

Mark schemes

1	(a) any two from:		
	• nuclear		
	• oil		
	• (natural) gas		2
	(b) 4 (hours)		1
	(c) a system of cables and transformers		1
	(d) The power output of wind turbines is unpredictable		1
	(e) 1500 / 0.6		1
	2500 (wind turbines)		1
	<i>allow 2500 with no working shown for 2 marks</i>		
	(f) Most energy resources have negative environmental effects.		1
			[8]
2	(a) any two from:		
	• bungee rope may snap		
	• rope may extend too much		
	• student may land in the river		2
	(b) gravitational potential		
	<i>correct order only</i>		1
	kinetic		1
	elastic potential		1
	(c) $\frac{1}{2} \times 40 \times 35^2$		1
	24 500 (J)		
	<i>accept 25 000 (J) (2 significant figures)</i>		1
	<i>allow 24 500 (J) with no working shown for 2 marks</i>		
			[7]

3

- (a) power output increases (to meet demand) due to people returning home from work / school

accept many electrical appliances are switched on (which increases demand)

1

accept other sensible suggestions

- (b) 00.00

accept midnight

1

allow answers between 00.00 and 04.00

- (c) any **two** from:

- conserves fuel reserves
- spare capacity to compensate for unreliable renewable resources
- provides spare capacity in case of power station emergency shut-down
- so as to not make unnecessary environmental impact

2

[4]**4**

- (a) 0.1 (°C)

1

- (b) power = energy transferred / time

allow $P = E / t$

1

allow $E = P \times t$

- (c) 1050 / 300

1

3.5 (W)

1

accept 3.5 (W) with no working shown for 2 marks

- (d) $1050 = m \times 4200 \times 0.6$

1

$$m = 1050 / (4200 \times 0.6)$$

1

$$m = 0.417 \text{ (kg)}$$

1

accept 0.417 (kg) with no working shown for 3 marks

- (e) any **one** from:

- energy used to heat metal pan (as well as the water)
- energy transfer to the surroundings (through the insulation)
- angle of solar radiation will have changed during investigation
- intensity of solar radiation may have varied during investigation

1

[8]

- 5** (a) weight (lifted)
or
 height (lifted) 1
- (b) any **two** from:
- calculate a mean
 - 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]**
- 6** (a) g.p.e. = mass × gravitational field strength × height
accept $E_p = mgh$ 1
- (b) $E_p = 50 \times 9.8 \times 20$ 1
- 9800 (J)
allow 9800 (J) with no working shown for 2 marks
answer may also be correctly calculated using $W = Fs$
ie allow $W = 490 \times 20$ for 1 mark
or answer of 9800 (J) using this method for 2 marks 1
- (c) 7840 (J)
allow ecf from '11.2' 1
- (d) $7840 = \frac{1}{2} \times 50 \times v^2$ 1

$$v = \sqrt{\frac{7840}{1/2 \times 50}}$$

allow $v^2 = \frac{7840}{(1/2 \times 50)}$ for this point

1

17.7(0875) (m / s)

1

18 (m / s)

allow ecf from '11.3' correctly calculated for **3** marks

allow 18 (m / s) with no working for **2** marks

answer may also be correctly calculated using $v^2 - u^2 = 2as$

1

(e) extension = 35 (m) and conversion of 24.5 kJ to 24500 J

1

$$24\,500 = \frac{1}{2} \times k \times 35^2$$

1

40

1

allow 40 with no working shown for **3** marks

an answer of '16.2' gains **2** marks

[11]

7

(a) It will have a constant speed.

1

(b) distance travelled = speed \times time

1

(c) $a = \frac{18 - 9}{6}$

6

1

$a = 1.5$

allow 1.5 with no working shown for **2** marks

1

(d) resultant force = mass \times acceleration

1

(e) $F = (1120 + 80) \times 1.5$

1

$F = 1800$ (N)

allow 1800 with no working shown for **2** marks

1

accept their 10.3×1200 correctly calculated for **2** marks

(f) $18^2 - 9^2 = 2 \times 1.5 \times s$

1

$$s = 18^2 - 9^2 / 2 \times 1.5$$

1

$$s = 81 \text{ (m)}$$

1

allow 81 (m) with no working shown for 3 marks

accept answer using their 10.3 (if not 1.5) correctly calculated for 3 marks

(g) **Level 2 (3–4 marks):**

A detailed and coherent explanation is provided. The response makes logical links between clearly identified, relevant points that include references to the numerical factor.

Level 1 (1–2 marks):

Simple statements are made. The response may fail to make logical links between the points raised.

0 marks:

No relevant content.

