Mark schemes

1 (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]

2 (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]

3 (a) 46 200

accept 46 000

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

ie 0.5 × 4200 × 22 provided no subsequent step

2

(b) Energy is used to heat the kettle.

1

[3]

4 (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 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

[8]

5   (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]

6 (a)   chemical

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]

7 (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 apply a 'best-fit' approach to the marking.

0 marks
No relevant information

Level 1 (1-2 marks)
There is a relevant statement about an energy saving method

Level 2 (3-4 marks)
There is at least one clear comparison of energy saving methods and their cost effectiveness with an appropriate calculation

Level 3 (5-6 marks)
There is a comparison of energy saving methods and their cost effectiveness with appropriate calculations. Comparison to include further detail.

examples of physics points made in the response

examples of relevant statements
• energy efficient boiler saves the most (energy / money) per year
• loft insulation costs the least to install
• double-glazing costs the most to install

examples of statements that include cost effectiveness
• loft insulation is the most cost effective in the long term
• double-glazing is the least cost effective
• loft insulation has the shortest payback time
• double-glazing has the longest payback time
• payback time calculated for any method

> *payback times:*
>
> *energy efficient boiler: 6.25 years*
>
> *loft insulation: 2 years*
>
> *double glazing: 100 years*
>
> *cavity wall insulation: 2.86 years*

examples of further detail
• for cost effectiveness install in the following order: loft, cavity wall, boiler, double-glazing
• for reducing energy use install in the following order: boiler, loft, cavity wall, double glazing
• don't install double-glazing for insulation purposes
• double-glazing won't pay for itself in your lifetime
• justified choice of best / worst method

6

(b) (i)   how effective a material is as an insulator

accept 'heat' for energy

accept how effective a material is at keeping energy in

accept the lower the U-value the better the insulator

accept the lower the U-value the lower the rate of energy transfer

1

(ii) (the U-value) decreases

1

[8]

8 (a) (i)   0.5 °C

1

(ii) data is continuous
or
both variables are continuous
or
independent variable is continuous
or
time is continuous

accept results / measurements for data

accept data is not categoric

one variable is continuous is insufficient

air temperature is continuous is insufficient

1

(b) (i)   20.5 (°C)

1

(ii) 60 (minutes)

accept 1 hour

1

(c) (i) so a comparison can be made
          or
          outside temperature is a control variable

          accept:
          (outside) temperature would affect energy required (to maintain
          temperature of the house)
          or
          (outside) temperature would affect internal temperature (of the
          house)
          or
          heat loss will be faster on a cold day

          outside temperature will affect the results is insufficient

          fair test is insufficient

          1

     (ii) the cost is equal to the number of kWh ✕ the cost per kWh

          accept (heating) bill depends on (number of) kWh used
          accept energy for kWh

          1

          calculation 0.8 / 8.0 = 0.1 or 10%

          allow 7.2 / 8.0 = 0.9 or 90%

          1

     (iii) heating is on for more / less time (than anticipated)

          1

          because some days it is cooler / warmer (than anticipated)

          accept other sensible suggestions
          *an answer giving two sensible situations gains **2** marks*
          possible examples:

          • *some houses have different amounts of*
             insulation

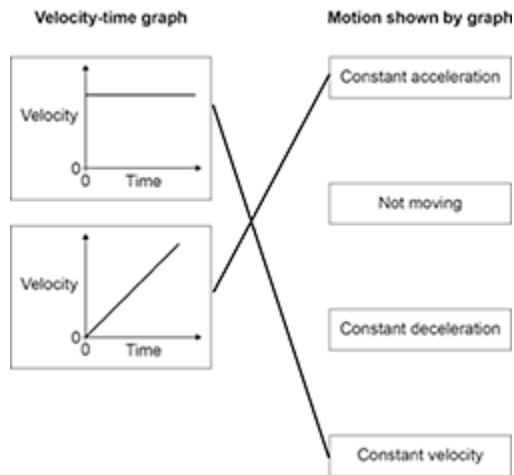   • *there are different styles of house*

          temperature (inside / outside) is always changing is insufficient

          1
                                                                          [9]

9 (a)

*if more than one line is drawn from a graph then all those lines are wrong allow **1** mark for 1 correct line*

2

(b) speed

1

(c) (i) 2.25

*allow **1** mark for correct substitution i.e.*

$$a = \frac{9-0}{4} \quad \text{or} \quad a = \frac{9}{4}$$

provided no subsequent step

2

(ii) the air resistance increases

1

(d) 2000 J

1

mass is half
or
kinetic energy depends on mass

*do **not** accept weight for mass*

1

[8]

10 (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]

11 (a) (i) electrical

correct order only

1

kinetic

1

sound

1

(ii) transferred into surroundings / atmosphere

accept warms the surroundings

allow released into the environment

becomes heat or sound is insufficient

1

(b) 0.7 / 70 %

*an answer of 70 without % or with the wrong unit **or** 0.7 with a unit gains **1** mark*

