SCIENCE Independent Learning Booklet

Key concept: 7E Energy

Sub units:

1. 7E.1 Heat and Temperature
2. 7E.2 Energy Transfer
3. 7E.3 Wasted Energy

THE PRIORY LEARNING TRUST

Working scientifically (WS) is a fundamental part of learning science. It is a combination of all the activities that scientists do and is an important part of learning about and learning through science.

Complete the tasks for each **sub unit** to develop your **WS skills** as well as your **A01** skills (recall knowledge and understanding).

Then tackle the mixed up problems for the **key concept** using the **recall – detect** and **solve approach** to develop your **A02 skills** (applying your knowledge and understanding).

Name:
Tutor group:
Science teacher:
Completion date for booklet:

Physics
Key concept: 7E Energy
Sub unit: 7E.1 Heat and Temperature

Week:

Date:

Signed,
Stamped,
or
acknowledged by your teacher.

Working Scientifically Skill: Test a hypothesis

Theme: Scientists theorise about the causes of patterns.

Task: Investigating heat and temperature

You are going to test these two hypotheses.

1) A *larger* volume of water will take *longer* to boil compared to a smaller one.
2) If the volume of the water is *increased*, then the rate of cooling will be *slower.*

Activity 1: How volume affects boiling time of water.

1. Use a measuring jug to place 200ml of cold water into an empty kettle.
2. Turn the kettle on.
3. Time how long it takes in seconds for the water to boil.
4. Once boiled, record the time, allow the water to cool and pour down the sink.
5. Repeat the process with fresh water for 400ml, 600ml and 800ml respectively.

Volume of water	Time taken for the water to boil (s)
200ml	
400ml	
600ml	
800ml	

Activity 2: Conclusion

It takes longer to boil a **small/large** (circle the correct answer) beaker of water than a **small/large** (circle the correct answer) beaker.

This is because the larger volume contains more w_ _ _ _ and needs to gain more internal e_ _ _ _ _ to reach 100°C.

The hypothesis: A larger volume of water will take longer to boil compared to a smaller one is **correct/incorrect** (delete as appropriate)

Activity 3: The rate of cooling

1. Boil 200ml of water using a kettle and place into a soup bowl.
2. Time how long it takes to cool down to room temperature.
3. Once completed poor the contents away.
4. Boil 800ml of water using a kettle and pour into the same soup bowl which is now empty.
5. Time how long it takes to cool down to room temperature.

Activity 4: The results

Which volume of water cooled down the fastest for you? Large or small?

_____

Explanation - Can you explain why?

Physics
Key concept: 7E Energy
Sub unit: 7E.1 Heat and Temperature

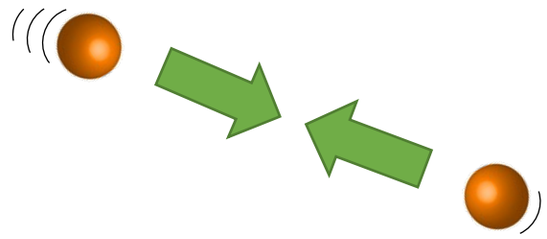
Working Scientifically Skill: Test a hypothesis

Theme: Scientists theorise about the causes of patterns.

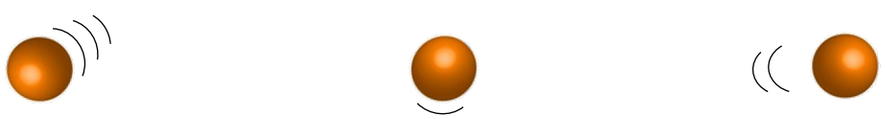
What facts can you recall about Heat and Temperature?
Use your knowledge organiser for guidance.

What do I know about the pH scale?
❑ **Answer** these questions about pH scale using your knowledge organiser for guidance.

What happens when particles bump into one another?
Energy is _____ from one particle to another.

