KS3

AQA big ideas - homework pack

ACTIVITY PACK

- Self and peer assessment ideas
- A mix of long and short tasks
- 80 homework tasks covering the 10 big ideas

teachit

1 Forces

Introduction

A collection of eight homework activities to engage students studying the Forces topic. There are two homework tasks for each of the four units, Speed, Gravity, Contact forces and Pressure.

The first of the two tasks in each unit is shorter, and students should spend up to 30 minutes on these. The second tasks are extended activities that could be completed over two or three weeks.

There are suggestions for creative ways that the homework activities can be assessed during the lesson, with opportunities for self and peer assessment. The accompanying PowerPoint has slides with the answers and assessment activities to use in class.

Contents

1.1 Speed

Task 1 Speed statements

1. Read the following statements about speed. Decide if these statements are true or false and explain why.
    a. If Jas travels 74 miles in two hours she is going at the same speed as Alex who travels 37 miles in one hour.
    b. A van passing the speed markings on a motorway in two seconds is travelling faster than a car that passes them in one second.
    c. If I cycle one mile at 9 mph I will arrive at the skate-park before my friend who lives half a mile closer to the park, sets off at the same time and runs there at 6 mph.

2. Write three statements about speed. The statements that you write can be true or false. For any false statements make sure that you have the correct answers

1.1 Speed

Task 2 Comparing cars

Many claims about the range of electric cars are made by manufacturers. These often do not match the experience of people who drive an electric car, leading to a new stress on drivers known as 'range-anxiety'! After all, an electric car cannot be restarted with a can of fuel. If the battery is flat the vehicle must be recovered from the roadside and taken to a charging point.

Family electric car	Manufacturer's official range (miles)	Independent test on UK roads range (miles)					Mean range in independent tests (miles)
		1	2	3	4	5	
A	144	98	122	135	84	113	
B	168	140	115	134	107	151	
C	279	259	238	240	262	267	

The range of a car depends on how the car is driven. Is it travelling fast or more slowly? Is the driver accelerating rapidly and breaking hard? The range also depends on temperature, weather and road conditions, the quality of the tyres and how much other features are being used, e.g. headlights and seat warmers.

- Calculate the mean range for each vehicle.

  Work out the distance travelled on these journeys. Which car would probably need to stop on its journey to recharge?

1. Car A travelled for two hours at 46 mph.
2. Travelling at a speed of 36 mph, car B took a journey which lasted three-and-a-half hours.
3. Car C travelled for three hours and forty-five minutes. Its speed was 62 mph.

Extension:

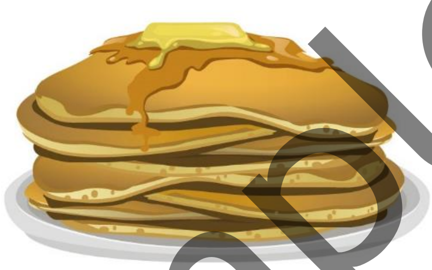
How would you conduct a fair test of these vehicles to find out the range of each in normal driving conditions on UK roads?

- What variables would you have to control?

Which ones would you not be able to fully control?

1.2 Gravity

Task 1 Pancakes on the Moon



This pile of pancakes has a mass of 500 g.

weight (N) = mass (kg) × gravitational field strength (N/kg)

(g on Earth = 10 N/kg)

1. How much does this pile weigh in newtons on Earth?
2. Find a website which allows you to convert weight on Earth into the weight on other planets, e.g.

exploratorium.edu/ronh/weight/

3. How much would the pancake pile weigh on the Moon?
4. What would be its mass on the Moon?
5. Choose four to eight other planets or bodies in space such as the Sun. Find out the weight of the pancake pile on each and present your results in a table.

Extension:

Jupiter is 318 times more massive than Earth. Why is the weight of the pancake pile on Jupiter not 318 times larger than it is on Earth?

1.2 Gravity

Task 2 Satellites and gravity

Investigate these questions. Write a short paragraph and use diagrams to help explain your answers. Remember to focus on the ideas of speed and gravity.

1. How do satellites stay in orbit?
2. What happens to old satellites?
3. What is 'gravity assist' and how does it help us to explore space?

Use reliable sites such as:

- smithsonianmag.com/smithsonian-institution/ask-smithsonian-how-does-satellite-stay-180954165/
- nesdis.noaa.gov/content/why-don't-satellites-fall-out-sky
- spaceplace.nasa.gov/spacecraft-graveyard/en/
- science.howstuffworks.com/dictionary/astronomy-terms/question102.htm

1.3 Contact forces

Task 1 Contact forces A

Read the following statement.

