MARK SCHEME

GCSE
PHYSICS
AQA - COMBINED SCIENCE

P1 - TEST 3
ENERGY
Intermediate

Mark schemes

1.

unless answers state otherwise advantages and disadvantages relate to hydroelectric

ignore answers that relate to the disadvantages of coal

advantages

any **two** from:

- renewable

- can meet electricity demand quickly

   allow idea of pumped storage to meet demand quickly

   allow short start-up time

- pumped storage to store energy for later use

- no air pollution / named gas eg sulfur dioxide / nitrogen oxides

   allow harmful gases

   ignore no carbon dioxide / greenhouse gases as an advantage

- no acid rain

- no fuel needed / no fuel cost

- does not cause global warming

   ignore reference to running cost

   ignore can be used as a leisure area

disadvantages

any **two** from:

- relies on rainfall / not as reliable (as coal)

- destruction of wildlife habitats (during construction)

   accept displacement of people

- <u>higher</u> set-up cost

   ignore unsightly

   ignore large area needed

4

[4]

2. (a) advantage

any **one** from:

- produce no / little greenhouse gases / carbon dioxide

    allow produces no / little polluting gases

    allow doesn't contribute to global warming / climate change

    allow produce no acid rain / sulphur dioxide

    reference to atmospheric pollution is insufficient

    produce no harmful gases is insufficient
- high(er) energy density in fuel

    accept one nuclear power station produces as much power as several gas power stations

    nuclear power stations can supply a lot of or more energy is insufficient
- long(er) operating life

    allow saves using reserves of fossil fuels or gas

1

disadvantage

any **one** from:

- produce (long term) radioactive waste

    accept waste is toxic

    accept nuclear for radioactive
- accidents at nuclear power stations may have far reaching or long term consequences
- high(er) decommissioning costs

    accept high(er) building costs
- long(er) start up time

1

(b) (i) 12 000 (kWh)

*allow **1** mark for correct substitution eg*

2000 × 6

or

2 000 000 × 6

or

$$\frac{12\ 000\ 000}{1000}$$

*an answer of 12 000 000 scores **1** mark*

2

(ii) any idea of unreliability, eg

- wind is unreliable

  reference to weather alone is insufficient
- shut down if wind too strong / weak
- wind is variable

1

(c) any **one** from:

- cannot be seen
- no hazard to (low flying) aircraft / helicopters
- unlikely to be or not damaged / affected by (severe) weather

  unlikely to be damaged is insufficient
- (normally) no / reduced shock hazard

  safer is insufficient

  less maintenance is insufficient

  installed in urban areas is insufficient

1

[6]

3. (a) water moves (from a higher level to a lower level)

1

transferring GPE to KE

1

rotating a turbine to turn a generator

accept driving or turning or spinning for rotating

moving is insufficient

1

transferring KE to electrical energy

*transferring GPE to electrical energy gains **1** mark of the **2** marks available for energy transfers*

1

(b) (TVs in stand-by) use electricity

accept power / energy

1

generating electricity (from fossil fuels) produces CO_2

accept greenhouse gas

accept sulfur dioxide

1

(CO_2) contributes to global warming

accept climate change for global warming

accept greenhouse effect if CO_2 given

accept acid rain if linked to sulfur dioxide

1

(c)   a factor other than scientific is given, eg economic, political or legal
                personal choice is insufficient

                                                                                            1
                                                                                                    [8]

4. (a)   16 800 000

                *allow **1** mark for substitution into correct equation*
                ie 100 × 4200 × 40

                                                                                        2

        (b)   7

                allow ecf from part (a)

                                                                                        1

        (c)   Marks awarded for this answer will be determined by
              the Quality of Written Communication (QWC) as well
              as the standard of the scientific response.

              No relevant content.

                                                                                    0 marks

              There is a brief explanation of the advantages and disadvantages
              of using solar energy to heat the water rather than using an electric
              immersion heater, including either advantages or disadvantages from
              the **examples** below.

                                                                            Level 1 (1–2 marks)

              There is some explanation of the advantages **and** disadvantages of
              using solar energy to heat the water rather than using an electric
              immersion heater, with at least **one** advantage and **one** disadvantage
              from the **examples** below.

                                                                            Level 2 (3–4 marks)

              There is a clear, balanced and detailed explanation of the advantages
              and disadvantages of using solar energy to heat the water rather
              than using an electric immersion heater, with a minimum of **two**
              advantages and **two** disadvantages from the **examples** below.

                                                                            Level 3 (5–6 marks)

examples of the points made in the response

advantages

- a renewable energy source

- energy is free

- does not pollute the atmosphere
    accept specific examples of polluting gases

- no fuel is burnt

- energy can be stored (in the water)

disadvantages

- only available in daylight hours

- availability fluctuates
    accept unreliable energy source

- insufficient hours of sunlight in some countries

- average low intensity in some countries

[9]

5.   (a)   80 °C

1

ΔE = 0.5 × 3400 × 80

1

ΔE = 136 000 (J)
           *an answer of 136 000 (J) scores **3** marks*

1

(b)   energy is dissipated into the surroundings
           allow any correct description of wasted energy

1

(c)   put a lid on the pan
           allow any sensible practical suggestion
           eg add salt to the water

1

(d)　efficiency = 300/500

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　1

efficiency = 0.6

　　　　　　*an answer of 0.6 or 60% scores **2** marks*
　　　　　　allow efficiency = 60%
　　　　　　*an answer of 0.6 with a unit scores **1** mark*
　　　　　　*an answer of 60 without a unit scores **1** mark*

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　1

(e)　lower rate of energy transfer

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　1

(so) potato soup will remain at a higher temperature

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　1

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　[9]

6.　(a)　the store of chemical energy (in the battery) decreases

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　1

the internal energy of the surrounding air increases.

