Paper One Extended Writing

Name: _____

Class: _____

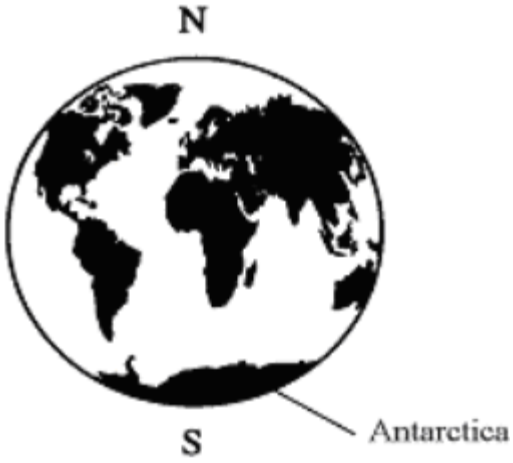
Date: _____

Time: **53 minutes**

Marks: **53 marks**

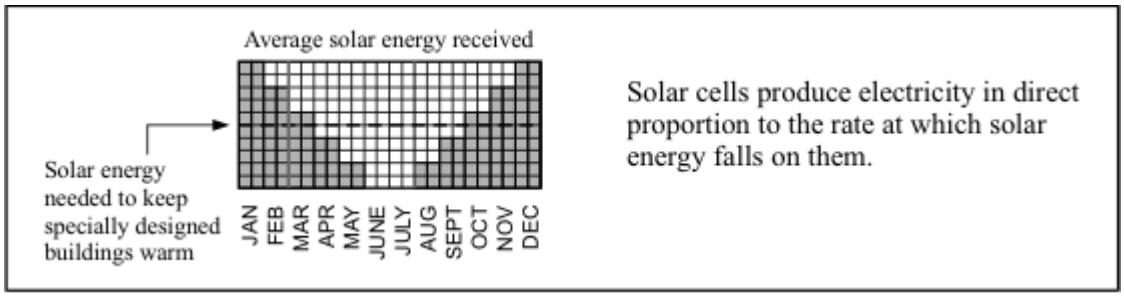
Comments:

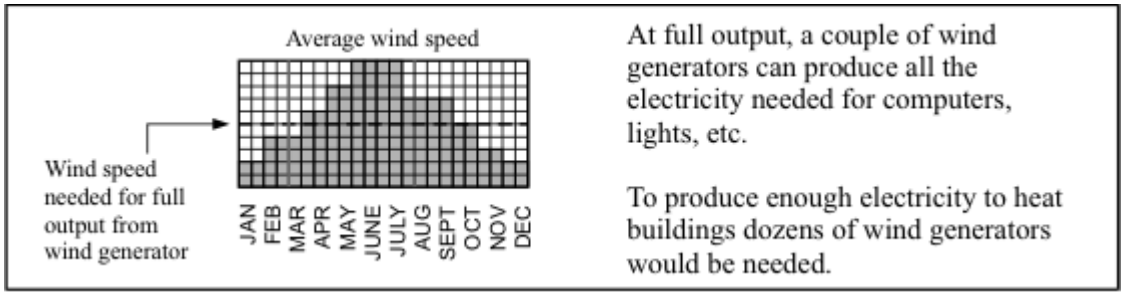
1 Antarctica is a huge land mass surrounding the Earth's south pole. It is covered in a very thick layer of ice and is the only remaining large area of the Earth's surface that has not been affected very much by humans.



There are, however, teams of scientists from various countries studying Antarctica. These scientists need electricity for lighting, for their computers and other scientific instruments and to communicate, via satellite, with the rest of the world. The temperature in Antarctica is always sub-zero, so the scientists need some way of keeping their buildings warm. They also need fuel to be able to get around on their snowmobiles.

Scientists cannot avoid affecting the environment. However, they want to affect it as little as possible.





Atmospheric pollution produced in one country eventually affects the whole of the Earth's atmosphere. The hole that appears each year in the ozone layer above Antarctica, for example, is mainly caused by pollutants such as CFCs from countries in the northern half of the Earth.

