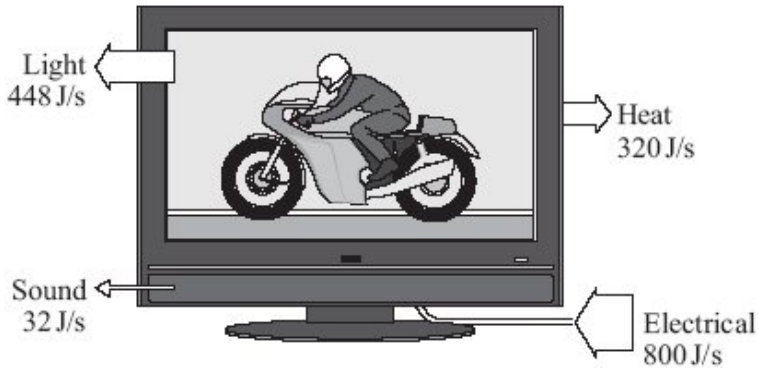
Q1. (a) The diagram shows the energy transformations produced by a TV.



(i) Use the information in the diagram and the equation in the box to calculate the efficiency of the TV.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....

.....

Efficiency = ...

(2)

(ii) What eventually happens to the useful energy transferred by the TV?

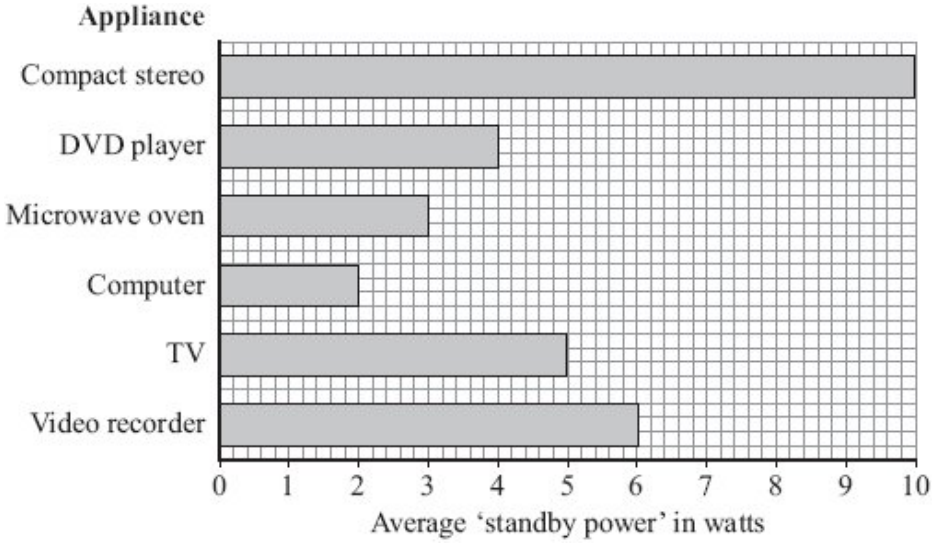
.....

.....

(1)

(b) Electrical appliances left on standby use energy.

The bar chart shows the power for the appliances that one family leaves on standby when they go on holiday.



The family is on holiday for a total of 175 hours.

(i) Use the information in the bar chart and the equation in the box to calculate the energy wasted by leaving the compact stereo on standby while the family is on holiday.

energy transferred (kilowatt-hour, kWh)	=	power (kilowatt, kW)	×	time (hour, h)

Show clearly how you work out your answer.

.....

.....

Energy wasted = ... kilowatt-hours

(2)

(ii) Electricity costs 12 p per kilowatt-hour.

Use the equation in the box to calculate the cost of leaving the compact stereo on standby while the family is on holiday.

total cost = number of kilowatt-hours × cost per kilowatt-hour

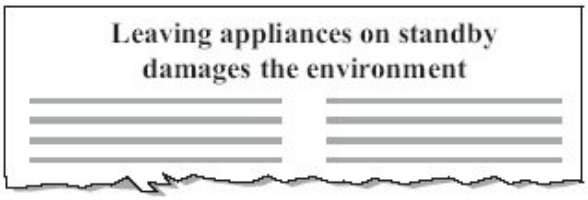
Show clearly how you work out your answer.