Indicative content

- doubling speed increase the kinetic energy
- kinetic energy increases by a factor of 4
- work done (by brakes) to stop the car increases
- work done increases by a factor of 4
- work done is force \times distance and braking force is constant
- so if work done increases by 4 then the braking distance must increase by 4

4

[14]

8

(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]

9

(a) dark matt

1

light shiny

1

(b) B A C

1

biggest temperature difference (80 °C)

dependent on first mark

1

(c) (i) (the can that is) dark matt

1

best absorber (of infrared radiation)

1

(ii) any **three** from:

- same area / shape of can
- surrounding temperature is the same for all cans
- same surface underneath cans
- same position in the room

3

(d) fox A

smaller ears

1

thicker fur

1

these minimise energy transfer

dependent on first 2 marks

1

[12]

10	(a) (i) electrical <i>correct order only</i>	1	
	kinetic	1	
	sound	1	
	(ii) transferred into surroundings / atmosphere <i>accept warms the surroundings</i> <i>allow released into the environment</i> <i>becomes heat or sound is insufficient</i>	1	
	(b) 0.7 / 70 % <i>an answer of 70 without % or with the wrong unit or 0.7 with a unit gains 1 mark</i>	2	
			[6]
11	(a) (i) <u>water</u>	1	
	heated <i>accept boiled or turned to steam</i> <i>do not accept evaporated</i>	1	
	<u>generator</u>	1	
	(ii) geothermal power stations provide a reliable source of electricity	1	
	(b) falling water	1	
			[5]

12

(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

$$2000 \times 6$$

or

$$2\,000\,000 \times 6$$

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]**13**

(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 CO₂

accept greenhouse gas
accept sulfur dioxide

1

(CO₂) contributes to global warming

accept climate change for global warming
accept greenhouse effect if CO₂ 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]

14

- (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= $24 \times \text{£}1.50 + 24 \times \text{£}16.00 = \text{£}420$

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 $\left(\frac{\text{£}30.00}{48000}\right) = 0.0625\text{p}/\text{£}0.000625$

buying cost per hour for halogen = $\left(\frac{\text{£}1.50}{2000}\right) = 0.075\text{p}/\text{£}0.00075$
*a calculation of both buying costs scores **1** mark*

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

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

15

(a) water heated by radiation (from the Sun)

accept IR / energy for radiation

1

water used to heat buildings / provide hot water

*allow for **1** mark heat from the Sun heats water if no other marks given*

*references to photovoltaic cells / electricity scores **0** marks*

1

(b) 2 (minutes)

$$1.4 \times 10^3 = \frac{168 \times 10^3}{t}$$

*gains **1** mark*

*calculation of time of 120 (seconds) scores **2** marks*

3

- (c) (i) 150 (kWh) 1
- (ii) £60(.00) or 6000 (p)
an answer of £6000 gains 1 mark
allow 1 mark for $150 \times 0.4(0)$ 150×40
allow ecf from (c)(i) 2
- (iii) 25 (years)
an answer of $6000 / 240$
or
 $6000 / \text{their (c)(ii)} \times 4$
gains 2 marks
an answer of $6000 / 60$
or
 $6000 / \text{their (c)(ii)}$ gains 1 mark, ignore any other multiplier of (c)(ii) 3
- (iv) any **one** from:
 - will get £240 per year
accept value consistent with calculated value in (c)(iii)
 - amount of light is constant throughout the year
 - price per unit stays the same
 - condition of cells does not deteriorate1
- (d) any **one** from:
 - angle of tilt of cells
 - cloud cover
 - season / shade by trees
 - amount of dirt1
- 16** (a) conduction [13]
must be in correct order 1
- convection 1
- (b) (i) 70
accept \pm half a square
(69.8 to 70.2) 1

(ii) 15
accept 14.6 to 15.4 for 2 marks
allow for 1 mark 70 – 55
ecf from (b)(i) ± half a square

2

(iii) C
 1

biggest drop in temperature during a given time
accept it has the steepest gradient this is a dependent
 1

(iv) starting at 70 °C and below graph for C
 must be a curve up to at least 8 minutes
 1

(v) because 20 °C is room temperature
accept same temperature as surroundings
 1

(c) (i) 6720
correct answer with or without working gains 3 marks
6 720 000 gains 2 marks
correct substitution of $E = 0.2 \times 4200 \times 8$ gains 2 marks
correct substitution of $E = 200 \times 4200 \times 8$ gains 1 mark
 3

(ii) the fastest particles have enough energy
accept molecules for particles
 1

to escape from the surface of the water
 1

therefore the mean energy of the remaining particles decreases
accept speed for energy
 1

the lower the mean energy of particles the lower the temperature (of the water)
accept speed for energy
 1

[16]**17**

(a) (i) 77
 1

(ii) Oil
 1

(b) water
accept H₂O
 1

(c) Carbon dioxide causes global warming

1

[4]

18

(a) (i) changing the distance may / will affect / change the voltmeter reading

*accept so only one independent variable**accept distance affects speed of wind (turbine)**accept it is a control variable**accept to give valid results**fair test is insufficient**to make the results accurate is insufficient*

1

(ii) any sensible practical suggestions, eg

- so fan reaches a steady / full speed

accept power for speed

- so wind (turbine) reaches a steady / full speed

- so voltmeter reaches / gives a steady reading

*accept accurate or valid reading a correct reading is insufficient**do **not** accept precise reading*

1

(iii) as the number of blades increases so does the (voltmeter) reading / output / voltage

number of blades affects the reading / output is insufficient

1

further relevant detail, eg

- voltmeter increase is greatest up to 3 blades

- voltmeter reading hardly changes with 4, 5 or 6 blades

accept does not change between 4 and 6 blades

- increase is directly proportional up to 3 blades

- it reaches a limit

accept does not change after 4 / 5 blades

- a numerical example giving two pairs of numbers, eg 2 blades = 0.6V, 4 blades = 1V

1

(b) C

reason scores only if C is chosen

1

wind speed / strength varies

accept wind is **not** constant / reliable

1

[6]

19

- (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]

20

- (a) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the [Marking guidance](#).

