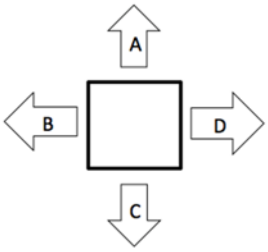
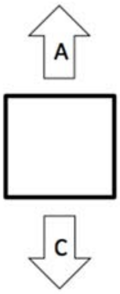
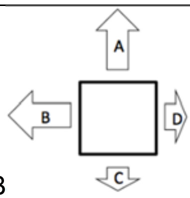
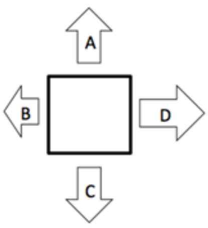
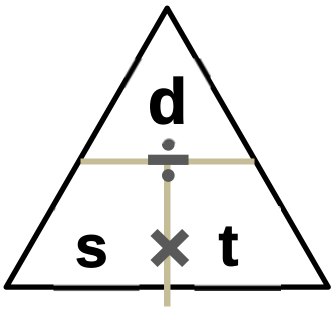
Year 7 Science:

Forces and Motion

Contents

Name 8 forces	Thrust, air resistance, friction, weight/gravity, reaction, upthrust, lift, magnetism
State the unit for force	Newton, N
State an example where friction is useful	Any example of useful friction (e.g. shoes on floor, tyres on road)
What is the motion of the car if all forces are balanced?	Constant speed/stationary
If C is weight/gravity, what is the force A? 	Reaction
Suggest how you can decrease friction	Using a lubricant such as oil, Vaseline or ball bearings
If force A is 10N and force C is 10N, what is the resultant  force acting on this object:	0N
What is the unit for weight?	Newtons, N
If an object has a resultant force of 0N, describe its motion	It is either stationary or moving at a constant speed
State an example of when friction is not useful	Any example of friction not being useful (e.g. in an engine, axles, motor, machinery)
What two things do the arrows on a force diagram demonstrate?	Size of force Direction of force
 If D is thrust, suggest the name of force B	Friction/drag/air resistance
If D is thrust, describe the motion of the object 	The object is accelerating in the direction of D

No	Core question	Answer
1	Name **three** common speeds	1. sound in air 330m/s 2. walking pace 1.4m/s 3. car in built up area 10.5m/s 4. car on motorway 31m/s 5. an aeroplane 250 m/s 6. light in a vacuum 300,000,000m/s.
2	What is the equation to calculate speed?	Speed = $\frac{\text{distance}}{\text{time}}$
3	What are the SI units of distance?	Metres (m)
4	What are the SI units of time?	Seconds (s)
5	What are the SI units of speed?	Metres per second (m/s)
6	Draw the equation triangle for speed	
7	Rearrange the speed equation to make distance the subject (d= ?)	d = s x t
8	Rearrange the speed equation to make time the subject (t = ?)	t= $\frac{d}{s}$
9	What is a scalar quantity? Give an example	a quantity that has a magnitude only e.g. speed, mass, temperature
10	What is a vector quantity? Give an example	a quantity that has both a magnitude and a direction e.g velocity, acceleration, force

Space for starter activities

Space for starter activities

Concept 1: What is a force?	*The unit of force is a Newton* *Describe how forces are generated from the interaction between two objects: they can be seen simply as pulls and pushes*

Give a key stage 2 definition for a force?

Give 3 examples of a force.

Why are forces useful?

What do we measure forces in?

What instrument can bne used to measure the size of a force?

How are forces represented on diagrams?

Key Idea: Forces

A ____________________ is needed to start an object moving.

A force can change the ____________________ , ____________________and ____________________ of an object.

Nothing starts to move without a ____________________ being involved.

Forces are ofen represented on diagrams using ________________. Forces are measure in _______________, named ater the famous physicist and mathematician.

Arrows Speed, Force, Shape , Direction, Netwons, Forces

Key Idea: Momentum

Momentum represents the mass and speed of an object. A object with _______ momentum is capable of tranfering a greater ________. Also an object with a _________momentum will need need a greater force to change its motion in the same amount of time compared to an object with _______ momentum

Less, Greater, large, force

Two tennis balls are thrown at you.

Question 1

a Which tennis ball is the hardest to stop?

Put a tick (✓) in the box next to the correct answer.

A Harder to stop ball 1 ☐

B Harder to stop ball 2 ☐

C Both the same ☐

b How would you explain your answer?

A It is going faster ☐

B It is going slower ☐

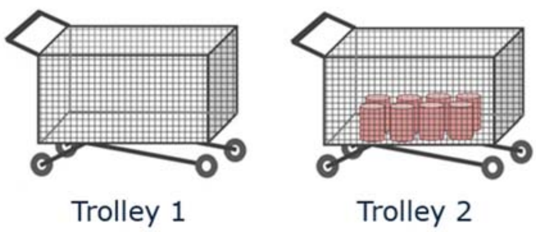
C It has more force ☐

D It has less force ☐

E It is the same ball ☐

Momentum

You are going to push these shopping trolleys round a corner.



Question 2

a Which shopping trolley is harder to push round a corner?

Put a tick (✓) in the box next to the correct answer.

A Harder to turn trolley 1 ☐

B Harder to turn trolley 2 ☐

C Both the same ☐

b How would you explain your answer?

Put a tick (✓) in the box next to the correct answer.

A	It has more force	☐
B	It has less force	☐
C	It weighs more	☐
D	It weighs less	☐
E	The wheels are the same	☐

Force or momentum?

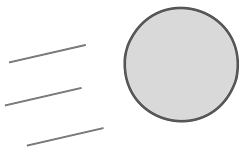
To really understand what a force is you need to know about momentum.

To do

Fill in the gaps to describe what happens.

You should only use the words ***force*** *and* ***momentum****.*

To answer



1. Hitting a rounders ball

John was batting.

He hit the rounders ball with a lot of _______________.

It flew quickly through the air with so much _______________ that James found it hard to stop.

James had to use a lot of _______________ to stop it.

2. **Riding on a shopping trolley**

After her shopping Jane liked to run with the  on.

At the end of her shop it was heavy so she needed a lot of _______________ to make it move.

It was hard to stop because it had a lot of _______________.

She needed a lot of _______________ to stop it.

Is it a force?

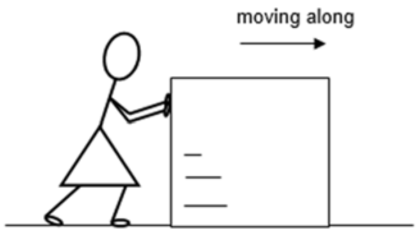
A force is a push or a pull. It is sometimes difficult to spot when there is a force.

For each picture decide: **force** or **no force**

Extension – Draw on the forces using arrows

1. Karen is pushing a large box across the floor.

It is moving steadily.

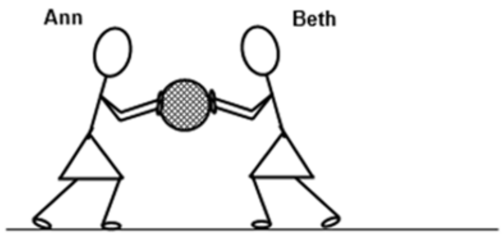


2.

During a game of football, Shane kicks the ball.

3. During a game of netball, Ann and Beth are both pushing on the ball.

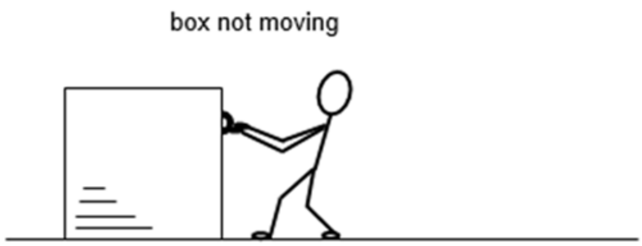
But it is **not moving**.



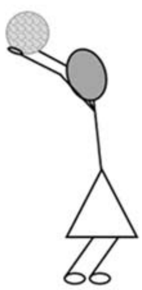
4.

A workman is trying to pull a heavy box across the floor.

The box but it is **not moving**.

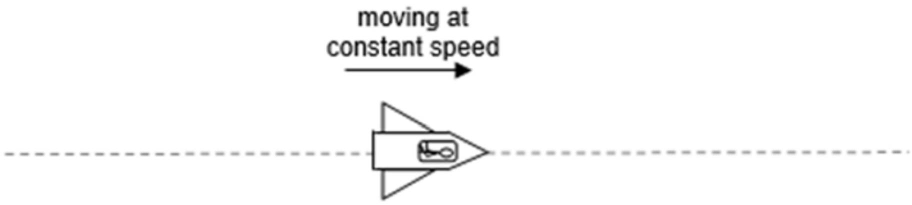


5.

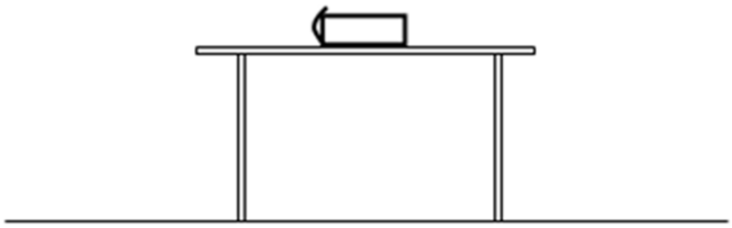


During a game of football, Alice takes a throw in.

6. A spacecraft is drifting through space. It is very far away from all other objects. There is no air in space, so there is no air resistance. The spacecraft is moving in a straight line at a constant speed.



7. A heavy book is sitting on a table.



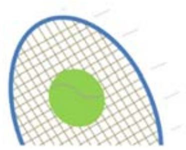
Key Idea:

A force makes things change: the speed, the direction and/or the shape of an object.

A force can act as a push, a pull or a twist.

Big force, little force

A tennis ball is hit with a tennis racket.

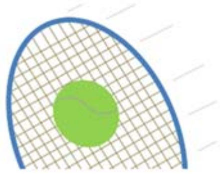


What does the force of the racket do to the tennis ball?

Look at these statements.
For each statement, tick (✓) **one** column to show what you think about it.

Statements	I am **sure** this is	I think this is correct	I think this is wrong	I am **sure** this is wrong
A It changes its speed.				
B It changes its direction.				
C It changes its shape.				

The same tennis ball is hit with a tennis racket, but with more force.



The ball is hit harder. What does the force of the racket do to the ball now?

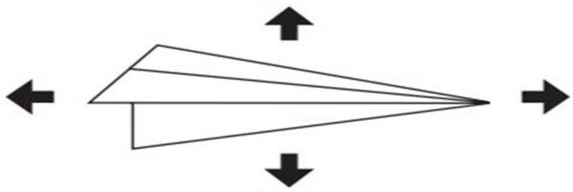
Look at these statements.

For each statement, tick (✓) **one** column to show what you think about it.

Statements	I am **sure** this is	I think this is correct	I think this is wrong	I am **sure** this is wrong
A It changes its speed *more.*				
B It changes its direction *more.*				
C It changes its shape *more.*				

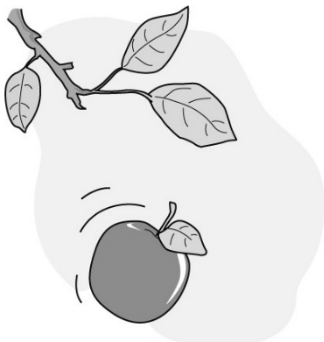
Representing Forces

Forces are represented by free-body diagrams. Arrows are used to show us the size and direction of the force. We label the size of the force in Newtons.