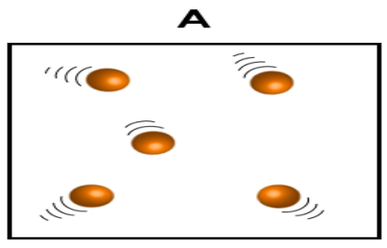


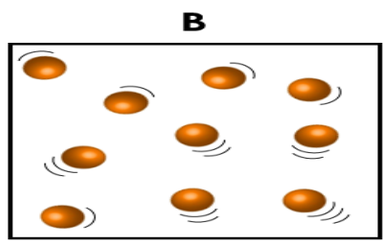
Which particle below has the most/least energy? Label the particle with the most/least energy,



What is temperature? Complete the sentence. Temperature is the average e_____ of the particles.

Which object? Has the highest temperature? Why?
_____
_____
_____
_____





Complete the sentence: When there is a temperature difference between two object, energy moves from the _____ to the _____ one.

Complete the sentence: Energy moves faster when the difference between objects is **bigger/smaller** (delete as appropriate)

What happens to the temperature when the same volume of cold and hot water are mixed?
_____
_____
_____

Complete the sentences:

The hotter the water the g_____ the energy of particles.
The cooler the water the lower the e_____ of particles.

What happens to the temperature when there is more of the cold material than hot.
_____
_____
_____

True or false?

An object will stop cooling when it reaches the temperature of its surroundings.

True/False (delete as appropriate)

Physics
Key concept: 7E Energy
Sub unit: 7E.2 Energy Transfer

Working Scientifically Skill: Make a quantitative experimental prediction.

Theme: Scientists theorise about causes of patterns. Causes can be direct/indirect, single/multiple.

Week:

Date:

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Task: Investigating energy transfer

This experiment is as old as the hills but it's plenty of fun and a great way to learn all about the conservation of energy too. You will need a heavy ball like a football and a smaller ball like a tennis ball and a 30cm ruler.

Activity 2:

1. For comparison first hold the football and smaller ball in each hand and drop them from the same height. Make a note of which one bounces up higher and how high they bounce! You could use your SLO – MO on your mobile phone to record the drop and bounce heights of both balls.
2. Drop each ball separately to record a bounce height measurement in the table below.
3. Next, place the smaller ball on top of the larger one and lift them both up in the air and then drop them!
4. What happens to the smaller ball?

Activity 1: Write you prediction here:

A prediction means what you think will happen in an experiment.
As you increase the drop height of my ball, what will happen to the bounce height?

Activity 3: Calculating the mean

1. Add your two bounce height results together for the football.
2. divide this total by how many results you obtained (two). The answer is your mean.
3. Record this value in the **Mean bounce height** (cm) column.

Ball Type	Bounce Height 1 (cm)	Bounce Height 2 (cm)	Mean bounce height (cm)
Football			
Tennis ball			

Activity 4: **Conclusion:** When you lift the ball up you give it _____ energy, when it falls this changes to _____ energy ('movement energy') and when it bounces some of this energy is transferred into _____ energy upwards and some is 'lost' as _____, sound etc, which is why it doesn't bounce up as high.

Physics
Key concept: 7E Energy
Sub unit: 7E.2 Energy Transfer

Working Scientifically Skill: Make a quantitative experimental prediction.

Theme: Scientists theorise about causes of patterns. Causes can be direct/indirect, single/multiple.

What facts can you recall about energy transfer?
Use your knowledge organiser for guidance.

What do I know about the energy transfer?

❑ **Answer** these questions about energy transfer using your knowledge organiser for guidance.

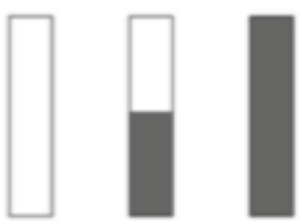
When an object starts moving it begins to fill its **chemical/gravitational/kinetic** energy store (circle as appropriate)

What does the height of the shaded bars compare?

_____

_____

_____



Complete the sentence:

When an object heats up it fills up its _____ energy store.

Can energy be destroyed? Yes or No (circle as appropriate)
What happens?

_____

_____

_____

Complete the sentence:

The amount of kinetic energy of an object depends on its _____ and _____.

