

Combined science - Physics - Key stage 4 - Energy

# **Efficiency and reducing unwanted energy transfers - worksheet**

Dr Fishwick



# Exam questions

1(a).

Producing electricity in power stations is not very efficient.

In power station A, 800 joules of energy from coal produce 300 joules of electrical energy.

Calculate the efficiency of this power station

answer \_\_\_\_\_ **[2]**

(b).

In another power station, B, 800 joules of energy from coal produces 350 joules of electrical energy.

Comment on the efficiency of power stations A and B.



**2.**

In a power station, 900 MJ of energy from fuel is needed to make 420 MJ of electrical energy.

Calculate the percentage efficiency.

Give your answer to two significant figures.

percentage efficiency = \_\_\_\_\_ **[2]**

The steam given out from the turbines in this power station can be used to heat nearby offices.

This would improve the overall efficiency of the power station.

Explain why. **[1]**



# Answers



Question			Answer/Indicative content	Marks	Guidance
1	a		0.375 (2)  but if incorrect	2	<b>allow</b> 0.38 / 0.37 (2)  <b>allow</b> 38% or 37.5% or 37% (2)  0.375% (1)  37.5 or 38 or 37 (1)
	b		power station B is more efficient /  ora	1	<b>allow</b> B uses same amount coal to produce <b>more</b> electrical energy than A  <b>ignore</b> B uses 800 joules to produce 350 joules
			Total	3	



Question			Answer/Indicative content	Marks	Guidance
2		i	47 (%) (2)	2	if not 2 sig fig max 1 for substitution which can be implied by answer  46 (%) (1)  46.6 (%) (1)  0.47 (%) (1)  OR  420 / 900 or 42000 / 900 (1)
		ii	idea that less energy wasted / wasted energy used for heating / AW (1)	1	<b>allow</b> not all the heat from power station wasted
			Total	3	



# In lesson questions



# Independent practice

1. Define the term dissipation
  - Dissipation is the ..... Transfer.....
2. How does a falling ball dissipate some of its energy before reaching the ground?
3. An apple has 70 J of energy in its gravitational store at the top of a tree. When it falls and reaches the floor there is only 62 J in its kinetic store. Explain why.
  - The apple has .....
  - This means it .....
  - Therefore .....
4. A rocket launched straight up has 2500 J in its kinetic store at launch. At maximum height it only has 2200 J in its gravitational store. Explain why.





# Independent practice

1. What does the efficiency of an appliance tell us?
  - Efficiency tells us how .....
2. What are the two equations for efficiency?
3. Why would a more efficient engine give a motorcycle a higher top speed?
4. Why would more efficient boiler lead to reduced gas bills?
5. How would a more efficient appliance help the environment?



# Independent practice

1. A motor uses 250 J of energy to lift a box. 180 J of this is transferred to the GPE store of a box. What is the efficiency of the motor?
2. A microwave runs at 900 W. If 750 W is transferred to the thermal store of the food, what is the efficiency?
3. A motor runs at 1000 W when lifting crates. If 250 W is transferred to the thermal store of the cables, what is the efficiency of the process?

## **Challenge: You will need to rearrange the equation**

1. A car engine is 25% efficient. How much input energy produces 100 J of useful energy?
2. A motor has an efficiency of 40%. How much useful energy is produced from 250 J?
3. A hair dryer has an efficiency of 80%. How much useful energy is produced from 2000 J?



# Independent practice

1. Why do we look to reduce unwanted energy transfers?
  - Unwanted energy transfer cause....
  - We want to reduce that because...
  - Therefore.....
2. Give an example of an unwanted energy transfer for a light bulb.
3. Explain how unwanted energy transfers are reduced in engines.
4. What does thermal conductivity mean?
5. Explain two ways to reduce energy transfers in heated buildings.
6. How does the thickness of a wall affect the building's rate of cooling?
7. Explain your answer.



# Answers



# Review

1. Define the term dissipation
  - Dissipation is the transfer **of energy to the thermal store of the surroundings.**
2. How does a falling ball dissipate some of its energy before reaching the ground? **Mechanically through friction. By pushing air molecules out of the way.**



# Review

3. An apple has 70 J of energy in its gravitational store at the top of a tree. When it falls and reaches the floor there is only 62 J in its kinetic store. Explain why.
- The apple has **pushed air molecules out of the way**
  - This means it **has transferred energy mechanically to the thermal store of the air molecules**
  - Therefore **not all energy has been transferred to kinetic store of apple.**



# Review

4. A rocket launched straight up has 2500 J in its kinetic store at launch. At maximum height it only has 2200 J in its gravitational store. Explain why.

- **The rocket had to move air molecules out of the way, so friction has caused energy to be transferred mechanically to the thermal store of the air molecules. This will reduce the energy available for the gravitational store as total energy must be conserved.**



# Review

1. What does the efficiency of an appliance tell us? **How good an appliance is at transferring energy usefully.**
2. What are the two equations for efficiency? **Efficiency = Useful power output/total power input x 100, efficiency = useful energy output / total energy input x 100.**
3. Why would a more efficient engine give a motorcycle a higher top speed? **More energy could be usefully transferred to the kinetic store**
4. Why would more efficient boiler lead to reduced gas bills? **Less energy wasted, less fuel burnt, lower overall cost of fuel**
5. How would a more efficient appliance help the environment? **Reduction in wasted energy, less fuels burnt, less impact on carbon dioxide levels.**





# Review

1. A motor uses 250 J of energy to lift a box. 180 J of this is transferred to the GPE store of a box. What is the efficiency of the motor? **0.72 (or 72 %)**
2. A microwave runs at 900 W. If 750 W is transferred to the thermal store of the food, what is the efficiency? **0.83 (or 83 %)**
3. A motor runs at 1000 W when lifting crates. If 250 W is transferred to the thermal store of the cables, what is the efficiency of the process? **0.75 (or 75 %)**
4. A car engine is 25% efficient. How much input energy produces 100 J of useful energy?  
**400 J**
5. A motor has an efficiency of 40%. How much useful energy is transferred from 250 J?  
**100 J**
6. A hair dryer has an efficiency of 80%. How much useful energy is transferred from 2000 J? **1600 J**



# Review

1. Why do we look to reduce unwanted energy transfers?
  - Unwanted energy transfer cause **energy to be wasted**
  - We want to reduce that because **it costs money to pay for energy**
  - Therefore **by reducing unwanted transfers we can improve efficiency and save money**
2. Give an example of an unwanted energy transfer for a light bulb.
  - **The wire transfers energy electrically heating the wire and the room.**
3. Explain how unwanted energy transfers are reduced in engines.
  - **By using a lubricant to reduce friction between components.**



# Review

4. What does thermal conductivity mean?
  - **Defines how easily energy is transferred through a material by conduction**
5. Explain two ways to reduce energy transfers in heated buildings.
  - **Draught excluders - reduce air flow preventing warm air leaving the building.**
  - **Double glazing - prevents heat transfer by conduction due to vacuum gap between glazing.**
  - **Loft / cavity wall insulation - prevents heat transfer by conduction due to air pockets in material**
  - **Foil backed radiators - reflects heat back into room.**



# Review

6. How does the thickness of a wall affect the building's rate of cooling?
  - **Thicker walls will reduce rate of cooling.**
7. Explain your answer.
  - **The thicker wall will reduce the rate at which energy is transferred to the outside, as the distance is increased. This means that it will stay warmer for longer.**