The arrows on a force diagram show us:

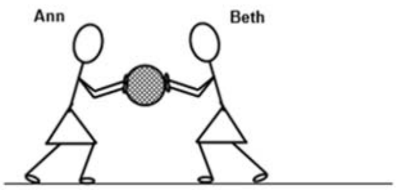
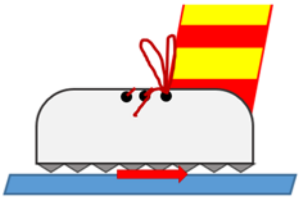
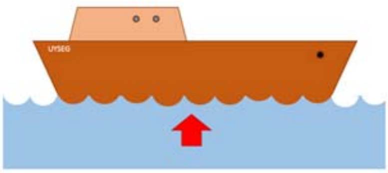
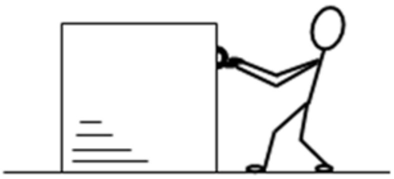
Because force have …….. Pieces of information they are known as …………………. Quantities. Try adding arrows to these scenarios to show in which direction the forces are acting



Name that force

Forces make things change.

Draw a line from each picture to the name of the force.

	●	●	Magnetic force
	●	●	Friction
	●	●	Pull
	●	●	Weight
	●	●	Upthrust
	●	●	Push
	●	●	Electrostatic force

Try and name the forces shown in the images below. And then explain what causes the force. An example has been done for you.

Picture Number	Name of force	Description
1		
2		
3		
4		
5		
6		
7		
8		
9		
10	Reactive	The force that acts against a push or a pull in solid objects

Notes:

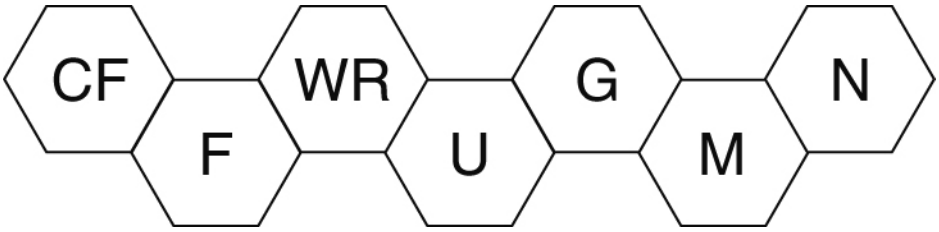
1 Write down *three* things that forces can do.

____

____

____

2



a What CF is the name for forces where things have to be touching to have an effect?

____

b What F is a force that happens when two things rub against each other? ______________

c What WR slows down objects moving in water? ______________

d What U force makes things float? ______________

e What G is a force that pulls things downwards? ______________

f What M is a force that attracts iron? ______________

g What N is the unit for force? ______________

h What M is measured in kilograms? ______________

3 Write down the names of *three* contact forces.

____

____

____

4 Write down the names of *three* non-contact forces.

____

____

Concept 2: Balanced Forces	*Use free body diagrams to represent balanced and unbalanced forces* *Investigate balanced and unbalanced forces and describe how they are measured*

1. What way will an object move if it has more than one force acting on it?

2. Name a force that may act on a swimmer.

3. If a runner want to increase their speed (accelerate) what they must do in terms of the forces acting on them.

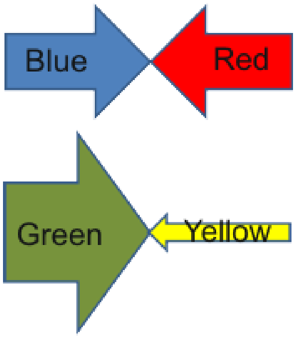
4. How do we represent forces on diagrams?

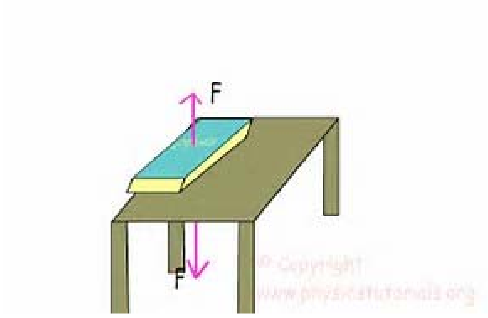
5. What name is given to the size of a force?

Key idea: Respresenting forces

- The ________ of the arrow represents the ____________(size) of the force
- The __________of the arrow shows the direction in which the ________ is acting.

Magnitude, direction, force, size





Cycling forces

Pedalling makes a force that pushes forwards.

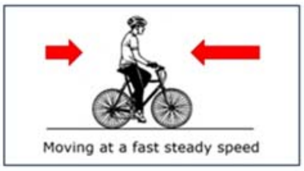
Friction and air resistance make a force that pushes backwards.

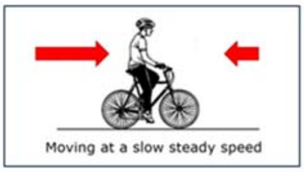
To do

Join the boxes to explain what happens when the forces change.

Draw one line from the **cycling forces** to **what happens next**. Draw another line to **why it happens**.

Cycling forces ...





... what happens next ...

- goes at a slow steady speed
- goes slower and slower
- stops
- goes backwards
- goes at a fast steady speed
- goes faster and faster

... why it happens

- there is no force
- the resultant force is forwards
- the resultant force is backwards
- there is no force left over

Key Points

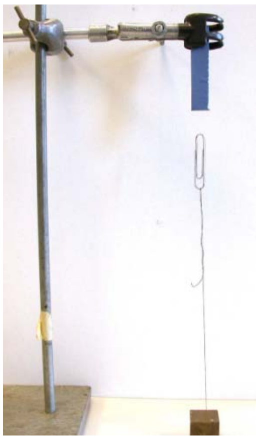
If forces are unbalanced they cause ……………………………….

If forces are balance object will continue at a ……………………… or be at……………………………………

Constant speed, rest, acceleration

Balanced forces

What is the same in these diagrams?



What is different?

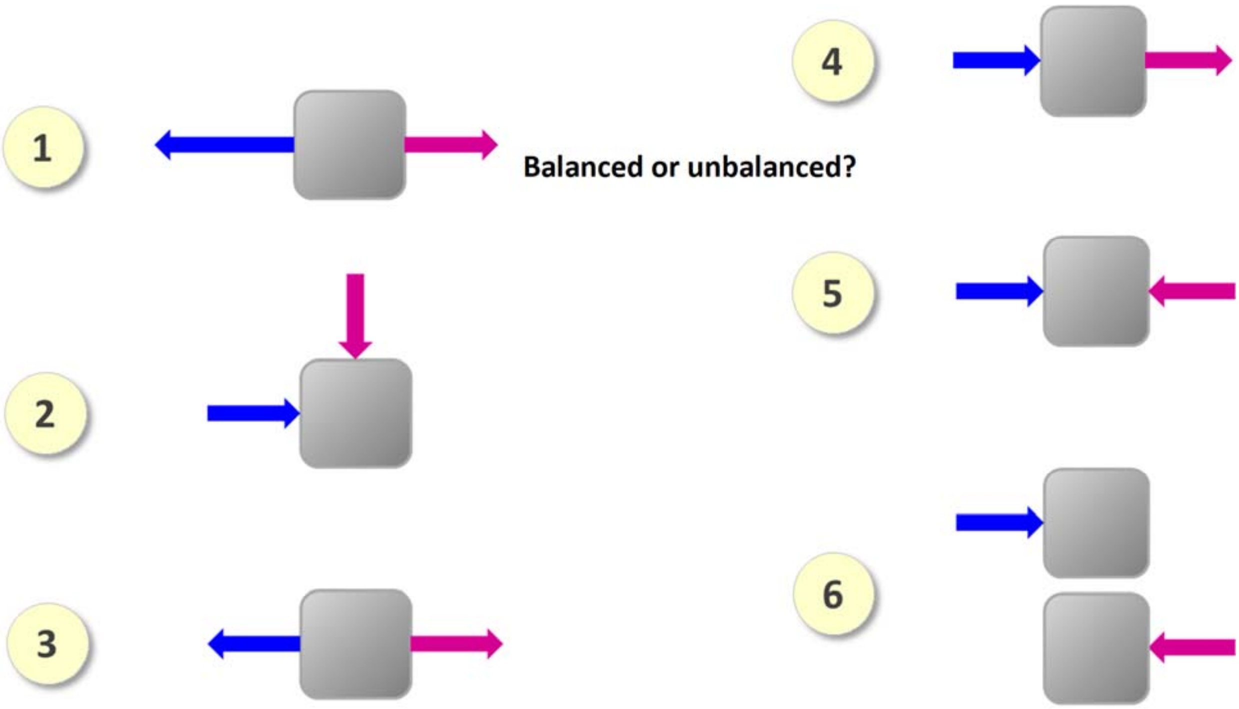
Name the forces and explain how they

are acting.

Label the forces on the plane and car.

We use free body diagrams to show forces in action.

The arrows show the size of the force and the direction it is acting in. For each decide whether the forces are balanced or not. And how can you tell.



Key points

- More than one __________ can act on an object at a time.
- These combine to give a _____________ force
- If the forces are ____________ the objects speed remains constant
- If the forces are _______________ the object will accelerate.

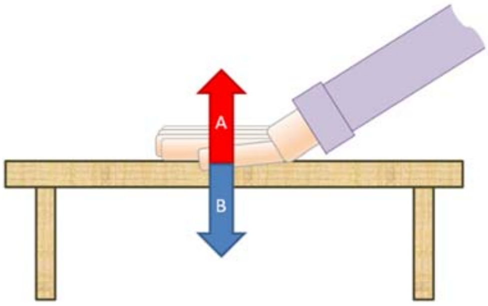
Balanced, Resultant, Force, Unblanced

Assessment task: Describing a pair of force

Forces ***always*** happen in pairs.

If I push the table, the table pushes my hand.

It squashes my hand.



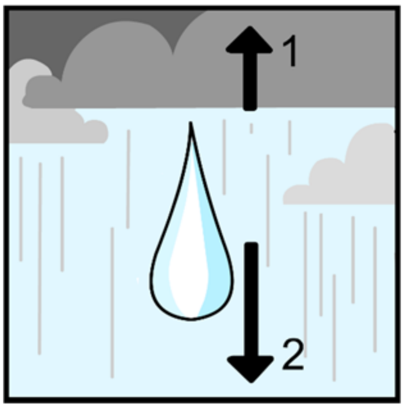
1. Read each statement about forces A and B.
   For each statement, tick (✓) **one** column to show what you think about it.

Statements		I am **sure** this is right	I think this is right	I think this is wrong	I am **sure** this is wrong
A	Force A is the force of the table on my hand.				
B	The force the table pushes my hand is the **opposite direction** to the force I push the table with.				
C	If I push harder, the table pushes harder on my hand.				
D	The force the table pushes my hand is the **same size** as the force I push the table with.				

