg) exerts on the carpet. In your answer you must determine: • the area of the chair legs in contact with the floor • the weight force of the chair • the pressure acting on the carpet. A person sat on the chair and then sat on the footstool for the same period of time. They noticed that the chair legs left deeper marks in the carpet than the footstool did, although both the chair and footstool have the same mass. Explain these differences in terms of pressure, force, and surface area.	
ANSWER	
1. calculate the **surface area** of the chair (remember units and multiply by number of legs)	Surface area of the chair legs: $4 \times 0.001 = 0.004$ m^2 Surface Area must be in m^2
2. calculate the **weight** of the chair $F_w = m \times g$	Weight of chair: $Fw = m \times g = 15 \times 10 = 150$ N
3. calculate the **pressure** of the chair with units $P = F/A$ (some questions may ask you to calculate 2 objects)	Pressure exerted: $P = F/A$ = 150 / 0.004 = 37 500 Pa (Nm^{-2})
4. state the **surface area** of both and compare	The footstool has a much larger surface area in contact with the floor than the chair.
5. state the **weight** of both and compare	The force applied to both the chair and the footstool are the same because the same person sits on both. (150N)
6. explain the $P = F / A$ *in words*	$P = F / A$, so if *Area* is bigger then the pressure must be smaller (or vice versa).
7. **link pressure** to the situation in the question	The larger pressure of the chair causes the chair legs to leave deeper marks in the carpet than the footstool did, which exerted less pressure on the carpet

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

Writing Excellence answers to Work and Power questions

Work and Power QUESTION	
Question: A bike with a mass of 20 kg is lifted onto a shelf that is 1.5 metres high. It takes 3 seconds to lift the bike. Calculate the power required to lift the bike onto the shelf. Before you calculate the power, you will need to: • determine the weight force of the bike • calculate the work done in lifting the bike.  A person pushed the same bike up a ramp that it was also at a height of 1.5m. It then took them a longer time to do this than lifting the bike. Explain whether the power needed to push the bike up the ramp is more or less than when it is lifted straight up to the same height. Refer to force and energy.	
ANSWER	
1. calculate the **weight** (force) of the object (bike) with units $F_w = m \times g$	$F_w = m \times g$ F = 20 x 10 = 200 N
2. calculate the **work done** by the bike with units $W = F \times d$	$W = F \times d$ W = 200 x 1.5 = 300 J
3. calculate the **power** required to lift the object (bike) with units $P = W / t$	$P = W / t$ P = 300 / 3 = 100 W
4. link the same height above ground to same work required	As the height above the ground is the same, **the same work is required** to travel up the ramp as lifting the bike straight up.
5. link the same work done to the same amount of energy gained	If the same amount of work is done, the same amount of energy is gained.
6. explain the ***W = F x d*** *in words* comparing the differences in F and d in both situations – with both equalling the same work done.	As $W = F \times d$, if d is increased, the amount of force required to do the same amount of work will be less, ie a ramp allows the same amount of work to be done with a smaller force over a greater distance.
7. Compare the power required in both situations by explaining ***P = W / t*** *in words*	The energy gained by the bike is the same in both cases, but the **time taken** to go up the ramp is greater than lifting it vertically. As $P = W / t$, a greater time would mean **less power is required**.

