

Specific Heat Capacity

Warm-Up

Which of the following is the correct definition of specific heat capacity? Tick **one** box.

The energy transferred when an object is burnt. ☐

The maximum amount of energy an object can store before it melts. ☐

The energy needed to raise 1 kg of a substance by 10 °C. ☐

The energy needed to raise 1 kg of a substance by 1 °C. ☐

PRACTICAL

- 1 Figure 1 shows the apparatus used by a student to investigate the specific heat capacities of various liquids. She measured out 0.30 kg of each substance, then supplied 15 kJ of energy to each sample using an immersion heater. She then recorded her results, shown in Table 1.

Grade
6-7

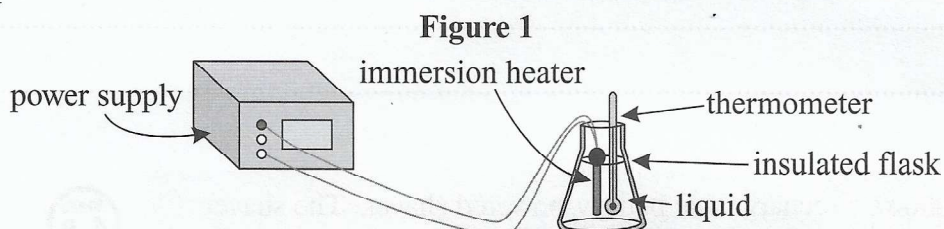


Table 1

Liquid	Mass (kg)	Temperature change (°C)	Specific heat capacity (J/kg °C)
A	0.30	12	4200
B	0.30	23	2200
C	0.30	25	

- 1.1 Complete Table 1 by calculating the specific heat capacity of Liquid C.
Use an equation from the Equations List.

[3]

- 1.2 Describe the energy transfers that occur when a liquid is heated using the equipment in Figure 1.

.....

.....

.....

.....

[4]

[Total 7 marks]

Exam Practice Tip

You may be asked about experiments you've never seen before in an exam, but don't panic. Take your time to read the experiment carefully and work out what's going on before attempting any questions to get full marks.



Conservation of Energy and Power

Warm-Up

Choose from the words on the left to fill in the blanks in the sentences on the right. You do not need to use all of the words.

total joules work done
energy lost minimum rate of watts

Power is the energy transfer or
..... It is measured in

- 1 An electric fan wastes some energy by transferring it to the thermal energy stores of its surroundings. Describe what is meant by 'wasted energy'.

Grade
4-6

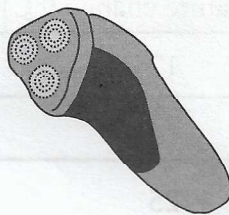
.....
.....
.....

[Total 1 mark]

- 2 Figure 1 shows a rechargeable battery-powered shaver. The shaver transfers some energy to useful energy stores and wastes some energy.

Grade
4-6

Figure 1



- 2.1 Which statements about energy are false? Tick **two** boxes.

Energy can be transferred usefully. ☐

Energy can be created. ☐

Energy can be stored. ☐

Energy can be dissipated. ☐

Energy can be destroyed. ☐

[1]

- 2.2 Give **one** example of a useful energy store and **one** of a wasted energy store that the shaver transfers energy to.

Useful energy store:

Wasted energy store:

[2]

- 2.3 Describe what effect increasing the power of the shaver would have on the shaver's battery life.

.....
.....

[1]

[Total 4 marks]

- 3 A student is investigating the insulating properties of various materials. He surrounds a beaker of water with each material, before heating the water using an electric immersion heater with a constant power of 35 W.



- 3.1 Write down the equation that links power, work done and time.

[1]

- 3.2 Calculate the work done by the immersion heater when it is operated for 600 s.

Work done = ... J
[2]

- 3.3 Whilst investigating the insulating properties of cotton wool, the student forgets to measure the time that he leaves the immersion heater on for. Calculate the time that the heater was on for, if it transferred 16 800 J of energy to the system.

