AQA GCSE PHYSICS (HIGHER) · 8463

PHYSICS



MARK SCHEME

4.1.2.2 EFFICIENCY (PACK 2)

SCORE	PERCENTAGE
/166	%

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Q1.

(a) higher

1

(b) low(er)

1

hot(ter)

allow warm(er)

1

(c) advantage:

- water heated continuously (by the Sun)

1

one disadvantage from:

- temperature of water is lower (for most of the time than water heated by immersion heater)
- water may not be hot enough

allow less control over water temperature

- it takes longer to heat the water

1

(d) $\frac{4\,030\,000}{4\,070\,000}$

1

0.99

*an answer of 99% scores **2** marks*
*an answer of 99 or 0.99% scores **1** mark*

1

*an answer of 0.99 scores **2** marks*
*allow an answer that rounds to 0.99 for **2** marks*

(e) power = energy transferred / time

allow P = E / t

1

(f) $5000 = \frac{4\,070\,000}{t}$

1

$t = \frac{4\,070\,000}{5000}$

1

t = 814

1

seconds

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other units of time must be consistent with numerical value

1

*an answer of 814 seconds scores **4** marks*
*an answer of 13.57 minutes scores **4** marks*

[12]

Q2.

(a) potential difference

allow p.d.
allow voltage

1

temperature

1

in this order only

(b) the current increases (when the potential difference increases)

1

(which) causes the temperature of the filament to increase

1

(so) the resistance increases

*do **not** accept resistance increases and then levels off*

1

(c) a higher proportion / percentage of the (total) power / energy input is usefully transferred

wastes less energy is insufficient

or
higher (useful) power / energy output for the same (total) power / energy input

1

(d) potential difference increases

1

current decreases

1

(e) 1000 (Ω)

reason only scores if R = 1000 (Ω)

1

potential difference is shared in proportion to the resistance

allow a justification using a correct calculation

1

(f) $12 = I \times 7000$

1

$$I = \frac{12}{7000}$$

1

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I = 1.71 × 10^{-3} (A)

*an answer that rounds to 1.7 × 10^{-3} (A) scores **3** marks*

1

I = 1.7 × 10^{-3} (A)

this answer only

or

I = 0.0017 (A)

*an answer of 2.4 × 10^{-3} (A) scores **2** marks*

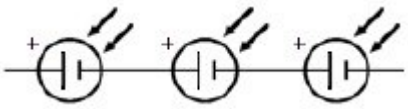
*if no other marks scored allow **1** mark for calculation of total resistance (7000 Ω)*

1

*an answer of 1.7 × 10^{-3} (A) scores **4** marks*

[14]

Q3.

(a) 

1

(b) $\text{current} = \frac{0.70}{2.5}$

1

current = 0.28 (A)

*an answer of 0.28 (A) scores **2** marks*

1

(c) 0.60 (V)

1

product of potential difference and current gives highest value

1

(d) $\text{efficiency} = \frac{\text{useful power output}}{\text{total power input}}$

1

(e) $0.20 = \frac{\text{useful power output}}{2.4}$

1

useful power output = 0.20 × 2.4

1

useful power output = 0.48 (W)

*an answer of 0.48 (W) scores **3** marks*

1

[9]

Q4.

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(a) current at 0.5 V = 0.91 (A)

1

P = 0.91 × 0.5

1

P = 0.455 (W)

*an answer of 0.455 (W) scores **3** marks*

1

(b) straight line with positive gradient

*allow for **1** mark a straight line that passes through (0.1, 0)*

1

positive y-axis intercept

ignore any values on y-axis

1

(c) $0.15 = \frac{0.52}{\text{total P}}$

1

total P = 3.47 (W)

1

$\text{area} = \frac{3.47}{450}$

1

area = 7.7×10^{-3} (m^2)

*an answer of 7.7×10^{-3} (m^2) scores **4** marks*

allow use of student's calculated incorrect total power for last 2 marking points

1

(d) connect the solar cells in parallel

1

(so that) the current has multiple paths it can take

or

the total resistance is less than the resistance of one solar cell

1

[11]

Q5.