.....

Cost = ... p

(1)

(c) A headline from a recent newspaper article is shown below.



Explain why leaving appliances on standby damages the environment.

.....

.....

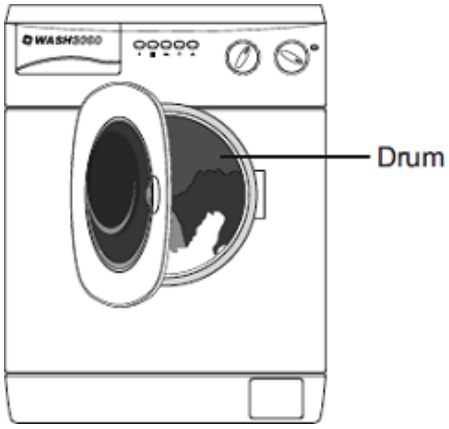
.....

.....

(2)

(Total 8 marks)

Q2. The picture shows a washing machine. When the door is closed and the machine switched on, an electric motor rotates the drum and washing.



(a) Complete the following sentences.

(i) An electric motor is designed to transform electrical energy into

..... energy.

(1)

(ii) Some of the electrical energy supplied to the motor is wasted as

..... energy and ..... energy.

(1)

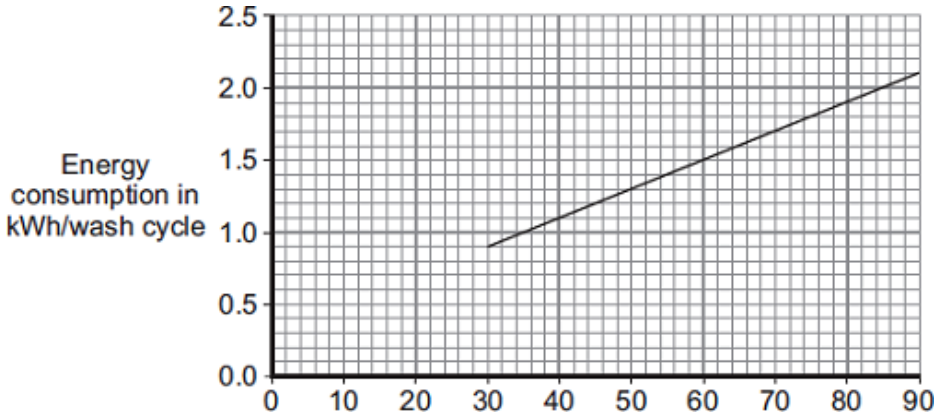
(b) What happens to the energy wasted by the electric motor?

.....

.....

(1)

(c) The graph shows that washing clothes at a lower temperature uses less energy than washing them at a higher temperature. Using less energy will save money.



(i) Electricity costs 15p per kilowatt-hour (kWh).

The temperature setting is turned down from 40 °C to 30 °C.

Use the graph and equation in the box to calculate the money saved each wash cycle.

total cost = number of kilowatt-hours x cost per kilowatt-hour

Show clearly how you work out your answer.

.....

.....

Money saved = ...

(2)

(ii) Reducing the amount of energy used by washing machines could reduce the amount of carbon dioxide emitted into the atmosphere.

Explain why.

.....

.....