What happens to the gravitational energy store when an object is raised to a large height?_____

_____

_____

Complete these sentences:

A raised object has a g_____ potential store (GPE)
A stretched object has an _____ energy store (EE)

What type of energy does a fuel like petrol store?_____

_____

_____

Give five ways energy can be transferred.

1. _____
2. _____
3. _____
4. _____
5. _____

Physics
Key concept: 7E Energy
Sub unit: 7E.3 Wasted Energy

Working Scientifically Skill: Describe energy transfers using a model diagram.

Theme: Scientists choose specific objects to study and use models to simplify understanding.

Week:

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Task: Energy transfers in appliances

❑ Go around your home and identify some common appliances or machines then state: what the **input energy** is for that appliance or machine, **what the useful energy** will be and **what forms** is the wasted energy in.

Appliance	Input energy	Useful energy output	Wasted energy output	Energy transfer diagram
TV	Electrical	Sound+ light	Thermal	Electrical → TV → Sound (useful); Light (useful); Thermal(non- useful)

Physics
Key concept: 7E Energy
Sub unit: 7E.3 Wasted Energy

Working Scientifically Skill: Describe energy transfers using a model diagram.

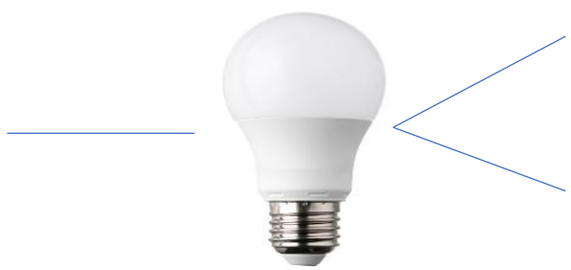
Theme: Scientists choose specific objects to study and use models to simplify understanding.

What facts can you recall about wasted energy?
Use your knowledge organiser for guidance.

What do I know about wasted energy ?

❑ **Answer** these questions about wasted energy using your knowledge organiser for guidance.

Draw simple energy transfer diagrams for a light bulb and hairdryer and car.



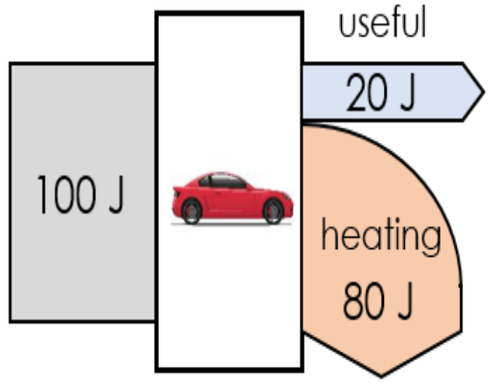
In a Sankey diagram, **what** do the arrows show? **What** does the width of the arrows show?

_____

_____

_____

_____



What do we mean by efficiency in terms of energy transfer?

_____

_____

_____

What is the efficiency equation? **Calculate** the efficiency of energy transfer in the appliance and machine below

Appliance	Input energy	Useful output energy	Efficiency (%)
Light bulb	250J	125J	
Car	1000J	600J	

