# 3.1 Energy: 30-minute Pack

AQA 8463 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

**Answer ALL questions. Show all your working.**

**1** State the principle of conservation of energy in one sentence.

**(a)** Write the conservation of energy principle. **(2)**

**(Total for Question 1 is 2 marks)**

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**2** Calculate the increase in gravitational potential energy when a 2.0 kg box is lifted 3.0 m. Use g = 10 N/kg and show your working.

**(a)** Calculate using E = m x g x h. **(2)**

.....

**(Total for Question 2 is 2 marks)**

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**3** Compare the use of one renewable energy resource and one non-renewable energy resource for generating electricity. In your answer include advantages and disadvantages of each.

**(Total for Question 3 is 6 marks)**


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**4** No device transfers all of its input energy usefully.

**(a)** Write down the equation used to calculate the efficiency of a device (as a decimal or a percentage). **(1)**

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**(b)** An electric motor is supplied with 500 J of energy. Of this, 150 J is wasted as thermal energy and sound. Calculate the efficiency of the motor. Give your answer as a percentage. **(3)**

.....

**(Total for Question 4 is 4 marks)**


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**5** A car slows down and comes to rest. Describe where the kinetic energy of the car goes. Give two places the energy goes and one short explanation.

**(a)** Name two stores or forms where the kinetic energy is transferred. **(2)**

**(b)** Give a short explanation why temperature of brakes increases. **(1)**

**(Total for Question 5 is 3 marks)**

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**6** Extended response 6-mark question.

A person boils 1.0 kg of water in a kettle. Describe and explain all the main energy transfers that happen from the moment the kettle is switched on until the water is boiling. Include where energy is stored, how energy is transferred, and why not all the electrical energy becomes thermal energy in the water.

**(Total for Question 6 is 6 marks)**


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# Mark scheme · 3.1 Energy: 30-minute Pack

## Question 1

(a) energy cannot be created or destroyed **B1**

(a) energy can be transferred from one store to another but the total energy is conserved, oe **B1**

**(a) Answer: Energy cannot be created or destroyed; it is transferred between stores so the total energy remains the same.**

## Question 2

(a) substitutes values into E = m x g x h: E = 2.0 x 10 x 3.0 **M1**

(a) 60 J cao **A1**

**(a) Answer: 60 J**

## Question 3

**Level 3** A detailed comparison of a named renewable and a named non-renewable resource, giving advantages AND disadvantages of both and making clear comparative points. Logically structured. **5-6**

**Level 2** Advantages and disadvantages of both resources are given with some comparison, or one resource is covered in detail. Mostly accurate. **3-4**

**Level 1** One or more isolated relevant advantages or disadvantages, with little or no comparison. **1-2**

**Level 0** No relevant content. **0**

**Indicative content:**

- Renewable (e.g. wind, solar, hydroelectric): will not run out.
- Renewable: no carbon dioxide released during generation, so does not add to climate change during use.
- Renewable disadvantage: output can be unreliable / depends on weather or time of day (wind, solar).
- Renewable disadvantage: high initial set-up cost; visual or noise impact; may need large areas of land.
- Non-renewable (fossil fuels: coal, oil, gas): reliable and can meet demand at any time.
- Non-renewable: relatively high power output; established technology.
- Non-renewable disadvantage: finite, so will run out.
- Non-renewable disadvantage: burning releases carbon dioxide (greenhouse gas) causing climate change; may cause acid rain.
- Nuclear (non-renewable) alternative: no $CO_2$ in generation but produces radioactive waste.
- A comparative judgement, e.g. renewables are cleaner but less reliable; fossil fuels are reliable but polluting and finite.

## Question 4

(a) efficiency = useful output energy transfer / total input energy transfer (allow the power version) **B1**

**(a) Answer: efficiency = useful output energy transfer / total input energy transfer**

(b) useful output = 500 - 150 = 350 J **M1**

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

(b) 0.7, so 70% **A1**

**(b) Answer: 70%**

## Question 5

(a) thermal energy of the brakes/tyres/road (heat) or thermal store of surrounding air **B1**

(a) sound energy (noise) or energy in deformation if parts bend, oe **B1**

**(a) Answer: Thermal energy in the brakes and sound energy.**

(b) friction between brake parts converts kinetic energy into thermal energy, causing temperature to rise, oe **B1**

**(b) Answer: Friction converts the car's kinetic energy into thermal energy in the brakes so their temperature rises.**

## Question 6

**Level 3** Detailed description and explanation of the energy transfers, including identification of stores, correct sequence of transfers, and evaluation of energy losses. Uses scientific terms and links causes and effects. **5-6**

**Level 2** Clear description of the main energy transfers and some explanation of losses. Some scientific terms used but with limited linking of causes and effects. **3-4**

**Level 1** Simple statements about energy transfers, e.g. electricity to thermal, with little or no explanation of losses or stores. **1-2**

**Indicative content:**

- Electrical energy supplied to the kettle from the mains when switched on.
- Energy transferred to the heating element then to the water by heating (conduction through the kettle base and convection in the water).
- Thermal energy store of the water increases as temperature rises.
- Some energy is transferred to the kettle metal and the air (waste heat) by conduction and convection; some energy is emitted as sound or light (small amount).
- Not all electrical energy becomes thermal energy in the water because of energy lost to the surroundings and heating the kettle itself; efficiency is less than 100%.
- Reference to the idea that the hotter water has more energy in its thermal store and that the energy transfer continues until boiling point is reached.


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