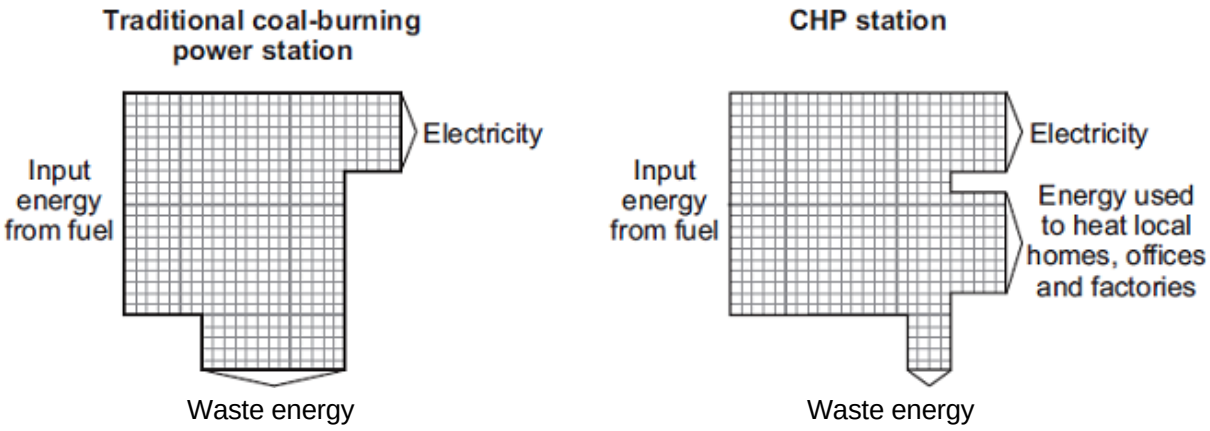
.....

.....

(2)

(Total 7 marks)

Q3. The Sankey diagrams show the energy transfers in a traditional coal-burning power station and a combined heat and power (CHP) station.



(a) What effect does the waste energy from a power station have on the surroundings?

.....

.....

(1)

(b) Calculate the efficiency of the CHP station.

Use the correct equation from the Physics Equations Sheet.

.....

.....

.....

Efficiency = ...

(2)

(c) Why is a CHP station more efficient than a traditional coal-burning power station?

.....

.....

.....

.....

(2)

(d) A CHP station is usually used to meet the demand for electricity within the local area. The electricity is not transmitted and distributed through the National Grid.

(i) What is the National Grid?

Tick (✓) **one** box.

A system of cables and pylons. ☐

A system of cables and transformers. ☐

A system of cables, transformers and power stations ☐

(1)

(ii) Using the electricity locally and not transmitting it through the National Grid increases the overall efficiency of a CHP station by 7%.

Give **one** reason why.

.....

.....

(1)
(Total 7 marks)

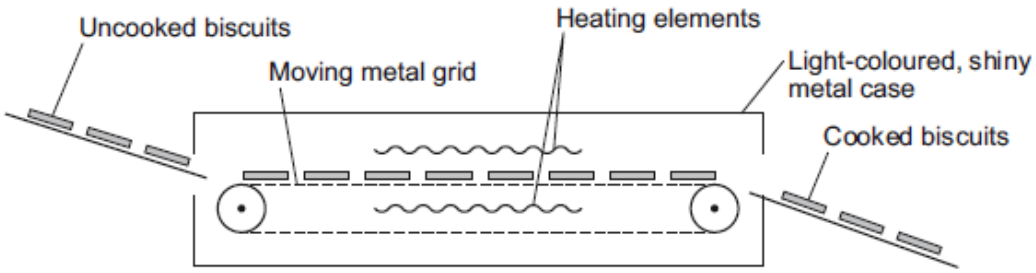
Q4. **Figure 1** shows one way that biscuit manufacturers cook large quantities of biscuits.

The uncooked biscuits are placed on a moving metal grid.

The biscuits pass between two hot electrical heating elements inside an oven.

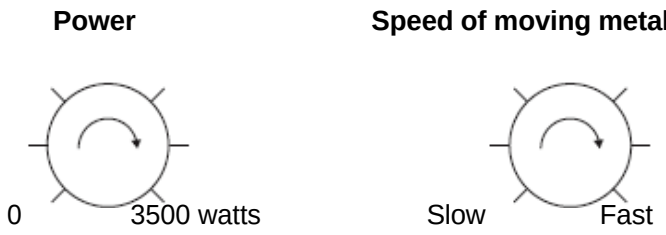
The biscuits turn brown as they cook.

Figure 1



The oven has two control knobs, as shown in **Figure 2**.

Figure 2



(a) Which type of electromagnetic radiation makes the biscuits turn brown?

.....

(1)

(b) Suggest **two** ways of cooking the biscuits in this oven, to make them turn browner.

1 .....

.....

2 .....

.....

(2)

(c) The inside and outside surfaces of the oven are light-coloured and shiny.