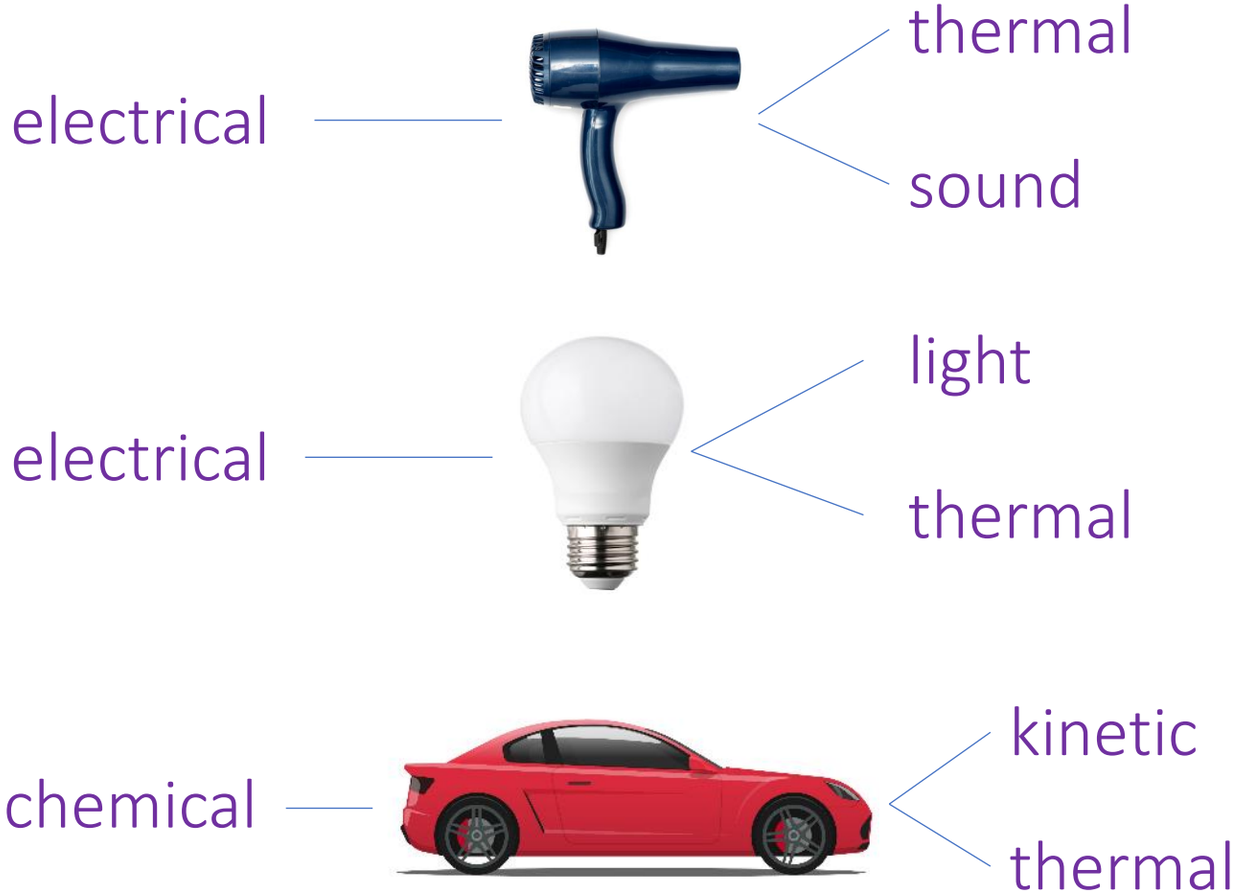
7E.3 MARKSCHEME

7E.3.1 AO1: Demonstrate knowledge and understanding of: 1) scientific ideas 2) scientific techniques and procedures.

What do I know about wasted energy ?

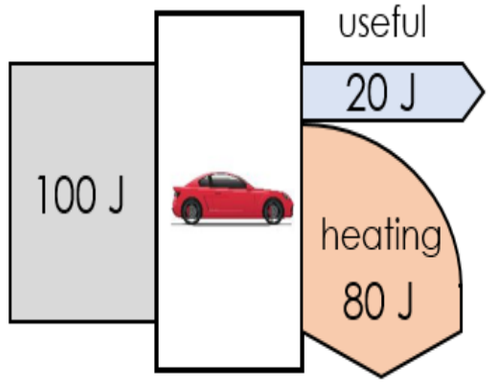
❑ **Answer** these questions about wasted energy using your knowledge organiser for guidance.

Draw simple energy transfer diagrams for a light bulb and hairdryer and car.



In a Sankey diagram, what do the arrows show? What does the width of the arrows show?

Arrows show where the input energy is transferred. The size of the arrows represents the amount of energy



What do we mean by efficiency in terms of energy transfer?