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

Writing Excellence answers to Conservation of Energy questions

Conservation of Energy QUESTION	
Question: A crane was lifting wood. The cable broke, and 150 kg of wood fell 12 m to the ground below. The wood had 15 000 J of kinetic energy just before it landed on the ground below. This was different from the amount of energy the wood had when it was hanging from the crane. Explain why there is a difference in the energy the wood had when it was hanging from the crane compared to just before it hit the ground. In your answer you should: • name the type of energy the wood had when it was hanging from the crane • calculate how much energy the wood had when it was hanging from the crane • calculate the difference between the kinetic energy of the wood just before hitting the ground and the energy the wood had when it was hanging from the crane • justify the difference in energy of the wood when it was hanging from the crane and then just before it hit the ground.	
ANSWER	
1. link the type of energy to the position at maximum height and minimum speed (velocity)	At the top, the wood has a certain amount of gravitational potential energy and no kinetic energy.
2. link the type of energy to the position at minimum height and maximum speed (velocity)	Just before the wood hits the ground, the gravitational potential energy has been converted into kinetic energy.
3. calculate the potential energy at maximum height $\Delta E_p = mg\Delta h$	E_P calculation: $E_P = mgh$ $E_p = 150 \times 10 \times 12 =$ **18 000 J**
4. compare the Difference between E_P and E_K (you may have to calculate E_k in some questions)	Difference between E_P and E_K: = 18 000 – 15 000 = **3 000 J**
5. link the difference in energy to other types of energy due to friction.	Some kinetic energy is lost as heat energy due to the **frictional force** of air resistance. (also some sound energy)
Conservation of Energy QUESTION	
Question: 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.	
ANSWER	
1. compare energy types at maximum and minimum height	Ian had gained gravitational potential energy at the top of the diving board and this was converted into kinetic energy. Kinetic energy would be at maximum just before he hit the water
2. state the assumption about the conservation of energy	We assume that all gravitational potential energy will equal the kinetic energy.
3. state $E_p = E_k$	Ep = Ek therefore $\frac{1}{2} mv^2 = mgh$
4. rearrange equation to make v^2 the focus (cancel m on both sides)	$v^2 = 2gh$ $v = \sqrt{2gh}$
5. calculate v with units	$v = \sqrt{2gh}$ $v = \sqrt{2 \times 10 \times 5}$ $v = 10\ ms^{-1}$

NOTE: The white column is how your answer would appear on your test paper so make sure you **write out complete sentences**. The grey area is just to help you structure your answer and would not appear in the question.

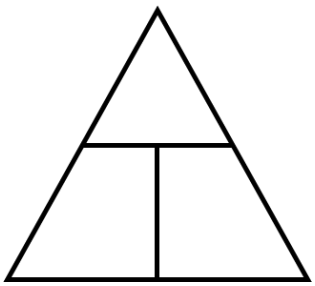
Formula revision Part 1

Success Criteria: We know we have achieved this when we can:

- Construct a Formula equation for Motion, Force and Pressure
- Be able to give the names and units used in each Formula
- Be able to solve a simple question using each Formula

Remember to answer questions:
1. Write down formula
2. Rearrange formula if needed
3. Show working
4. Give answer with units

1. Calculating **speed (velocity)** - Fill in triangle and give names and units for each Letter

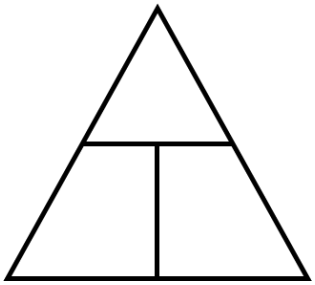


Letter	Name	Units
v		
d		
t		

$v = \Delta d/\Delta t$

Sample Question: A cyclist rides at a speed of **20 m s^{-1}** for **30 seconds**. Calculate the **distance** she travels.

2. Calculating **acceleration** - Fill in triangle and give names and units for each Letter



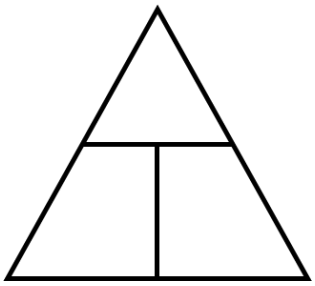
Letter	Name	Units
a		
v		
t		

$a = \Delta v/\Delta t$

Sample Question: A car accelerates from **5 m s^{-1}** and reaches a speed of **20 m s^{-1}**

If the car takes **12 s** to reach this speed, calculate the **acceleration** of the car.

