GCSE
PHYSICS

Topic Paper: 1.2.2 & 1.3 Efficiency, national and global energy resources
Part 1 & 2 Mark Scheme

MARK SCHEME

77 Marks

M1. (a) (i) 5.88 (watts)

*an answer of 5.9 scores **2** marks*

*allow **1** mark for correct substitution ie*

$0.42 = \frac{\text{power out}}{14}$

*allow **1** mark for an answer of 0.0588 or 0.059*

2

(ii) 8.12

allow 14 – their (a)(i) correctly calculated

1

(b) (i) input power / energy would be (much) less (reducing cost of running)

accept the converse

electricity is insufficient

1

(also) produce less waste energy / power

accept 'heat' for waste energy

1

(as the waste energy / power) increases temperature of the cabinet

1

so cooler on for less time

1

(ii) line graph

need to get both parts correct

accept scattergram or scatter graph

both variables are continuous

allow the data is continuous

1

(c) number of bulbs used-halogen=24 (LED=1)

1

total cost of LED = £30 + £67.20 = £97.20

accept a comparison of buying costs of halogen £36 and LED £30

1

total cost of halogen= 24 x £1.50 + 24 x £16.00 = £420

or

buying cost of halogen is £36 **and** operating cost is £384

accept a comparison of operating costs of halogen £384 and LED £67.20

*allow for **3** marks the difference in total cost is £322.80 if the number 24 has not been credited*

1

statement based on correct calculations that overall LED is cheaper

*must be **both** buying **and** operating costs*

an alternative way of answering is in terms of cost per hour:

buying cost per hour for LED $\left(\frac{£30.00}{48000}\right)$ = 0.0625p/£0.000625

buying cost per hour for halogen = $\left(\frac{£1.50}{2000}\right)$ = 0.075p/£0.00075

*a calculation of both buying costs scores **1** mark*

operating cost per hour for LED = $\left(\frac{£67.20}{48000}\right)$ = 0.14p/£0.0014

operating cost per hour for halogen= $\left(\frac{£16.00}{2000}\right)$ = 0.8p/£0.008

*a calculation of both operating costs scores **1** mark*

all calculations show a correct unit

***all** units correct scores **1** mark*

statement based on correct calculations of **both** buying **and** operating costs, that overall LED is cheaper

*correct statement scores **1** mark*

1

[12]

M2. (a) (i) produces carbon dioxide / nitrogen oxides

accept greenhouse gases

ignore pollutant gases

1

that (may) contribute to global warming

accept causes global warming

damages ozone layer negates this mark

accept alternative answers in terms of: sulfur dioxide / nitrogen oxides causing acid rain

1

(ii) carbon capture / storage

answer must relate to part (a)(i)

collecting carbon dioxide is insufficient

or

plant more trees

or

remove sulfur (before burning fuel)

1

(b) (i) (power station can be used) to meet surges in demand

accept starts generating in a short time

can be switched on quickly is insufficient

1

(ii) can store energy for later use

accept renewable (energy resource)
accept does not produce CO_2 / SO_2 / pollutant gases

1

(c) (i) turbines do not generate at a constant rate

accept wind (speed) fluctuates
accept wind is (an) unreliable (energy source)

1

(ii) any **one** from:

energy efficient lighting (developed / used)
use less lighting is insufficient

increased energy cost (so people more likely to turn off)
accept electricity for energy

more people becoming environmentally aware

1

[7]

M3. (a) four calculations correctly shown

200 ×10 – 1800 = £200
100 ×10 – 2400 = –£1400
50 ×10 – 600 = –£100
20 ×10 – 75 = 125

*accept four final answers only **or** obvious rejection of solar water heater and underfloor heating, with other two calculations completed any 1 complete calculation correctly shown **or** showing each saving ×10 of all four calculations = 1 mark answers in terms of savings as a percentage of installation cost **may** score savings mark only*