Explain why.

.....

.....

.....

.....

.....

.....

(3)
(Total 6 marks)

Q5. A homeowner had a new gas boiler installed.

(a) The following information is an extract from the information booklet supplied with the boiler.

Fuel	Natural Gas
Water temperature	60 °C
Energy supplied to gas boiler	8.0 kJ/s (8.0 kW)
Efficiency	0.95

(i) Use the equation in the box to calculate the energy transferred each second by the gas boiler to the water inside the boiler.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

.....

.....

Energy transferred by the gas boiler each second = ... kJ

(2)

(ii) The energy value of the gas used in a home is measured in kilowatt-hours (kWh).

The homeowner has a pre-payment meter and pays £30 into his account. With a pre-payment meter, gas costs 15p per kilowatt-hour.

Use the equations in the box to calculate the total number of hours that the gas boiler would operate for £30.

energy transferred = power × time
total cost = number of kilowatt-hours × cost per kilowatt-hour

Show clearly how you work out your answer.

.....

.....

.....

.....

Number of hours = ...

(2)

(b) Although the gas boiler is very efficient, some energy is wasted.

Explain what happens to the waste energy.

.....

.....

.....

.....

(2)
(Total 6 marks)

Q6. Describe, in as much detail as you can, how the energy stored in coal is transferred into electrical energy in a power station.

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total 5 marks)

Q7. (a) Nuclear fuels and the wind are two of the energy sources used to generate electricity in the UK.

Explain the advantages of using energy from nuclear fuels to generate electricity rather than using energy from the wind.

Include in your answer a brief description of the process used to generate electricity from nuclear fuels.

.....

.....

.....

.....

.....

.....

.....

.....

(4)

(b) In the UK, most electricity is generated in power stations that emit carbon dioxide into the atmosphere. The impact of these power stations on the environment could be reduced by the increased use of 'carbon capture' technology.

Describe how 'carbon capture' would prevent the build-up of carbon dioxide in the atmosphere.

.....

.....

.....

.....

.....

(2)
(Total 6 marks)

Q8. (a) Solar energy is a *renewable* energy source that can be used to generate electricity.

(i) What is meant by an energy source being *renewable*?

.....

(1)

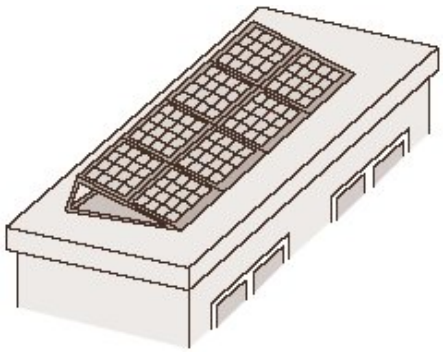
(ii) Name **two** further renewable energy sources used to generate electricity.

1 .....

2 .....

(1)

(b) A householder uses a bank of solar cells to generate electricity for his home.
The solar cells are tilted to receive the maximum energy input from the Sun.



The data in the table gives the average energy input each second (in J/s), to a 1 m^2 area of solar cells for different angles of tilt and different months of the year.

Month	**Angle of tilt**			
	20°	30°	40°	50°
February	460	500	480	440
April	600	620	610	600
June	710	720	680	640
August	640	660	640	580
October	480	520	500	460
December	400	440	420	410

(i) Use the data in the table to describe how the average energy input to the solar cells depends on the angle of tilt.

.....

.....

.....

.....

(2)

(ii) The bank of solar cells used by the householder has an area of 8 m^2.

The efficiency of the solar cells is 0.15

Use the equation in the box to calculate the average **maximum** electrical energy available from the bank of solar cells each second in June.

$$\text{efficiency} = \frac{\text{useful energy transferred by the device}}{\text{total energy supplied to the device}}$$

Show clearly how you work out your answer.