3. Calculating **Force (general)** - Fill in triangle and give names and units for each Letter



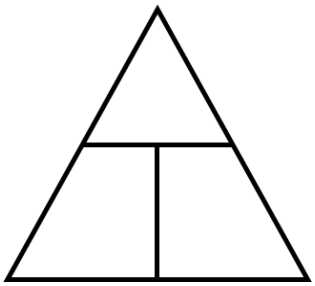
Letter	Name	Units
F		
m		
a		

$F_{net} = ma$

Sample Question: A car broke down and needs to be pushed. Three people pushed the car with a force of **450 N.** Friction can be ignored. If the car with the driver inside it had a mass of **900 kg**, calculate the car's **acceleration.**

Remember to convert mass to weight:
F (weight) = Mass x Gravity
Acceleration due to gravity = $10ms^{-2}$

4. Calculating **pressure** - Fill in triangle and give names and units for each Letter



Letter	Name	Units
P		
F		
A		

P= F / A

Sample Question: A **70 kg** snowboarder stands uses a snowboard which has a mass of **2.5 kg.** The snowboard has a surface area in contact with the snow of **0.60 m^2.** Calculate the pressure on the snow.

Remember:
To convert cm^2 to m^2
Divide by 10,000

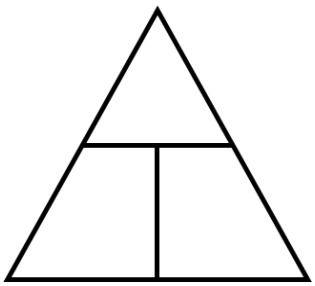
Formula revision Part 2

Success Criteria: We know we have achieved this when we can:

- Construct a Formula equation for Work, Power and Energy
- Be able to give the names and units used in each Formula
- Be able to solve a simple question using each Formula

Remember to answer questions:
1. Write down formula
2. Rearrange formula if needed
3. Show working
4. Give answer with units

1. Calculating **work** - Fill in triangle and give names and units for each Letter



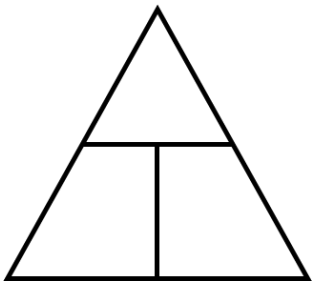
Letter	Name	Units
W		
F		
d		

W = Fd

1. Sample Question: A motorbike of mass **150 kg** is lifted **2 m** onto a display stand.

What is the work done to lift the motorbike onto the display stand?

2. Calculating **power** - Fill in triangle and give names and units for each Letter



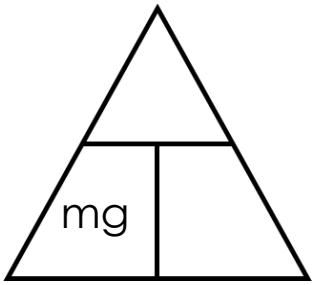
Letter	Name	Units
P		
W		
t		

P = W/t

1. Sample Question: A crane lifts **800 kg** of concrete a height of **25 m** in **20 s**.

Calculate the power needed by the crane to lift the concrete.

3. Calculating (gravitational) **potential Energy** - Fill in triangle and give names and units for each Letter



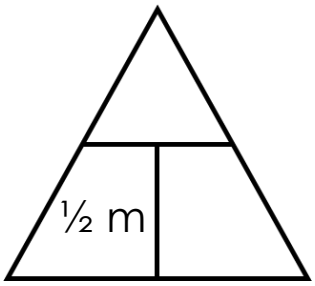
Letter	Name	Units
E_p		
m		
g		
h		

$E_p = mgh$

Sample Question: A dog, mass **45 kg**, jumps off a bridge into the water below. The bridge is **1.5 m** above the water. Calculate the **gravitational potential energy** the girl loses when she hits the water.

Remember to convert mass to weight:
F (weight) = Mass x Gravity
Acceleration due to gravity = $10ms^{-2}$

4. Calculating **kinetic energy** - Fill in triangle and give names and units for each Letter



Letter	Name	Units
E_k		
m		
V^2		

$E_k = ½ mv^2$

Sample Question: The world record for a men's team sprint of 1000 m sprint is an average speed of **23.9 ms^{-1}.** If the mass of a rider was **70 kg + 7 kg** for his bike, calculate the riders **kinetic energy** output when he crossed the line.