0 marks

No relevant content.

Level 1(1-2 marks)

There is a basic explanation of **one** feature

or

a simple statement relating reduction in energy transfer to **one** feature.

Level 2(3-4 marks)

There is a clear explanation of **one** feature

or

a simple statement relating reduction in energy transfer to **two** features.

Level 3(5-6 marks)

There is a detailed explanation of at least **two** features

or

a simple statement relating reduction in energy transfer to all **four** features.

Examples of the points made in response***extra information****accept throughout:**heat for energy**loss for transfer*

plastic cap:

- plastic is a poor conductor
accept insulator for poor conductor
- stops convection currents forming at the top of the flask so stopping energy transfer by convection
- molecules / particles evaporating from the (hot) liquid cannot move into the (surrounding) air so stops energy transfer by evaporation
- plastic cap reduces / stops energy transfer by conduction / convection / evaporation

glass container:

- glass is a poor conductor so reducing energy transfer by conduction
- glass reduces / stops energy transfer by conduction

vacuum:

- both conduction and convection require a medium / particles
- so stops energy transfer between the two walls by conduction and convection
- vacuum stops energy transfer by conduction / convection

silvered surfaces:

- silvered surfaces reflect infrared radiation
accept heat for infrared
- silvered surfaces are poor emitters of infrared radiation
- infrared radiation (partly) reflected back (towards hot liquid)
- silvered surfaces reduce / stop energy transfer by radiation

6

- (b) (the ears have a) small surface area
ears are small is insufficient

1

so reducing energy radiated / transferred (from the fox)

accept heat lost for energy radiated

*do **not** accept stops heat loss*

1

[8]**21**

(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

[9]**22**

(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 CO₂ / SO₂ / 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

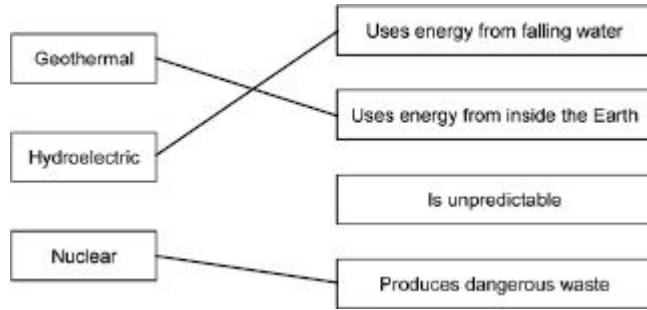
(ii) any **one** from:

- 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]

23



allow 1 mark for each correct line
 if more than one line goes from an energy source then all lines from that energy source are wrong

[3]

24

(a) electrical

1

chemical

1

light

1

(b) 25% **or** 0.25

allow 1 mark for correct substitution, ie $50 \div 200$ provided no subsequent step shown

or

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]

25

(a) any **three** from:

- gas can be switched on (and off) quickly but nuclear cannot
gas has a short start-up time alone is insufficient
- gas can be used to meet surges in demand
accept specific times from graph, anything from 1700 to 2200
- gas can contribute to / meet the base load
- nuclear provides base load
or
 nuclear is used to generate all of the time

3

- (b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the [Marking guidance](#), and apply a 'best-fit' approach to the marking.

0 marks

No relevant content.

Level 1 (1-2 marks)

There is a brief description of one advantage **or** disadvantage of using either biogas or wind

or

makes a conclusion with a reason.

Level 2 (3-4 marks)

There is a description of some advantages **and** / **or** disadvantages for biogas **and** / **or** wind

or

there is a direct comparison between the two systems **and** at least one advantage / disadvantage

or

a detailed evaluation of one system only with a conclusion.

Level 3 (5-6 marks)

There is a clear and detailed comparison of the two systems.

There must be a clear conclusion of which system would be best with at least one comparative reason given for the choice made.

Examples of the points made in the response *extra information*

Biogas

- renewable
- energy resource is free
- reliable energy source
accept works all of the time
- does not depend on the weather
- uses up (animal) waste products
- concentrated energy source
- cheaper (to buy and install)
accept once only
- shorter payback-time (than wind)
- adds carbon dioxide to the atmosphere
when waste burns it produces carbon dioxide is insufficient
- contributes to the greenhouse effect
or
contributes to global warming
- no transport cost for fuels

Wind turbine

- renewable
- energy resource is free
- not reliable
- depends on the weather / wind
- will be times when not enough electricity generated for the farm's needs
- dilute energy source
- longer payback-time (than biogas)
- more expensive (to buy and install)
accept once only
- does not produce any carbon dioxide
accept does not pollute air

*accept pollutant gases for carbon dioxide
produces visual or noise pollution is insufficient
harmful gases is insufficient*

6
[9]