'Forces push and pull objects. They make things start and stop moving. They make materials change shape. Some forces only have an effect when objects are touching. These are called contact forces. Other forces have an effect when objects are separate from each other. These are non-contact forces. Here are some forces: friction, air resistance, gravity, tension, upthrust, electrical force, compression, resultant force, magnetic force.'

- Find out which of these forces are contact forces.
- Three of these forces are non-contact forces as they work across a distance. Which ones are they?
- Choose three contact forces. When does each type of contact force occur? Use simple diagrams to help you explain.

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Task 1 Contact forces B

Draw a picture of a swimming pool. Include people enjoying the water: some floating in inflatable rings, others throwing a beach ball between them, someone diving into the water and another person sitting on a beach ball at the side of the pool.

On your drawing, label examples of these forces: friction, gravity, upthrust, compression, air resistance, and tension. Annotate your labels to explain what each force is doing.

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Task 1 Contact forces C

Find out a bit more about the force of gravity and the force of friction.

Write a comparison of the two forces. In what ways are they similar? In what ways are they different?

1.3 Contact forces

Task 2 Metal extension

Four different materials (brass, cast iron, copper, and an aluminium alloy) have been tested to measure their extension.

The final measurement for each type of material represents the fracture point.

- Draw a graph for the data you have been given.
- Describe each line shown on their graph.

Force (N)	Extension of material (cm)			
	Brass	Cast iron	Copper	Aluminium alloy
1	0.25	0.5	1.0	2.0
2	0.5	1.0	2.0	4.0
3	0.75	1.5	3.0	6.0
4	1.0	2.0	5.0	9.0
5	1.25	2.5	5.5	
6	1.5	3.0	7.0	
7	1.75		11.0	
8	2.0			
9	2.5			
10	3.0			

Questions:

1. Which material is the strongest?
2. Which material is the most ductile because it stretched the most?
3. Which material is also quite ductile?
4. Which material is the stiffest?
5. Which material is the most brittle because it fractures (breaks) before it has extended very far?

1.4 Pressure

Task 1 Shoe pressure

Aisha and Luke love to dance. At one dance venue, Aisha was told she could not wear her stilettos (very narrow-heeled shoes). When told her heels would damage the dance floor, Aisha decided to investigate.

She found her mass (45 kg) and converted this into her weight in newtons. Then she measured the area of one heel (1 cm^2). Using pressure = force ÷ area, Aisha worked out her pressure on the dance floor.

- **What result did she get?**
- **Why is this result incorrect?**

  Aisha realised she had made an error, so she measured the area under the ball of her foot. It was 50 cm^2. She added this to the area of her heel.

- **How much less was the pressure exerted by her foot now she had combined the areas of the heel and the sole?**

  Luke pointed out that this was not the full story. He decided to calculate the force and pressure on the wooden floor when Aisha is standing on both feet.

- **What did he find out?**

  Luke wondered if he could create pressure as high as Aisha's stilettos when he wears his trainers on the dance floor. Luke's mass is 62 kg. He drew the outline of one trainer onto gridded paper and estimated it was 7 cm wide and 22 cm long.

- **What pressure does Luke exert when he stands on one foot?**

  Luke thought that if he stood *en pointe,* on one foot, like a ballet dancer he could exert the same high pressure on the floor as Aisha when she balances on one heel. He found the area on the front edge of his trainer was 1.5 cm^2.

- **Did he match Aisha's pressure?**

1.4 Pressure

Task 2 Pressure examples

Read the statements below. You will find that the statements are more of a challenge to explain as you go down the list. Don't panic. Search and see if you can find explanations that make sense to you.

Choose five and include at least one of the harder examples. For each,

a. Explain how the pressure is created (you could draw a diagram to help).

b. Is a higher or a lower pressure produced?

c. What effect does it have?

d. Use keywords such as 'force', 'area' and 'pressure'.

Try to write each answer in only one or two sentences and put the answers *in your own words*.

Clue: for some statements, you will need to think about how pressure has been reduced or increased by removing air or by heating gases.

Clue: some changes in pressure involve an increase in the force of gravity.

Pressure statements

- Wide padding on straps of school bag.
- Sharp teeth of a tiger.
- Studs on football boots.
- A camel's large splayed feet.
- Lie down when you find yourself sinking in mud.
- Rescue services use a ladder to rescue a person who has fallen through the ice.
- Using a drinking straw to drink.
- A vacuum cleaner.
- A saline drip raised above a hospital patient.
- Hot air balloons.
- Steam engines.
- Hydraulics.