2

hot water boiler

correct answers only

1

(b) less electricity / energy to be generated / needed from power stations

accept less demand

1

reduction in (fossil) fuels being burnt

accept correctly named fuel

accept answer in terms of:
fewer light bulbs required because they last longer (1 mark)
less energy used / fuels burnt in production / transport etc. (1 mark)

ignore reference to CO_2 or global warming

ignore reference to conservation of energy

1

[5]

M4. (a) 1.8 (p)

*these **4** marks can be broken down as follows:*

***1** mark for correct transformation and substitution into efficiency equation*

ie 0.8 ×1200 – useful power

PLUS

***1** mark for useful power = 960 W / 0.96 kW*

PLUS

***1** mark for waste energy transferred = 0.24 ×0.5*

or

waste energy transferred = 0.12 (kWh)

PLUS

***1** mark for cost = 0.12 ×15*

where a mathematical error has been made full credit should be given for subsequent correct method

4

(b) the waste energy is transferred as heat and sound

1

to the surroundings where it spreads out / is shared by surrounding particles

accept air for surroundings

1

[6]

M5. (a) (i) £190

nb mention idea of cost per J in £ will come to an approx figure full credit given

*allow **1** mark for showing that the energy loss through the roof is ¼ of the total energy loss ie 150 / 600*

2

(ii) £142.50

allow ecf 50 % of their (a)(i) ×1.5 ie their (a)(i) ×0.75

1

(b) transferred to surroundings / atmosphere

or becomes spread out

1

[4]

M6. (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)

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]

M7. (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 changes

accept specific changes in conditions
eg shorter hours of daylight in winter

cloud cover

accept idea of change
must be stated or unambiguously implied
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]

M8. (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) two output arrows

one arrow should be wider – judged by eye

1

narrower arrow labelled light or useful (energy / output / power)

only scores if first mark awarded

and

wider arrow labelled waste (energy / output / power)

accept heat

ignore numerical values

1

(c) (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:

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

[8]

M9. (a) (i) 7.6

*allow **1** mark for correct substitution and / or transformation*

ie $0.95 = \frac{x}{8}$

95 ×8.0

2

(ii) 25 (hours)

*allow **1** mark for obtaining number of kWh = 200*
an answer of 26(.3) gains both marks

2

(b) any **two** from

transferred to the surroundings / air / atmosphere

becomes spread out

shared between (many) molecules

(wasted as) heat / sound

2

[6]

M10. (a) (i) kinetic

accept KE
*do **not** accept movement*

1

(ii) 0.75

*allow **1** mark for correct substitution ie* $\frac{60\,000}{80\,000}$

or
75 %

*an answer 0.75 % **or** 0.75 with a unit gains **1** mark only*
*an answer 75 with or without a unit gains **1** mark only*

2

(b) any **one** from:

large areas of land are flooded

uses large areas of land / takes up large areas of land is insufficient

people's homes may be destroyed

habitat (of animals and plants) lost / damaged

construct is neutral
very noisy is neutral

1

(c) (i) system of cables and transformers

both required for the mark
accept power lines / wires for cables
ignore reference to pylons
inclusions of power stations / consumers negates answer

1

(ii) less energy loss / wasted (in the cables)

accept heat for energy
*do **not** accept no energy loss*
*do **not** accept electricity for energy*

1

as the cables are shorter

1

[7]

M11. (a) (i) 4

*allow **1** mark for correct transformation and substitution*

ie $\frac{0.6}{0.15}$

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

(iii) any **one** from:

time of day / year

position of solar cells

angle of solar cells (to the Sun)

latitude

cloud cover

solar cells covered in dust / dirt

accept charger for solar cells
accept any reasonable suggestion that would lead to a change in intensity of sun(light)
the weather is insufficient
*do **not** accept any physical changes to the charger eg area*

1

causes a change in intensity of sun(light)

accept brightness for intensity
accept a description of the reduction of intensity

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

[8]