Remember to add mass together

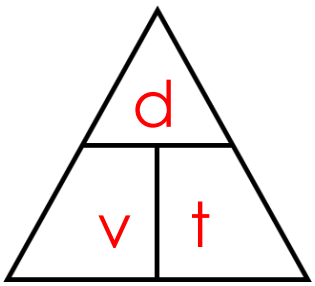
ANSWERS Formula revision Part 1

Success Criteria: We know we have achieved this when we can:

- Construct a Formula equation for Motion, Force and Pressure
- Be able to give the names and units used in each Formula
- Be able to solve a simple question using each Formula

Remember to answer questions:
1. Write down formula
2. Rearrange formula if needed
3. Show working
4. Give answer with units

1. Calculating **speed (velocity)** - Fill in triangle and give names and units for each Letter



Letter	Name	Units
v	Velocity / speed	**$m\ s^{-1}$**
d	distance	m
t	time	s

$v = \Delta d / \Delta t$

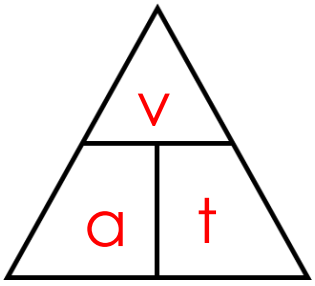
Sample Question: A cyclist rides at a speed of **20 ms^{-1}** for **30 seconds**. Calculate the **distance** she travels.

d = v x t

d = 20 ms^{-1} x 30 s

d = 600 m

2. Calculating **acceleration** - Fill in triangle and give names and units for each Letter



Letter	Name	Units
a	acceleration	ms^{-2}
v	velocity	ms^{-1}
t	time	s

$a = \Delta v / \Delta t$

Sample Question: A car accelerates from **5 ms^{-1}** and reaches a speed of **20 ms^{-1}**

If the car takes **12 s** to reach this speed, calculate the **acceleration** of the car.

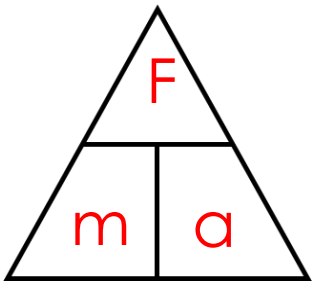
a = Δv / Δt

$\Delta v = 20\ ms^{-1} - 5\ ms^{-1} = 15\ ms^{-1}$

a = 15 ms^{-1} / 12 s

a = 1.25 ms^{-2}

3. Calculating **Force (general)** - Fill in triangle and give names and units for each Letter



Letter	Name	Units
F	Force	N
m	mass	kg
a	acceleration	ms^{-2}

$F_{net} = ma$

Sample Question: A car broke down and needs to be pushed. Three people pushed the car with a force of **450 N.** Friction can be ignored. If the car with the driver inside it had a mass of **900 kg**, calculate the car's **acceleration.**

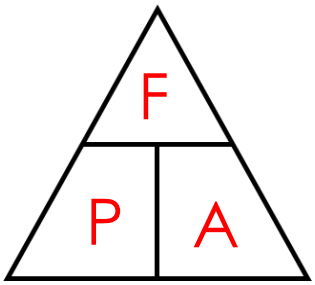
a = F / m

a = 450 N / 900 kg

a = 0.5 ms^{-2}

Remember to convert mass to weight:
F (weight) = Mass x Gravity
Acceleration due to gravity = 10ms^{-2}

4. Calculating **pressure** - Fill in triangle and give names and units for each Letter



Letter	Name	Units
P	Pressure	Nm^{-2} or Pa
F	Force	N
A	Area	m^2

P= F / A

Sample Question: A **70 kg** snowboarder stands uses a snowboard which has a mass of **2.5 kg.** The snowboard has a surface area in contact with the snow of **0.60 m^2.** Calculate the pressure on the snow.