26

(a) (i) 5(.0)

1

(ii) 35 **or** their (a)(i) \times 7 correctly calculated
*allow 1 mark for correct substitution, ie 5 **or** their (a)(i) \times 7 provided
no subsequent step shown*

2

(iii) 525(p)

or

(£) 5.25

or

their (a)(ii) \times 15 correctly calculated

*if unit p or £ given they must be consistent with the numerical
answer*

1

(iv) decreases

1

temperature difference (between inside and outside) decreases

accept gradient (of line) decreases

*do **not** accept temperature (inside) decreases*

*do **not** accept graph goes down*

1

(b) air (bubbles are) trapped (in the foam)

*do **not** accept air traps heat*

foam has air pockets is insufficient

1

(and so the) air cannot circulate / move / form convection current

air is a good insulator is insufficient

no convection current is insufficient

*answers in terms of warm air from the room being trapped are
incorrect and score no marks*

1

[8]

27

(a) (matt) black is a good emitter of infrared / radiation

accept heat for infrared / radiation

ignore reference to good absorber

attracts heat negates this marking point

1

to give maximum (rate of) energy transfer (to surroundings)

accept temperature (of coolant) falls fast(er)

accept black emits more radiation for 1 mark

black emits most radiation / black is the best emitter of radiation for 2 marks

1

(b) the fins increase the surface area

accept heat for energy

1

so increasing the (rate of) energy transfer

or

so more fins greater (rate of) energy transfer

1

(c) 114 000

allow 1 mark for correct temperature change, ie 15 (°C)

or

allow 2 marks for correct substitution, ie $2 \times 3\,800 \times 15$

answers of 851 200 or 737 200 gain 2 marks

or

substitution $2 \times 3800 \times 112$ or $2 \times 3800 \times 97$ gains 1 mark

an answer of 114 kJ gains 3 marks

3

(d) increases the efficiency

1

less (input) energy is wasted

accept some of the energy that would have been wasted is (usefully) used

or

more (input) energy is usefully used

accept heat for energy

1

[9]

28

(a) any **one** from:

- energy / source is constant
- energy / source does not rely on uncontrollable factors
accept a specific example, eg the weather
- can generate all of the time
will not run out is insufficient

1

- (b) (dismantle and) remove radioactive waste / materials / fuel

accept nuclear for radioactive
knock down / shut down is insufficient

1

- (c) any **two** from:

- reduce use of fossil fuelled power stations
accept specific fossil fuel
accept use less fossil fuel
- use more nuclear power
accept build new nuclear power stations
- use (more) renewable energy sources
accept a named renewable energy source
*do **not** accept natural for renewable*
- make power stations more efficient
- (use) carbon capture (technology)
*do **not** accept use less non-renewable (energy) sources*

2

- (d) (by increasing the voltage) the current is reduced

1

this reduces the energy / power loss (from the cable)

accept reduces amount of waste energy
accept heat for energy
*do **not** accept stops energy loss*

1

and this increases the efficiency (of transmission)

1

[7]

29

- (a) iron

1

hairdryer

1

kettle

1

answers can be in any order

- (b) (i) **Y**

1

- (ii) bar drawn with any height greater than **Y**
ignore width of bar

1

- (c) (bigger volume) takes more time (to boil)
accept explanation using data from graph 1
- (so) more energy transferred
*do **not** accept electricity for energy* 1
- (and) this costs more money
ignore reference to cost of water
wasting more money because heating more water than needed is insufficient 1
- 30** (a) (i) an unreliable energy source 1
- (ii) a renewable energy source 1
- (b) plant / grow (at least) one new tree 1
- (c) greater than 4% 1
- 31** (a) light *correct order only* 1
- electrical 1
- (b) 0.2 or 1/5
accept 20% for both marks
allow 1 mark for correct substitution ie $\frac{35\,000}{175\,000}$
*answers of 0.2% **or** 20 gain 1 mark only* 2
- [8]
- [4]

(c) 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

[5]

32

(a) (i) kinetic

*do **not** accept movement*

1

(ii) thermal sound

accept heat for thermal
*do **not** accept noise for sound*
***both** answers required in either order*

1

(b) transferred to surroundings / surrounding molecules / atmosphere

'it escapes' is insufficient

or

becomes dissipated / spread out

accept warms the surroundings
accept degraded / diluted
accept a correct description for surroundings eg to the washing machine
*do **not** accept transformed into heat on its own*

1

(c) (i) 3 (.0 p)

*allow **1** mark for correct substitution of correct values ie 0.2×15*
*allow **1** mark for calculating cost at 40°C (16.5p)*

or

cost at 30°C (13.5p)

2

(ii) any **two** from:

- less electricity needed
ignore answers in terms of the washing machine releasing less energy
an answer in terms of the washing machine releasing CO₂ negates mark
*do **not** accept less energy is produced*
- fewer power stations needed
- less fuel is burned
accept a correctly named fuel
*do **not** accept less fuel is needed*

2

[7]

33

(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 only 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]**
- 34** (a) grid
- accept any unambiguous indication*
- 1
- (b) (i) A (only)
- 1
- (ii) D (only)
- 1
- (c) less than
- 1
- [4]**
- 35** (a) (i) correct data point identified (4, 0.96)
- 1