How much of the input energy is transferred into useful output energy

What is the efficiency equation? Calculate the efficiency of energy transfer in the appliance and machine below

$$\text{Efficiency} = \frac{\text{Useful output energy}}{\text{Input energy}}$$

Appliance	Input energy	Useful output energy	Efficiency (%)
Light bulb	250J	125J	50%
Car	1000J	600J	60%

3.9 Mixed up problems

1 The flowchart shows a series of energy changes.

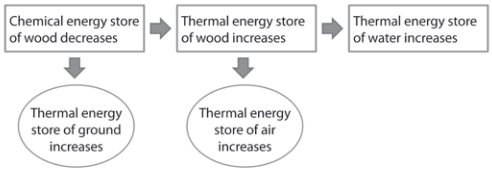
Which situation could the flowchart be describing?

A A fire for keeping people warm

B A cooker for heating water

C A fire for heating water

D A stove for warming a room.



2 The table shows how much energy a cereal provides and the energy used for different activities.

i) How much Popsicles cereal does Max need to eat to provide the energy for 100 minutes of standing?

ii) Max eats one serving with skim milk. How long can he run for on that energy?

POPSICLES breakfast cereal
Nutrition Information

	1 serving with milk	**100g of cereal**
Energy	900 kJ	1400 kJ

Activity	**Energy per minute** (kJ)
Sitting	6
Standing	7
Walking	15
Running	30

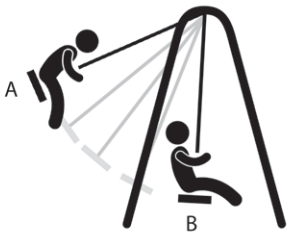
3 Zoe on the swing has 500 J of energy. As she moves from A to B she transfers 400 J from her gravitational potential store.

At B, how much energy is in her:

i) Gravitational potential store

ii) Kinetic energy store?

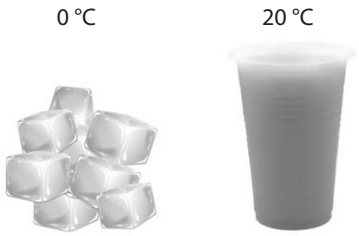
Assume no energy is wasted as heat.



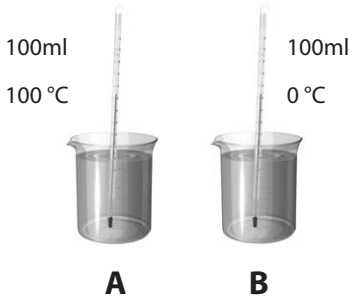
1 /3 2 /3 3 /3 no hints: +1 Total /10

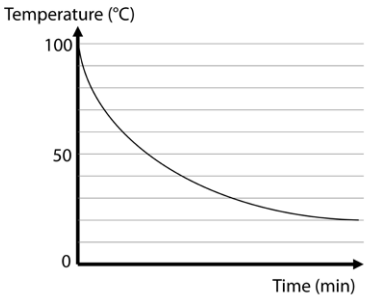
4 Joel quickly adds 100g of ice to 200g of cold drink. What is the best estimate of the new temperature?

A	B	C	D	E
0 °C	5 °C	10 °C	15 °C	20 °C



5 Two beakers are left in a room at 20 °C. Beaker A has water at 100 °C. The graph shows how its temperature changes. Beaker B contains the same volume of water at 0 °C. Sketch how its temperature changes on the same axes.





6 Bo cooks a baked potato on an open fire. She notices it takes longer to cook than in her oven at home.

i) Draw an energy diagram for the open fire. Label the input and output energy, and useful and wasted energy.

ii) How would an energy diagram for the cooker be different?

iii) Explain why it takes longer to cook on an open fire.

Open fire

Oven

1	/3	2	/3	3	/3	no hints: +1 Total	/10

Hints

Contact Forces

1.1 Find missing forces
Q2. Write down the total force upwards and downwards.
Q3. Write down the total force left and right.
Q4. Write down the total force upwards and downwards.
1.2 Explain floating & sinking
Q2. How does removing mass affect density?
Q3. Try putting the densities in order.
Q4. Think why the balloon sinks in air.
1.3 Calculate density
Q2. What is the meaning of a high density?
Q3. Remember the formula for density.
Q4. How does volume affect density?
1.4 Friction factors
Q2. How much does the force change each time?
Q3. Which shows friction doubles when weight doubles?
Q4. What other factors could affect friction and the results?
1.5 Friction and motion
Q2. How does air resistance change as she speeds up?
Q3. How does drag change as the ball gets faster?
Q4. When are the weight and air resistance balanced?
1.6 Mixed up problems
Q1. What is the total upwards force to balance weight?
Q2. Remember the formula for density.
Q3. Try putting the densities in order.
Q4. How will friction change for the same weight?
Q5. Is the force to move the trainer exactly 2.5 or 3 N?
Q6. What is air resistance on the Moon?