2

[6]

12 (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*

<div align="right">1</div>
<div align="right">[12]</div>

13 (a) (i) temperature (increase) and time switched on are <u>directly</u> <u>proportional</u>

>*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*

<div align="right">2</div>

(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

<div align="right">1</div>

(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]

14 (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
*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]

15 (a) (i) 5(.0)

1

(ii) 35 **or** their (a)(i) × 7 correctly calculated

*allow **1** mark for correct substitution, ie 5 **or** their (a)(i) × 7 provided no subsequent step shown*

2

(iii) 525(p)
or
(£) 5.25
or
their (a)(ii) × 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]

16   (a)   (matt) black is a good <u>emitter</u> 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 × 3 800 × 15*
>
> *answers of 851 200 **or** 737 200 gain **2** marks*
>
> *or*
>
> *substitution 2 × 3800 × 112 **or** 2 × 3800 × 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]

17 (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

[8]

18 (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* $\dfrac{35\,000}{175\,000}$

        *answers of 0.2% **or** 20 gain **1** mark only*

2

(c)   any **one** from:

- produces no (pollutant) gases
  or
  no greenhouse gases

          accept named gas

          accept no <u>air</u> 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]

19   (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 x 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 CO_2 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]

20   (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]

21   (a)   (i)

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

1.6 (W)

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

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:

• 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]

22 (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]

23 (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

  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]

24   (a)   (i)   0.6
              or
              60<u>%</u>

*allow **1** mark for correct substitution ie $\dfrac{720}{1200}$ 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]

---

25 (a)　(i)　7.6

> *allow **1** mark for correct substitution and / or transformation*
>
> *ie* $0.95 = \dfrac{x}{8}$
>
> *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]

---

26 (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]

27   (a)   (i)   kinetic

accept KE

*do **not** accept movement*

1

      (ii)   0.75

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

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 <u>and</u> 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]

28   (a)   heat / thermal
or / and
sound
  *do **not** accept noise*
  other forms of energy eg light negates answer

1

(b) 0.4
    or
    40 %

$$\text{allow } \textbf{1} \text{ mark for } \frac{2000}{5000}$$

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]

29 (a) (i) 4

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

$$\text{ie } \frac{0.6}{0.15}$$

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]

30   (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]

31 (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 <u>proportion / percentage</u> 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 CO_2 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]

32 (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]

33 (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

(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]

34 (a) (i) silvered surfaces

      more than the correct number of ticks in a row negates the mark

radiation

2

plastic cap

conduction, convection (both required)

	conduction	convection	radiation	
vacuum	✔	✔		
silvered surfaces			✔	(1)
plastic cap	✔	✔		(1)

(ii)

      any mention of air or any other substance in a vacuum scores zero

because there are no particles in a vacuum

      accept atoms / molecules for particles

      accept vacuum is empty space

      accept there is nothing in a vacuum

      accept there is no air / gas in the vacuum

conduction **and** convection need particles / medium

      *need reference to both conduction **and** convection*

      accept correct descriptions

2

(b) (i) less heat lost (to air above the heater)

> *do **not** accept **no** heat lost*

light shiny surfaces are poor emitters (of radiation)

> *accept radiators for emitters*
> *references to reflection are neutral*

or dull, matt surfaces are good emitters (of radiation)

> *do **not** credit answers which infer reflection from the underside of the hood*
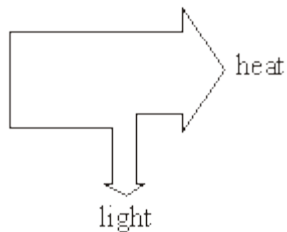> *ignore correct reference to absorption*

2

(ii) correct diagram drawn with one output arrow narrower than the other

> *ignore input*

arrows correctly labelled with energy form
eg

> *flow charts score zero*

2

(iii) energy cannot be destroyed

> *accept (principle of) conservation of energy*
> *do **not** accept because energy cannot be lost without clarification*

1

[9]

35 (a) 32,400,00 J

> *allow **1** mark for correct substitution*
> 3.24×10^{7} J

2

(b) (3kW) fan heater

> *accept 3kW*
> *accept the middle one*

1

(c)

features common to more than one heater, treat as neutral

<u>oil-filled</u>

low level heat

cannot be knocked over / space saving / no trailing wires
> *do **not** accept just wall-mounted*

or more control over heat output
> *do **not** accept just 3 heat settings*

1

<u>fan</u>

warms (office) rapidly **or** can be used to cool air (in summer)
> *accept can be used as a fan*
> *accept cool air fan (setting)*
> *accept 'it has a cool air setting in case it gets too hot'*
> *do **not** accept a specific reference to cooling the heater*