(ii) a decrease in

1

(b) (i) no / less atmospheric pollution

accept specific examples eg no CO₂ / greenhouse gases produced

accept no harmful gases / fumes

accept reduced pollution from transportation (of coal)

accept does not contribute to global warming

it / they refers to solar cells

*do **not** accept no / less pollution*

does not harm the environment is insufficient

it is a renewable energy source is insufficient

1

(ii) 8

allow 1 mark for showing correct method ie $\frac{7600}{950}$ provided that no subsequent step is shown

2

(iii) increase

1

(iv) **these marks can score even if (b)(iii) is wrong**

less / no electricity generated

accept energy for electricity

accept reduced power / voltage output

1

(because) lower light intensity (hitting solar panel / cell)

or

so decreases money paid / gained (from selling electricity)

allow less light / sun (hitting solar panel / cell)

1

[8]**36**

(a) increases the voltage (across the cables)

or

decreases the current (through the cables)

1

reducing energy losses (in cables)

accept heat for energy

*do **not** accept electricity for energy*

*do **not** accept no energy loss*

accept wires do not get as hot

or

increases efficiency of (electricity / energy) transmission

ignore reference to travel faster

1

- (b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the Marking Guidance, and apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1-2 marks)

There is a brief description of one advantage or disadvantage of using either overhead or underground cables.

Level 2 (3-4 marks)

There is a description of some of the advantages **and** / **or** disadvantages for both overhead and underground cables, with a minimum of three points made. There must be at least **one** point for each type of cable.

Level 3 (5-6 marks)

There is a clear and detailed description of the advantages and disadvantages of overhead **and** underground cables, with a minimum of five points made. At least one advantage and one disadvantage for each type of cable.

examples of the points made in the response

marks may be gained by linking an advantage for one type of cable with a disadvantage for the other type of cable

eg

overhead cables are easy to repair = 1 mark

overhead cables are easier to repair = 1 mark

overhead cables are easier to repair than underground cables = 2 marks

Overhead
Advantages

- (relatively) quick / easy to repair / maintain / access
easy to install is insufficient
*do **not** accept easy to spot / see a fault*
- less expensive to install / repair / maintain
less expensive is insufficient
- cables cooled by the air
accept thermal energy / heat removed by the air
- air acts as electrical insulator
accept there is no need for electrical insulation (around the cables)
- can use thinner cables
difficult to reach is insufficient
land beneath cables can still be used is insufficient

Disadvantages

- spoil the landscape
- greater risk of (fatal) electric shock
- damaged / affected by (severe) weather
*accept specific examples eg high winds, ice
more maintenance is insufficient*
- hazard to low flying aircraft / helicopters
*kites / fishing lines can touch them is insufficient
hazard to aircraft is insufficient*

Underground

Advantages

- cannot be seen
- no hazard to aircraft / helicopters
- unlikely to be / not damaged / affected by (severe) weather
less maintenance is insufficient

(normally) no / reduced shock hazard

installed in urban areas is insufficient

Disadvantages

- repairs take longer / are more expensive
*accept harder to repair / maintain
have to dig up for repairs is insufficient*
- (more) difficult to access (cables)
*hard to locate (cables) is insufficient
faults hard to find is insufficient*
- (very) expensive to install
- thicker cables required
- need cooling systems
- need layers of electrical insulation
- land disruption (to lay cables)
accept damage to environment / habitat(s)
or
cannot use land either side of cable path
accept restricted land use

(c) examples of acceptable responses:

allow 1 mark for each correct point

- closest to cables field from underground is stronger
- field from overhead cables stronger after 5 metres
- field from underground cables drops rapidly
- field from overhead cables does not drop much until after 20 metres
accept values between 20 and 30 inclusive
- overhead field drops to zero at / after 50 metres
- underground field drops to zero at / after 30 metres
- (strength of) field decreases with distance for both types of cable
if suitably amplified this may score both marks

2

(d) ethical

1

[11]

37

(a) (i)

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

1.6 (W)

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

2

(ii)

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

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:

- 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 CO₂ 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]**38**

(a) *answers must be in terms of nuclear fuels*

concentrated source of energy

idea of a small mass of fuel able to generate a lot of electricity

1

that is able to generate continuously

accept it is reliable

or *can control / increase / decrease electricity generation*

idea of available all of the time / not dependent on the weather

ignore reference to pollutant gases

1

the energy from (nuclear) fission

1

is used to heat water to steam to turn turbine linked to a generator

1

(b) carbon dioxide is not released (into the atmosphere)

1

but is (caught and) stored (in huge natural containers)

1

[6]**39**

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

- produces no (air / atmospheric) pollution
accept named pollutant eg CO₂
accept no harmful gases
accept produces no emissions
accept does not add to global warming
environmentally friendly is insufficient
- energy (source) is free
accept no fuel costs
accept the wind / it is free

1

(ii) any **one** from:

- waves
- tides
- falling water
accept hydroelectric
*do **not** accept water (flow)*
- solar
accept Sun / sunlight
accept solar panels / cells
- geothermal
- biofuel / biomass
accept a named biofuel