P = F / A

Mass = 70 kg + 2.5 kg = 72.5 kg

F_{weight} = 72.5 x 10 = 725 N

P = 725 N / 0.60 m^2

P = 1208.3 Nm^2

Remember:

To convert cm^2 to m^2

Divide by 10,000

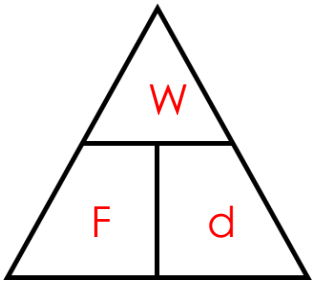
ANSWERS Formula revision Part 2

Success Criteria: We know we have achieved this when we can:

- Construct a Formula equation for Work, Power and Energy
- Be able to give the names and units used in each Formula
- Be able to solve a simple question using each Formula

Remember to answer questions:
1. Write down formula
2. Rearrange formula if needed
3. Show working
4. Give answer with units

1. Calculating **work** - Fill in triangle and give names and units for each Letter



Letter	Name	Units
W	Work	J
F	Force	N
d	distance	m

W = Fd

Sample Question: A motorbike of mass **150 kg** is lifted **2 m** onto a display stand.

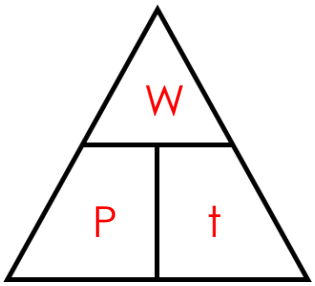
What is the work done to lift the motorbike onto the display stand?

F_w = 150 kg x 10 = 1500 N

W = Fd

W = 1500 N x 2 m W = 3000 J

2. Calculating **power** - Fill in triangle and give names and units for each Letter



Letter	Name	Units
P	Power	W
W	Work	J
t	time	s

P = W/t

2. Sample Question: A crane lifts **800 kg** of concrete a height of **25 m** in **20 s**.

Calculate the power needed by the crane to lift the concrete.

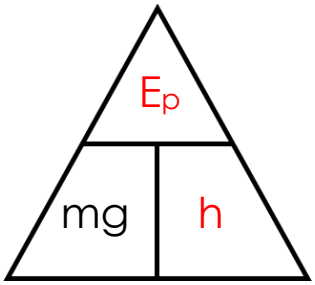
Fw = 800kg x 10 = 8000N

W = Fd

W = 8000 N x 25 m = 200,000 J

P = W/t = 200,000 / 20 P = 10,000

3. Calculating (gravitational) **potential Energy** - Fill in triangle and give names and units for each Letter



Letter	Name	Units
E_p	Potential energy	J
m	mass	kg
g	Acceleration due to Gravity (10)	ms^{-2}
h	height	m

$E_p = mgh$

Sample Question: A dog, mass **45 kg**, jumps off a bridge into the water below. The bridge is **1.5 m** above the water. Calculate the **gravitational potential energy** the girl loses when she hits the water.

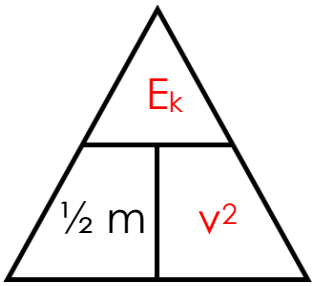
$E_p = mgh$

$E_p = 45\ kg \times 10 \times 1.5\ m$

$E_p = 675\ J$

Remember to convert mass to weight:
F (weight) = Mass x Gravity
Acceleration due to gravity = $10ms^{-2}$

4. Calculating **kinetic energy** - Fill in triangle and give names and units for each Letter



Letter	Name	Units
E_k	Kinetic energy	J
m	mass	kg
V^2	Velocity squared	ms^{-1}

$E_k = ½\ mv^2$

Sample Question: The world record for a men's team sprint of 1000 m sprint is an average speed of **23.9 ms^{-1}.** If the mass of a rider was **70 kg + 7 kg** for his bike, calculate the riders **kinetic energy** output when he crossed the line.

$m = 70\ kg + 7\ kg = 77kg$

$Ek = ½\ m\ v^2$

$Ek = ½\ 77\ kg \times (23.9)^2$

$Ek = 38.5 \times 571.2$

$Ek = 21{,}991.6\ J$

Remember to add mass together