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　1

　　　　　　*accept description of energy becoming less usefully stored for **2** marks*

(b)　kinetic energy = ½ mass × velocity²

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　1

(c)　$E_K = ½ × 0.8 × 12^2$

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　1

$E_K = 57.6$ (J)

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　1

　　　　　　*allow 57.6 (J) without working shown for **2** marks*

(d)　lower proportion of wasted energy
　　　　　　accept less energy is wasted

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　1

higher proportion of energy is converted into <u>kinetic</u> energy
　　　　　　accept more kinetic energy

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　1

(e) **Level 2 (3–4 marks):**
A relevant and coherent argument which demonstrates processing and numerical analysis of the information presented and draw a conclusion which is logically consistent with the reasoning and refers to payback time for the vehicles.

Level 1 (1–2 marks):
Simple comparisons are made which demonstrate a basic ability to numerically analyse the information presented. The conclusion, if present, may not be consistent with the calculations.

0 marks:
No relevant content

Indicative content
- The electric car costs £12 000 more to buy
- Running cost of electric car = £3 000
- Running cost of petrol engine car = £24 000
- Total cost of electric car = £30 000
- Total cost of petrol engine car = £39 000
- The electric car cost £1 750 less to run each year
- The electric car will save £9 000
- Additional cost is covered in 6.9 years
- So the electric car will be cheaper over the 12 year lifetime

or

Electric
27000 / 12 = 2250
Annual cost = 2250 + 250 = 2500

Petrol
15000 / 12 = 1250
Annual cost = 1250 + 2000 = 3250

So electric is £750 cheaper per year

4

[11]

7. (a) $$\text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}} (\times 100)$$

$$\text{allow efficiency} = \frac{\text{useful output}}{\text{total input}} (\times 100)$$

1

(b)   (efficiency =) $\dfrac{1.2 \times 10^{18}}{1.3 \times 10^{18}}$ ($\times 100$)

                                                                                    1

= 0.92
or
92 (%)

            allow an answer that rounds to 0.92

or
92 (%)

                                                                                    1

            ignore units

            *an answer of 0.92 or 92 (%) scores **2** marks*

(c)   at a high potential difference and a low current

                                                                                    1

(d)   power = $\dfrac{\text{energy transferred}}{\text{time}}$

       allow $P = \dfrac{E}{t}$

                                                                                    1

(e) $8000 = \dfrac{E}{1200}$

            if a conversion of 8000 has been attempted, this mark
            can be awarded

                                                                                    1

(E =) 1200 × 8000

            if a conversion of 8000 has been attempted, this mark
            can be awarded

                                                                                    1

(E =) 9 600 000 (kJ)

            this answer only

                                                                                    1

            *an answer of 9 600 000 (kJ) scores **3** marks*

(f)   any **four** from:

(environmental advantages)
- renewable / sustainable (energy source)
- conserves fossil fuels
- no release of pollutant gases e.g. sulfur dioxide
- no release of greenhouse gases
    allow does not release carbon dioxide

- does not contribute to global warming

(environmental disadvantages)
- noise pollution
- visual pollution
- bird kill
- not always windy so more use of fossil fuel power stations
    ignore destruction of habitat
    max 3 *marks if only refers to advantages or disadvantages*
    ignore references to cost

4

[12]

8. (a) **Level 3 (5–6 marks):**
A full, detailed and coherent plan covering all the major steps is provided, which outlines what needs to be measured to calculate specific heat capacity. The steps are set out in a logical manner that could be followed by another person to calculate the specific heat capacity.

Level 2 (3–4 marks):
The substantive content of a plan is present but may be missing some steps. The plan may not be in a completely logical sequence but leads towards the calculation of the specific heat capacity.

Level 1 (1–2 marks):
Simple statements relating to relevant apparatus or steps are made but they may not be in a logical order. The plan would not allow another person to calculate specific heat capacity.

0 marks:
No relevant content.

Indicative content
- measure the mass of metal
- correct use of balance
- description of how work is done or energy transferred to metal
    eg electrical work, mechanical work (eg dropping lead shot)
- how energy transfer or work done is measured
    eg electrical using joulemeter, mechanical decrease in potential energy store of falling lead shot
- equate work done / energy transferred = increase in thermal energy store of the metal
- calculate specific heat capacity

6

(b) 4 600 = 1 × 657 × temperature change

1

temperature change = 4 600 / 657

1

= 7 (°C)
    *allow 7 with no working shown for **3** marks*

1

(c) Type of material

1

(d) heat loss

1

then any **one** from:

- turned off the power supply too early
- incorrectly measured mass of material
- incorrectly measured temperature
- incorrectly read the change in thermal energy

1

(e)   would give a more accurate value **or** the calculated specific heat capacity will be smaller

1

because the bubble wrap insulates the material **or** prevents heat loss

1

[14]