1

- (b) (i) 3000 (kilowatts)
accept 3 megawatts / MW
accept 3 000 000 watts / W 1
- (ii) (average) wind speed below 6 m/s
answers giving a wind speed greater than 3 but less than 6 m/s
gain both marks
allow 1 mark for calculating the output as 500 kW (maximum)
and
allow 1 mark for wind speed too low or wind not strong enough
*do **not** accept wind above 25 m/s*
*do **not** accept the turbines are frozen* 2
- (iii) A small amount of nuclear fuel generates a large amount of electricity.
both required
- Nuclear power stations do not depend on the weather to generate electricity. 1

[6]**40**

- (a) 9
allow 2 marks for power = 1400 (kW)
if a subsequent calculation is shown award 1 mark only
or
allow 1 mark for correct substitution and transformation

$$\text{power} = \frac{5600}{4}$$
allow 1 mark for using a clearly incorrect value for power to read a corresponding correct value from the graph 3
- (b) (i) system of cables and transformers
both required for the mark
ignore reference to pylons
inclusion of power stations / consumers negates the mark
wire(s) is insufficient 1

(ii) (uses step-up transformer to) increase pd / voltage
accept (transfers energy / electricity at) high voltage
or
 (uses step-up transformer to) reduce current
accept (transfers energy / electricity at) low current
ignore correct references to step-down transformers

1

(c) build a power station that uses a non-renewable fuel or biofuel
accept a named fuel
eg coal or wood

or

buy (lots of) petrol / diesel generators

1

stockpile supplies of the fuel

accept fuel does not rely on the weather

or

fuel provides a reliable source of energy

accept as an alternative answer idea of linking with the National Grid (1)

and taking power from that when demand exceeds supply (1)

or

when other methods fail

or

when it is needed

answers in terms of using other forms of renewables is insufficient

1

[7]

41

(a) fan

1

drill

1

washing machine

four circled including correct three scores 1 mark

five circled scores zero

1

- (b) Appliances only transfer part of the energy usefully

1

The energy transferred by appliances makes the surroundings warmer

1

[5]

42

- (a) gas (burning)

1

- (b) (i) (transmission) cables and (step-up and step-down) transformers
*if transformers are named ie step-up transformer then both step-up
 and step-down must be given
 mention of power station or consumer negates mark*

1

- (ii) voltage

1

more efficient

1

- (c) increase

1

[5]

43

- (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

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

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

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 $100 \times 510 \times 50$

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]

44

- (a) (i) energy from hot rocks in the Earth
accept heat that occurs naturally in the Earth
accept steam / hot water rising to the Earth's surface
accept an answer in terms of the energy released by radioactive decay in the Earth
heat energy is insufficient 1
- (ii) water is pumped / moved 1
- up (to a higher reservoir)
this mark point only scores if first mark point is awarded 1
- (b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the Marking Guidance and apply a 'best-fit' approach to the marking.

0 marks

No relevant content

Level 1 (1-2 marks)

There is a brief description of at least one advantage or disadvantage for either the planned wind turbines or the suggested electricity power link.

Level 2 (3-4 marks)

There is a description of advantages and disadvantages for either the planned wind turbines or the suggested electricity power link.

or

A description of the advantages or disadvantages for both the planned wind turbines and the suggested electricity power link.

Level 3 (5-6 marks)

There is a clear and detailed description of at least one advantage and one disadvantage for both the planned wind turbines and suggested electricity power link.

examples of the points made in the response

Offshore wind turbines

advantages

- renewable (energy resource)
- low running costs
- energy is free
- no gas emissions (when in use)
accept a named gas eg CO₂
accept no fuel is burned
accept less dependent on fossil fuels
- land is not used (up)

disadvantages

- unreliable – accept wind does not always blow
ignore references to destroying or harming habitats
- hazard to birds / bats
- visual pollution – do not accept noise pollution
*do **not** allow if clearly referring to onshore wind turbines*
*do **not** accept spoils landscape*
- difficulty of linking turbines to the National Grid
- large initial cost
- difficult to erect / maintain
accept a lot of maintenance needed
- CO₂ emissions in manufacture (of large number of turbines)

Suggested Link**advantages**

- income for Iceland
- using Iceland's (available) energy (resources)
accept using (Iceland's) renewable energy (resources)
*do **not** accept reduce the amount of Iceland's wasted energy*
- provide electricity when wind does not blow / reliable
- provide electricity at times of peak demand
- even out fluctuations in supply
- excess electricity from Britain (windy days) to Iceland and used to pump water up to store energy
- Britain less dependent on fossil fuels
accept Britain needs fewer (new) power stations
accept conserves fossil fuels

disadvantages

- large initial cost
accept expensive (to lay cables)
- power loss along a long cable
- (engineering) difficulties in laying / maintaining the cable
accept difficult to repair (if damaged)

6

[10]

45

- (a) (i) kinetic (energy)
allow gravitational potential (energy) / gpe
movement is insufficient

1

- (ii) dissipates into the surroundings
allow warms up the surroundings / air / motor
accept lost to the surroundings
accept lost as heat
ignore reference to sound
it is lost is insufficient