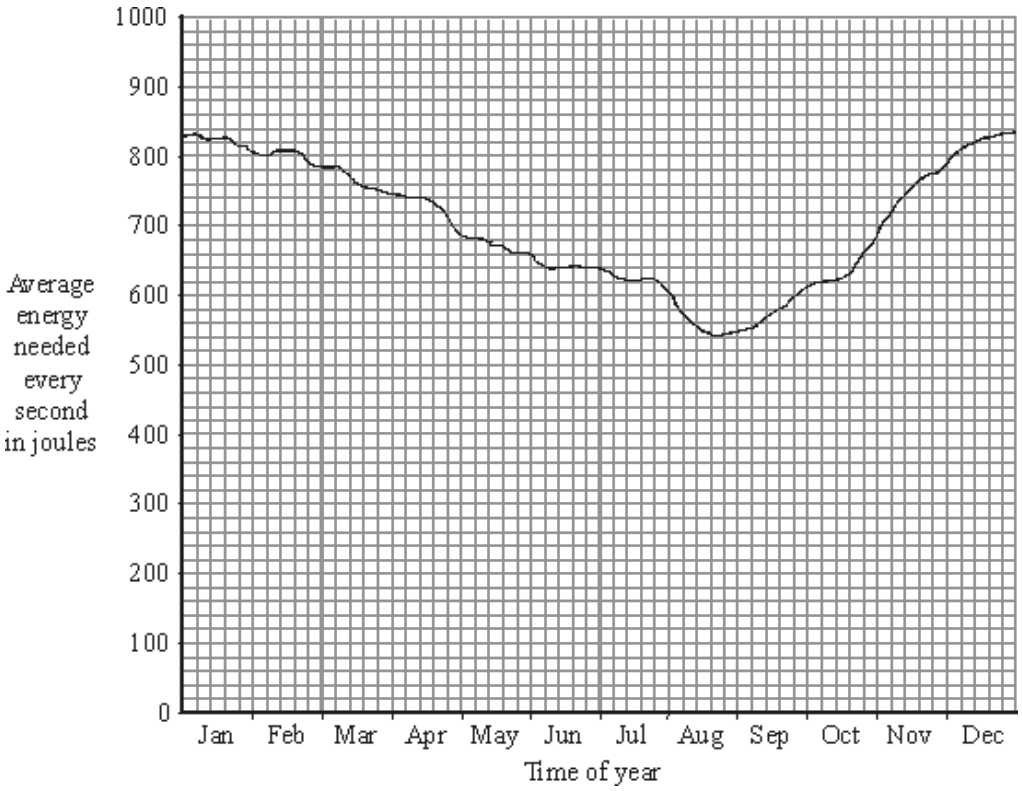
.....

.....

Maximum energy = ... joules/second

(3)

(c) The graph shows how the householder's electrical energy needs change over one year.



Why would it be advisable for the householder to remain connected to the National Grid?

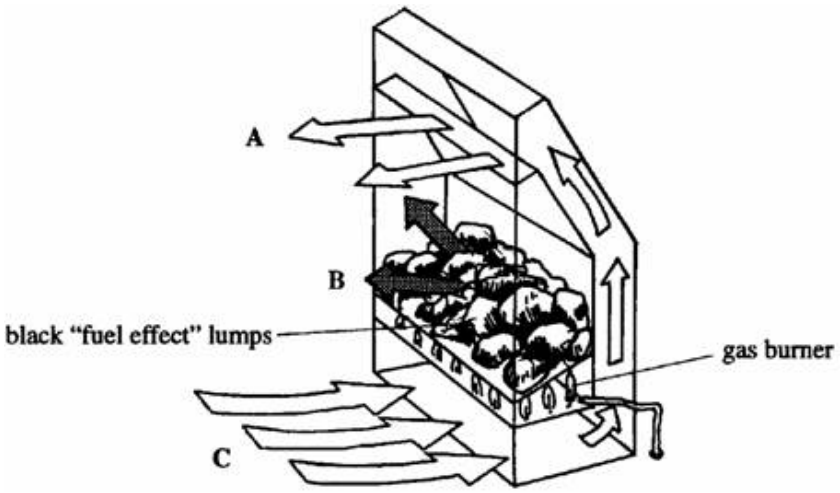
.....

.....

(1)

(Total 8 marks)

Q9. The diagram comes from a leaflet about a "coal effect" gas fire.
It shows how air circulates through the fire.