(a) weight (lifted)

or

height (lifted)

1

(b) any **two** from:

- calculate a mean

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- spot anomalies
- reduce the effect of random errors

2

(c) as speed increases, the efficiency increases

1

(but) graph tends towards a constant value

or

appears to reach a limit

accept efficiency cannot be greater than 100%

1

(d) heating the surroundings

1

(e) 0 (%)

1

[7]

Q6.

(a) geothermal

1

nuclear

1

biofuel

1

(b) gravitational (potential)

1

kinetic

1

sound

1

(c) (i) 90% or 0.9(0)

*an answer of 0.9(0) with a unit gains **1** mark*

2

(ii) 60 (MW)

allow 10%

1

(iii) increased

1

[10]

Q7.

(a) any **two** from:

- cost per kWh is lower (than all other energy resources)

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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 m^2 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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[8]

Q8.

(a) field

correct order only

1

current

1

force

accept motion

accept thrust

1

(b) (i) arrow pointing vertically downwards

1

(ii) increase current / p.d.

accept voltage for p.d.

1

increase strength of magnetic field

accept move poles closer together

1

(iii) reverse (poles of) magnets

1

reverse battery / current

1

(c) (i) 1.5 or 150%

efficiency = 120 / 80 (× 100)

*gains **1** mark*

an answer of 1.5 % or 150

*gains **1** mark*

2

(ii) efficiency greater than 100%
or
output is greater than input
or
output should be 40 (W)

1

(iii) recorded time much shorter than actual time

accept timer started too late

accept timer stopped too soon

1

[12]

Q9.

(a) chemical

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correct order only

1

kinetic

1

sound

1

(b) 48% or 0.48

*an answer of 0.48 with a unit gains **1** mark*
*an answer of 0.48% gains **1** mark*
*an answer of 48 with or without a unit gains **1** mark*

2

[5]

Q10.

(a) (i) 150

1

(ii) transferred to the surroundings by heating

reference to sound negates mark

1

(iii) 0.75

*450 / 600 gains **1** mark*
*accept 75% for **2** marks*
*maximum of **1** mark awarded if a unit is given*

2

(iv) 20 (s)

*correct answer with or without working gains **2** marks*
*correct substitution of 600 / 30 gains **1** mark*

2

(b) (i) to avoid bias

1

(ii) use less power and last longer

1

1 LED costs £16, 40 filament bulbs cost £80

or

filament costs (5 times) more in energy consumption

1

(iii) any **one** from:

- availability of bulbs
- colour output
- temperature of bulb surface

1

[10]

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Q11.

(a) (i) temperature (increase) and time switched on are directly proportional

accept the idea of equal increases in time giving equal increases in temperature

answers such as:

- *as time increases, temperature increases*
- *positive correlation*
- *linear relationship*
- *temperature and time are proportional*

*score **1** mark*

2

(ii) any **one** from:

"it" refers to the metal block

- energy transfer (from the block) to the surroundings

accept lost for transfer

accept air for surroundings

- (some) energy used to warm the heater / thermometer (itself)

accept takes time for heater to warm up

- (metal) block is not insulated

1

(iii) 15 000

*allow **1** mark for correct substitution, ie 50 × 300 provided no subsequent step shown*

2

(b) lead

reason only scores if lead is chosen

1

needs least energy to raise temperature by 1°C

accept needs less energy to heat it (by the same amount)
lowest specific heat capacity is insufficient

1

[7]

Q12.

(a) electrical

1

chemical

1

light

1

(b) 25% **or** 0.25

*allow **1** mark for correct substitution, ie 50 ÷ 200 provided no subsequent step shown*
or

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*answers of 25 with a unit **or** 0.25 with a unit gain **1** mark*
*answers of 25 without a unit **or** 0.25% gain **1** mark*

2

(c) the information board can be used anywhere it is needed

1

[6]

Q13.