The forces on a **falling raindrop**

To answer

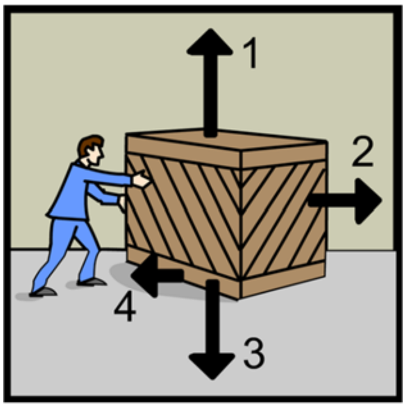
1. Name force 1.
2. Name force 2.
3. Which way does the resultant force point?
4. Describe the **motion** of the raindrop.



The forces on a **crate being pushed across a floor**

To answer

1. Name forces 1, 2, 3 and 4.
2. Which way does the resultant force point?
3. Describe the **motion** of the crate.



Concept 3 7P1.3 Resultant Forces:	*Define resultant force* *Calculate the resultant force acting on objects* *Describe and investigate how the size of a resultant force causes motion*

1. Can you ever have a single force acting alone on an object?

2. State two ways you could change the forces on an object to make it accelerate.

3. What can be done to reduce the force of friction?

4. If you stand on the floor what force acts against your weight?

5. Are forces scalar or vector quantities?

Key Idea: Different types of quantity.

Many measurement in science are made as physical quantities.

These are split into ………..categories. If they have magnitude(size) only they are known as …………………

If they have both magnitude and direction they are know as ……………………

An example of a scalar quantity is ………………

An example of a vector quantity is ………………

Speed, Vector, Scalar, Two, Force

………

………

………

………

………

………

………

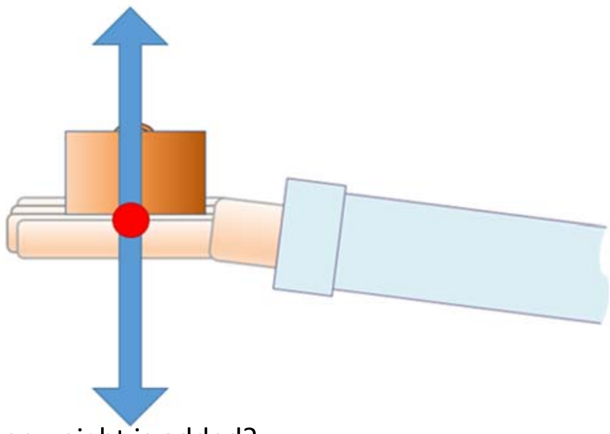
………

Adding weight

This activity is about what happens to the forces needed to hold a weight still.

To hold a weight in my hand, I need to push up with a force.

The weight pushes down with a force.



Predict

What do you think will happen to each force when another weight is added?

....

....

Explain

Explain why you think this will happen.

....

....

If I hold a weight in my hand, then double it.

Observe

Describe what happens to the force I am pushing up with.

....

....

Explain

Were your prediction and explanation correct?

Try to improve your first explanation to explain this more clearly.

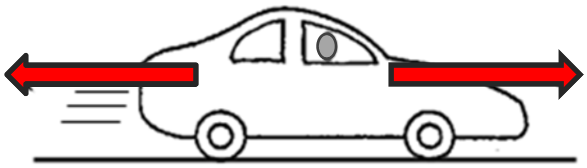
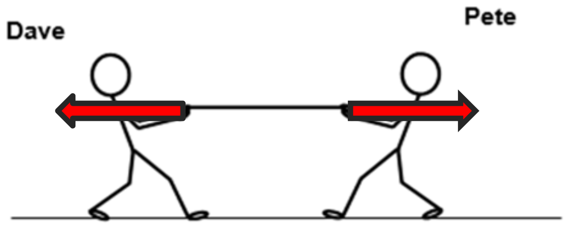
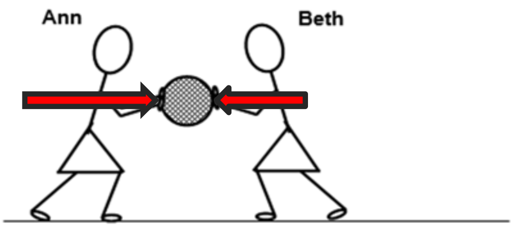
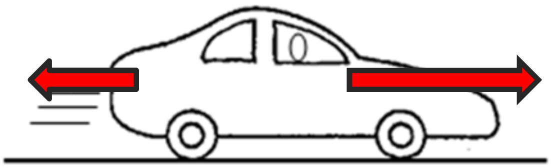
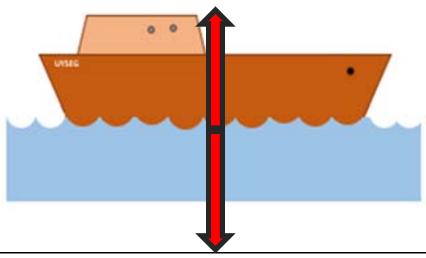
....

....

Balanced or unbalanced?

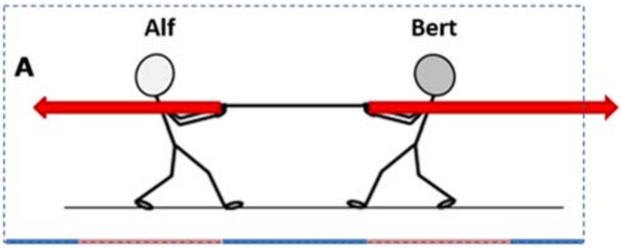
Look at each pair of forces.

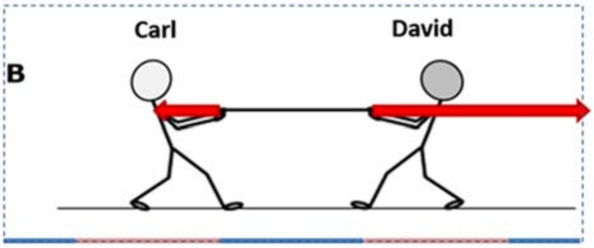
Are they **balanced** or **unbalanced**? Put a ring round the right answer.

1		Balanced or Unbalanced
2		Balanced or Unbalanced
3		Balanced or Unbalanced
4		Balanced or Unbalanced
5		Balanced or Unbalanced

Resultant force

The resultant force is the force left over to make things change.





a Which tug of war has the biggest resultant force?

Put a tick (✓) in the box next to the correct answer.

A Tug of war A ☐

B Tug of war B ☐

C Both the same ☐

b How would you explain your answer?

Put a tick (✓) in the box next to the correct answer.

A Bert pulls with the biggest force ☐

B Carl pulls with the smallest force ☐

C Carl and David have the biggest difference in force ☐

D Bert and David both pull the same way ☐

Calculating the resultant force

More than one force can push or pull an object.

The forces add together, but their direction is important.

Examples

1. **What is the resultant force on the bicycle?**

The forces are pushing against each other

The biggest force pushes forwards

The difference in the forces

= the big force – the small force

= 60 -15

= 45

The resultant force is <u>45 N forwards</u>

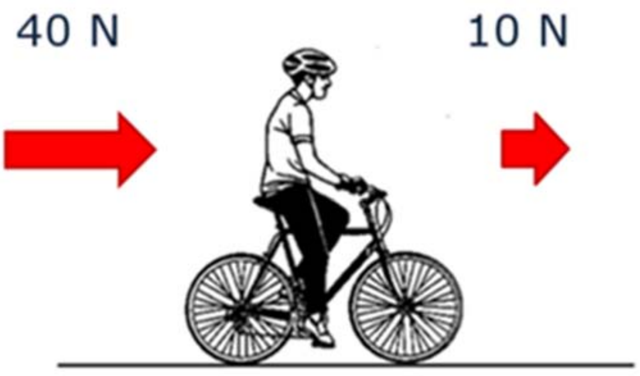
2. What is the resultant force on the bicycle now?

The forces are both push forwards. They add together.

The resultant force = 40 + 10

= 50

The resultant force is <u>50 N forwards</u>



Questions:

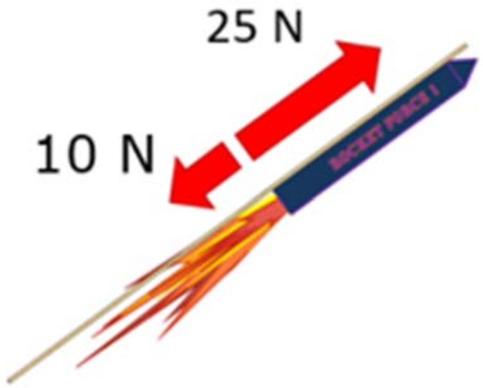
Calculate the resultant force in each example

The sum effect of more than one force on an object is called the resultant force.

The resultant force is calculated by working out the difference between opposing forces.

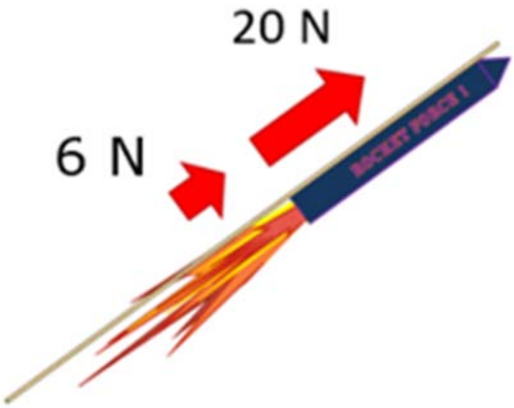
1

2



3

4



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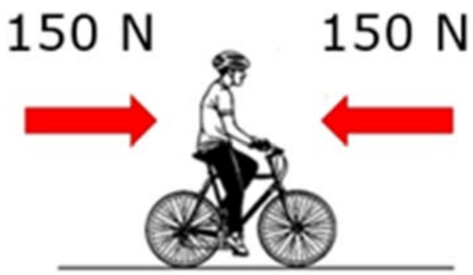

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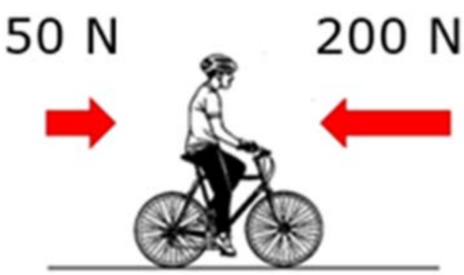
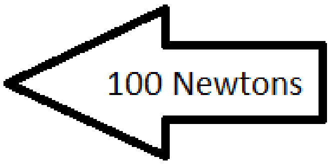
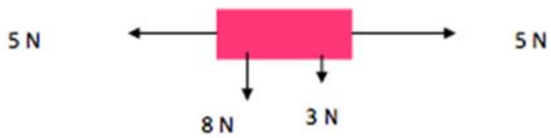
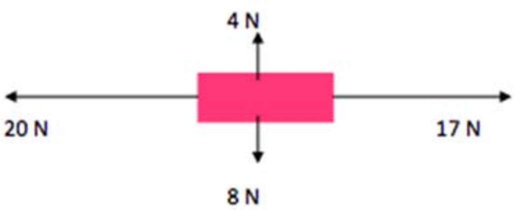