Teaching notes and answers

1.1 Speed

Task 1 Speed statements

1. Answers (also on slide two of the PowerPoint).
   a. If Jas travels 74 miles in two hours she is going at the same speed as Alex who travels 37 miles in one hour.

      True – they are both travelling at 37 mph.

   b. A van passing the speed markings on a motorway in two seconds is travelling faster than a car that passes them in one second.

      False – the van is travelling slower as took two seconds to travel the distance covered in one second by car.

   c. If I cycle one mile at 9 mph I will arrive at the skate-park before my friend who lives half a mile closer to the park, sets off at the same time, and runs there at 6 mph.

      False – the first person covered one mile in 6.7 minutes; the second person would have covered one mile in 10 minutes but only had to run half a mile so took 5 minutes.

2. Working in pairs, students can mark each other's work. If there are any disagreements, they can go to another pair for adjudication.

Task 2 Comparing cars

Answers (slide three of the PowerPoint)

Family electric car	Manufacturer's official range (miles)	Independent test on UK roads range (miles)					Mean range in independent tests (miles)
		1	2	3	4	5	
A	144	98	122	135	84	113	**110.4**
B	168	140	115	134	107	151	**129.4**
C	279	259	238	240	262	267	**253.2**

1. Car A travelled for two hours at 46 mph. **92 miles**
2. Travelling at a speed of 36 mph, car B took a journey which lasted three-and-a-half hours. **126 miles**
3. Car C travelled for three hours and forty-five minutes. Its speed was 62 mph. **232.5 miles**

   None of them would need to recharge but it might be wise to recharge car B.

Extension:

This can be followed up as a class discussion. Below are some discussion points.

- How would you conduct a fair test of these vehicles to find out the range of each in normal driving conditions on UK roads?
- What variables would you have to control? Numerous variables linked to temperature, wind speed, weather; size and shape of the car; road surface, corners, etc.; speed, acceleration, etc; other vehicles on road.
- Which ones would you not be able to fully control? Temperature/weather conditions, if test carried out on actual UK roads; other vehicles if road not closed.

1.2 Gravity

Task 1 Pancakes on the Moon

Students can mark their answers. Students write a sentence or two to explain any errors they made and what they have learned from these. The answers are on slide four of the PowerPoint.

Answers

This pancake pile has a mass of 500 g.

1. How much does this pile weigh in newtons? 5 N
2. How much would the pancake pile weigh on the Moon? 0.8 N
3. What would be its mass on the Moon? 500 g or 0.5 kg
4. Choose four to eight other planets or bodies in space such as the Sun. Find out the weight of the pancake pile on each and present your results in a table.

Mercury	1.8	**Uranus**	4.4	**neutron star**	7.0×10^{11}
Venus	4.5	**Neptune**	5.6	**Io**	0.91
Mars	1.8	**Pluto**	0.3	**Europa**	0.66
Jupiter	12.6	**Sun**	135.3	**Ganymede**	0.72
Saturn	5.3	**white dwarf**	6.5×10^{6}	**Callisto**	0.63

Extension:

Jupiter is 318 times more massive than Earth. Why is the weight of the pancake pile on Jupiter not 318 times larger than it is on Earth?

Force of gravity depends on the size of the planet and how far from the centre the pile of pancakes is. Jupiter has a radius eleven times greater than Earth's radius so this reduces the weight that might have been predicted. If Jupiter had the same radius as Earth then the weight would be much greater (see exploratorium.edu/ronh/weight/).

Task 2 Satellites and gravity

Students can offer their answers to the class. After a class discussion, students add notes to their answers.

1.3 Contact forces

Task 1 Contact forces

There are three tasks; each should take about 30 minutes to complete. You could give all students the same task or give a mixture of tasks. Some students could be given two or three tasks or use the tasks for several homework activities.

Assessment suggestions

a. Self-assessment. Give themselves a traffic light colour to show how confident they feel with this.

- Friction, air resistance, tension, upthrust, electrostatic force, and compression are contact forces.
- Gravity, magnetic force, and electrostatic force are non-contact forces.

b. Marking grid for peer assessment (slide six of PowerPoint).

Images	Correct force labels	Annotated (label with explanation)
Someone floating		
Throwing a ball		
Someone diving		
Someone sitting on a ball		

c. Suggested answers

Use these statements to make some true or false statements (slides seven of the PowerPoint have some prepared). Students can put their hands up if they think a statement is true.

- Friction opposes other forces.
- Friction occurs when one object is moving in the opposite direction to another object. This occurs when objects/materials are touching.
- Friction is a contact force.
- Friction is increased by rough surfaces and decreased by smooth, slippery surfaces.
- Solids, liquids and gases can all exert friction.
- Gravity is a force exerted between two objects.
- All objects exert a pull of gravity on other objects.
- Gravity can be felt across space, the objects don't have to be touching.
- Larger objects have a greater force of gravity.
- The force of gravity becomes weaker when objects move further apart.
- Gravity is always positive – the objects always attract each other; they don't repel.
- Gravity pulls objects towards the Earth.

