Name: _____

Class: _____

Date: _____

Mr. Rawson • GCSE Physics

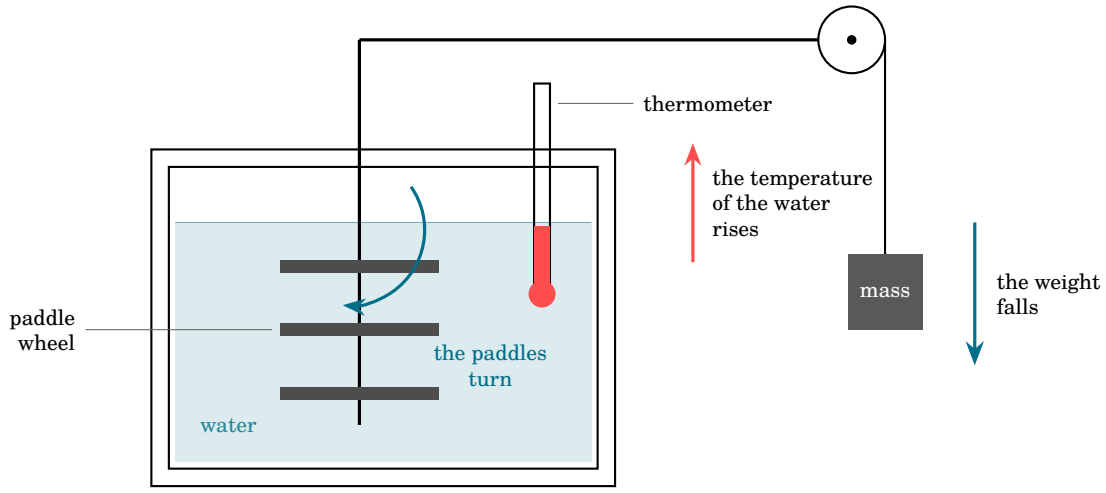
Energy 1 — Stores and Systems

AQA Specification • §P1.1.1 Energy stores and systems • *P1 Energy*

aP1-1 A system is an object, or a group of objects. When a system changes, the way energy is stored in it changes too.
aP1-2 You should be able to describe those changes for five standard situations: an object thrown upwards, a moving object hitting an obstacle, an object accelerated by a constant force, a vehicle slowing down, and water brought to the boil in an electric kettle.

It takes energy to lift a mass, and that energy does not vanish once the mass is up there. It is stored — physicists say it is in the mass's **gravitational potential store**, which is just a way of saying *how much energy it has because of its height*. Let go, and the store empties into energy of motion: the **kinetic** store. So far, so familiar.

But what about the other stores? In the 1840s **James Joule** had an idea. If gravitational potential energy turns into kinetic energy, could that motion be pushed one step further, into the **thermal** store? And not argued for on paper. **Measured.** So he built this, and read it with a thermometer good to a fraction of a degree.



the container — what does it have to be made of?

He could. The temperature rose — and it rose by the amount the falling mass predicted. Nothing was burned and nothing hot went near the water; a weight fell, paddles turned, and the water warmed. **Mechanical work goes straight into the thermal store**, at a fixed rate of exchange you can put a number on. The unit of energy is named after him.

1) **Explain** where the energy in the warmed water had come from, and what had to happen to the weights for it to get there.

2) **Deduce** what Joule's container had to be like for his measurement to work. Think about what would happen to his numbers if the warmth of the water leaked into the walls of the tub, and from the walls into the room.

A word about the word "store"

A store is **not a place**. It is an **amount** — the energy something has because of one particular thing about it: how fast it is moving, how high it is, how hot it is, how stretched, what it is made of.

Physicists gave up saying "types of energy" because it made energy sound like a substance that turns into different stuff, the way ice turns into water. It does not. There is one quantity, measured in joules, and all that ever changes is **which store you count it in**.

A **pathway** is the route the energy takes on the way between two stores. The test: *a store is still there when nothing is happening; a pathway only exists while the transfer is going on.* A hot cup of tea still has a thermal store in an hour's time. Switch off the current and there is nothing left in the wire — so an electric current is a pathway, not a store. Same for light and for sound.

3) **Name** the eight energy stores. Two are done for you.

Store	**An example of something storing energy this way**
Kinetic	a cyclist freewheeling downhill
Thermal	
Chemical	the food in your lunch
Gravitational potential	
Elastic potential	
Electrostatic	
Magnetic	
Nuclear	

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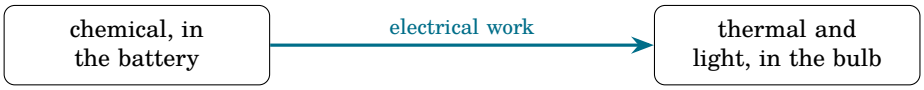
4) Identify whether each of these is a *store* or a *pathway*. Tick one box per row.

Pathway: A way energy moves from one store to another. There are four: mechanical work, electrical work, heating, and radiation. A pathway is not a store.

	Store	Pathway
Light from a lamp	☐	☐
The chemical store of a battery	☐	☐
Sound from a speaker	☐	☐
A stretched elastic band	☐	☐
Heating a pan on a hob	☐	☐
A book held above the floor	☐	☐
Current in a kettle element	☐	☐
A spinning flywheel	☐	☐

5) Complete a transfer diagram for each situation: the store that empties, the pathway, and the store that fills. Here is one done for you.

A torch switched on



A ball thrown straight up

A moving car hits a wall

A trolley pushed with a constant force

A cyclist braking to a stop

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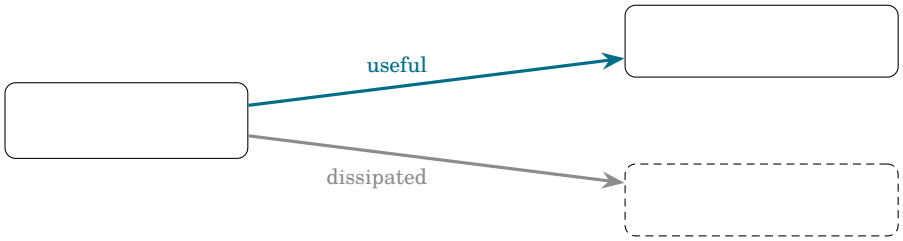
6) **Complete** this one for a kettle boiling water. Not all of the energy ends up somewhere useful — the dashed box is for the part that does not.



7) **Explain** what the dashed box has in common with the brakes of the cyclist above. Is that energy destroyed?

8) **Explain** what a *system* is, and why you must say where its edge is before describing any change. Use Joule's tub as your example.

9) **Explain** why a physicist would never say the energy in a battery has been "used up". Say where it has actually gone. **[3]**

Where this idea came from

In the 1740s **Émilie du Châtelet** dropped brass balls into soft clay from different heights and measured the dents. Doubling the speed did not double the dent — it quadrupled it. Nobody had told her energy was conserved; she found the pattern in her own data, exactly as you did with the spring.