Time = ... s
[2]

[Total 5 marks]

- 4 A car contains a worn out engine with a power of 32 000 W. The car takes 9.0 s to accelerate from rest to 15 m/s. A mechanic replaces the engine with a more powerful but otherwise identical one. The new engine has a power of 62 000 W.



- 4.1 Explain how the new engine will affect the time it takes for the car to accelerate from rest to 15 m/s.

[3]

- 4.2 Calculate how long it will take for the car to accelerate to 15 m/s now. You can assume that the total amount of energy wasted whilst the car is accelerating is the same for both engines.

Time = ... s
[4]

[Total 7 marks]

Exam Practice Tip

For really big powers, you might see the unit kW, which stands for kilowatt. Don't let this put you off though, you just need to remember that $1000 \text{ W} = 1 \text{ kW}$. You might see this in a few other units too, for example $1000 \text{ m} = 1 \text{ km}$.



Conduction and Convection

- 1 Use words from the box below to complete the passage. You can only use each word **once** and you do not need to use all of the words.

Grade
4-6

solids density liquids volume gases hotter cooler

Convection occurs in and

It is where a change in causes particles to move from to regions.

[Total 3 marks]

- 2 A student uses the apparatus in **Figure 1** to investigate conduction. She heats blocks of different materials, shown in **Figure 2**, and uses a stopwatch to measure the time it takes for the upper surface of the block to increase in temperature by 2°C .

Grade
6-7

Figure 1

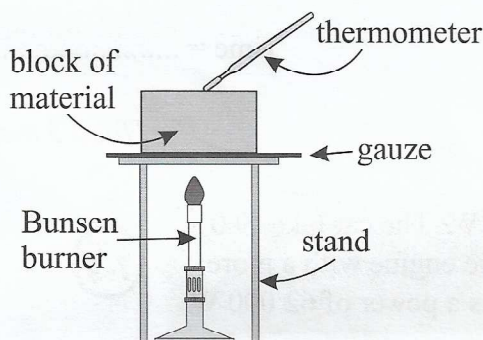
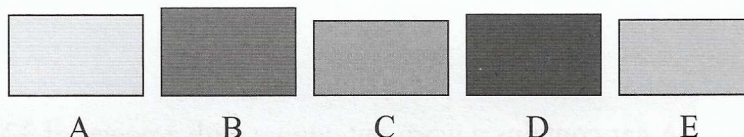


Figure 2



- 2.1 Suggest **one** way to improve the student's experiment.

[1]

- 2.2 Describe, in terms of particles, the energy transfers that take place within a block as it is heated.

[3]

Table 1

Block	A	B	C	D	E
Time taken (s)	83	37	74	97	86

- 2.3 **Table 1** shows the student's results.

Suggest a conclusion you can make about block B, compared to the other blocks.

[1]

[Total 5 marks]



Reducing Unwanted Energy Transfers

Warm-Up

Which of the following options would reduce the air resistance acting on a cyclist?
Circle **one** box.

Wearing clothes that
are more thermally
insulating

Lubricating the
bicycle's wheels

Changing the colour
of his clothes

Wearing a more
streamlined helmet

- 1 Which of the following statements are true? Tick **two** boxes.

Grade
4-6

The thickness of a house's walls does not affect the rate at which it loses energy. ☐

Thicker walls decrease the rate of energy lost from a house. ☐

Thicker walls increase the rate of energy lost from a house. ☐

Bricks with a higher thermal conductivity transfer energy at a faster rate. ☐

[Total 1 mark]

- 2 **Figure 1** shows a thermal image of a house. Different parts of the outside of the house are at different temperatures. The owner wants to keep the inside of the house as warm as possible.

Grade
4-6

Figure 1



- 2.1 Suggest where the highest rate of unwanted energy transfer occurs in the house.

..... [1]

- 2.2 Suggest **one** way to reduce this unwanted energy transfer.

..... [1]

- 2.3 A second house is tested and it is found that the majority of its unwanted energy transfers occur around the doors and windows. Suggest **two** ways to reduce these energy transfers.

1.

2.

