3.17 Efficiency, Power and Energy Resources: 30-minute Pack

Total Marks

AQA 8464 · Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 An electric fan heater transfers 540000 J of energy to a room in 6 minutes. power = energy transferred / time

(a) Calculate the power output of the heater, in watts. **(3)**

.....

(Total for Question 1 is 3 marks)

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2 An electric motor is supplied with 500 J of energy. It transfers 350 J of this energy usefully by doing work. The rest of the energy supplied is wasted. efficiency = useful output energy transfer / total input energy transfer

(a) Calculate the efficiency of the motor as a percentage. **(2)**

.....

(b) Calculate the energy wasted by the motor. **(1)**

.....

(c) State the main way in which the wasted energy from the motor is dissipated to the surroundings. **(1)**

(Total for Question 2 is 4 marks)

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3 Here are six energy resources used to generate electricity in the UK: coal, wind, natural gas, solar, nuclear, biofuel.

(a) State which three of these resources are non-renewable. **(2)**

(b) Describe the general trend in the mix of energy resources used to generate the UK's electricity since 1990. **(3)**

(Total for Question 3 is 5 marks)

4 Kwame investigates the effect of a lubricant on friction. He pulls a wooden block across a bench using a newtonmeter and records the maximum force needed to start the block moving. He then repeats the test after coating the underside of the block with a thin, even layer of oil.

(a) Identify one variable Kwame should keep the same to make this a fair test. **(1)**

(b) Explain, in terms of energy, why the reading on the newtonmeter is lower once the oil has been applied. **(2)**

(c) Kwame obtains the following maximum force readings, in newtons, for three repeats without oil: 6.2, 6.6, 6.0. Calculate the mean force. **(1)**

(d) Give one reason why taking repeat readings and calculating a mean improves the validity of Kwame's conclusion. **(1)**

(Total for Question 4 is 5 marks)

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5 Wind power stations and gas-fired power stations are both used to generate electricity in the UK.

(a) Compare the reliability of these two ways of generating electricity, and explain why gas-fired power stations are often used to provide 'back-up' generation. **(4)**

(Total for Question 5 is 4 marks)

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6 Evaluate the extent to which the UK should generate more of its electricity from renewable resources rather than non-renewable resources. In your answer, consider environmental impact, reliability of supply and the finite nature of fossil fuels.

(Total for Question 6 is 6 marks)

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Mark scheme · 3.17 Efficiency, Power and Energy Resources: 30-minute Pack

Question 1

(a) converts time to seconds: 6 * 60 = 360 s **M1**

(a) 540000 / 360 (correct substitution) **M1**

(a) 1500 W cao **A1**

(a) Answer: 1500 W

Question 2

(a) 350 / 500 (correct substitution) **M1**

(a) 70% cao **A1**

(a) Answer: 70%

(b) 150 J (500 - 350), ft from total minus useful **B1**

(b) Answer: 150 J

(c) as heat (thermal energy), mainly due to friction in the motor's bearings/moving parts (accept sound as an additional minor pathway) **B1**

(c) Answer: Mostly as heat, transferred to the thermal energy store of the surroundings, due to friction in the motor.

Question 3

(a) any one of coal, natural gas, nuclear correctly identified **B1**

(a) all three of coal, natural gas and nuclear identified, with no renewable resource incorrectly included **B1**

(a) Answer: Coal, natural gas and nuclear.

(b) the proportion of electricity generated from fossil fuels, especially coal, has decreased significantly, oe **B1**

(b) the proportion of electricity generated from renewable resources, e.g. wind and solar, has increased, oe **B1**

(b) this trend is linked to targets to reduce carbon dioxide emissions/reach net zero emissions by 2050, oe **B1**

(b) Answer: Since 1990 the UK has used much less coal and other fossil fuels and much more renewable energy, especially wind and solar, to generate electricity, partly to meet targets to cut carbon dioxide emissions.

Question 4

(a) any one of - the mass of the block, the surface material of the bench, the area of the block in contact with the bench, the speed at which the block is pulled **B1**

(a) Answer: For example, the mass of the block.

(b) the layer of oil separates the two solid surfaces, reducing the friction between them, oe **B1**

(b) less energy is transferred (wasted) to the thermal energy store of the surroundings by heating, so less force is needed to overcome friction and start the block moving, oe **B1**

(b) Answer: The oil reduces friction between the block and the bench, so less energy is wasted as heat and less force is needed to move the block.

(c) 6.27 N, accept awrt 6.3 N **B1**

(c) Answer: 6.27 N (or 6.3 N to 2 sf)

(d) it reduces the effect of random error/anomalous readings, giving a more accurate and reliable value to compare with the 'with oil' result, oe **B1**

(d) Answer: It reduces the effect of random error, giving a more reliable value to use in the comparison.

Question 5

(a) the output of a wind power station depends on wind speed, so it is intermittent/cannot be guaranteed at all times, oe **B1**

(a) a gas-fired power station can generate electricity on demand, whenever it is needed, regardless of the weather, oe **B1**

(a) this makes gas-fired generation more reliable in the short term than wind, oe (comparative statement) **B1**

(a) gas-fired power stations can be used to 'fill the gap' and quickly meet demand when renewable output is low, e.g. on a still day, oe (any four distinct points) **B1**

(a) Answer: Wind power is intermittent (it depends on wind speed) so is less reliable than gas, which can generate electricity on demand whenever needed; gas stations are therefore used as reliable back-up when wind output is low.

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Question 6

Level 3 A balanced and detailed discussion of renewable and non-renewable resources is given, with points that are logically linked. A clear, justified conclusion is reached that is well supported by the evidence discussed throughout the answer.	**5-6**
Level 2 Relevant points for and/or against increased use of renewable resources are given, with some linkage between ideas. A judgement may be attempted but is only partly supported by the argument given.	**3-4**
Level 1 Basic, isolated statements are made about renewable and/or non-renewable resources, with little or no linkage between ideas. The answer only partially addresses the question.	**1-2**
Level 0 No relevant content.	**0**

Indicative content:

- Renewable resources (e.g. wind, solar, tidal, hydroelectric) do not release carbon dioxide when generating electricity, so contribute less to global warming/climate change than fossil fuels.
- Renewable resources will not run out, whereas fossil fuels are finite (non-renewable) and will eventually run out.
- Many renewable resources are intermittent/unreliable, e.g. wind and solar output depends on the weather, so cannot always meet demand on their own.
- Non-renewable resources such as gas and coal can generate electricity on demand, reliably, regardless of weather or time of day.
- Burning fossil fuels releases carbon dioxide and other pollutants, e.g. sulfur dioxide causing acid rain, harming the environment and human health.
- Nuclear power (a non-renewable fuel) gives reliable, low-carbon electricity, but produces radioactive waste and has high build/decommissioning costs.
- Some renewable resources have high set-up costs, require specific locations, or can damage local habitats, e.g. hydroelectric dams or tidal barrages.
- A mixed approach, increasing renewables while retaining some reliable back-up (e.g. gas or nuclear) and/or investing in energy storage, may be needed to balance reliability with reducing emissions.
- A justified conclusion, either way, that is clearly supported by the points made.

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