1

<u>ceramic</u>

can be switched on for set periods of time
> *do **not** accept just has a timer*

or can be switched on before office is used / switched off automatically at night

1

[6]

36 (a) electrical

1

sound
> *correct order only*

1

(b) the energy transformed by the TV will be destroyed

1

(c) a higher efficiency than

1

[4]

37 (a) (i) 0.6

accept 60 %
*allow **1** mark for useful energy = 480*
*answer 0.6 with any unit or 60 gains **1** mark only*

2

(ii) transferred to surroundings

accept goes into the air
accept heats the surroundings up
accept gets spread out
accept transferred into heat (only)

*do **not** accept wasted / lost unless qualified*
destroyed negates mark
transferred into light / sound negates mark

1

(b) (i) 1.75

*allow **1** mark for converting to kW*
*answers of 0.7, 0.525, 0.35, 0.875, 1.05, 5.25 gains **1** mark*
*answers of 1750 or 17.5 gains **1** mark*

2

(ii) 21p or £0.21 or their (b)(i) × 12

1

(c) any **two** from:

- (more) electricity needs to be generated

    (more) electricity is being used

- (more) power stations needed

- (more) fossil fuels burnt

    accept named fossil fuel

- (more) pollutant gases emitted

    accept named gas
    accept harmful for pollutant
    accept greenhouse gases
    accept atmospheric pollution

    accept answer in terms of any form of electricity generation and an associated environmental problem

2

[8]

38 (a) £15

*allow **1** mark for use of 125 (kWh)*
*allow **1** mark for an answer 1500*
*allow **both** marks for 1500 pence / p*
*allow **1** mark for correct calculation of annual cost for either freezer*
(£27 and £42)

2

(b) £45

or their (a) × 3

*allow **1** mark for correct use of 3*
*allow **1** mark for 12 − 9 = 3*

2

(c) <u>any</u> **two** from:

the marks are for the explanation

yes **plus** explanation

- less electricity / energy needed / used
  accept less energy wasted

- less (fossil) fuels burned
  accept a named fossil fuel
  *do **not** accept conserving (fossil) fuels*

- less polluting gases emitted
  accept a named polluting gas / greenhouse gases / carbon
  emissions / reduce global warming
  accept an answer in terms of nuclear fuel
  eg   less nuclear fuel required (1)
  *   less nuclear waste (1)*

2

or <u>no</u> **plus** explanation

- old freezer must be disposed of

- hazardous chemicals inside freezer
  accept CFC gases

- *(*lot of*)* energy used in producing new freezer

[6]

39 (a) (i) makes it warmer / raises the temperature

accept produces convection (current)

accept makes it less dense

1

(ii) reduced **or** slows down

1

(b) (i) electrical energy (to run the pump) must be paid for

accept electricity for electrical energy

accept electricity is needed for the pump

accept it uses electricity

accept because of the pump

1

(ii) more useful (heat) energy is transferred into the house than the energy used to operate the pump

or reduced cost of heating the house is greater than the cost of running the (electrical) pump

or costs little to run compared to the savings made

*accept for **1** mark*

reduces energy bills

***or** reduced fuel costs / heating costs owtte*

*do **not** accept it's cheap*

2

[5]

40 (a) iron

1

hairdryer

1

kettle

answers can be in any order

1

(b) sound

1

(c) is more efficient than

1

[5]

41 (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]

42 (a) kinetic

accept movement

1

(b) (i) 3 (kWh)

allow 1 mark for selecting the correct information

1

(ii) transfers more energy

accept transform or use for transfer

accept electricity for energy

*allow higher (average) power **and** switched on for more time*

2

(iii) any **one** from:

- use the internet

- brochures

- reading adverts

- visiting shops

- recommendation from friends / plumbers

1

[5]

43 (a) (i) as a source of thermal <u>radiation</u>

accept heat for thermal radiation

accept to act as the Sun

*do **not** accept sunlight alone*

1

(ii) any **one** from:

- volume of water

  accept amount for volume

- distance between lamp and boiling tube

- initial / starting temperature of water

- same room temperature

  *do **not** accept time or same insulation material*

1

(iii) any **one** from:

