

MARK SCHEME

GCSE

PHYSICS

AQA - COMBINED SCIENCE

P1 - TEST 5

ENERGY

Advanced

Mark schemes

1.

(a) radiation

ignore infra red, IR, or heat

1

(b) (i) 105 000 000

$(E = mc\theta)$

accept answers in standard form eg. 1.05×10^8

$E = 5000 \times 4200 \times 5$ gains **1** mark

Unit mark is independent, but must match value given for full marks

if no other marks gained 1 mark for any correct unit of energy

2

J / joules

not lower case j

allow Joules

allow units in words eg kilojoules

*allow 105 000 kJ or 105 MJ for **3** marks. These figures must have units.*

allow units written as words Eg. kilojoules

not KJ, kj, mJ, Mj

1

(ii) 6600(s) / 6560(s) / 6563(s) / 6562.5(s)

$(E = Pt)$

allow ecf from (b)(ii)

allow answers in minutes and hours provided correct and unit changed on answer line

eg. 109 / 110 minutes or 1.8 hours

*if correct answer given with incorrect unit, maximum mark of **2** eg 6600 minutes*

$105\,000\,000 = 16\,000 \times t$ gains **1** mark

$t = 105\,000\,000 / 16\,000$ gains **2** marks

$t = 105\,000\,000 / 16$ gains **1** mark

or

$6\,562\,500(s)$ gains **2** marks

3

(iii) energy gained from surroundings / air

allow heat

ignore air is warmer or pool is colder

1

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2.

(a) any **two** from:

- cost per kWh is lower (than all other energy resources)
allow it is cheaper
ignore fuel cost
ignore energy released per kg of nuclear fuel
- infrastructure for nuclear power already exists
accept cost of setting up renewable energy resources is high
accept many renewable power stations would be needed to replace one nuclear power station
accept (France in 2011 already had a) surplus of nuclear energy, so less need to develop more renewable capacity for increased demand in the future
accept France benefits economically from selling electricity
- more reliable (than renewable energy resources)
accept (nuclear) fuel is readily available
ignore destruction of habitats for renewables

2

(b) any **two** from:

- non-renewable
allow nuclear fuel is running out
- high decommissioning costs
accept high commissioning costs
- produces radioactive / nuclear waste
allow waste has a long half-life
- long start-up time
- nuclear accidents have widespread implications
allow for nuclear accident a named nuclear accident
eg Fukushima, Chernobyl
ignore visual pollution

2

(c) 0.48 (kW)

allow 1 mark for correct substitution
ie $0.15 = P / 3.2$
an answer of 480 W gains 2 marks
an answer of 48 or 480 scores 1 mark

2

- (d) the higher the efficiency, the higher the cost (per m² to manufacture)

accept a specific numerical example

1

more electricity could be generated for the same (manufacturing) cost using lower efficiency solar panels

or

(reducing the cost) allows more solar panels to be bought

accept a specific numerical example

1

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3.

- (a) 90% of 2.1011
2.16.1011

2

- (b) (i) Can be located anywhere
Continuous output
Sustain coal industry
any 2 for 1 mark each

- (ii) Low running cost
No atmospheric pollution
Gives calm coastal waters
any 2 for 1 mark each

- (iii) High installation costs – built in sea
Coast environmental damage – wildlife disturbance
Time dependence – need dropping tide
any 2 for 1 mark each
(1 for a valid disadvantage, 1 for reason)

6

[8]

4.

- (a) a value of 1°C or less
reason only scores if a correct value for the resolution is given
*do **not** allow 0 / zero*

1

temperatures in investigation are recorded to the nearest degree (Celsius)

or

differences between temperature rises for different materials is greater than 1°C

1

(b) any **one** from:

- room temperature / start temperature (of material)
- type of insulation
- thickness of insulation
- time that cylinder was heated for
- the power output of the immersion heater

allow amount

1

(c) aluminium

reason only scores if 'aluminium' is given

1

smallest temperature rise

allow smaller temperature rise (than the other metals)

accept justification by calculation

1

(d) 500(J / kg °C)

allow temperature increase = 18 °C for 1 mark

correct substitution $18000 = 2 \times c \times 18$ gains 2 marks provided no subsequent step

or

correct substitution and rearrangement

$c = 18000 / (2 \times 18)$ gains 2 marks provided no subsequent step

allow 2 marks for 474 (J / kg °C) (a SHC calculated using a temperature of 19 °C)

allow 1 mark for substitution $18000 = 2 \times c \times 19$ provided no subsequent step

or

substitution and rearrangement

$c = 18000 / (2 \times 19)$ provided no subsequent step

allow 2 marks for a SHC calculated using a temperature increase of an incorrect metal, ie

900 (J / kg °C for aluminium)

391 (J / kg °C for copper)

450 (J / kg °C for iron)

134 (J / kg °C for lead)

3

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5.