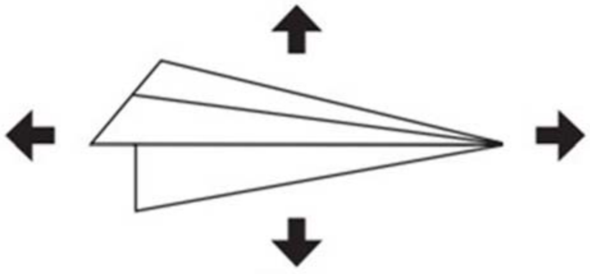
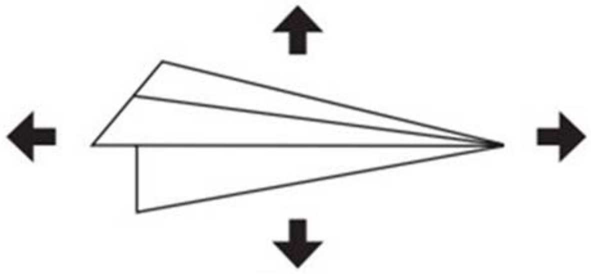
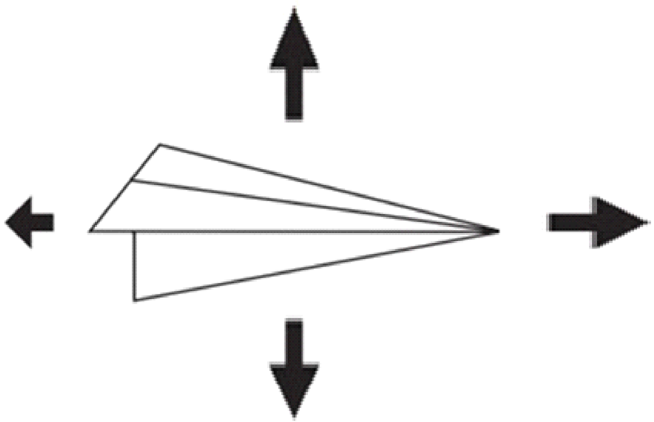
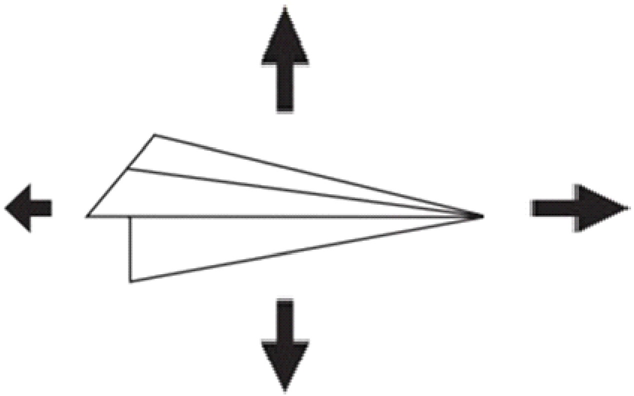
The overall effect is



Forces	Resultant
	
	
	
	

Key Learning Points about forces:

- **All the force on an object can be resolved down to the resultant force.**
- **This resultant force explains the motion of an object**

	If the object is stationary and the forces are balanced………..
	If the object is moving at constant speed and the forces are balanced……….
	If the object is stationary and the forces are unbalanced……
	If the object is moving at constant speed and the forces are unbalanced……….

What happens next?

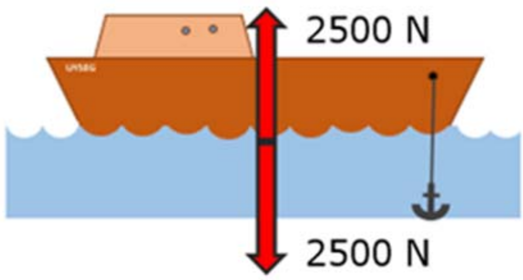
REMEMBER:-

"Forces make things change"

Work out the resultant force in each picture.

Link each picture with what happens next.

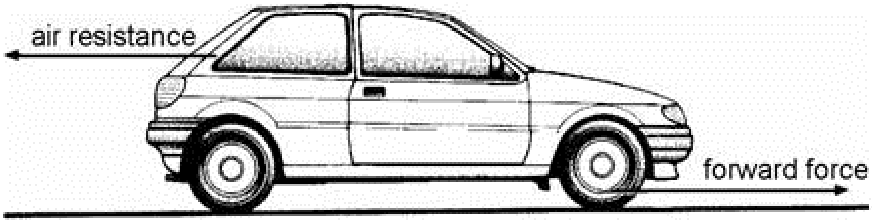
The forces



What happens next?

- Gets faster and faster
- Goes at a faster steady speed
- Goes at same steady speed
- Stops
- Gets slower and slower
- Goes at a slower steady speed
- Stays still
- Goes backwards

Q6. When a car is being driven along, two horizontal forces affect its motion. One is air resistance and the other is the forward force.



(a) (i) Explain how molecules in the air cause air resistance.

....

....

(ii) Explain why air resistance is larger when the car is travelling faster.

....

....

1 mark

(b) (i) Compare the sizes of the forward force and the air resistance when the car is speeding up.

The forward force is ....

1 mark

(ii) Compare the sizes of the two forces while the car is moving at a steady 30 miles per hour.

The forward force is..

(c) The forward force has to be larger when the car is travelling at a steady 60 mph than when it is travelling at a steady 30 mph. Why is this?

....

....

1 mark

(d) The forward force is the result of the tyres **not** being able to spin on the road surface. What is the name of the force that stops the tyres spinning?

....

Concept 4: Non-Contact Forces	*Describe and investigate how objects can interact at a distance without contact (magnetic fields, gravity and electrostatic charge)*

1. How do we represent forces on diagrams?

2. What are the units of force?

3. What do call the overall forces on an object?

4. What happens to an object that has a non-zero resultant force?

5. What word would describe the motion of an object with a 0N resultant force?

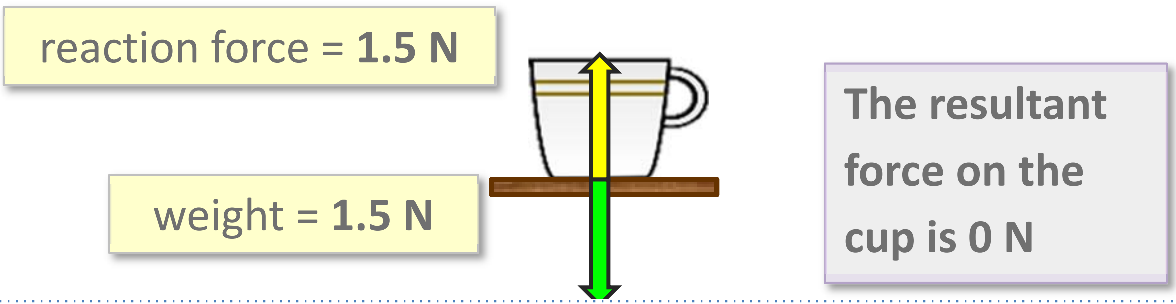
6. What does the term 'contact' mean?

Complete

It is normal for an object (e.g. car) to have several .... acting on it at the same time.

These can be **.............** together to create one, single force called the **...............**force.

An example:



Categorizing forces

Forces can be split into two categories. Contact and Non-contact.

The simple different between them is that Contact forces exist when there is a physical contact between two or more objects.

Non Contact Forces	Contact Forces

Extended writing task 1

Describe the forces acting on an object as it falls from a great height. How do these forces affect the velocity of the object?

Peer feedback	Teacher feedback

Self-assessment
WWW
EBI

Improve your answer using the feedback provided.

1. Circle the letter of all the points they have made in their work.
2. Add the letter on their work

A. as the object starts to fall the force of gravity is stronger than the force of air resistance B. this makes the object accelerate C. as the object accelerates, it increases it's air resistance D. as the air resistance increases, the object does not accelerate as fast E. eventually the forces of air resistance and gravity will be balanced F. the object will fall at a constant speed G. this constant speed is called terminal velocity H. when the object hits the ground the force of gravity is balanced by the reaction force of the ground pushing up on the object I. the object is stationary as the forces are balanced J. as the object is no longer moving, there is no air resistance.

Fill in the gaps in these sentences using words from the box. You do not need to use all of the words:

When a car is travelling at a constant speed, the forces on it are ___________________. The forwards force from the ___________________ is exactly balanced by the forces of air ___________________ and ___________________.

Balanced forces do not change the ___________________ of something. A car with balanced ___________________ on it will carry on moving at the same speed.

___________________ forces make objects ___________________ or slow down.

Moving objects do not need ___________________ to keep moving. A space probe orbiting the Sun has no forces of ___________________ to slow it down. It will carry on ___________________ the Sun.

balanced balanced do do not engine forces forces friction friction orbiting resistance speed speed up unbalanced unbalanced

Complete the following sentences. Include one of the following words or phrases in each answer.

and	because	but	however	such as
Therefore	which	so	to	

1 Some forces are non-contact forces …

2 Friction is a force that slows down moving objects …

3 Weight is a force …

4 Stationary objects have forces on them …

5 Unbalanced forces can change the speed of a moving object …

6 Water resistance is a form of friction…

7 Aeroplanes have streamlined shapes …

8 There are forces on a tennis ball when it is in the air …

Optional Demo

Marble Investigation;

1. Can you draw a pair of arrows to represent the forces when the marble moved to the left?

2. Can you draw a pair of arrows to represent the forces when the marble moved to the right?

3. Can you draw a pair of arrows to represent the forces when the marble stayed still.

4. Next to each diagram of forces can you say whether the forces are balanced or unbalanced?

5. If the forced are balanced did the marble **change speed (accelerate)** or stay the **same speed**

Keyword	Definition
Force	A push or pull that changes an object speed direction or shape.
Resultant force	The force that explains the motion of an object.
Magnitude	The size of something
Newton	The units used to measure forces
Weight	The force acting on mass due to gravity
Lubrication	Addition of a substance to reduce friction
Scalar	A quantity with only magnitude(size) such as energy or speed
Vector	A quantity with both magnitude and direction such as a force or acceleration

Concept 5: What is speed and how fast do things go?	Recall common speeds

Speed- what do you already know?

1. What does mph mean on this car speedometer?

2. Which one of these is not the scientifically correct way to write metres per second?

   a) m/s b) ms^{-1} c) mps

3. Which car is travelling faster- a car travelling 31mph or a car travelling 31 m/s?

4. If a car was travelling at 5m/s, how far would it have travelled in 2 seconds?

5. If an aeroplane was travelling at 250m/s, how many seconds would it take to travel 500m?

Key Idea

Complete this matching task

- firstly put written descriptions in order of slowest to fastest
- then add the correct speed

1. Strong breeze	a) 330m/s
2. commuter train	b) 1.4m/s
3. walking pace	c) 25m/s
4. light in a vacuum	d) 6m/s
5. car in built up area	e) 10.5m/s
6. car on motorway	f) 300,000,000m/s.
7. a ferry	g) 31m/s
8. an aeroplane	h) 18m/s
9. cycling pace	i) 250 m/s
10. sound in air	j) 55m/s

100m world record

Florence Griffith-Joyner meeting the US President

Florence Griffith-Joyner broke the 100m world record on July 16th 1988.

Her fans called her 'Flo-Jo'.

More than thirty years later, her record still stands.

Fill in the gaps to describe Flo-Jo's world record breaking 100m race.
*You should only use the words **average** and **instantaneous***

The race:

In 1988 Flo-Jo ran the 100m in 10.49 seconds and set a new world record. Her _______________ speed for the race was 9.5 m/s.

As the starting gun went off her _______________ speed was zero. She quickly sped up and at the 50m point her _______________ speed was 11.0 m/s. For the first half of the race her _______________ speed was 8.6 m/s.

After the half-way point Flo-Jo slowed a little. Her _______________ speed for the second half of the race was 10.7 m/s. In the last few metres she sped up again and on the finish line her _______________ speed was 11.2 m/s.

