Conservation of energy and efficiency

Task 1: Conservation of energy

a) **State** the law of the conservation of energy.

b) **Complete** the sentence.

Within an energy system, the total energy before an interaction is …

c) An object with 560 J of energy in its gravitational potential energy store can transfer a total of _____ energy as it falls.

Task 2: Useful and wasted energy

a) **Describe** the term dissipation.

b) **Why** is dissipated energy often referred to as wasted energy?

c) **Complete** the table identifying useful and wasted energy for appliances.

	Useful energy	**Wasted energy**
electric kettle		
tablet computer		
hair straighteners		

d) **Describe** the energy stores and transfers in this scenario. **Explain** how the energy has been dissipated.

A battery powered toy train going around a track.

Task 3: Efficiency

a) **Calculate** the efficiency of a phone charger that has 50 J of energy input and transfers 40 J of energy electrically to the chemical store in the phone's battery.

b) **Calculate** the efficiency of a smartwatch that transfers 6 J of energy by light radiation when 10 J is input.

c) **Calculate** the efficiency of a lawnmower that dissipates 3,000 J of thermal energy to the surroundings when it has an energy input of 12,000 J.

Task 4: Sankey diagrams

Sketch a Sankey diagram for a washing machine with an input of 20,000 J chemical energy if it transfers 15,000 J to thermal energy and 5,000 J to kinetic energy.

Conservation of energy and efficiency

Answers

Task 1: Conservation of energy

a) **State** the law of the conservation of energy.

Energy can be transferred usefully, stored or dissipated, but cannot be created or destroyed.

b) **Complete** the sentence.

Within an energy system, the total energy before an interaction is …

equal to the total energy after the interaction.

c) An object with 560 J of energy in its gravitational potential energy store can transfer a total of *560 J* energy as it falls.

Task 2: Useful and wasted energy

a) **Describe** the term dissipation.

The transfer and spreading out of energy stores into less useful forms.

b) **Why** is dissipated energy often referred to as wasted energy?

Dissipated energy is often referred to as wasted energy because it has not been transferred to a useful form.

c) **Complete** the table identifying useful and wasted energy for appliances.

	Useful energy	**Wasted energy**
electric kettle	*thermal (internal) energy store of the water*	*infrared radiation or sound radiation dissipated to the surroundings*
tablet computer	*light and sound radiation*	*infrared radiation dissipated to the surroundings*
hair straighteners	*thermal (internal) energy store of the metal plates*	*infrared radiation dissipated to the surroundings*

d) **Describe** the energy stores and transfers in this scenario. **Explain** how the energy has been dissipated.

A battery powered toy train going around a track.

The chemical energy store in the battery is transferred mechanically to the kinetic energy store in the wheels. Some energy is also transferred to the thermal energy store in the wheels. This is an example of dissipation because the energy has been transferred to a less useful store and 'wasted'.

Answers

Task 3: Efficiency

a) **Calculate** the efficiency of a phone charger that has 50 J of energy input and transfers 40 J of energy electrically to the chemical store in the phone's battery.

efficiency = useful energy output ÷ energy input

efficiency = 40 ÷ 50

efficiency = 0.8

0.8 x 100 = ***80% efficient***

b) **Calculate** the efficiency of a smartwatch that transfers 6 J of energy by light radiation when 10 J is input.

efficiency = useful energy output ÷ energy input

efficiency = 6 ÷ 10

efficiency = 0.6

0.6 x 100 = ***60% efficient***

c) **Calculate** the efficiency of a lawnmower that dissipates 3,000 J of thermal energy to the surroundings when it has an energy input of 12,000 J.

useful energy output = 12,000 J - 3,000 J = 9,000 J

efficiency = useful energy output ÷ energy input

efficiency = 9,000 J ÷ 12,000 J

efficiency = 0.75

0.75 x 100 = ***75% efficient***

Task 4: Sankey diagrams

Sketch a Sankey diagram for a washing machine with an input of 20,000 J chemical energy if it transfers 15,000 J to thermal energy and 5,000 J to kinetic energy.