Power and Efficiency

1. A vehicle has an input power from fuel of 20 kW and a useful output power of 6 kW.

Calculate the power it wastes.

A 3 kW
B 6 kW
C 14 kW
D 20 kW

Your answer [1]

2. Which wall would allow the **most** heat transfer through the wall?

A. **Thick** wall made from a material with **high** thermal conductivity.
B. **Thick** wall made from a material with **low** thermal conductivity.
C. **Thin** wall made from a material with **high** thermal conductivity.
D. **Thin** wall made from a material with **low** thermal conductivity.

Your answer [1]

3. A radio transfers 30 J of potential energy to 27J of useful energy.

What is the efficiency and energy loss for the radio?

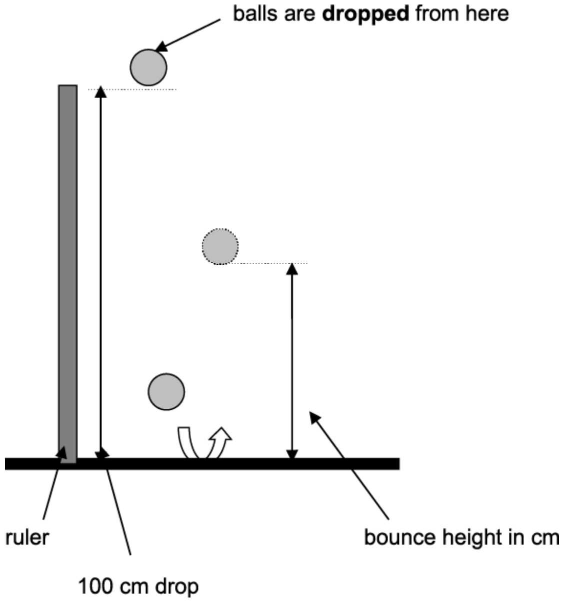
	Efficiency	**Energy loss**
A	10%	3J
B	10%	27J
C	90%	3J
D	90%	27J

Your answer [1]

4 (a). Kate investigates how well different balls bounce.

She drops different balls from the same height and measures the height the balls bounce.

She repeats the experiment 3 times for each ball.



Her results are shown in the table.

Ball	Drop height (cm)	1st reading bounce height (cm)	2nd reading bounce height (cm)	3rd reading bounce height (cm)	Mean bounce height (cm)
Red	100	75	77	73	75
Blue	100	61	62	60	61
Green	100	60	31	58	
White	100	84	86	85	85
Yellow	100	26	24		26

Calculate the **mean** bounce height for the **green** ball.

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[1]

answer:………………… cm

(b). Kate missed one result for the **yellow** ball.

Calculate the **missing** result for the **yellow** ball.

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answer: ………………………… cm **[1]**

(c). Evaluate the reliability of the results

Suggest how she could have improved her experiment.

--- **[3]**

(d).

i. Kate suggests that 15% of the ball's initial energy was not transferred usefully. Use calculations to show that this is correct and suggest where the energy was transferred to.

--- **[2]**

ii. How could the efficiency of the ball be improved?

--- **[1]**

5(a). Look at the information about different electric motors.

Electric motor	**Energy input per hour (J)**	**Useful energy output per hour (J)**	**Energy 'wasted' per hour (J)**
A	72 000	60 000	
B	54 000	36 000	
C	18 000		3 000
D		48 000	12 000
E	54 000	48 000	

Calculate the % efficiency of electric motor **E**.

Use the equation: Efficiency = Useful output energy transfer / Input energy transfer

Give your answer to **2** significant figures.

Answer = -------------------------- % **[2]**

(b).

i. Calculate the energy input per hour in J for electric motor **D**.

Answer = -------------------------- J **[2]**

ii. Which electric motor has the **lowest** 'wasted' energy in one hour?

____ **[1]**

iii. Which electric motor has the **highest** 'wasted' energy in one hour?

