3.16 Energy Stores, Transfers and Calculations: Test Pack

Total Marks

AQA 8464 · Calculator allowed · about 25 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A ball is thrown vertically upwards from a person's hand. It rises, reaches a highest point, and falls back down. Air resistance is negligible.

(a) State what happens to the size of the kinetic energy store of the ball as it rises from the person's hand to its highest point. **(1)**

(b) State what happens to the size of the gravitational potential energy store of the ball over the same rise. **(1)**

(c) State which energy store is at its maximum value when the ball is at its highest point. **(1)**

(Total for Question 1 is 3 marks)

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2 An electric kettle transfers 138000 J of energy to the water inside it in 60 s. power = energy transferred / time

(a) Calculate the power of the kettle. **(2)**

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(Total for Question 2 is 2 marks)

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3 Evaluate a method that could be used to determine the specific heat capacity of a liquid, such as water, in a school laboratory. In your answer you should refer to: the equipment and measurements needed, how energy losses to the surroundings could be reduced, and how the specific heat capacity would be calculated from the results.

(Total for Question 3 is 6 marks)

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4 The specific heat capacity of water is 4200 J/kg °C, aluminium is 897 J/kg °C, copper is 385 J/kg °C, and lead is 130 J/kg °C. change in thermal energy = mass * specific heat capacity * temperature change

(a) A 2 kg block of copper is supplied with 10000 J of energy. Calculate the temperature rise of the copper block. **(2)**

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(b) A 2 kg block of lead is supplied with the same amount of energy (10000 J). Without calculating, state and explain which block, copper or lead, has the greater temperature rise. **(1)**

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(Total for Question 4 is 3 marks)

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5 Two identical-sized balls, A and B, are dropped from the same height above the ground at the same time. Ball A is made of solid rubber. Ball B is made of solid steel, which is denser than rubber, so ball B has a greater mass than ball A. Air resistance is negligible for both balls.

(a) State which ball, A or B, has the greater kinetic energy store just before it reaches the ground, and explain your answer. **(3)**

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(Total for Question 5 is 3 marks)

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Mark scheme · 3.16 Energy Stores, Transfers and Calculations: Test Pack

Question 1

(a) decreases (to zero at the highest point) **B1**

(a) Answer: Decreases

(b) increases (to a maximum at the highest point) **B1**

(b) Answer: Increases

(c) gravitational potential (energy store) **B1**

(c) Answer: Gravitational potential energy store

Question 2

(a) 138000 / 60 (correct substitution) **M1**

(a) 2300 W cao **A1**

(a) Answer: 2300 W

Question 3

Level 3 A detailed, logically sequenced method is described, covering the equipment and measurements needed, at least one way of reducing energy losses to the surroundings, and correct use of the equation to calculate specific heat capacity. Reliability (e.g. repeats) is also considered. **5-6**

Level 2 Most of the required equipment and measurements are described, with some reference to reducing energy losses or improving reliability, but the method is not fully detailed or has gaps. **3-4**

Level 1 One or more isolated relevant points are made about the equipment or method, with little or no linkage or detail. **1-2**

Level 0 No relevant content. **0**

Indicative content:

- Use a known mass of the liquid (measured with a balance) in an insulated container, e.g. a calorimeter or polystyrene cup.
- Use an electrical heater (immersion heater) connected to a joulemeter, or an ammeter, voltmeter and timer, to supply and measure the energy transferred to the liquid.
- Use a thermometer or temperature probe to record the initial temperature and the final temperature of the liquid.
- Insulate the container, for example with a lid and lagging, to reduce energy transferred to the surroundings, which would otherwise make the calculated specific heat capacity too high.
- Stir the liquid regularly so the temperature is evenly distributed and the thermometer reading is representative.
- Use the equation change in thermal energy = mass * specific heat capacity * temperature change, rearranged to specific heat capacity = energy transferred / (mass * temperature change).
- Repeat the experiment, for example three times, and calculate a mean value for the specific heat capacity to improve reliability and help identify anomalous results.
- Compare the calculated value with the accepted (data book) value to assess the accuracy of the method.
- Recognise limitations, such as some energy being used to heat the container or thermometer itself, or energy lost before the heater is switched off, and suggest improvements, e.g. better insulation or a container with a lower heat capacity.

Question 4

(a) 10000 / (2 * 385) (correct substitution) **M1**

(a) 13.0°C (awrt 13) cao **A1**

(a) Answer: 13.0°C (awrt 13)

(b) lead, because it has a lower specific heat capacity than copper, so for the same mass and energy input its temperature rises by more, oe **B1**

(b) Answer: Lead, because it has a lower specific heat capacity, so the same energy input causes a bigger temperature rise.

Question 5

(a) ball B (the steel ball) **B1**

(a) ball B has the greater mass, so it starts with a greater gravitational potential energy store at the same height (gravitational potential energy = mass * g * height) **B1**

(a) as air resistance is negligible, nearly all of this gravitational potential energy is transferred to the kinetic energy store as it falls, so ball B has the greater kinetic energy **B1**

(a) Answer: Ball B (steel), because its greater mass gives it a greater initial gravitational potential energy store, nearly all of which transfers to kinetic energy since air resistance is negligible.

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