

Exercise walk-through

1.7

National and global energy resources (4.1.3)

AQA · GCSE · Physics

Five situations the specification names

Rising and falling

Describing a change: an object projected upwards trades kinetic for gravitational potential.

A vehicle slowing down empties kinetic and fills the thermal store of the brakes.

Collisions and currents

A moving object hitting an obstacle: kinetic empties, thermal stores fill.

A kettle: electrical work fills the thermal store of the water.

A worked chain from spring to speed

- 1 **Known** $k = 50 \text{ N/m}$, $e = 0.12 \text{ m}$, $m = 0.020 \text{ kg}$; all base units.
- 2 **Store** $E_e = \frac{1}{2}ke^2 = \frac{1}{2} \times 50 \times 0.12^2 = 0.36 \text{ J}$.
- 3 **Transfer** at release all E_e becomes E_k .
- 4 **Rearrange** $v = \sqrt{2E_k/m} = \sqrt{2 \times 0.36/0.020}$.
- 5 **Answer** $v = 6.0 \text{ m/s}$, 2 s.f., unit from $\sqrt{\text{J/kg}}$.

The stairs question, start to finish

- 1 **Known** $m = 60.0 \text{ kg}$, $h = 175 \text{ cm} = 1.75 \text{ m}$, $t = 1.40 \text{ s}$, $g = 9.8 \text{ N/kg}$.
- 2 **Energy** $E_p = mgh = 60.0 \times 9.8 \times 1.75 = 1029 \text{ J}$.
- 3 **Power** $P = E_p/t = 1029/1.40$.
- 4 **Answer** $P = 735 \text{ W}$.
- 5 **Check** her total power is higher: her body also heats and pushes air.

Exercises 2.1·2.3

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

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

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

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2.1 A resource that is replenished as it is used.

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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]

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]

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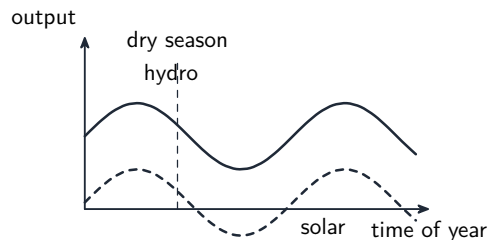
3.1 Transport: use electric vehicles instead of petrol/diesel – charged from electricity generated without fossil fuels, so less CO₂ from engines. Electricity generation: replace coal/gas power stations with renewable generation or nuclear – those release no CO₂ while running, so the same demand is met with fewer fossil-fuel emissions. (Cycling/public transport/walking also credit in the first pair; reducing demand for appliances also credits in the second.)

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]

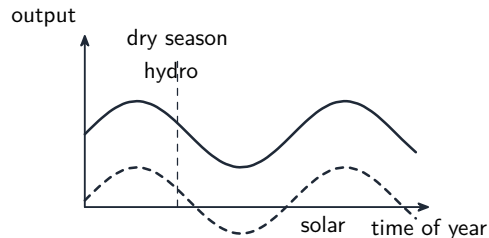


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Full solution 3.2

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.

Exercise 3.3

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]

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

(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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3.3 (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.