____ **[1]**

iv. Describe how energy is 'wasted' in an electric motor.

____

____ **[1]**

v. Suggest how this 'wasted' energy can be reduced in an electric motor.

____

____ **[1]**

6. A domestic wind turbine has a power rating which varies from 1.0 kW to 3.0 kW.

i. The domestic wind turbine has an electrical resistance of 23 Ω.

It generates a current of 11 A on a windy day.

Calculate the **power** output in kW of the turbine on this day.

Answer = ________________________ kW **[4]**

ii. Suggest why the manufacturer gives a range for the power rating of the wind turbine.

____

____ **[1]**

iii. Using just **one** domestic wind turbine may be an unreliable source of power for a house.

State a reason why.

____

____ **[1]**

7. A boiler has an input energy of 720 kJ from the gas it burns.

It transfers 540 kJ of useful energy to the home.

What is the efficiency of the boiler?

Use the equation: efficiency = useful output energy transfer ÷ total input energy transfer

A 0.12

B 0.75

C 0.90

D 1.33

Your answer **[1]**

8(a). A student investigates how the thickness of insulation affects the cooling of a cup of tea.

Fig. 16.1 is a diagram of her apparatus.

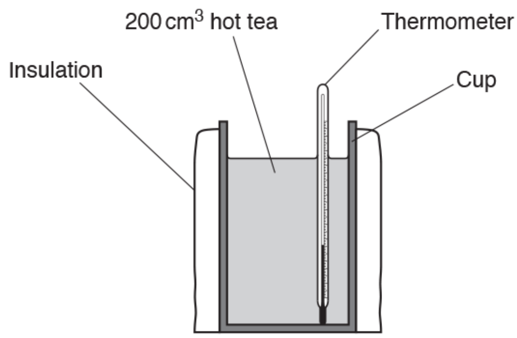


Fig. 16.1

The student wraps a layer of insulation around a cup containing 200 cm^3 of hot tea.

She measures the temperature of the tea at the start of the experiment and after 10 minutes.

She repeats the experiment with different thicknesses of the insulation.

Table 16.1 shows her results.

Thickness of the insulation (mm)	Temperature of tea (°C)		
	Start	End	Difference
2	90	65	25
4	88	66	22
6	91	72	19
8	89	73	16
10	98	84	14
12	100	60	

Table 16.1

i. Calculate the temperature difference when the thickness of insulation is 12 mm.

Temperature difference = ... °C **[1]**

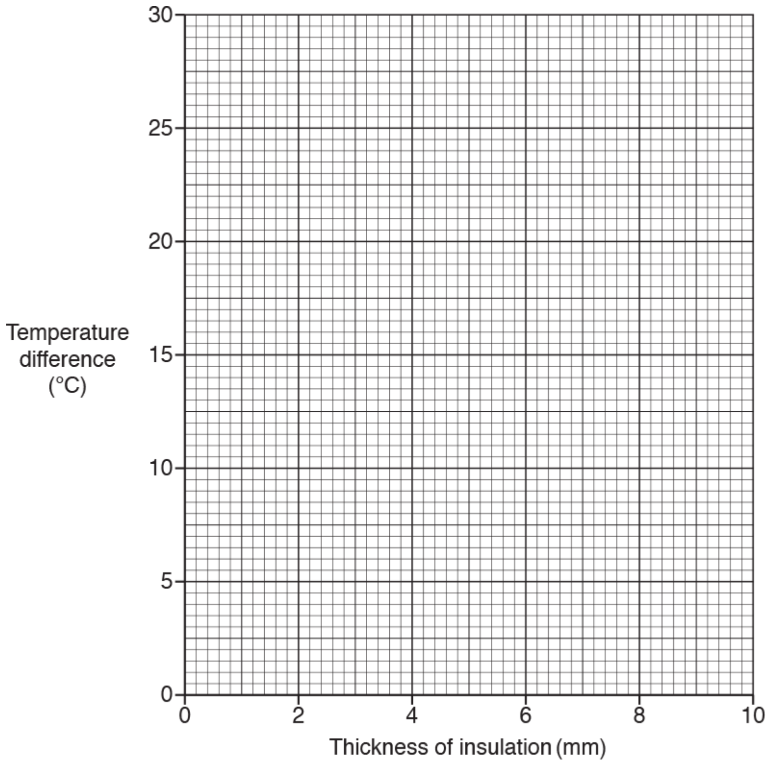
ii. The result when the thickness of the insulation is 12 mm is anomalous.