1

- (b) energy (required) increases with load

*accept positive correlation**do **not** accept (directly) proportional*

1

further amplification eg increases slowly at first (or up to 4 / 5 N),
then increases rapidly

*simply quoting figures is insufficient**an answer that only describes the shape
of the line gains no marks*

1

- (c) (i)
- $E = P \times t$

2880

*accept £28.80 for all **3** marks**an answer £2880 gains **2** marks**allow **1** mark for obtaining 48 h **or** converting to kW**allow **2** marks for correct substitution**ie $4 \times 48 \times 15$* *note: this substitution may be shown as two steps**an answer 2 880 000 gains **2** marks**an answer £4.80 / 480 gains **2** marks**an answer of 192 (ie calculation of energy without subsequent
calculation of cost) gains **1** mark)*

3

- (ii) any sensible suggestion eg

conserves fossil fuels

less (fossil) fuels burned

less pollutant gas (produced)

accept a named pollutant gas

less greenhouse gas (produced)

saves energy is insufficient

1

[8]**46**

- (a) 13 500 (J)

*allow **1** mark for correct substitution, ie $90 \times 10 \times 15$ provided no
subsequent step shown*

2

(b) 17

or

$$\sqrt{\frac{\text{their (a)}}{45}}$$

correctly calculated and answer given to 2 or 3 significant figures

*accept 17.3**allow 2 marks for an answer with 4 or more significant figures, ie 17.32***or***allow 2 marks for correct substitution, ie $13\,500 / \text{their (a)} = \frac{1}{2} \times 90 \times v^2$* **or***allow 1 mark for a statement or figures showing $KE = GPE$*

3

(c) work is done

1

(against) friction (between the miner and slide)

accept 'air resistance' or 'drag' for friction

1

(due to the) slide not (being perfectly) smooth

*accept miners clothing is rough***or**

causing (kinetic) energy to be transferred as heat/internal energy of surroundings

*accept lost/transformed for transferred**accept air for internal energy of surroundings*

1

[8]**47**

(a) (i) 0.6

or

60%

*allow 1 mark for correct substitution ie $\frac{720}{1200}$ provided no subsequent step shown**an answer of 0.6 / 60 with a unit gains 1 mark only**an answer of 60 gains 1 mark only*

2

(ii) heat

allow thermal

1

- (b) 12 000 p
or
 £120

to score both marks the unit must be consistent with the numerical answer

answers 12 000 and 120 gain 1 mark only

*allow 1 mark for correct substitution ie 800×15 **or** 800×0.15*

provided no subsequent step shown

2

[5]

48

- (a) can be replaced as fast / faster than it is used

accept will not run out

can be used again negates this mark

1

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

- reduce demand on power stations / National Grid (system)
- to increase the amount of electricity generated (from renewable energy)
- to conserve fossil fuels
accept use less fossil fuels
- plenty of animal waste / fuel (available)
accept so animal waste can be used usefully
accept to save money / sell the electricity
produces less harmful gases / SO_2 is insufficient
better for environment is insufficient

1

- (c) 60 (months) / 5 (years)

ignore any unit given

1

(d) *answers must be in terms of the biogas generator*

any **two** from:

- reliable energy source
or
does not depend on the weather
accept works all of the time
- uses up waste products
accept animal waste readily available
- not visually polluting
- concentrated energy source
- quieter
ignore it is renewable
*do **not** accept generates more electricity (than wind turbine)*

2

[5]**49**

(a) (i) 7.6

allow 1 mark for correct substitution and / or transformation

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

$$95 \times 8.0$$

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]

- 50** (a) (i) solar and wind
both required for mark either order 1
- (ii) 37(%)
*accept their **two** sources in a(i)*
correctly added as an error carried forward (ecf) 1
- (b) **A** 1
- (c) gas is non-renewable
*do **not** accept they are not all renewable*
statements such as gas produces CO₂ is neutral 1
- [4]**

- 51** (a) kinetic 1
- (b) (i) generates a lot more energy / electricity / power
need fewer conventional large-scale hydroelectric power stations is neutral
- or**
- can supply (energy / electricity / power) to more homes 1
- (ii) Large areas of land are flooded. 1
- (c) (i) National Grid
this answer only 1
- (ii) less energy / heat loss (from the cables)
accept wasted for loss
accept answers in terms of fewer transformers needed
*do **not** accept less electricity lost / wasted*
*do **not** accept no energy lost* 1

(d) any **one** from:

- fewer rivers (suitable for generators)
- less mountainous (so rivers fall smaller distances)
accept answers in terms of difficulty linking villages and towns to grid (in Nepal)
accept answers in terms of more isolated communities
accept answers in terms of UK having more resources for large-scale power stations

1

[6]

52

(a)

marks are awarded only for the reason but must match the ringed answer

*for both marks a **MAYBE** answer should include a **YES** and **NO** response answers in terms of the sources being renewable or non-renewable are insufficient*

any **two** from:

YES answers may include:

- wind produces no pollutant gases
accept wind burns no fuel
accept CO₂ / SO₂ / oxides of nitrogen / greenhouse gas for pollutant gases
- nuclear produces no pollutant gases
accept nuclear burns no fuel
- (burning) gas does not produce SO₂
accept gas does not cause acid rain
*do **not** accept they don't / none produce pollutant gases*