(a) conduction

1

(b) (i) there is a bigger temperature difference between the water and the surrounding air

accept the water is hottest / hotter

1

so the transfer of energy (from hot water) is faster

accept heat for energy

ignore temperature falls the fastest

1

(ii) 120

allow 1 mark for converting kJ to J correctly, ie 4 032 000

or

correctly calculating temperature fall as 8°C

or

allow **2** marks for correct substitution, ie $4\,032\,000 = m \times 4200 \times 8$

answers of 0.12, 19.2 **or** 16.6 gain **2** marks

answers of 0.019 **or** 0.017 gain **1** mark

3

(iii) water stays hot for longer

1

so heater is on for less time

accept so less energy needed to heat water

1

so cost of the jacket is soon recovered from) lower energy costs / bills

accept short payback time

1

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6.

(a) 600 kg = 5880 N

1

$$\text{power} = \frac{5880 \times 35}{45}$$

1

$$= 4573.3 \text{ (W)}$$

this step without the previous steps stated gains 3 marks

1

$$\% \text{ Eff.} = \frac{4573.3 \times 100}{8000}$$

1

$$= 57.17 \text{ (\%)}$$

allow 57.17 with no working shown for 5 marks

1

(b) gpe = $600 \times 9.8 \times 35$

1

$$= 205\,800$$

1

$$gpe = KE = \frac{1}{2} m v^2$$

1

$$v = \sqrt{\frac{2 \times KE}{m}}$$

1

$$= \sqrt{\frac{411\,600}{600}}$$

1

$$= 26.2 \text{ (m / s)}$$

allow 26.2 with no working shown for 6 marks

1

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7.

- (a) the wall has two / three layers

allow the wall is thick

1

cavity wall insulation / brick / block has a low thermal conductivity

1

so less energy is transferred by conduction

allow rate of energy transfer is lower

ignore any reference to convection and / or radiation

1

- (b)

$$T = 17.4 + \left(\frac{(20.8 - 17.4)}{2} \right)$$

or

$$T = 20.8 + \left(\frac{(20.8 - 17.4)}{2} \right)$$

1

$$T = 19.1 \text{ (}^\circ\text{C)}$$

1

an answer in the range 18.5–19.1 scores 2 marks

(c) chemical energy store of the fuel decreases 1

thermal energy store of the water increases

allow kinetic energy store of the water particles increases

1

thermal energy store of the air / atmosphere increases

allow kinetic energy store of the air particles increases

1

(d) $E = 15\,000\,000$ (J) 1

$t = 600$ (s) 1

$$p = \frac{15\,000\,000}{600}$$

allow a correct substitution of incorrectly / not converted values of E and / or t

1

$P = 25\,000$ (W)

allow a correct calculation using incorrectly / not converted values of E and / or t

1

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8.

(a) (i) infrared (radiation) 1

accept IR (radiation)

(ii) (heated) water turns to steam 1

ignore reference to fossil fuels

*do **not** accept water evaporates to steam*

1

steam turns a turbine 1

turbine turns a generator 1

accept turbine connected to a generator

1

- (b) (i) (so the molten salts) can store large amounts of energy
accept there is a small temperature change for a large energy transfer
accept heat for energy 1
- (ii) 16 (hours)
an answer that rounds to 16 gains 2 marks eg 15.71
allow 1 mark for a correct substitution ie $2\,200\,000 = 140\,000 \times t$ 3
- (iii) the number of daylight hours varies
less sunlight is insufficient 1
- the (mean) power (received from the Sun per square metre) varies
accept an answer in terms of maximum possible electrical output only possible during Summer for 1 mark 1
- (c) (i) non-renewable power stations have higher Capacity Factors than renewable power stations 1
- fuel (for non-renewable power stations) is always available
reference to non-renewable power stations operating all the time is insufficient
non-renewable energy sources are reliable is insufficient 1
- (most) renewable energy sources are unpredictable / unreliable
accept (most) renewable energy sources depend on the weather 1
- (ii) the (proportion of) time that solar storage power stations can generate electricity is greater (than for other renewable energy sources) 1

[14]