(a) Explain in detail why the air travels from **C** to **A**.

.....

.....

.....

.....

.....

.....

(4)

(b) The black “fuel effect” lumps become very hot.

(i) Name the process by which the lumps transfer thermal energy to the room as shown at **B**.

.....

(1)

(ii) Suggest **one** feature of the black “fuel effect” lumps which make them efficient at transferring energy.

.....

.....

(1)

(Total 6 marks)

M1. (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]

M2. (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]

M3. (a) warms it

*do **not** accept answers in terms of waste gases **or** pollution*

1

(b) 80% **or** 0.8

*answers of 80 **or** 0.8 plus a unit gain **1** mark **only***
***or** allow **1** mark for a correct substitution, ie* $\frac{16}{20}$
*an answer of 35% **or** 0.35 gains **1** mark*
*answers of 85%, 75%, 0.85 **or***
*0.75 gain **1** mark*

2

(c) some of the energy that would be wasted (by a coal-burning power station)

accept less waste energy

1

is usefully used (to heat homes etc)

accept energy used to heat homes etc

1

(d) (i) A system of cables and transformers

1

(ii) less energy / power loss / wasted (in shorter cables)

accept no energy / power loss / wasted (in shorter cables)
accept energy is lost when transmitted through cables
*do **not** accept electricity for energy*

1

[7]

M4. (a) infrared / IR

correct answer only

1

(b) any **two** from:

- increase the power / watts

  allow increase the temperature of the oven or make the oven hotter
- decrease the speed

  allow leave the biscuits in for longer
- put biscuits through again

  increase radiation is insufficient
  ignore changes to the design of the oven

2

(c) (inside) surface is a (good) reflector or poor absorber (of IR)

Ignore bounce for reflect
surface is a (good) reflector of light does not score
surface is a (good) reflector of light and infrared / heat does score

1

(and) <u>outside</u> surface is poor emitter (of IR)

1

(so) increases the energy reaching the biscuits

allow reduces energy loss or makes oven more efficient
*do **not** accept no energy losses*
keeps oven hotter is insufficient

1

[6]

M5. (a) (i) 7.6

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

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

95 × 8.0

2

(ii) 25 (hours)

*allow **1** mark for obtaining number of kWh = 200*

an answer of 26(.3) gains both marks

2

(b) any **two** from

- transferred to the surroundings / air / atmosphere
- becomes spread out
- shared between (many) molecules
- (wasted as) heat / sound

2

[6]

M6. coal has chemical energy
when burnt heat/energy produced longest
used to boil water/make steam sequence
used to turn turbine(s)
which now have ke
turbine(s) turn generator(s)
(where (ke) transferred electrical energy)
(or electrical energy produced)

any 5 for 1 mark each

[5]

M7. (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]

M8. (a) (i) replaced faster than it is used

accept replaced as quick as it is used
accept 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(*)
  *(*)do **not** accept water / oceans*
  accept OTEC
- fall of water
  accept hydroelectric
- biomass
- geothermal
  accept a named biomass / biofuel eg wood

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) 864

*an answer of 108 gains **2** marks*
*allow **1** mark for using 720 value only from table*
*allow **2** marks for answers 852, 816, 768, 825*
*allow **1** mark for answers 106.5, 102, 96, 103 (.125)*

3

(c) the solar cells will not meet demand at all times of the year / day
accept to maintain a constant supply of electricity / energy

or to make up the shortfall in energy required at certain times of the year

or to be able to sell surplus electricity (to the National Grid)
accept to provide energy at night
*do **not** accept because it's cloudy on it's own*

1

[8]

M9. (a) convection
air is heated by the burner / particles gain energy
air expands / particles move about more / particles move faster
air becomes less dense / particles are more spread out
air rises / particles rise - *not* heat rises
air from C moves into the heater / particles from C move into the heater to replace it / them
any four *for 1 mark each*

4

(b) (i) radiation
for one mark

1

(ii) black surface radiates / emits well
(*allow* absorbs and emits well) (*allow* comparison with shiny / white surfaces)

large surface area needed
high temperature (of the lumps)
any one for 1 mark

1

[6]