Task 2 Metal extension

Display the graph axis (slide eight of the PowerPoint), ask students to come up and complete the graph. Students can mark their graphs.

Answers

1. Which material is the strongest? **Brass (A)**
2. Which material is the most ductile because it stretched the most? **Copper (C)**
3. Which material is also quite ductile? **Aluminium alloy (D)**
4. Which material is the stiffest? **Brass (A)**
5. Which material is the most brittle because it fractures (breaks) before it has extended very far? **Cast iron (B)**

1.4 Pressure

Task 1 Shoe pressure

Display the answers (slides 9–12 of the PowerPoint). Working in pairs, students describe any incorrect answers and explain where the error lay.

Answers

Aisha decided to investigate. She found her mass (45 kg) and converted this into her weight in newtons. Then she measured the area of one heel (1 cm²). Aisha worked out the pressure of one heel on the dance floor.

45 kg = 450 N 450 ÷ 1 cm² = 450 N/cm²

What result did she get?

Why is this result incorrect?

Aisha realised she had made an error. She measured the area under the ball of her foot. It was 50 cm². How much less was the pressure exerted by her foot now she had combined the areas of the heel and the sole?

50 cm² + 1 cm² = 51 cm² 450 ÷ 51 = 8.8 N/cm². So, this was 441.2 N/cm² less than one heel alone.

Luke pointed out that this was not the full story. He wondered what the force and pressure are when Aisha is standing on both feet. The force does not change whether she is standing on one foot or two.

Force = 450 N   51 cm² × 2 = 102 cm²   450 ÷ 102 = 4.4 N/cm² (the pressure is halved).

Luke wondered if he could create pressure as high as Aisha's stilettos when he wears his trainers on the dance floor. Luke's mass is 62 kg. He drew the outline of one trainer onto gridded paper and estimated it was 7 cm wide and 22 cm long. What pressure does Luke exert when he stands on one foot?

62 kg = 620 N   7 × 22 = 154 cm²   620 ÷ 154 = 4.0 N/cm².

Luke thought that if he stood *en pointe* on one foot like a ballet dancer he could exert the same high pressure on the floor as Aisha when she balances on one heel. He found the area on the front edge of his trainer was 1.5 cm². Did he match Aisha's pressure?

620 ÷ 1.5 = 413.3 N/cm².

Task 2 Pressure examples

As a class, go through each statement and ask different students for their explanations. Students can correct their answers if needed. They should hold up a traffic light colour at the end to indicate how well they understand pressure.

Suggested answers:

- Wide padding on straps of school bag. The weight of the bag is spread over the wide part of the strap, reducing pressure on shoulders.
- Sharp teeth of a tiger. The force of the tiger's bite is concentrated on the teeth's small area, which increases the pressure of the bite.
- Studs on football boots. A footballer's weight is concentrated on a small area of studs, increasing pressure, making studs sink into pitch and increasing grip.
- A camel's large splayed feet. The camel's weight is spread over a large area of feet, reducing pressure and preventing the camel from sinking into the sand.
- Lie down when you find yourself sinking in mud. This spreads your weight, reducing pressure and stopping you from sinking.
- Rescue services use a ladder to rescue a person who has fallen through the ice. The ladder spreads the weight over a larger area than if standing on feet. It stops the ice from breaking as easily.
- Using a drinking straw to drink. Sucking the air out of the straw reduces the pressure inside it. The drink now has a higher pressure and moves into the straw.
- A vacuum cleaner. Air is sucked out of space in the cleaner, creating a vacuum. Air at higher pressure flows into the cleaner, carrying dirt particles with it.
- Saline drip raised above a hospital patient. Raising saline bags increases the force of gravity on liquid, making saline flow into the vein which it is at a lower pressure.
- Hot air balloons. The air in the balloon is heated, reducing its pressure relative to the cooler, denser air outside. Hot air rises.
- Steam engines. Water is heated, creating steam that is held in container, increasing pressure. Steam under high pressure moves the engine's piston.
- Hydraulics. Fluid under pressure is used to power an engine. Pressure on a small amount of fluid can generate a large amount of power.

1 Forces

1.1 Speed

Task 1 - speed statements

1. If Jas travels 74 miles in 2 hours she is going at the same speed as Alex who travels 37 miles in one hour

True – they are both travelling at 37 mph

2. A van passing the speed markings on a motorway in two seconds is travelling faster than a car that passes them in one second.