High speed one

1. Two toy cars, blue and red, travel along a 2 metre track.

The red car starts 20 cm ahead of the blue car.

Both cars start at the same time.

Both cars stop at the same time. The blue car is then 10 cm ahead.

a. Which car was faster?

Put a tick (✓) in the box next to the best answer.

A The blue car ☐

B The red car ☐

C Both had the same speed ☐

b. What is **the best explanation** for your answer?

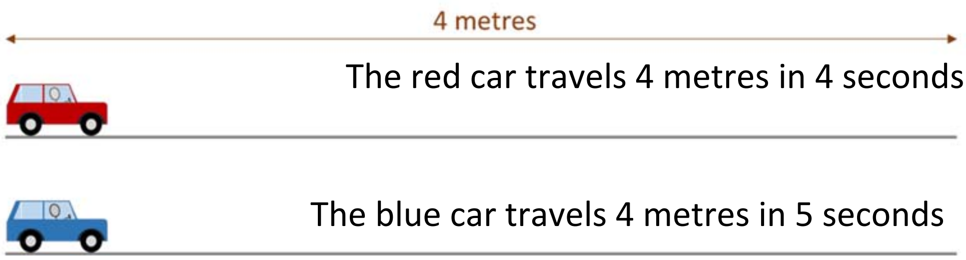
Put a tick (✓) in the box next to the best answer.

A Both cars started and stopped at the same time ☐

B The blue car travelled further than the red car in the same time ☐

C The red car finished behind the blue car ☐

1. Two toy cars, red and blue, are having a race.



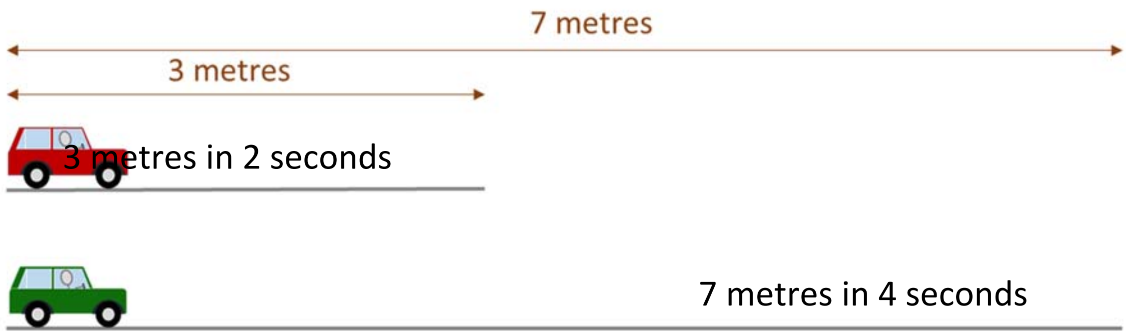
Which car was faster?

A The red car ☐

B The blue car ☐

C Both had the same speed ☐

2. Two toy cars, red and blue, are having a race.



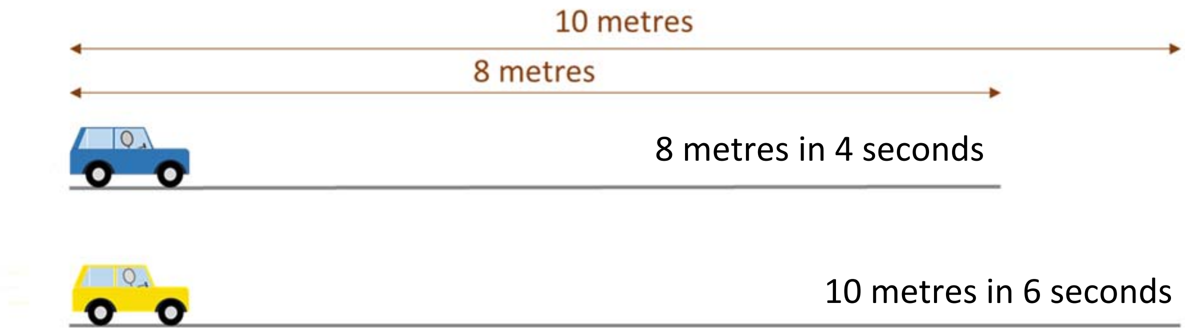
Which car was faster?

A The red car ☐

B The green car ☐

C Both had the same speed ☐

3. Two toy cars, blue and yellow, are having a race.



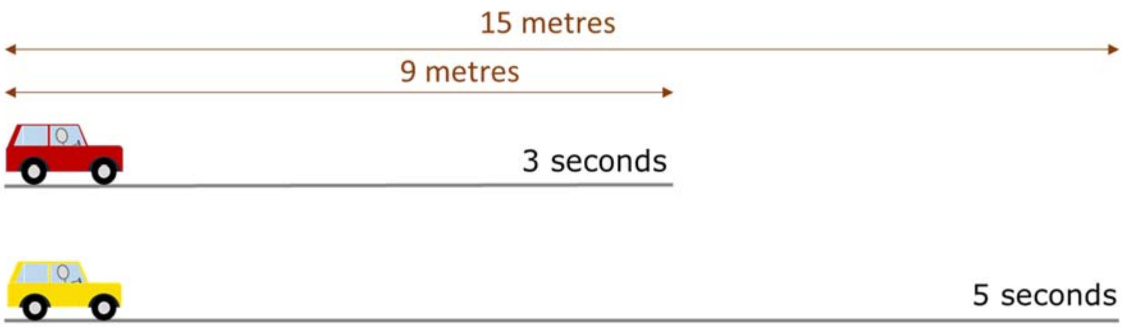
Which car was faster?

A The blue car ☐

B The yellow car ☐

C Both had the same speed ☐

4. Two toy cars, red and blue, are having a race.



Which car was faster?

A	The red car	☐
B	The yellow car	☐
C	Both had the same speed	☐

Apply your knowledge of the **common speeds** to the following questions. Make corrections and additions when the answers are discussed in class

1. Which travels more quickly?

a) car on motorway 31m/s

b) cycling pace 6m/s

c) car in built up area 10.5m/s

d) walking pace 1.4m/s

2. If someone cycled at 6m/s for 12 metres, how long would it take them to get there?

3. If someone cycled at 6m/s for 10s, how far would they travel?

Concept 5: The speed equation	Recall the speed equation

What are the units for speed.

What instrument can be used to measure time?

What instrument can be used to measure distance?

What are the units for distance?

What are the units for time?

Key Idea

The speed equation

The speed equation (words)

The speed equation (symbols)

Apply your knowledge of the **speed equation** to the following questions. Make corrections and additions when the answers are discussed in class

1. What is the equation to calculate speed?

2. A bicycle travelled at 6 m/s. What was distance measured in?

3. A ferry travels at 18m/s. This was calculated using the speed = distance/time equation. Which units were used to measure time?

4. A commuter train travels at 55m/s. Which units were used to measure distance?
   A. Hours
   B. Seconds
   C. Kilometres
   D. Metres

5. What instrument should be used to measure the length of a swimming pool?

6. What instrument could be used to record the time taken to run a 5km race?

7. Why is it important when recording the time when an athlete crosses the finish line you must stand at the finish line not at the starting line?

Concept 7: Calculating speed	Calculate the speed of objects

Key Idea

Very important steps when using any equation

- **Highlight** the relevant bits of the question
- Decide what **equation** to use
- **Substitute** in the numbers (in Standard units)
- **Work** out the answer + **Units** on the answer

Example question 3

A dog walker covers 150 m of park in 107 seconds. How fast are they walking?

1. A train travels 440m in 8 seconds. How fast is the train travelling?

2. A driver on the motorway looks away from the road for two seconds to check their phone. Their car travelled 62 m in that time. How fast was their car going?

3. A ferry covers 72 m in 4 seconds. Show that it’s speed is less than the speed of the train in question 1.

4. A car travelling 4km takes 5 minutes. Calculate the average speed.

5. A plane takes 8 hours to cross the Atlantic. A journey of 7000km. How fast does it travel?

6. A headless chicken runs 40m across a field in 10 seconds. Calculate its speed.

7. A sloth climbs a 15m tree in 10 minutes. How fast does it travel?

8. CHALLENGE A ship take 2 day to travel across the 700km miles of Mediterranean sea. What is its average speed?

Concept 8: Rearranging the speed equation	Calculate distance and time by rearranging the speed equation

<u>A different type of speed question</u>

A car travels at 250m/s for 30 seconds. How far did it travel?

What is more challenging about this question compared to the last ones?

What would you do to try and answer this question? What information do you need?

Key Idea

The equation for speed

Apply your knowledge of **rearranging the** s**peed equation** to the following questions. Make corrections and additions when the answers are discussed in class

Example:

1. An object travels 45m in 12s. What is it’s speed?

2. A ball travels at 2m/s. How long does it take for the ball to travel 32m?

3. A train travelling at 40m/s sounds it’s horn for 3.5 seconds. How far has the train travelled during that time?

4. A teenager mooches towards school at 0.15m/s. If they are 12 m away from the school gate, how long will it take to get there?

5. A cyclist leaves the house travelling at 4m/s. It takes them 13 seconds to realise they had left their front door unlocked. How far away from home had they travelled?

6. A car travels 144m in 12 seconds. What is its speed?

7. A snake slithers away from its enclosure at 0.6m/s. It is 75m away from the exit of the zoo. How long has it got to travel at that speed before it escapes into the wild?

8. A toddler spots an ice cream van in the park. They zoom off at 2m/s and caught up with after 5 seconds. How far away did they get?

9. A cricket ball is smashed across the park. It takes 12 seconds to roll to a stop 96 m away from the batsman. How fast was it travelling?

CHALLENGE How far is the moon if it take a rocket travelling at 1500m/s 4 days to reach it and return to earth?

Concept 9: Scalar and vector quantities	*Recall common speeds*

What do you think these words mean?

Quantity	Definition
Speed	
Velocity	
mass	
force	
Time	
acceleration	

What are scalar and vector quantities?

scalar	meaning	example
vector	meaning	example

Select from the following answers

a quantity that has a magnitude only

a quantity that has both a magnitude and a direction

speed, mass , force, time, velocity

Apply your knowledge of **scalar and vector quanitites** to the following questions. Make corrections and additions when the answers are discussed in class

Are these scalar or vector quantities?

For each one explain how you know

1) The football player was running 10 miles an hour towards the goal.

This is

I think this because

2) The temperature of the room was 15 degrees Celsius.

This is

I think this because

3) The volume of that box at the west side of the building is 14 m^3.

This is

I think this because

4) The car accelerated north at a rate of 4 meters per second squared.