(a) (i) replaced faster than it is used

accept replaced as quick as it is used
accept it will never run out
*do **not** accept can be used again*

1

(ii) any **two** from:

***two** sources required for the mark*

- wind
- waves
- tides
- fall of water

*do **not** accept water / oceans*
accept hydroelectric

- biofuel

accept a named biofuel eg wood

- geothermal

1

(b) (i) any **two** from:

- increases from 20° to 30°
- reaches maximum value at 30°
- then decreases from 30°
- same pattern for each month

*accept peaks at 30° for **both** marks*
*accept goes up then down for **1** mark*
ignore it's always the lowest at 50°

2

(ii) 648

*an answer of 129.6 gains **2** marks*
*allow **1** mark for using 720 value <u>only</u> from table*
*allow **2** marks for answers 639, 612, 576, 618(.75)*
*allow **1** mark for answers 127.8, 122.4, 115.2, 123.75*

3

(c) (i) (sometimes) electricity demand may be greater than supply (of electricity from the system)

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accept cloudy weather, night time affects supply

or

can sell (excess) electricity (to the National Grid)

1

(ii) decreases the current

accept increases the voltage

1

reducing energy loss (along cables)

accept less heat / thermal energy lost / produced

1

[10]

Q14.

(a) (i) $efficiency = \frac{useful\ energy\ out\ (\times 100\%)}{total\ energy\ in}$

1.6 (W)

*allow **1** mark for correct substitution ie* $0.2 / \frac{20}{100} = \frac{output}{8}$

2

(ii) $efficiency = \frac{useful\ energy\ out\ (\times 100\%)}{total\ energy\ in}$

32 (%) / 0.32
or
their (a)(i) ÷ 5 correctly calculated

ignore any units

1

(b) (i) any **two** from:

- comparison over same period of time of relative numbers of bulbs required eg over 50 000 hours 5 CFL's required to 1 LED
  accept an LED lasts 5 times longer
- link number of bulbs to cost eg 5 CFL's cheaper than 1 LED
  an answer in terms of over a period of 50 000 hours CFLs cost £15.50 (to buy), LED costs £29.85 (to buy) so CFLs are cheaper scores both marks
  an answer in terms of the cost per hour (of lifetime) being cheaper for CFL scores 1 mark if then correctly calculated scores both marks
- over the same period of time LEDs cost less to operate (than CFLs)

2

(ii) any **one** from:

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- price of LED bulbs will drop
  *do **not** accept they become cheaper*
- less electricity needs to be generated
  accept we will use less electricity
- less CO_2 produced
- fewer chips needed (for each LED bulb)
- fewer bulbs required (for same brightness / light)
- less energy wasted
  *do **not** accept electricity for energy*

1

[6]

Q15.

(a) any **two** from:

- black is a good emitter of (infrared radiation)
  accept heat for radiation
  ignore reference to absorbing radiation
- large surface (area)
- matt surfaces are better emitters (than shiny surfaces)
  accept matt surfaces are good emitters
  ignore reference to good conductor

2

(b) 90% or 0.9(0)

$$efficiency = \frac{useful\ energy\ out\ (\times 100\%)}{total\ energy\ in}$$

allow 1 mark for correct substitution, ie $\frac{13.5}{15}$
provided no subsequent step shown
*an answer of 90 scores **1** mark*
*an answer of 90 / 0.90 with a unit scores **1** mark*

2

(c) (producing) light
allow (producing) sound

1

(d) any **two** from:

- wood is renewable
  accept wood grows again / quickly
  accept wood can be replanted
- (using wood) conserves fossil fuels

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accept doesn't use fossil fuels

- wood is carbon neutral

  accept a description

  cheaper / saves money is insufficient

2

(e) $E = m \times c \times \theta$

2 550 000

*allow **1** mark for correct substitution*
ie 100 × 510 × 50
provided no subsequent step shown
*answers of 1 020 000, 3 570 000 gain **1** mark*

2

joules /J

accept kJ / MJ
*do **not** accept j*
for full credit the unit and numerical answer must be consistent

1

[10]

Q16.

