**M1.**(a)     (i)       77

**1**

(ii)     Oil

**1**

(b)     water

*accept H2O*

**1**

(c)     Carbon dioxide causes global warming

**1**

**[4]**

**M2.**          (a)     (i)      any **one** from:

•        waves

*do* ***not*** *accept water*

•        tides

•        falling water

*accept hydroelectric*

•        biofuel / biomass

•        solar

*accept sun / sunlight
do* ***not*** *accept light
accept solar cells / panels*

•        geothermal

*do* ***not*** *accept heat*

**1**

(ii)     decrease

**1**

(b)     (i)      increases from 4am (to 8am) remains constant from 8am (to 10am)

*accept increases from 30 000*

*accept stays constant from 40 000*

*allow* ***1*** *mark for goes up then stays the same*

*for full credit must be some indication of time or power*

**2**

(ii)     natural gas

**1**

**[5]**

**M3.**         (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]**

**M4.**                          3
20            0.3

*each for 1 mark*

**[3]**

##

          (a)     sectors nearer to correct value than to 1% either side
coal                      35%
nuclear                  5%
gas                       24%
moving water        1%

*each for 1 mark -
to a maximum of 3 marks
deduct 1 mark if sector left blank*

three sectors labelled correctly w.r.t. rank order of size

*for 1 mark*

**4**

(b)     (fossil) fuels (*allow* combustible/flammable/non renewable)

**1**

(c)     moving water/hydro
wind/waves/tides/solar (*allow* geothermal/
wood/biomass)

*each for 1 mark*

**2**

(d)     any indication that we get more (energy from nuclear sources)

*gains 1 mark*

          **but**5 times  as much/more

*gains 2 marks*

**2**

**[9]**

**M6.**          (a)     only accept answers in terms of the argument of the nuclear power scientist any **three** from:

•        produces a lot of energy for a small mass of fuel **or** is a concentrated energy source

*accept amount for mass*

•        it is reliable **or** it can generate all of the time

•        produces no pollutant gases

*accept named gas or greenhouse gases do* ***not*** *accept no pollution*

•        produces only a small volume of (solid) waste

*accept amount for volume*

•        advances in technology will make fuel reserves last much longer

*accept an argument in terms of supply and demand*

**3**

(b)     any **one** from:

•        may leak into the ground / environment

•        geological changes

*accept earthquakes etc*

•        may get into the food chain

*do* ***not*** *accept answers in terms of property prices or ‘damages the environment’*

•        over time if location not correctly recorded it may be excavated

**1**

(c)     any **three** from:

•        overall add no carbon dioxide to the environment

*accept do not add to global warming*

*accept they are carbon neutral*

•        power companies can sell electricity at a higher price

*accept power companies make more profit*

•        opportunity to grow new type crop

*accept specific examples e.g. growing plants in swamps*

*accept extends the life of fossil fuel reserve*

•        more jobs

•        more land cultivated **or** different types of land utilised

**3**

**[7]**

**M7.**

*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]**

**M8.**(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**

**[4]**

**M9.**          (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]**

**M10.**          (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*

*power = *

*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]**

**M11.**(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]**

**M12.**(a)     (i)      high levels of infrared radiation (from the Sun)

*allow lots of (solar) energy (available)*

*do* ***not*** *accept ‘heat’ for infrared*

*‘it is hot’ is insufficient
‘lots of sunlight’ is insufficient*

**1**

(ii)     reflected

**1**

(iii)    boiler

*correct order only*

**1**

turbine

**1**

transformer

**1**

(b)     2 100 000 (kWh)

*allow* ***1*** *mark for correct substitution i.e. 140 000 × 15 provided no subsequent step*

**2**

(c)     (i)      only 1 wind turbine was considered

*accept only one location is considered*

**1**

**or**

other wind turbines may have generated more electricity

*accept insufficient sample size*

only 1 week’s weather was reported on

**or**

wind speed varies from one week to another

*‘wind speed varies’ is insufficient*

**1**

(ii)     any **one** from:

•        wind speed is too high / low

*allow no wind
allow too windy*

•        wind is unreliable.

*allow wind is variable*

**1**

(iii)    any **one** from:

•        wind is a renewable energy source

•        do not use fuel

•        energy source is free

•        do not release carbon dioxide

•        do not release greenhouse gases

•        do not release sulfur dioxide

•        do not cause acid rain

•        do not cause climate change

•        do not cause global warming

•        do not cause global dimming.

*answer must be an advantage of wind, converse answers in terms of fossil fuels are insufficient*

*accept do not release pollutant gases*

*‘no pollution’ is insufficient*

**1**

**[11]**

**M13.**        (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]**

**M14.**(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](../resources/AG_BL/menus/Markingguidance.pdf), 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]**

**M15.**(a)     (i)      water

**1**

heated

*accept boiled or turned to steam*

*do* ***not*** *accept evaporated*

**1**

generator

**1**

(ii)     geothermal power stations provide a reliable source of electricity

**1**

(b)     falling water

**1**

**[5]**

**M16.**          (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]**

##

          (a)     cooking and heating water 30
heating rooms 50

*each for 1 mark*

**2**

(b)     coal
*idea that* amount used fell/declined/line goes down

*gains 1 mark*

          **but** *idea that* fall/decline is steady/gradually/approx halved

*gains 2 marks*

          gas
*ideas that*amount used rose/increased
in/from 1980/more used before 1980/ref to 1980
        as an important date/*rapid* increase in use
(*credit idea that* gas>coal from c.1990
*in either part with 1 mark (to maximum 4)*

*each for 1 mark*

**max 4**

(c)     •    *less* carbon dioxide produced

•        less change to weather/food production/gained
warming/water levels (no mark for “greenhouse gas” alone)

•        no/less sulphur dioxide produced/coal produces sulphur dioxide

•        less acid rain/damage to fish/buildings/trees/crops/animals/tumours etc
(do not credit reference to cost unless : cheaper so can spend more on environment)

*(“It” used in an answer will refer to “gas”) any 3 for 1 mark each*

**3**

**[9]**