

# National and Global Energy Resources

## Mark Scheme 1

<b>Level</b>	GCSE (9-1)
<b>Subject</b>	Combined Science: Trilogy - Physics
<b>Exam Board</b>	AQA
<b>Topic</b>	6.1 Energy
<b>Sub-Topic</b>	National and Global Energy Resources
<b>Difficulty Level</b>	Silver Level
<b>Booklet</b>	Mark Scheme 1

**Time Allowed:** 60 minutes

**Score:** /59

**Percentage:** /100

**Grade Boundaries:**



- M1.(a)** the store of chemical energy (in the battery) decreases 1
- the internal energy of the surrounding air increases. 1
- accept description of energy becoming less usefully stored for 2 marks*
- (b) kinetic energy =  $\frac{1}{2} \text{ mass} \times \text{velocity}^2$  1
- (c)  $E_k = \frac{1}{2} \times 0.8 \times 12^2$  1
- $E_k = 57.6 \text{ (J)}$  1
- allow 57.6 (J) without working shown for 2 marks*
- (d) lower proportion of wasted energy  
*accept less energy is wasted* 1
- higher proportion of energy is converted into kinetic energy  
*accept more kinetic energy* 1
- (e) **Level 2 (3–4 marks):**  
A relevant and coherent argument which demonstrates processing and numerical analysis of the information presented and draw a conclusion which is logically consistent with the reasoning and refers to payback time for the vehicles.
- Level 1 (1–2 marks):**  
Simple comparisons are made which demonstrate a basic ability to numerically analyse



the information presented. The conclusion, if present, may not be consistent with the calculations.

**0 marks:**

No relevant content

**Indicative content**

- The electric car costs £12 000 more to buy
- Running cost of electric car = £3 000
- Running cost of petrol engine car = £24 000
- Total cost of electric car = £30 000
- Total cost of petrol engine car = £39 000
- The electric car cost £1 750 less to run each year
- The electric car will save £9 000
- Additional cost is covered in 6.9 years
- So the electric car will be cheaper over the 12 year lifetime

**or**

Electric

$$27000 / 12 = 2250$$

$$\text{Annual cost} = 2250 + 250 = 2500$$

Petrol

$$15000 / 12 = 1250$$

$$\text{Annual cost} = 1250 + 2000 = 3250$$

So electric is £750 cheaper per year

4

[11]

**M2.(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]

**M3.(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 CO<sub>2</sub>

*accept greenhouse gas*  
*accept sulfur dioxide*

1

(CO<sub>2</sub>) contributes to global warming

*accept climate change for global warming*



*accept greenhouse effect if CO<sub>2</sub> 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]

**M4.(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  
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]

- M5.** (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*

6

(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]

**M6.**

(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 CO<sub>2</sub>*
  - 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*
- CO<sub>2</sub> 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)*



**M7.** (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<sub>2</sub> 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]