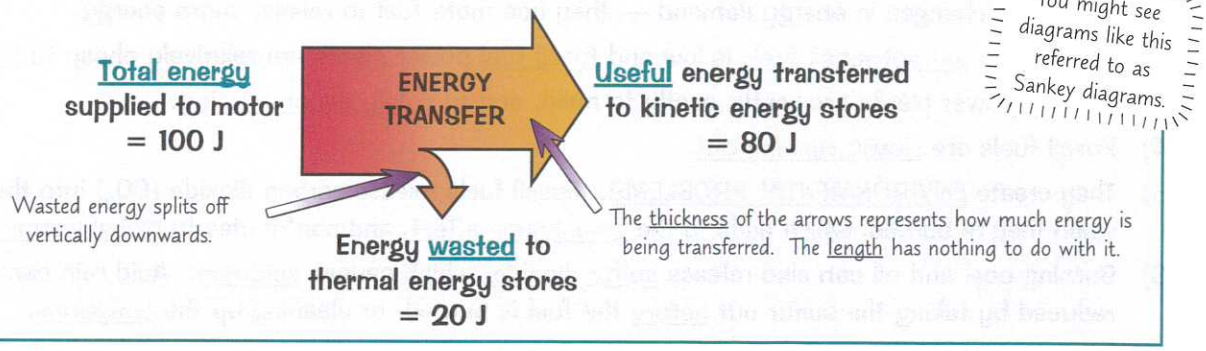
Reducing Unwanted Energy Transfers

There are many ways you can reduce the amount of energy that is wasted during a process (and so increase its efficiency) — lubrication and thermal insulation are two of the main ones that you need to know about.

You can Use Diagrams to Show Efficiency

No device is 100% efficient (see previous page), but some are more efficient than others. You can use diagrams like the one below to show the different energy transfers made by a device, and so how efficient it is:

Diagram for an electric motor with 80% efficiency:



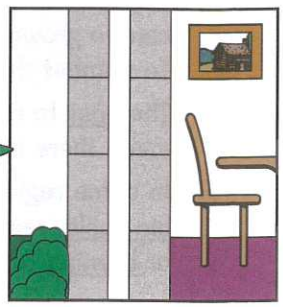
You can reduce the amount of energy that's wasted in various ways — including by lubrication and by thermal insulation. Decreasing the amount of wasted energy means that a higher proportion of the supplied energy is transferred to useful stores, so the efficiency of the process is increased.

Lubrication Reduces Energy Transferred by Friction

1) Whenever something moves, there's usually at least one frictional force acting against it.
2) This transfers energy mechanically (work is done against friction) to the thermal energy store of the objects involved, which is then dissipated by heating to the surroundings. For example, pushing a box along the ground causes energy to be transferred mechanically to the thermal energy stores of the box and the ground. This energy is then radiated away to the thermal energy store of the surroundings.
3) For objects that are touching each other, lubricants can be used to reduce the friction between the objects' surfaces when they move. Lubricants are usually liquids (like oil), so they can flow easily between objects and coat them.

Insulation Reduces the Rate of Energy Transfer by Heating

1) When one side of an object is heated, the particles in the hotter part vibrate more and collide with each other. This transfers energy from their kinetic energy stores to other particles, which then vibrate faster.
2) This process is called conduction. It transfers energy through the object.
3) All materials have a thermal conductivity — it describes how well a material transfers energy by conduction. For example, metals have a high thermal conductivity and gases (like air) have a low thermal conductivity.
4) In a building, the lower the thermal conductivity of its walls, the slower the rate of energy transfer through them (meaning the building will cool more slowly).
5) Some houses have cavity walls, made up of an inner and an outer wall with an air gap in the middle. The air gap reduces the amount of energy transferred by conduction, because air has a very low thermal conductivity.
6) Thicker walls help too — the thicker the wall, the slower the rate of energy transfer.



Don't waste energy — turn the TV off while you revise...

Unwanted energy transfers can cost you a lot in energy bills — it's why so many people invest in home insulation.

Q1 Suggest one way to improve the efficiency of an electric motor. [1 mark]

Reducing Unwanted Energy Transfers

1 A woman is cycling in a race. Before the race, she puts oil on the bike chain. Grade 4-6

Explain why putting the oil on the bike chain increases the efficiency of the woman's cycling.

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[Total 2 marks]

2 A builder is trying to minimise the rate at which a house cools. Grade 4-6

a) The builder can build the walls of the house using bricks A-D. Based on the information in the table below, which type of brick should she use?

	Thermal conductivity	Brick width
☐ **A**	High	10 cm
☐ **B**	High	15 cm
☐ **C**	Low	10 cm
☐ **D**	Low	15 cm

[1]

b) Give **one** other way the builder could reduce the rate at which the house cools.

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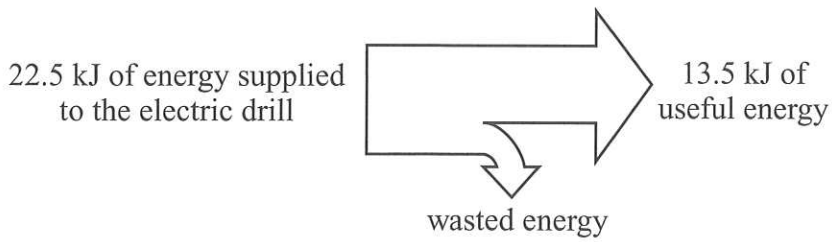
[1]

c) **Figure 1** shows the energy transfer diagram for the builder's electric drill. It shows the energy transferred when it is used for 30 seconds.

Figure 1



Calculate how much energy is wasted during this time.

Wasted energy = ... kJ

[1]

[Total 3 marks]