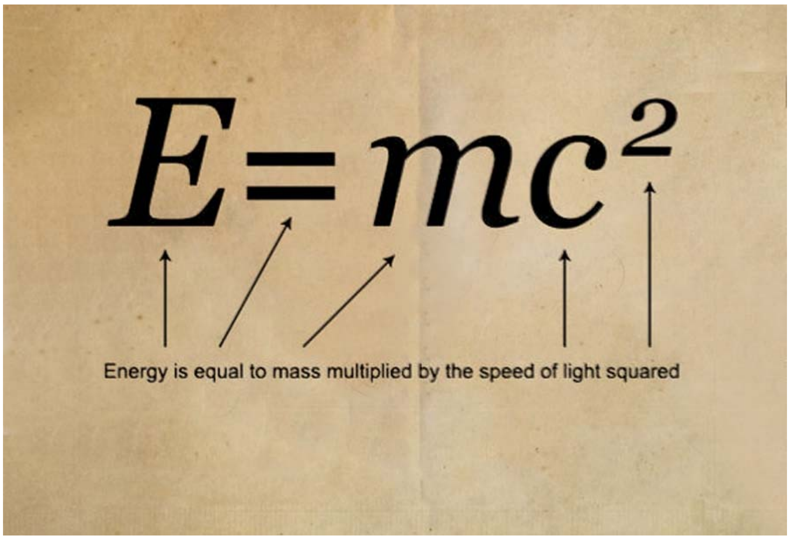
This is

I think this because

No.	Answer	Mark out of 6
1		
2		
3		
4		
5		
6		
1		
2		
3		
4		
5		
6		

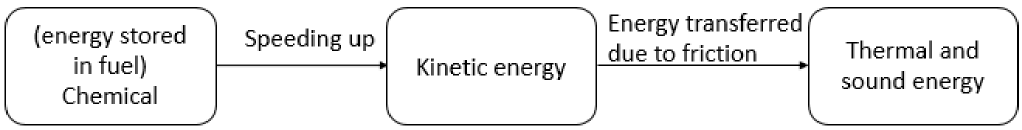
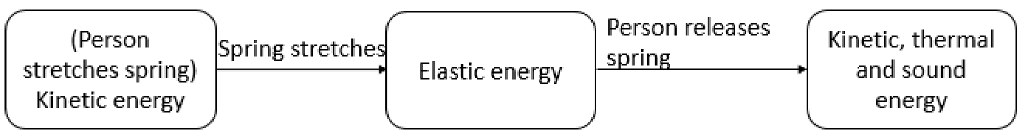
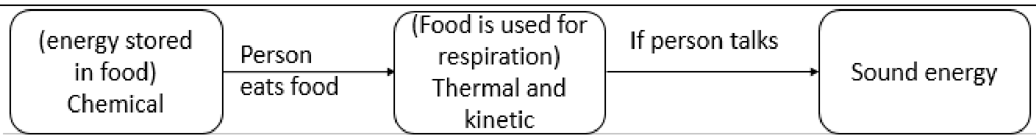
Year 7 Science:

Energy



Contents

7P3 Energy Core Questions

Question	Answer
1. What is the symbol and unit for energy?	Joule, J
2. Name 9 forms of energy	Gravitational potential energy Chemical Sound Electrical Nuclear Light Thermal Elastic Kinetic
3. Describe what is meant by a system	An observed object or environment. This could be as big as the universe, a room, a car, a beaker or a petri dish.
4. Describe what is meant by conservation of energy	The total energy in a closed system remains the same when an energy transfer takes place
5. Draw an energy transfer diagram for a car speeding up	
6. Draw an energy transfer diagram for when a ball falls and lands on the ground	
7. Draw an energy transfer diagram for stretching a spring	
8. Draw an energy transfer diagram for when food is used in our bodies	
9. State 2 common waste energies	Thermal and sound
10. Describe what happens to waste energy	It is dissipated to the surroundings

Concept 1: Types of Energy	*The 9 forms of energy* *Identify stored and forms of energy in situations and devices*

Key idea: Energy

Energy can exist in many different forms such as ________________,

_____________ and ______________. Energy cannot be ___________ or ____________ this is known as the ______ of conservation of energy.

Sound, law, created, light, destroyed, heat

Picture	Energy	Store or Transfer
Lightning	Electrical	

Energy transfers

Lola takes a penalty for the school team.

What **energy transfer** is needed to score a goal in the top corner?

What energy **transfer** is needed to score a goal in the top corner?

Put a tick (✓) in the box next to the correct answer.

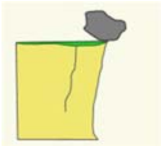
A chemical store → kinetic store ☐

B kinetic store → gravity store ☐

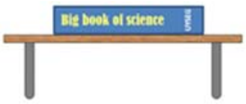
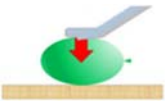
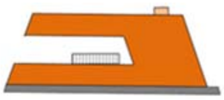
C chemical store → gravity store + kinetic store ☐

D kinetic store → gravity store + heat store ☐

E chemical store → gravity store + kinetic store + heat store ☐

1.	A person taking a nap		Energy store No energy store ☐
2.	Packet of crisps		Energy store No energy store ☐
3.	Rock on top of a cliff		Energy store No energy store ☐
4.	A person after a long run		Energy store No energy store ☐
5.	Ball rolling along		Energy store No energy store ☐

Identify the matching energy and the reason to each picture.

Object(s)	Form of energy	Reason
	an elastic store	it is moving
Bu 	a gravitational store	it has chemicals that can react
	kinetic	it is high up
Ba 	a chemical store	it is warmer than the coldest thing
Magnets 	heat	it is squashed and springy
	electromagnetic	the magnets will spring apart

Forms energy

Energy takes many different forms.

Each type of form has a special name.

These are the main forms of energy that we will be thinking about during this topic:

_____________ - The energy objects have when they are moving.

______________ – The energy an object has because it is warm. All objects have this no matter how cold they are. The hotter, the more energy.

____________ – The energy transferred by sound waves. These are vibrating particles and so are not very different from kinetic and Thermal

___________ – The energy transferred by light waves.

________________ – the energy stored in molecules until they undergo chemical reactions. Examples are fuels like petrol, cake that supplies energy to people, batteries and body fat which is where we store our energy until we need it.

_________________________ potential energy – the energy things have by being high up and large. The best way I can think of identifying objects with a lot of gravitational potential energy is thinking about how worried you would be about it falling on your head.

________________ potential energy – the energy of a stretched thing that could be released. Examples are a compressed spring, drawn bow, tight elastic band, bungee cord at full stretch. A bit like gravitational you could think about how worried are you about the thing pinging at you.

___________________ – the energy transferred in electrical circuits, lightning and static electricity.

___________________ potential energy – just like elastic except the 'ping' is caused by magnets attracting or repelling

Concept 7P3.2 Energy Transfers and Conservation	*Describe what is meant by a system* *Explain what is meant by conservation of energy* *Explain that there are energy transfers in a closed system, but no net change to the total energy in the system*

1. Name 3 forms of energy.

2. Give an example of a system with large amounts of kinetic energy.

3. Give an example of a system with large amounts of thermal energy.

4. State the unit of energy.

5. Explain what a store of energy is.

6. What does the term transfer mean?

Key Point: Conservation of energy

Energy exists in many different ___________. Although it cannot be ____________ or _____________ energy can be moved between the different forms. We call this process an ________ ___________. In an energy transfer the ______ amount of energy does not change. Just the amount of each type of energy.

Total , Destroyed, energy transfer, Forms, created

Energy doesn't just stay in one store, it is always **transferring** from one type or store to another. It can also transfer within the same type of energy store, for example when objects collide kinetic energy in one objects becomes kinetic energy in another.

The world is a complicated place with many interactions in terms of energy. To overcome this we try to think about isolated systems which do not interact with objects outside. We call these systems 'closed' systems. In reality these are extremely difficult to create, but it is the most useful way to try to think about energy transfers.

System

....

....

Transfer

....

....

The law of conservation of energy

....

....

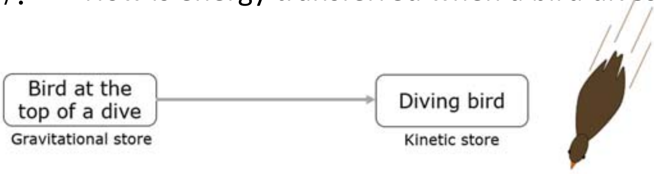
6. How is energy transferred by a catapult?

A Mechanically

B Electrically

C By heating

7. How is energy transferred when a bird dives?



A Mechanically

B Electrically

C By heating

8. How is energy transferred from a very hot cup of tea?

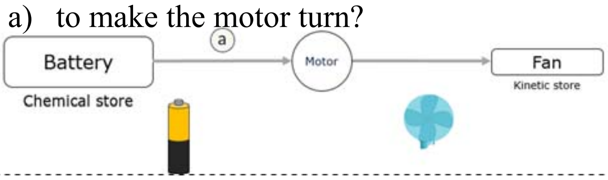
A Mechanically

B Electrically

C By heating

9. How is energy transferred when a fan is switched on:

a) to make the motor turn?

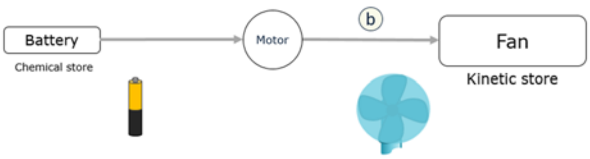


A Mechanically

B Electrically

C By heating

b) to make the fan turn?



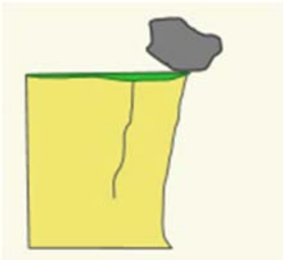
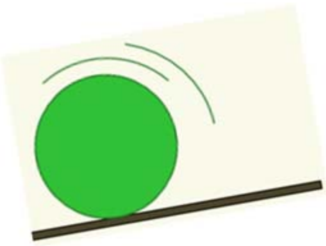
A Mechanically

B Electrically

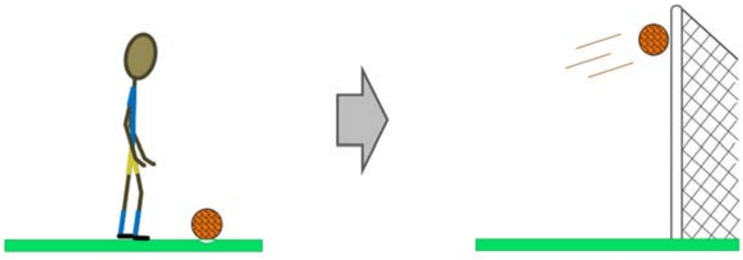
C By heating

Is energy transferred?

Which of these is transferring energy to a new store?

10.	A person taking a nap		Transfer to a new store No transfer of energy	☐ ☐
11.	Packet of crisps		Transfer to a new store No transfer of energy	☐ ☐
12.	Rock on top of a cliff		Transfer to a new store No transfer of energy	☐ ☐
13.	A person after a long run		Transfer to a new store No transfer of energy	☐ ☐
14.	Ball rolling uphill		Transfer to a new store No transfer of energy	☐ ☐

Lola takes a penalty for the school team.



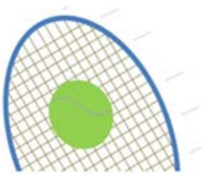
What **energy transfer** is needed to score a goal in the top corner?

Put a tick (✓) in the box next to the correct answer.

A	chemical store → kinetic store	☐
B	kinetic store → gravity store	☐
C	chemical store → gravity store + kinetic store	☐
D	kinetic store → gravity store + heat store	☐
E	chemical store → gravity store + kinetic store + heat store	☐

Moving energy to different stores

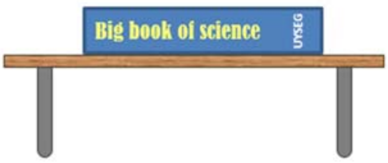
It is important to use the right words to describe an **energy transfer**.



A. Hitting a ball

B. Boiling water

C. Lighting a bulb for one minute



D. Holding a book on a shelf

E. Lifting a weight with a see-saw

Is each description right?

For each statement, tick (✓) **one** column to show what you think.

