Exercise walk-through

1.7
National and global energy resources (4.1.3)

AQA · GCSE · Physics

Specific heat capacity

- When a substance is heated, the energy in its thermal store increases and its temperature rises:
- ΔE is the change in thermal energy in J, m the mass in kg and $\Delta\theta$ the temperature change in °C.
- The **specific heat capacity** c is the energy needed to raise the temperature of 1 kg of a substance by 1 °C, in J/kg °C.
- This equation is on the equations sheet.

$$\Delta E = m\,c\,\Delta\theta$$

Power

- **Power** is the rate at which energy is transferred, or the rate at which work is done.
- A more **powerful** motor lifts the same load through the same height in less time.
- P is **power** in watts, E energy transferred in J, W the **work done** in J and t the time in s.
- A transfer of 1 J per second is a power of 1 **watt** (W).

$$P = \frac{E}{t} \qquad P = \frac{W}{t}$$

National and global energy resources

- The main energy resources are **fossil fuels** (coal, oil and gas), **nuclear fuel**, bio-fuel, wind, hydroelectricity, geothermal, the tides, the Sun and water waves.
- We use them for transport, electricity generation and **heating**.
- A **renewable** resource is one that is being, or can be, replaced as it is used.
- **Fossil fuels** and **nuclear fuel** are **non-renewable**: they will run out.

Exercises 2.1·2.3

2.1 State what is meant by a renewable energy resource. [1]

renewable resource

2.2 Sort these into renewable and non-renewable: wind, coal, nuclear fuel, tides, natural gas, bio-fuel. [2]

wind | coal | nuclear fuel | tides | natural gas | bio-fuel

2.3 Give one energy resource whose output does not change with the weather, and one whose output does. [2]

output vs weather

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2.1 State what is meant by a renewable energy resource. [1]

renewable resource

2.1 A resource that is replenished as it is used.

2.2 Sort these into renewable and non-renewable: wind, coal, nuclear fuel, tides, natural gas, bio-fuel. [2]

wind | coal | nuclear fuel | tides | natural gas | bio-fuel

2.2 Renewable: wind, tides, bio-fuel. Non-renewable: coal, nuclear fuel, natural gas.

2.3 Give one energy resource whose output does not change with the weather, and one whose output does. [2]

output vs weather

2.3 Weather-independent: nuclear / fossil-fuel / hydroelectric / geothermal / tidal (any one, B1). Weather-dependent: wind / solar.

Exercise 3.1

3.1 The UK generated electricity in 2018 using a mix of resources. Transport and electricity generation released the largest amounts of carbon dioxide.

Explain **one** change that would reduce carbon dioxide released by transport, and **one** change that would reduce carbon dioxide released by generating electricity. [4]

transport

electricity generation

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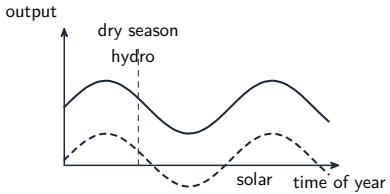
3.1 Transport: use electric vehicles instead of petrol/diesel – charged from electricity generated without fossil fuels, so less CO_2 from engines. Electricity generation: replace coal/gas power stations with renewable generation or nuclear – those release no CO_2 while running, so the same demand is met with fewer fossil-fuel emissions. (Cycling/public transport/walking also credit in the first pair; reducing demand for appliances also credits in the second.)

Setup for exercise 3.2

3.2 A remote village uses a hydroelectric generator. A graph of its power output across a year shows deep dips in the dry season. Solar panels are added.

(a) Explain why adding solar panels improves the reliability of the village's electricity supply. Use the pattern of the two outputs in your answer. [2]

(b) Give one reason, other than reliability, why the village might prefer hydroelectric to solar power. [1]



3.3 A tidal barrage and a nuclear power station are both proposed to supply 1.6 GW to a coastal city.

(a) Compare the two proposals for reliability of supply. [2]

tidal barrage | nuclear power station | 1.6 GW

(b) Compare the two proposals for environmental impact. [4]

Exercise 3.2

(c) The planning decision is delayed for years even though the physics of both is well understood. Explain why the decision is not a scientific one. [2]

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3.2 (a) Hydro dips in the dry season while solar output peaks in the same sunny months; the two resources fail at different times, so a supply gap in one is covered by the other and the combined output varies less. (b) Any one: hydro generates at night and on dull days; solar panels need large roof/land area; hydro's cost per unit can be lower at village scale; hydro output is steadier minute-to-minute.

3.3 (a) The nuclear station is fully reliable – it runs continuously on demand and does not depend on weather; the barrage's output follows the tide's timetable – predictable but not constant, with no output at slack tide, so it cannot alone meet demand at every hour. (b) Nuclear: no CO_2 while running but produces radioactive waste that must be stored safely for many years. Barrage: no CO_2 and renewable, but permanently changes the estuary – flooding mudflats upstream and altering habitats for birds and fish. (Either order; a paired comparison scores.) (c) The science identifies the environmental effects and the engineering of each option; choosing between them weighs cost, jobs, local opposition, safety policy and ethics – political, social, ethical and economic decisions that scientists alone cannot settle.