- greater sensitivity / precision

  *do **not** accept more reliable (negates mark)*

- could link to a computer for (automatic) data analysis

- could take more frequent readings

- reduces instrument reading error

  accept more accurate

  *do **not** accept easier to use on its own*

1

(b) (i) acts as a control

accept to be able to make a comparison

accept to see the difference

*do **not** accept 'to make it a fair test' OWTTE on its own*

1

(ii) (plastic) <u>foam</u> and aluminium foil

1

(iii) (aluminium) <u>foil</u> is a <u>poor</u> absorber of thermal radiation

accept heat / infra red for thermal radiation

1

or (aluminium) <u>foil</u> is a (good) reflector of thermal radiation

*do **not** accept 'reflects sunlight' on its own*

(plastic) <u>foam</u> traps air which is a (good) insulator

accept (plastic) foam is a poor conductor / (good) insulator

*do **not** accept 'the material' is a good insulator / poor conductor*

1

(c) particles vibrate with a bigger / stronger amplitude / faster / with more (kinetic) energy

accept particles vibrate more

*do **not** accept <u>start</u> to vibrate only*

1

energy transferred by <u>collisions</u> with other particles

*do **not** accept answers in terms of*

free/mobile electrons

1

[9]

44 (a) (i) 7pm

accept 19.00 / 1900

1

(ii) 8pm

accept 20.00 / 2000

1

temperature drops more slowly

accept heat for temperature accept line is less steep

1

(b)   insulator

1

conduction *

1

convection *

        * answers can be either way around

1

(c)   (i)   4 (years)

1

    (ii)   it is the cheapest / cheaper / cheap

        do **not** accept answers in terms of heat rising or DIY

1

has the shortest / shorter payback time

        do **not** accept short payback time

1

[9]

45   (a)   four calculations correctly shown

        $200 \times 10 - 1800 = £200$
        $100 \times 10 - 2400 = -£1400$
        $50 \times 10 - 600 = -£100$
        $20 \times 10 - 75 = 125$

        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]

46   (a)   (i)   heat

1

(ii)   temperature increases **or** (cause) convection (currents)

accept gets warmer
accept gets hotter

1

(iii)   60% **or** 0.6

60 without % scores 1 mark
0.6 with a unit scores 1 mark
60 with incorrect unit scores
1 mark

or correct substitution $\frac{120}{200}$
for 1 mark

2

(b)   street

1

more (energy transferred as) light or less (energy transferred as) heat or useful energy output the highest

can only score this mark if first mark scored

all efficiencies calculated correctly score 2nd mark point

1

[6]

47 (a) generator

accept dynamo
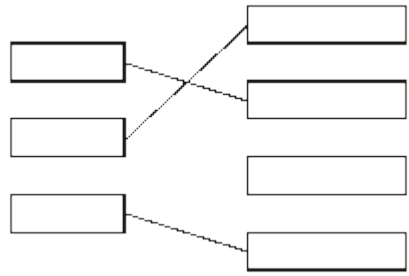*accept alternator*

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

[10]

48 light;
sound;
heat;
kinetic/movement

for 1 mark each

[4]

49 (a) insulation

allow example e.g fibreglass

1

double glazing

allow curtains

1

draught excluder

allow double glazing / close fitting door

allow turning down thermostat once only / turn down the heating

1

(b) transfers more useful energy

allow converts more energy into light / less into heat / less energy wasted

1

[4]

50 (a) 60% sector correct
other two sectors closer to 13:7 than 12:8 or 14:6
sectors correctly labelled (w.r.t rank order of size)

each for 1 mark

3

(b)　(i)　*ideas that wasted energy*
　　　　is transferred to　　surrounding air
　　　　　　　　　　　　　　　　pan
　　　　　　　　　　　　　　　　stove
　　　　is converted to another/correctly named energy form
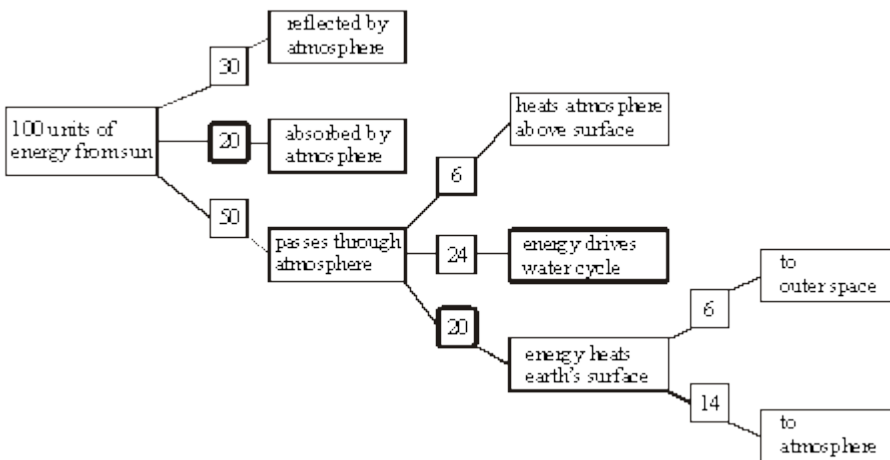　　　　　　　*any 2 for 1 mark each*

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　2

　　(ii)　40

　　　　　　for 1 mark

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　1
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　[6]

51

　　　　each for 1 mark
　　　　allow 'error carried forward' to the last box'

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　[3]