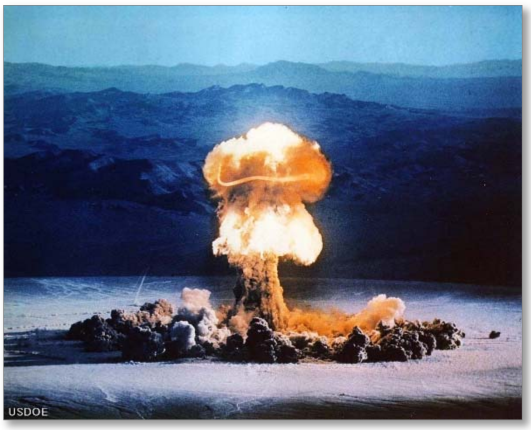
Statements		I am **sure** this is right	I think this is right	I think this is wrong	I am **sure** this is wrong
A	Energy is moved from the chemical store of my arm to the kinetic store of me, the racket and the ball				
B	A chemical store of energy is transferred to a kinetic store and a heat store				
C	Energy is transferred from the chemical store of the battery to the heat store of the bulb and the room				
D	The book has gravitational energy				
E	A store of chemical energy is changed into a store of gravitational energy				

Draw and energy transfer diagram to outline the energy transfers taking place in the pictures below.

Chemical energy → **Electrical current** → **Kinetic energy (Hands)**

(Stored in battery) **(Electrically transferred)** **Mechanically Transferred)**

→ **Eventually all energy will be dissipated to the surrounding a heat**


USDOE

Conservation of energy

Energy cannot be created or destroyed. Therefore the amount of energy in a closed system must be the same at the end of a transfer as it was at the start,

e.g A person transfers 500J of chemical energy into 300 J of kinetic energy and the rest as heat.

How much heat was released?

The answer must be 200J so that the total energy at the end is the same as it was as the start 500J. Which is the same as 300J + 200J

Complete the missing numbers

1. In a bulb 100J of electrical energy is transferred into 50J of thermal energy and ______ of light energy
2. A car transfers 1,000J of chemical energy into 400J of kinetic energy and ______ of thermal energy
3. A hair dryer transfers 5000J of electrical energy into 4000J of thermal energy, 950J of kinetic energy and ________ of sound energy
4. A kitchen blender transfers 900J of electrical energy into 700J of kinetic energy, 100J of sound energy and ___________ of thermal energy
5. A rocket taking off transfers 150,000J of chemical energy into 100,000J of gravitational energy, 30,000J of thermal energy, 10,000J of light energy and _________ of sound energy

Using the situations you saw earlier in the lesson for ideas come up with at least 5 questions like those above and test the person next to you. Try to use as many energy types as you can.

Extension Activity

Name the form of energy. Then give you own example of where you might find a lot of this energy.

1. ..is the energy a moving object has
2. ..is stored in a stretched object
3. .. is stored in objects raised above the ground
4. .. is carried by the electrical current in a circuit
5. ..is stored in chemicals & food
6. .. allows us to see
7. .. is stored between 2 magnets held apart from one another
8. .. travels as vibrations that allow us to hear
9. .. is stored in the nucleus of an atom
10. .. transfers energy away from objects that are at high temperatures

TASK –

For each of the 3 examples provided, **write out energy-flow diagrams for each** ([1] for each correct diagram**).**

Bonus marks:

Some of the output energy is USEFUL, but some of the energy is WASTED – identify these on your energy-flow diagrams ([1] for each correct example).

EXTENSION:

Use this extra information to calculate any missing energy values involved ([1] for each correct value):

Example 1: Elastic energy = 40J, sound energy = 3J, thermal energy = 7J, K.E. (of arrow) = ?

Example 2: Kinetic energy = 20,000J, sound energy = 2,500J, thermal energy = 3,500J, G.P.E. (at start) = ?

Example 3 (at bottom): Elastic energy = 10,000J, thermal energy = 750J, sound energy = 50J, G.P.E. (at start) = ?

Concept 7P3.3 Representing Energy Transfers and Wasted Energy	*Draw and interpret energy transfer diagrams* *State 2 common forms of waste energies* *Describe how energy is dissipated and stored in less useful ways*

1. State what is meant by a system.

2. If a microwave uses 800J of energy. And 600J of this is transferred to the food. How much is wasted?

3. What objects have kinetic energy?

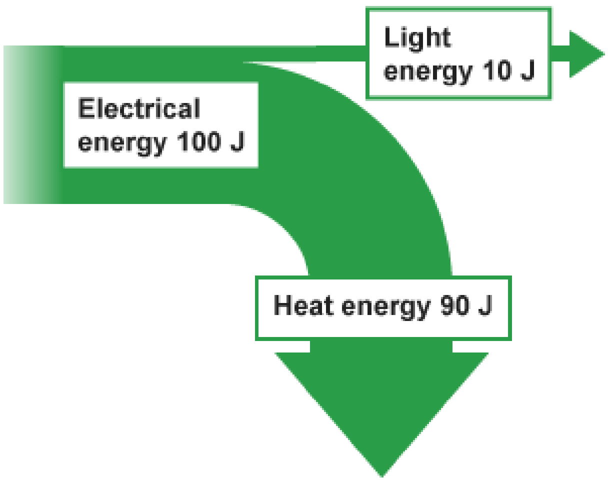
4. Draw an energy transfer diagram for raindrop.

5. State the law of conservation of energy.

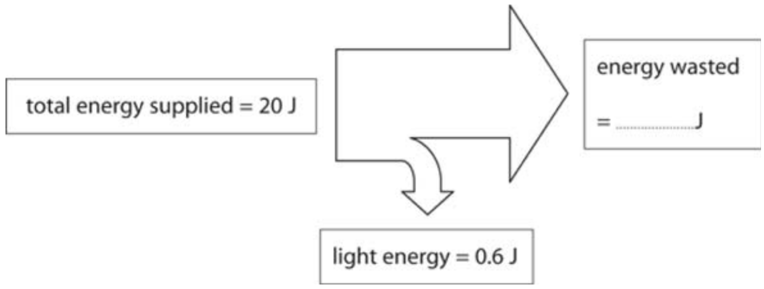
We can represent, or show, how energy is transferred to different stores using **Sankey diagrams.**

A Sankey diagram shows the energy stores. And it shows *how much* energy is moved to each store.

Sankey diagrams have line widths proportional to the energy they represent. Any arrow coming off results in the main arrow becoming narrower by the width of the daughter arrow. **Here, the electrical energy store is transferred to stores of light energy and heat energy in a light bulb.**



1. This is the Sankey diagram for a light bulb:

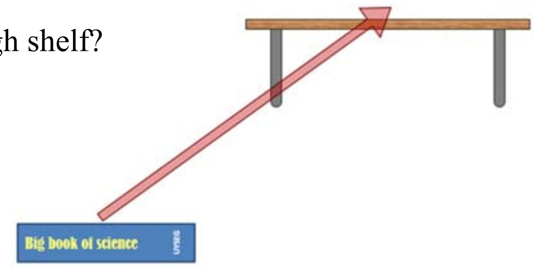


What form of energy was transferred into the light bulb?

What form of energy was wasted?

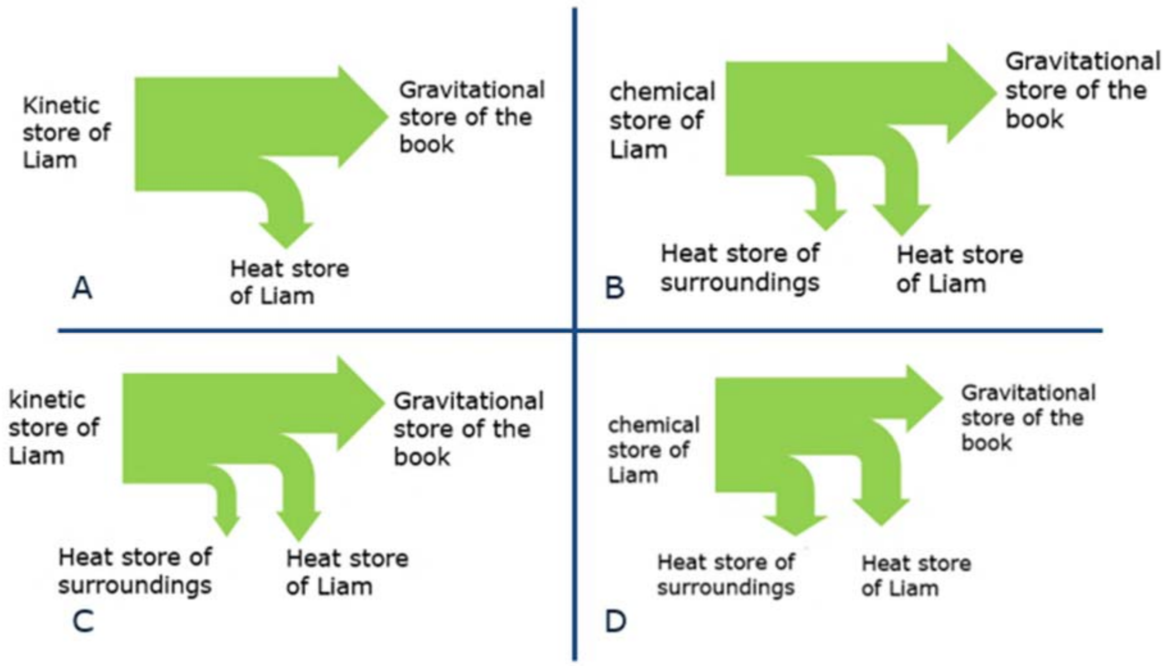
What amount of energy was wasted?

1. What happens when Liam lifts the book onto a high shelf?

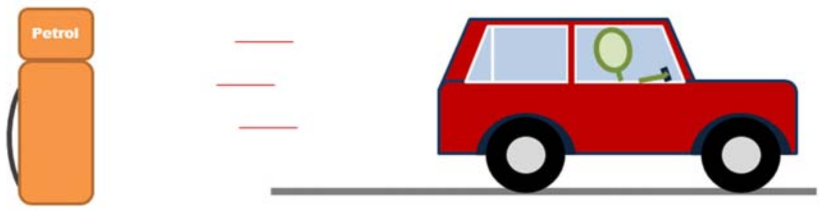


Which Sankey diagram best shows what happens?

Put a tick (✓) next to the correct answer.