Electric circuits

2.1 Complete loops
Q2. How many bulbs are in the loop of switch D?
Q3. Are the heater and fan in the same loop?
Q4. Which loops are complete with this combination?
2.2 Ammeter readings
Q2. i) How do you combine several loops?
Q3. i) A1 + A2 = A3. ii) What happens to current when you add more components?
Q4. What do you know about current in a loop?
2.3 Bulb brightness
Q2. Which circuit has more components?
Q3. Which loops combine?
Q4. Which loop has more components?
2.4 Batteries to bulbs
Q2. The resistors are like bulbs, compare it to Q1.
Q3. i)-iii) Think about the number of batteries per bulb.
Q4. What is the effect of cancelling out two batteries?
2.5 Mixed up problems
Q1. Where can the switch be part of both loops?
Q2. Remember how the currents from each loop combine.
Q3. Is it position or resistance that affects brightness?
Q4. Think about the number of batteries per bulb.
Q5. Which loops are complete when switch Z is open?
Q6. How do the currents in the three loops combine?

Energy transfer

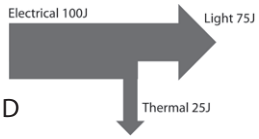
3.1 Identify energy change
Q2. Which stores are filled before the catapult fires?
Q3. How much bigger is the input than output store?
Q4. What energy store does the fuel (gas) have?
3.2 Energy in/out
Q2. First calculate the energy in two mastery bars.
Q3. i) Look at the value with skim milk. ii) Put the answer from i) into the equation: energy in = energy out.
Q4. Find the total energy for both activities. See how much energy is left from two servings of cereal.
3.3 KE and GPE transfers
Q2. i) How much GPE has the marble lost when it is half way down? ii) What has happened to the GPE at C?
Q3. i)-iii) KE is biggest when the speed is fastest. GPE is biggest when the height is greatest.
Q4. i)-iv) KE is biggest when the speed is fastest. GPE is biggest when the height is greatest.
3.4 Temperature change
Q2. What is the average of the hot and cold buckets?
Q3. Will the temperature be closer to the 100 g or 200 g?
Q4. Is the final temperature closer to the tea or cold water?
3.5 Temperature graphs
Q2. The line for the beaker that warms quicker is steeper.
Q3. Start by drawing a dotted line 'if no milk added'. Adding milk makes the temperature drop quickly.
Q4. The line for the one that cools quicker has a steeper slope.
3.6 Interpret energy diagrams
Q2. How many squares are there at the start?
Q3. What store does the energy move to when a car brakes?
Q4. What device uses a chemical energy store?
3.7 Identify wasted energy
Q2. i)-ii) What input energy store does a tablet use? Which stores are part of watching a cartoon and which not?
Q3. i)-ii) Energy is wasted where there is friction.
Q4. The height relates to the gravitational potential energy.
3.8 Calculate efficiency
Q2. i) What fraction of energy is transferred to a useful store? ii) The KE is the efficiency x the amount of input energy.
Q3. What fraction of energy is transferred to a useful store?
Q4. What fraction of energy is transferred to a useful store?
3.9 Mixed up problems
Q1. What is the input energy store and the final output store?
Q2. Calculate how much energy for100 minutes of standing.
Q3. i) Calculate the change in GPE. ii) The energy has moved from the GPE to the KE store.
Q4. Will the temperature be closer to ice or the cold drink?
Q5. The line starting nearer room temperature is less steep.
Q6. i)-ii) What else does the fire heat apart from the potato? iii) Compare how much energy is wasted by each.

Answers

Energy transfer

3.1 Identify energy change

Q2. D.

Q3. 