Suggest a reason why this result appears to be anomalous.

---**[1]**

(b). Plot a graph of the results in **Table 16.1** and draw a line of best fit.

Ignore the anomalous result for 12 mm.



[2]

(c). Describe how the temperature difference is affected as the thickness of the insulation increases.

---**[1]**

(d). Suggest how the thickness of the insulation affects the rate of cooling of the tea.

---**[1]**

(e). This experiment could be improved.

Describe two **different** ways of improving the experiment.

1 ____

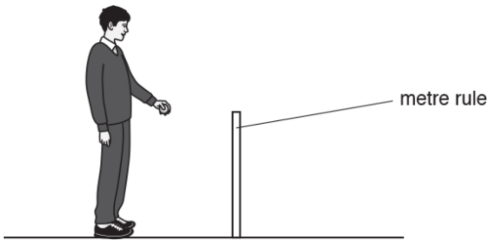
____

2 ____

____ **[2]**

9 (a). A student wants to investigate how a ball bounces.

He drops the ball from different heights and measures the bounce height each time.



He calculates the ratio bounce height / drop height.

The table shows his results.

Drop height (cm)	Bounce height (cm)	Bounce height / drop height
100	70	0.70
80	64	0.80
60	54	0.90
40	40	1.00
20		

The student predicts the ratio bounce height / drop height to be 1:1 when the drop height is 20 cm.

i. Suggest why he has made this prediction.

____

____ **[1]**

ii. Use ideas about energy to explain why this prediction cannot be correct.

____

____ **[1]**

(b). Suggest **two** improvements to his experiment.

1 ____

____

____

2 ____

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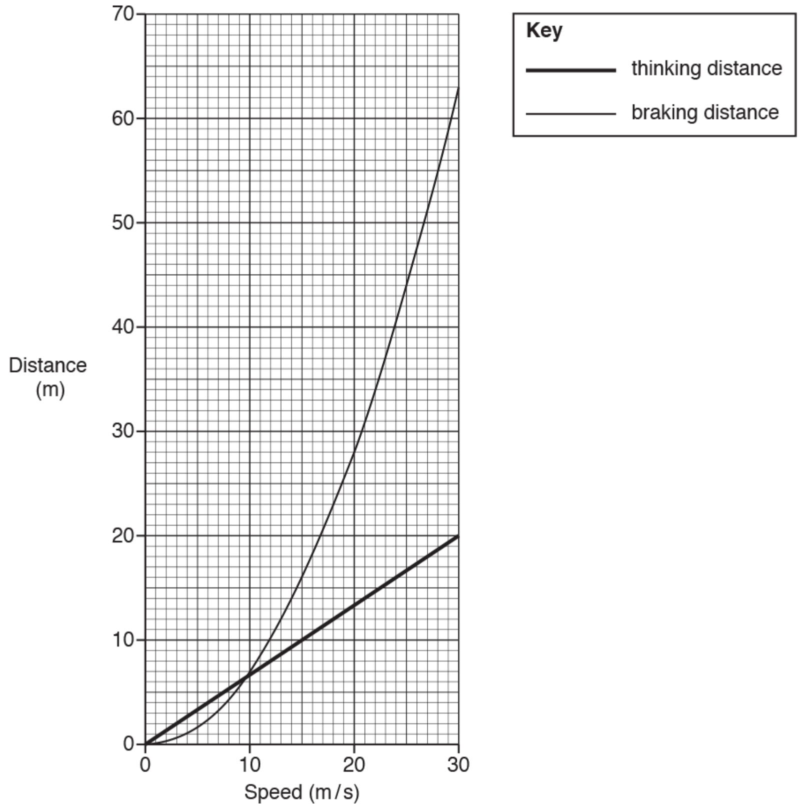
____ **[2]**

