3.17 Efficiency, Power and Energy Resources: Test Pack

AQA 8464 · Calculator allowed · about 25 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Efficiency is an important idea in physics whenever energy is transferred from one store to another.

(a) State what is meant by the efficiency of a device. **(1)**

(b) Give one reason why no device can be 100% efficient. **(1)**

(Total for Question 1 is 2 marks)

2 Many countries, including the UK, are trying to change the mix of resources used to generate electricity.

(a) State three reasons why many countries, including the UK, are trying to reduce the proportion of their electricity generated using fossil fuels (coal, oil and natural gas). **(3)**

(Total for Question 2 is 3 marks)

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3 Aaliyah investigates how the thickness of an insulating material affects the rate of cooling of hot water. She wraps identical metal cans, each containing 200 cm^3 of water starting at 80°C, in different thicknesses of the same insulating material, and records the temperature of the water in each can every 2 minutes for 10 minutes. With 1 cm of insulation, the water cools from 80°C to 60°C in 10 minutes.

(a) Identify: (i) the independent variable, (ii) the dependent variable, (iii) one variable that Aaliyah should control (keep the same) in this investigation. **(3)**

(b) Calculate the mean rate of temperature decrease, in °C per minute, for the can with 1 cm of insulation. **(2)**

.....

(c) Suggest one improvement Aaliyah could make to her method to increase the validity of her comparison between different thicknesses of insulation. **(2)**

(Total for Question 3 is 7 marks)

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4 An immersion heater has a power rating of 3 kW. It is switched on for 15 minutes and has an efficiency of 95%. power = energy transferred / time

(a) Calculate the total energy supplied to the heater. Give your answer in joules. **(2)**

.....

(b) Calculate the useful energy transferred to the water. **(2)**

.....

(c) Calculate the percentage of the total energy supplied that is wasted, and state the energy store to which most of this wasted energy is transferred. **(2)**

.....

(Total for Question 4 is 6 marks)

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Mark scheme · 3.17 Efficiency, Power and Energy Resources: Test Pack

Question 1

(a) the proportion (fraction or percentage) of the total energy input to a device that is transferred usefully, oe **B1**

(a) Answer: The proportion of the total input energy that is usefully transferred.

(b) some energy is always wasted (dissipated) to the surroundings, usually as heat or sound, due to a named cause such as friction or electrical resistance, oe **B1**

(b) Answer: Some energy is always wasted to the surroundings, for example as heat due to friction.

Question 2

(a) fossil fuels are non-renewable (finite) and will eventually run out, oe **B1**

(a) burning fossil fuels releases carbon dioxide, which contributes to global warming/climate change, oe **B1**

(a) burning fossil fuels can release other pollutants, e.g. sulfur dioxide or particulates, that cause acid rain/air pollution/harm health, oe (any three distinct reasons) **B1**

(a) Answer: Any three of: fossil fuels are finite and will run out; burning them releases carbon dioxide which causes global warming; burning them releases pollutants that cause acid rain or air pollution.

Question 3

(a) independent variable: the thickness of the insulating material **B1**

(a) dependent variable: the temperature of the water (after a fixed time)/rate of cooling **B1**

(a) control variable: any one of - volume/mass of water, starting temperature of water, type of insulating material, type/size of can, whether the can has a lid **B1**

(a) Answer: Independent: thickness of insulation. Dependent: temperature of the water. Control (any one): starting temperature of the water.

(b) (80 - 60) / 10 (correct method) **M1**

(b) 2°C/min cao, unit required **A1**

(b) Answer: 2°C per minute

(c) a suitable improvement, e.g. use a lid on each can, use a draught-free room, or use a data logger for continuous readings **B1**

(c) a linked reason, e.g. a lid reduces uncontrolled energy loss by evaporation/convection from the open top, so the comparison isolates the effect of the insulation thickness alone **B1**

(c) Answer: Use a lid on each can, so that energy loss from the open top of the can does not affect the comparison between different insulation thicknesses.

Question 4

(a) correct unit conversions and substitution: 3000 * (15 * 60) = 3000 * 900 **M1**

(a) 2700000 J cao, accept 2.7 * 10^6 J or 2.7 MJ **A1**

(a) Answer: 2700000 J (2.7 MJ)

(b) 0.95 * 2700000, ft their value from (a) **M1**

(b) 2565000 J cao, accept 2.565 MJ, ft from (a) **A1**

(b) Answer: 2565000 J (2.565 MJ)

(c) wasted energy = 2700000 - 2565000 = 135000 J, then (135000 / 2700000) * 100 **M1**

(c) 5% AND thermal energy store of the surroundings/casing of the heater (transferred by heating), both required **A1**

(c) Answer: 5% is wasted, mostly to the thermal energy store of the surroundings.

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