False – the van is travelling slower as it took 2 secs to travel the distance covered in 1 sec by car.

1.1 Speed

Task1 - speed statements

3. If I cycle one mile at 9 mph I will arrive at the skate-park before my friend who lives half a mile closer to the park, sets off at the same time, and runs there at 6mph.

False – The first person covered 1 mile in 6.7 minutes; the second person would have covered one mile in 10 mins but only had to run half a mile so took 5 mins.

1.1 Speed

Task 1 - comparing cars

Family electric car	Manufacturer's official range (miles)	Independent test on UK roads Range (miles)					Mean range in independent tests (miles)
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A	144	98	122	135	84	113	**110.4**
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C	279	259	238	240	262	267	**253.2**

1. Car A travelled 92 miles.
2. B travelled 126 miles.
3. Car C travelled 232.5 miles.

None of them would need to recharge but it might be wise to recharge car B.

1.2 Gravity

Task1 - pancakes on the moon

This pancake pile has a mass of 500 g.

1. How much does this pile weigh in newtons? **5 N/**
2. How much would the pancake pile weigh on the moon? **0.8 N**
3. What would be its mass on the moon? **500g or 0.5 kg**

Space object	Weight (N)
Mercury	1.8
Venus	4.5
Mars	1.8
Jupiter	12.6
Saturn	5.3
Uranus	4.4

Space object	Weight (N)
Neptune	5.6
Pluto	0.3
Sun	135.3

Space object	Weight (N)

1.2 Gravity

Task 2 - shuttle to Venus

Position of the shuttle on the diagram	Strength of gravity relative to each other	
	Earth	**Venus**
1		
2		
3		
4		
5		

1.3 Contact forces

Task1 - contact forces B

Images	Correct force labels	Annotated (a label with an explanation)
Someone floating		
Throwing a ball		
Someone diving		
Someone sitting on a ball		

1.3 Contact forces

Task1 – contact forces C

	True or false?
Friction is a non-contact force.	
Friction is increased by rough surfaces.	
Larger objects have a greater force of gravity.	
Only solids can all exert friction.	
Friction is a non-contact force.	
The force of gravity becomes stronger when objects move further apart.	
Gravity pulls objects towards the Earth.	

1.3 Contact force

Task 2 – metal extension

Extension (cm)

Force (N)

1.4 Pressure

Task1 - shoe pressure

Aisha decided to investigate. She found her mass (45 kg) and converted this into her weight in newtons. Then she measured the area of one heel ($1cm^2$). Aisha worked out the pressure of one heel on the dance floor.

Her answer was **45kg = 450N $450/1cm^2 = 450N/cm^2$**

Why is this result incorrect?

Aisha realised she had made an error. She measured the area under the ball of her foot. It was $50\ cm^2$. How much less was the pressure exerted by her foot now she had combined the area of the heel and the sole?

$50\ cm^2 + 1cm^2 = 51\ cm^2$

$450/51 = 8.8\ N/cm^2$.

So, this was $441.2\ N/cm^2$ less than one heel alone.

1.4 Pressure

Task 1 - shoe pressure

Why is this result incorrect?

Aisha realised she had made an error. She measured the area under the ball of her foot. It was 50 cm^2. How much less was the pressure exerted by her foot now she had combined the area of the heel and the sole?

50 cm^2 + 1cm^2 = 51 cm^2

450/51 = 8.8 N/cm^2.

So, this was 441.2 N/cm^2 less than one heel alone.

1.4 Pressure

Task 1 - shoe pressure

Luke pointed out that this was not the full story. He wondered what the force and pressure are when Aisha is standing on both feet.

The force does not change whether she is standing on one foot or two.

Force = 450N

$51 cm^2 \times 2 = 102\ cm^2$

$450 \div 102 = 4.4\ cm^2$

1.4 Pressure

Task 1 - shoe pressure

Luke wondered if he could create pressure as high as Aisha's stilettos when he wears his trainers on the dance floor. Luke's mass is 62kg. He drew the outline of one trainer onto gridded paper and estimated it was 7cm wide and 22cm long. What pressure does Luke exert when he stands on one foot?

62kg = 620N   7x22=154 cm^2 620/154 = 4.0 N/cm^2

6.3 Chemical energy

Task 2 - hand warmers and cold packs

Luke thought that if he stood en point on one foot like a ballet dancer he could exert the same high pressure on the floor as Aisha when she balances on one heel. He found the area on the front edge of his trainer was 1.5cm^2. Did he match Aisha's pressure?

620 ÷ 1.5 = 413.3 N/cm^2