10. The graph shows thinking and braking distances for a car at different speeds.



Describe how **thinking distance** varies with increasing speed.

Use data from the graph in your answer.

____

____

____

____ **[2]**

11 (a). A student investigates the rate of cooling using a cardboard box to model the walls of a building.

She puts a beaker of hot water into the cardboard box. She measures the temperature of the water every two minutes.

She investigates how the rate of cooling changes with the thickness of the walls.

Here are the results of one of her experiments.

Time (minutes)	Temperature of water (°C)
0	90
2	75
4	63
6	54
8	47
10	41
12	37

i. Plot the results on the grid in **Fig. 22.1**.

Two of the points have been plotted for you.

[2]

ii. Draw a line of best fit on your graph.

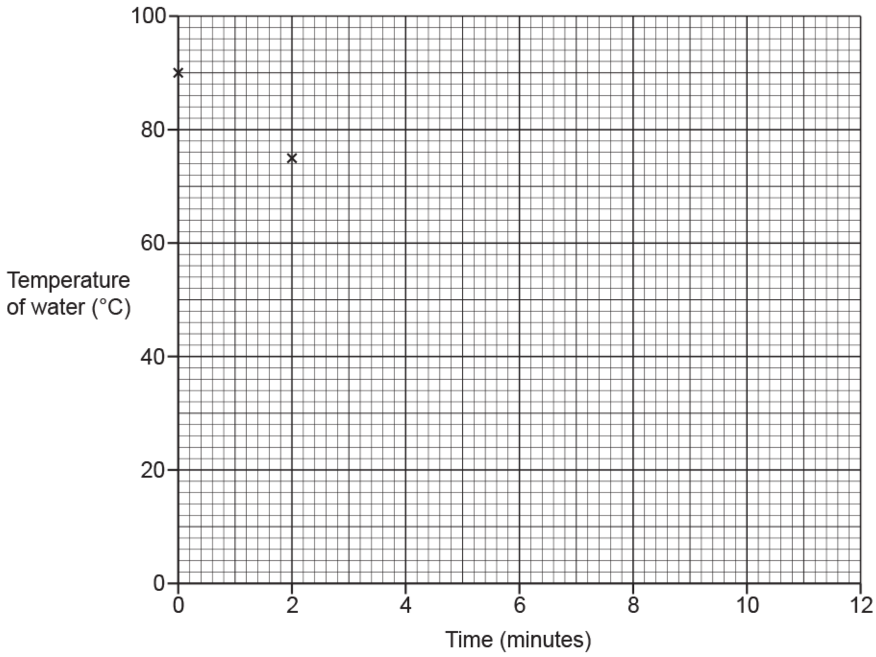


Fig. 22.1

[1]

iii. Describe how the temperature of the water changes with time.
Use data from the graph in **Fig. 22.1** in your answer.

____

____

____ **[2]**

iv. The thickness of the cardboard box is doubled. Everything else stays the same.

Sketch a line on the graph in **Fig. 22.1** to suggest what these new results may look like.
Label your line **Z**.

[1]

v. Suggest **one** way to improve the investigation.

____

____ **[1]**

(b). Explain why the rate of cooling of a metal box is different to a cardboard box.
Assume the thickness of the walls is the same in both boxes.

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____ **[1]**

(c). Describe a method she can use to do this investigation.

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____

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____ **[3]**

END OF QUESTION PAPER