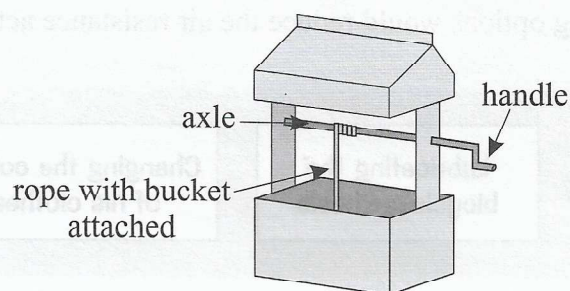
[2]

[Total 4 marks]

- 3 **Figure 2** shows an old-fashioned well. The handle is turned, which rotates the axle. This causes the rope attached to the bucket to wrap around the axle, raising the bucket from the well.



Figure 2



A student measures the time taken to raise a bucket of water from the well. After lubricating the axle of the well, the student repeats the test and finds the time taken is shorter. Explain why.

.....

.....

.....

.....

.....

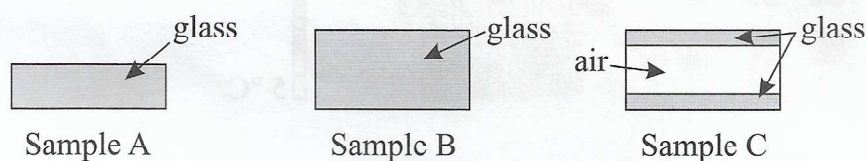
[Total 3 marks]

PRACTICAL

- 4 A student investigates which type of window is the best at reducing unwanted energy transfers. The student places different samples of windows on a hot plate and measures how long it takes for the top surface of the window sample to reach 30 °C.



Figure 3



Thermal conductivity
 glass = 0.2 W/mK
 air = 0.03 W/mK

Figure 3 shows the cross-sections of each window sample. Rank them from best to worst for reducing unwanted energy transfers from a house and explain your choices.

Best: Second best: Worst:

.....

.....

.....

.....

.....

.....

[Total 5 marks]



Efficiency

- 1 20 kJ of energy is transferred to a mobile phone battery to fully charge it once it has lost all charge. It transfers 16 kJ of useful energy during use until it needs to be recharged.



- 1.1 Write down the equation that links efficiency, total input energy transfer and useful output energy transfer.

[1]

- 1.2 Calculate the efficiency of the battery.

Efficiency = ... [2]

[Total 3 marks]

- 2 An electric motor has a useful power output of 57 W and an efficiency of 75%. Calculate the total power input for the motor. Use an equation from the Equations List.

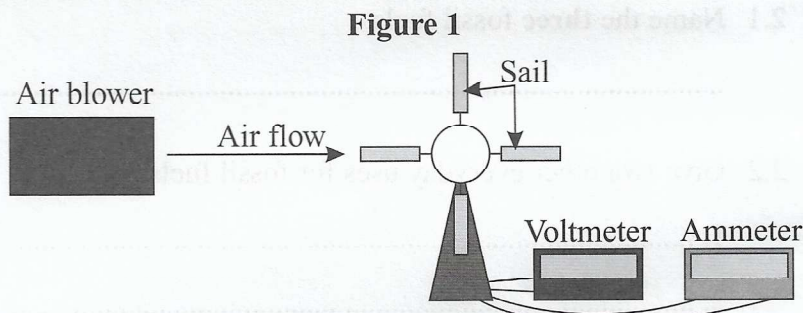


Input power = ... W [Total 3 marks]

- 3 A student investigates the efficiency of a scale model of an electricity generating wind turbine using the equipment in **Figure 1**.



The student changes the number of sails on the turbine and measures the power output from the turbine's generator. The air blower is supplied with 533 W and has an efficiency of 0.62.



- 3.1 When using two sails, the efficiency of the turbine was 13%. Calculate the power generated. Give your answer to 2 significant figures.

Output power = ... W [4]

- 3.2 Suggest **two** ways the student could increase the efficiency of the turbine.

1.
2.

[2]

[Total 6 marks]