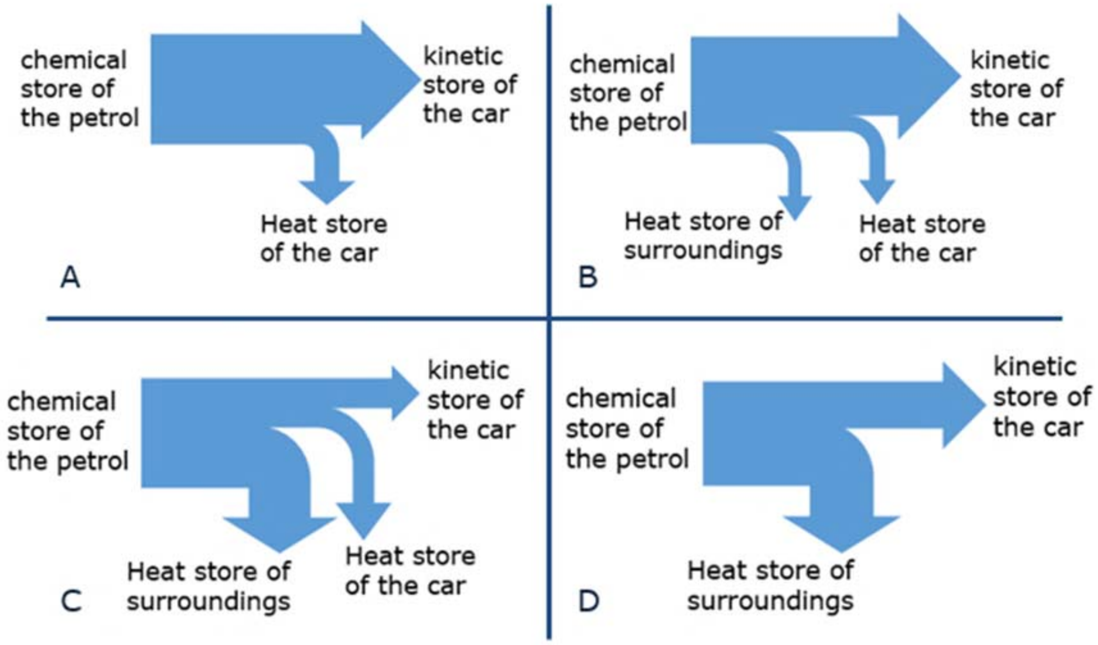
2. What happens when this car sets off and speeds up to 30 mph?



Which Sankey diagram best shows what happens?

Cars are about 20% efficient

Put a tick (✓) next to the correct answer.

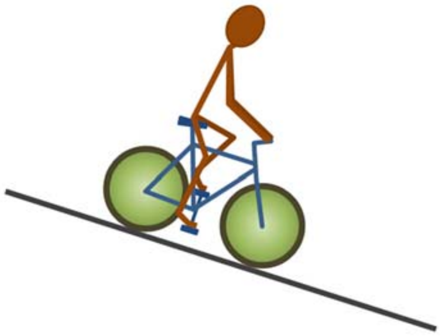


Wasted energy

In the examples we have looked at some of the energy stores in the Sankey diagrams are not as ‘useful’ as others. In the light bulb example, the thermal energy store is not useful. Why not?

No energy transfer is 100% **efficient**. This means that every time energy transfers from one store to another, some useful energy is always ‘lost’. It doesn’t disappear but instead becomes thermal or sound energy that is generally no use to us. Can you think of some examples?

Heating by friction



Lucy is **freewheeling** down a steep hill.

Some of her energy is being transferred by friction to a heat store.

Where is energy transferred by friction to a heat store?

For each place, tick (✓) **one** column to show what you think.

Places		I am **sure** this is right	I think this is right	I think this is wrong	I am **sure** this is wrong
A	The brakes				
B	The tyres				
C	The air				
D	Her feet				

Slower football

After Dylan kicks the football it slows down.

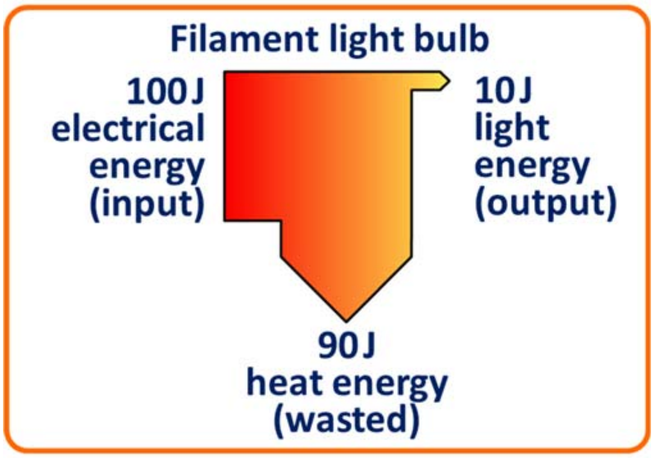
1. Why does the football slow down?

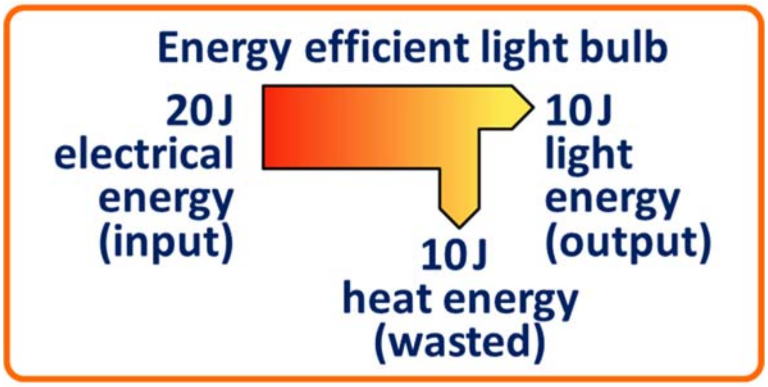
   For each statement, tick (✓) **one** column to show what you think.

Places		I am **sure** this is right	I think this is right	I think this is wrong	I am **sure** this is wrong
A	Its kinetic store of energy gets used up				
B	It bashes into air particles making them move faster				
C	It bashes into blades of grass making them move				
D	The force pushing it gets used up				

Sankey diagrams continued.

All the energy transfers (useful and wasted) that are associated with a device can be represented by a **Sankey diagram**.





Q1) How do the energies of these two Sankey diagrams compare

Q2) Which bulb due you think is more efficient

Q3 Explain your answer too question 2

Q4) How do the Sankey diagrams show conservation of energy.

Q5) Do the Sankey diagrams represent an open or closed system.

Key points to remember when constructing a Sankey diagram.

A Sankey diagram uses arrows to represent all the output energies

The ***thickness of each arrow is proportional to the amount of energy involved at that stage***

For each sketch a Sankey diagram and identify the waste energy stores.

1. A car transfers 8000J of chemical energy into 4000J of heat energy and 4000J of kinetic energy.

2. A blender transfers 600J of electrical energy into 200J of heat energy and 400J of kinetic energy.

3. A crossbow transfers 2500J of elastic potential energy into 2400J of kinetic energy and 100J of sound energy.

4. A TV transfers 1500J of electrical energy into 500J of heat energy, 400J of sound energy and 600J of light energy.

5. A motorbike transfers 10,000J of chemical energy into 6,000J of kinetic energy, 2,000J of thermal energy, 1000J of sound energy and 1000J of light energy.

6. A kettle transfers 90,000J of electrical energy to 80,000J of thermal energy and 10,000J of sound energy.

7. A solar panel (photovoltaic cell) transfers 150J of light energy to 100J of electrical energy and 50J of thermal energy

Extended writing task 1

Describe the energy transfers taking place as a when a person plays a piano.

In you answer include.

- The forms of energy present
- The transfer process
- And the law of conservation of energy.

Peer feedback	Teacher feedback

Self-assessment WWW   EBI

Improve your answer using the feedback provided.

____

____

____

____

____

____

____

____

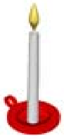
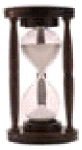
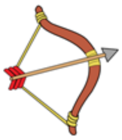
Energy Extended Writing Task 1
Mark Scheme

3. Circle the letter of all the points they have made in their work.
4. Add the letter on their work

K. A person is a store of chemical energy L. As they move their hand they transfer this into kinetic energy through mechanical work. M. This kinetic energy is then transferred to the workings of the piano again through mechanical work. N. As the hammer strikes the sting the vibration of the string transfers the kinetic energy into sound energy. Here energy is being transferred as a wave (mechanically) O. This sound energy eventually dissipates as heat. P. As the process is not 100% efficient some energy is lost in the form of heat to the surroundings at each stage. Q. The energy at the start of the transfer system will be the same as the total energy at the end.

Energy in and energy out

Energy comes in lots of forms. Things work when energy changes from one form to another.

	Example Description	Energy In	Energy Out
	Electric cooker		Heat energy
		Chemical energy	
	Guitar String (being plucked)		Sound energy
	Burning Candle	Chemical energy	
	Egg timer (falling sand)		Kinetic energy
	Arrow shot from bow		Kinetic energy
	Document scanner		Electrical energy

For the following devices state what energy stores and pathways are involved:

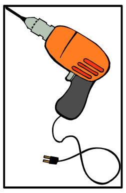
Light bulb:

Input Energy ____________

Useful Energy ___________

Waste Energy _________

Electric Drill:



Input Energy ___________

Useful Energy ___________

Waste Energy___________

TV:

Input Energy ____________

Useful Energy ___________

Waste Energy ___________

Car engine:

Input Energy ____________

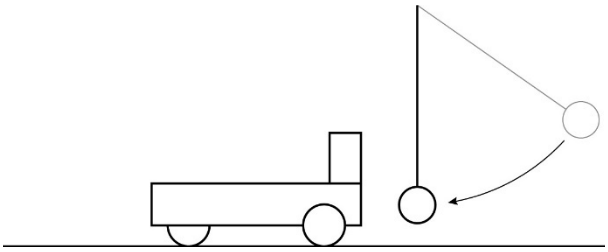
Useful Energy ___________

Waste Energy ___________

Where in the lab are these energy transfers taking place?

1. Electrical to light	e.g. projector or any electric light that is on
2. Chemical to heat	a person (heat released by respiration)
3. Chemical to kinetic	any moving person
4. Electrical to kinetic	e.g. fan in projector or OHP, hard disk drive in computer
5. Electrical to sound	e.g. noise from moving parts in a computer or projector
6. Light to chemical	e.g. a photosynthesising plant
7. Electrical to heat	any electrical device, e.g. bulb

Stored energy



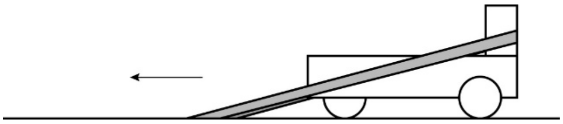
Swing the pendulum to make the trolley move along the bench.

1 How did the pendulum gain gravitational potential energy?

2 How did the trolley gain kinetic energy?

3 How could you increase the gravitational energy stored in the pendulum?

4 Write down different ways you could use a pendulum to make the trolley travel twice as far.



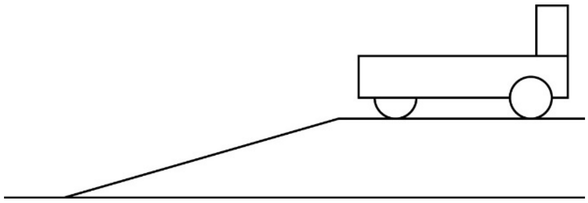
Use the elastic band to make a trolley move along the bench.

5 How did the elastic band gain elastic potential energy?

6 How did the trolley gain kinetic energy?

7 How could you increase the elastic potential energy stored in the elastic band?

8 Describe how you could use other elastic objects to make the trolley travel along the bench.



Use the ramp to make a trolley move along the bench.

9 How did the trolley gain gravitational potential energy?

____

10 How did the trolley gain kinetic energy?

____

11 How could you increase the energy stored in the trolley?

____

12 Describe how we use other forms of stored energy to make life-size vehicles travel.

____

Keyword	Definition
Energy	The capacity for doing work.
Closed system	A system which does not allow transfer of energy or matter in and out.
Transfer	The size of something
Conservation	When something doesn’t change.
System	An observed object or environment. This could be as big as the universe, a room, a car, a beaker or a petri dish.

No.	Answer	Mark out of 6
1		
2		
3		
4		
5		
6		
1		
2		
3		
4		
5		
6		