(a) heat / thermal
or / and
sound

*do **not** accept noise*
other forms of energy eg light negates answer

1

(b) 0.4
or
40 %

*allow **1** mark for* $\frac{2000}{5000}$
or
equivalent fraction
*an answer 0.4 % gains **1** mark*
*answers 0.4 or 40 given with any unit gains **1** mark*
*40 without % gains **1** mark*

2

[3]

Q17.

(a) (i) 4

*allow **1** mark for correct transformation and substitution*
ie $\frac{0.6}{0.15}$

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substitution only scores if no subsequent steps are shown

2

(ii) diagram showing two output arrows with one arrow wider than the other with the narrower arrow labelled electrical / electricity / useful

1

(b) any **one** from:

- to check reliability / validity / accuracy
- to avoid bias

1

(c) any **two** from:

- produce no / less (air) pollution
  accept named pollutant
  accept produces no waste (gases)
- energy is free
  accept it is a free resource
  *do **not** accept it is free*
- (energy) is renewable
- conserves fossil fuel stocks
- can be used in remote areas
- do not need to connect to the National Grid

2

[6]

Q18.

(a) (i) 0.75

*allow **1** mark for correct transformation and substitution*
ie 0.15 = 5

2

(ii) 2

accept 1.5 ÷ their (a)(i) correctly calculated

1

(b) any **one** from:

- seasonal <u>changes</u>
  accept specific <u>changes</u> in conditions
  eg shorter hours of daylight in winter
- cloud cover
  accept idea of <u>change</u>
  must be stated or unambiguously implied

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eg demand for water will not (always) match supply of solar energy

*do **not** accept figures are average on its own*

*do **not** accept solar panels are in the shade*

1

[4]

Q19.

(a) (i) 0.2 **or** 1/5

accept 20% for both marks

*allow **1** mark for correct substitution answer of 0.2%*
***or** 20 gains **1** mark*
ignore units

2

(ii) wasted

accept transformed to heat / other forms
accept transferred to the air / surroundings sound = neutral

1

(b) (i) any **one** from:

- can fly at night

  accept can fly when it is cloudy
  accept as a back-up

- can stay in the air for longer

- can fly in the winter

- can fly faster

  increases power is neutral

1

(ii) any **one** from:

- produces no (pollutant) gases

or no greenhouse gases

accept named gas
accept no air pollution
*do **not** accept no pollution*
accept less global warming
accept harmful for pollutant
accept produces no carbon
*do **not** accept environmentally friendly*

- produces no / less noise

- less demand for fuels

  accept any other sensible environmental advantage

1

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(iii) accept any sensible suggestion eg, map the Earth's surface / weather forecasting / spying / monitoring changes to the Earth's atmosphere, etc

*do **not** accept ideas in terms of transporting*

accept use as a satellite

1

[6]

Q20.

(a) generator

accept dynamo
accept alternator

1

(b) (i) 1400

ignore units

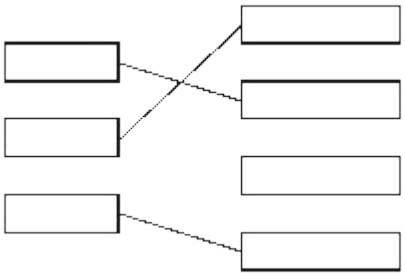
1

(ii) 0.3 or 30%

*any incorrect unit penalise **1** mark*
*allow **1** mark for the correct use of 600 **or** 0.3% **or** 30*

2

(c) **1** mark for each correct link



if more than 3 lines are drawn, mark only 3 lines starting with those that are incorrect

3

(d) (i) 110

no tolerance

1

(ii) 12

no tolerance

1

(iii) wind speed may be too low to operate the generator

accept wind may not always blow
accept power depends on wind speed
accept does not generate if wind speed is too high
accept does not generate if wind speed is above 12 (m/s)
accept does not generate if wind speed is below 1.6 (m/s)
accept it is unreliable
*do **not** accept answers referring to cost only*

1

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[10]

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