NO answers may include:

- nuclear produces radioactive waste
- (burning) gas produces CO₂ / pollutant gases / air pollution
accept contributes to global warming / greenhouse effect

2

- (b) nuclear power stations use a non-renewable fuel
accept uranium / plutonium is non-renewable
*do **not** accept some are unrenewable*

1

[3]**53**

- (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]

54

(a) 1 080 000

allow 1 mark for correct substitution

ie $\frac{1}{2} \times 15\,000 \times 12 \times 12$

2

(b) any **one** from:

- KE (of wind) more than doubles
- mass of air (hitting blades) more than doubles
- area swept out by blades more than doubles
do not accept blades are larger / have a bigger area
- area swept out by blades increases x 4

1

[3]

55

(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]

56

(a) (i) decommissioning

1

- (ii) level of radiation **or** radiation dose (to workers) decreased
accept the isotope / cobalt(-60) has decayed (a lot)
accept the isotope / cobalt(-60) has decayed in 2 half lives
accept exposed to less radiation
*do **not** accept no radiation left*

1

- less hazardous / dangerous (to workers' health)
accept safer
*do **not** accept there is no hazard*
accept allows reactor to cool (down)
an answer of radiation levels decrease by 75 % or drops to 25 %
*gains **2** marks*

1

- (b) (i) more in favour
or
 fewer against
quoting figures alone is insufficient
*do **not** accept it increases*
ignore any reasons given

1

- (ii) any **one** from:
- sample too small
 - do not know how many (people) were asked
 - different people asked (in different years)
 - sample not representative (of population)
 - people did not understand the questions
 - do not know who carried out the surveys
*do **not** accept they are biased unless acceptable reason for bias given*
 - do not know if surveys asked same questions

1

(iii) any **one** from:

- no / less pollutant gases produced
accept a named gas
accept does not contribute to global warming
- reliable source (of energy / electricity)
- running out of fossil fuels
accept a named fossil fuel
- conserve fossil fuels
accept fossil fuels won't have to be used
- meet increasing demand
- less reliance on imported fossil fuels / electricity
accept named fossil fuel
- concentrated energy source(s)
- lower transportation costs for fuel
- to replace old nuclear power stations
ignore references to efficiency / job creation / local economy / selling electricity

1

(c) economic issues

1

[7]

57

(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

(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]**58**

(a) (i) gas

1

(ii) one variable is categoric, the other is continuous

1

(iii) fuel is **not** burned

accept nothing is burned

*do **not** accept they don't use fossil fuels*

1

(b) (i) boiler

1

steam

1

turbine

1

generator

1

(ii) any **one** from:

- wind
accept wind turbines
- waves
- tidal
accept tide
- geothermal
- solar
accept the Sun / sunlight
accept solar panels / cells
*do **not** accept light*
- falling water
accept hydroelectric
*do **not** accept water*
*do **not** accept any named biofuel*

1

(iii) 18 000

*allow **1** mark for showing a correct method*
ie $36\ 000\ 000 \div 2\ 000$
*an answer of 0.018 gains **1** mark*

2

[10]

59

(a) (i) radiation

1

(ii) traps (small pockets of) air

*do **not** accept it's an insulator*
*do **not** accept reduces conduction and / or convection*
*do **not** allow it doesn't allow heat to escape*

1

(b) (i) bigger temperature difference (between the water and surroundings)
at the start (than at the end)

*do **not** accept water is hotter*

1

- (ii) starting temperature (of the water)
accept thickness of fleece
*do **not** accept same amount of fleece*
*do **not** accept thermometer / can*
*do **not** accept time is the same* 1
- (iii) 18 (°C)
correct answer only 1
- (iv) **M** 1
- smallest temperature drop (after 20 mins)
*cannot score if **M** is not chosen*
accept it's the best insulator
accept smallest loss in heat
accept keeps heat / warmth in for longer 1

[7]

60

- (a) transferred to surroundings / surrounding molecules / atmosphere
'it escapes' is insufficient
or
 becomes dissipated / spread out
accept warms the surroundings
accept degraded / diluted
accept a correct description for surroundings eg to the washing machine
*do **not** accept transformed into heat on its own* 1
- (b) a smaller proportion / percentage of the energy supplied is wasted
owtte
accept a statement such as 'less energy is wasted' for 1 mark
*do **not** accept costs less to run*
ignore references to uses less energy 2

(c) (i) 2.4 (p)

accept 2 p if it is clear from the working out this is rounded from 2.4 p

allow 1 mark for correct substitution of correct values

ie 0.2×12

allow 1 mark for calculating cost at 40 °C (13.2 p)

or

cost at 30 °C (10.8 p)

2

(ii) any **one** from:

- less electricity needed

ignore answers in terms of the washing machine releasing less energy

an answer in terms of the washing machine releasing CO₂ negates the mark

*do **not** accept less energy is produced*

- fewer power stations needed

- less fuel is burned

accept a correctly named fuel

*do **not** accept less fuel is needed*

1

[6]