Q4. D

3.2 Energy in/out

Q2. 67.5 minutes (2024 kJ /30 kJ/min).

Q3. i) Two servings = 1800 kJ.
ii) 300 minutes (5 hours).

Q4. 300 kJ. The sum is 1800 kJ - (30 x 30) kJ– (40 x 15) kJ.

3.3 KE and GPE transfers

Q2. i) 0.25 J. ii) Just before the end - 0.5 J.

Q3. i) Just before it hits the ground - E. ii) A. iii) C.

Q4. i) A. ii) Just above the ground - C. iii) D. iv) B.

3.4 Temperature change

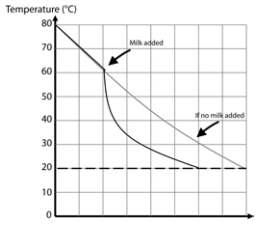
Q2. 50 °C.

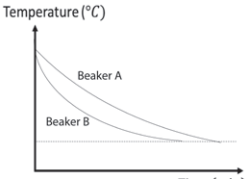
Q3. 40 °C.

Q4. 100 g.

3.5 Temperature graphs

Q2. C.

Q3. 

Q4. 

3.6 Interpret energy diagrams

Q2. i) 100 J (5 squares from 10). ii) 20 J (1 square from 10).

Q3. At the top - C

Q4. C

3.7 Identify wasted energy

Q2. i) input: chemical, output: light, sound, heat (thermal). ii) useful: light, sound, wasted: heat.

Q3. i) Friction in motor/pulley. ii) Electrical -> kinetic & gravitational potential stores.

Q4. As car goes down, some energy is lost as heat and sound. On the next hill there is less in the gravitational store, so it can only climb a lower hill.

3.8 Calculate efficiency

Q2. i) Engine A (efficiency is 1/4 or 0.25). ii) Engine A: KE = 100kJ (0.25 x 400). Engine B: KE = 240kJ (0.6 x 400).

Q3. ¼ or 0.25.

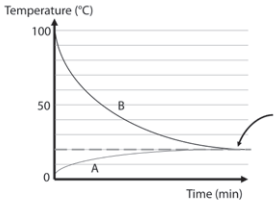
Q4. 1/10 or 0.1.

3.9 Mixed up problems

Q1. C

Q2. i) 50 g (for 700 kJ). ii) 30 minutes.

Q3. i) 100 J. ii) 400 J.

Q4. D. 

Q5.

Q6. i) Chemical -> potato (thermal, useful) and air/ground (thermal, wasted). ii) Less energy wasted. iii) Fire heats potato/ground/air. Oven heats only potato and air.

Gravity

4.1 Gravity & distance

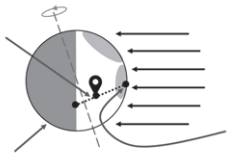
Q2. 2, 1, 3.

Q3. i) Path goes around Uranus anti-clockwise. ii) Jupiter/ Saturn have greater mass and larger gravity to move comet.

Q4. A.

4.2 Seasons & daylight

Q2.



Q3. P

Q4. Panel receives less energy at Y.

4.3 Changing appearance

Q2. i) C. ii) B. iii) D. iv) A.

Q3. i) D. ii) C. iii) A. iv) B.

Q4. A.

4.4 Planetary orbits

Q2. i) d has a longer year length. ii) d has a lower temperature. iii) Neither planet has seasons.

Q3. Pluto: year length 248, temperature -218 °C. Eris: year length 560, temperature -240 °C.

Q4. A diagram (like Q1): energy or rays fan out from Sun with fewer hitting distant places.

4.5 Calculate weight

Q2. No, the weight on Earth = 1000 N.

Q3. No, the weight on Mars = 10 N.

Q4. Yes, the weight = 360 N.

4.6 Mixed up problems

Q1. i) Earth. ii) Sun. iii) Jupiter.

Q2. i), Winter, B. ii), Summer, A.

Q3. C.

Q4. Year length.

Q5. 184 N.

Q6. i) a) K-186f has a shorter year than Earth. ii)) Its surface temperature could be higher than the Earth's because it is closer to its star. iii K-186f has no tilt so its days do not vary.