Checkpoint revision and extension

Aim

The aim of the revision activity is to provide support for students who need to progress from *Know* to *Apply* for the AQA syllabus mastery goals.

The aim of the extension activity is to provide extension for students who have already achieved *Apply.* The activity is also suitable for higher ability or older students in need of further *extension* work.

Revision activity notes

The activity is a series of six tasks focused on the *Apply* aspects of the AQA key stage 3 specification. Students can work independently using their textbooks, allowing you to circulate and support students with the areas they find more difficult. Each task has a straightforward initial activity which all could manage without help.

Task 1: Students identify the force and distance in three examples of work done, after being shown an example. Students then consider how levers make a job easier to do. Only qualitative descriptions are required.

Task 2: Simple true/false activity on thermal energy.

Task 3: A description of an investigation into how starting temperature affects rate of cooling. Students identify variables from the description, plot a graph, describe the pattern, and explain why all of the water ends up the same temperature.

Task 4: Students are reminded of the particle arrangement in solids, liquids, and gases. They are then asked to describe the processes of conduction and convection using key words, to help students explain scientifically.

Task 5: Students explain thermal energy transfer by radiation, using key words.

Task 6: Students are provided with key words, to help explain types of insulation.

'Work' is a word used in everyday language, but it has a very specific meaning in physics. In any explanation, keep referring to the idea that work is *done* and energy is *transferred* whenever a force moves an object. Help students consolidate their ideas by considering which energy store has increased and which decreased. The formula for work done is intended for extension only: this is covered at GCSE level.

Thermal energy transfer is another misunderstood idea. Ideas such as letting cold air in, ice cubes cooling the drink, and heat rising are embedded. Understanding what thermal energy depends on is challenging. Use as many everyday examples as you can: a cup and a pot of tea might be at the same temperature, but the pot of tea has much more energy; some objects take longer to heat or cool, like jam on a jam tart fresh from the oven. Challenge students' answers to emphasise the thermal energy transferred from hot to cold. To help students understand the difference between conduction and convection, link to the kinetic theory model and the behaviour of particles in solids, liquids, and gases.

Additional notes

- The revision activity should be appropriate for students achieving less than 74% in the Checkpoint assessment.

- You can review students' answers to questions in the Checkpoint assessment in Kerboodle. You may decide not to cover all tasks in the revision activity, based on students' performance on specific questions.
- An index of which task covers which outcome is given in the Teacher handbook.
- This revision activity could also be used as a revision sheet for all students.

Revision activity answers

Task 1

Work, energy, and machines

1

Action	Force	Distance
weightlifter lifting a weight	gravitational/weight	height lifted
catapult pulled back	tension/pulling force	length pulled back
car crashes, leaving a dent	force of collision/pushing force	depth of dent

2 Wheels, pulleys, ramp, scissors, wheelbarrow, etc.

3 **a** The hand moves further down than the lid lifts up; the input force of your hand is less than the output force

b The input force moves much further for a longer handle; this means that there is a bigger output force

c The input force (hand) moves much further than the output force (weight of lifeboat); this means there is a greater output force

Task 2

Thermal energy

(top to bottom): F, T, T, F

Task 3

Investigating cooling

1 The independent variable is starting temperature

The dependent variable is temperature after 5 minutes/final temperature

The control variables are volume of water, time before taking final temperature, room temperature, size of beaker

2 (top to bottom): 10, 9, 8, 6, 5

3 Student's graphs should have both axes labelled with units, points plotted correctly, line of best fit drawn.

4 The higher the starting temperature, the greater the temperature fall in 5 minutes.

5 20 °C, because heat energy is transferred from hot to cold; when the water is the same temperature throughout, there will be no net energy transfer.

Task 4

Thermal energy transfer by particles

1 Solid diagram showing closely-packed particles; liquid diagram with particles a little further apart, taking the shape of the bottom of the container (box); gas diagram with particles spread apart filling the box.

2

Description of particles	Solid	Liquid	Gas
close together		✓	
arranged in a pattern	✓		
can move around each other		✓	✓

3 Drawing showing particles in a rod; drawing should show a source of heat and indicate that particles near the heat source are vibrating faster and colliding with particles close by.

Example description: As the particles get hotter, they vibrate faster. These vibrations are passed to the neighbouring particles. In metals, the electrons are free to move and collide with particles, transferring the thermal energy faster. This is called conduction.

4 Drawing showing heated water moving away from element and cooler water moving towards it.

Example description: The water near the element gets hotter, so the particles move faster. The particles move further apart, making the water less dense. The hot, less dense water rises, and the colder, more dense water sinks down. This is called a convection current.

Task 5

Thermal energy transfer by radiation

For example: The thermal energy is transferred from the fire by radiation. Since it travels as a wave in a straight line, the person blocks the radiation, and you are in a shadow.

Task 6

Insulation

1 Example description: The feathers trap layers/pockets of air, which is a good insulator. This is because the air particles are far apart, which makes them poor conductors. Since the air is trapped, the thermal energy cannot be transferred by convection.

2 Example description: The runner is very hot and so radiates heat energy. The shiny metal foil reflects the heat energy back, so the runner doesn't cool too quickly.

3 Example description: There are no particles in a vacuum. Particles are needed for both conduction and convection. Thermal energy can be transferred through the vacuum only by radiation, as it is a wave and does not need particles. So, the vacuum allows the liquid in the flask to stay hot for longer.

Extension activity notes

Students could work individually or in pairs for this activity. The first activity – sorting the levers – would work best in pairs so that the students can discuss their ideas and understanding. Start students off by checking they understand the diagrams of the classes of lever, and remind them of the formula to calculate work done.

Have examples of the levers in the classroom, so that students can look at how the levers work more carefully. This will help them identify the effort, load, and pivot. It would also be useful to have access to the textbook and/or the internet.

Extension activity answers

1 First–class levers: see-saw; scissors; spade; spanner

Second–class levers: hole punch; bottle opener; paper cutter; door

2 Example description:

Spanner: The work done by the effort is equal to the force applied by the hand multiplied by the distance from the bolt/nut. The work done by the load is equal to the force on the bolt/nut multiplied by the smaller distance from the bolt. The work done by the load equals the work done by the effort due to conservation of energy. Since the effort moves more than the load, the spanner can increase the output force.

Improvements: Increase the distance of the effort to the pivot, or decrease the distance of the load to the pivot.

Marking guidance for this task, for information:

1 to 2 marks: Simple explanation of one lever but no attempt to explain how to calculate work done.

3 to 4 marks: For one lever, an explanation of how to calculate work done by both load and effort, and explained in terms of conservation of energy, and an explanation of how to improve the design, or an attempt to explain for both levers.

5 to 6 marks: For both levers, an explanation of how to calculate work done by both load and effort, and explained in terms of conservation of energy AND an explanation of how to improve the design.