Discuss the advantages and disadvantages of using the following energy sources to meet the scientists' needs:

- solar energy
- energy from the wind
- natural gas (present in large quantities deep down in the Antarctic land mass)
- diesel oil (which would have to be imported)

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(Total 10 marks)

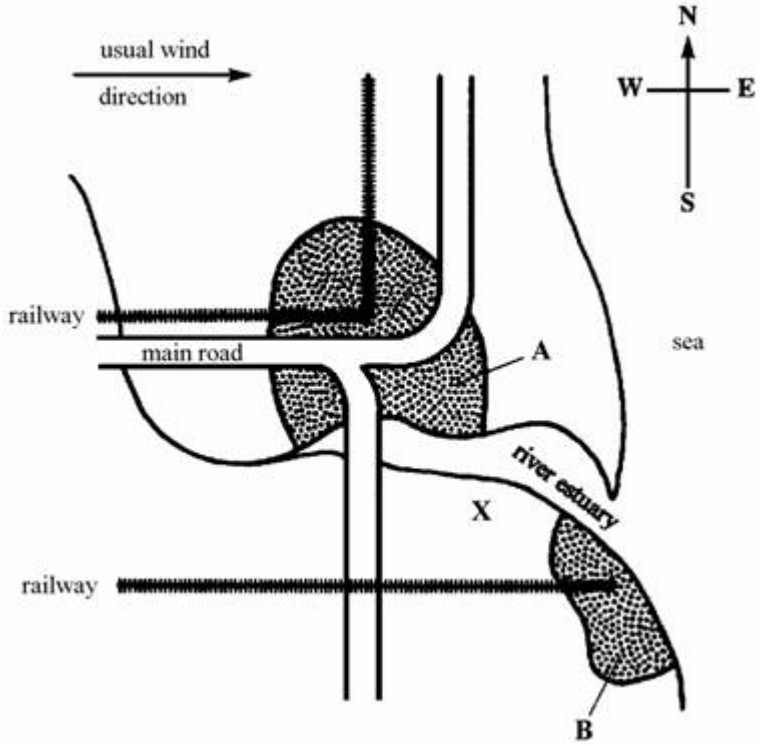
2 The map below shows the position of two towns, **A** and **B**, on the banks of a large river estuary.

A is an important fishing and ferry port.

The wind usually blows from the west. The major roads and railways are shown.

A power station is to be built in area X to generate electricity for the region.

The choice is between a nuclear power station and a coal fired power station.



(a) State the advantages and disadvantages of the two methods of generating electrical energy.

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(6)

(b) Which method would you choose for this site?

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Explain the reason for your choice.

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(3)
(Total 9 marks)

3 **Table 1** shows information about different light bulbs.

The bulbs all have the same brightness.

Table 1

Type of bulb	Input power in watts	Efficiency
Halogen	40	0.15
Compact fluorescent (CFL)	14	0.42
LED	7	0.85

(a) (i) Calculate the useful power output of the CFL bulb.

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Useful power output = ... watts

(2)

(ii) Use your answer to part **(i)** to calculate the waste energy produced each second by a CFL bulb.

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Waste energy per second = ... joules

(1)

(b) (i) A growth cabinet is used to investigate the effect of light on the rate of growth of plants.

The figure below shows a growth cabinet.

In the cabinet the factors that affect growth can be controlled.

A cooler unit is used to keep the temperature in the cabinet constant. The cooler unit is programmed to operate when the temperature rises above 20 °C.

The growth cabinet is lit using 50 halogen bulbs.

Changing from using halogen bulbs to LED bulbs would reduce the cost of running the growth cabinet.

Explain why.

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(4)

(ii) A scientist measured the rate of growth of plants for different intensities of light.

What type of graph should be drawn to present the results?

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Give a reason for your answer.

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(1)

(c) **Table 2** gives further information about both a halogen bulb and a LED bulb.

Table 2

Type of bulb	Cost to buy	Lifetime in hours	Operating cost over the lifetime of one bulb
Halogen	£1.50	2 000	£16.00
LED	£30.00	48 000	£67.20

A householder needs to replace a broken halogen light bulb.

Compare the cost efficiency of buying and using halogen bulbs rather than a LED bulb over a time span of 48 000 hours of use.

Your comparison must include calculations.

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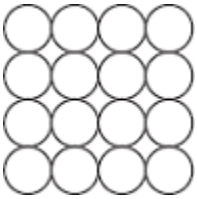
(4)
(Total 12 marks)

4 According to kinetic theory, all matter is made up of small particles. The particles are constantly moving.

Diagram 1 shows how the particles may be arranged in a solid.

Diagram 1



(a) One kilogram of a gas has a much larger volume than one kilogram of a solid.

Use kinetic theory to explain why.

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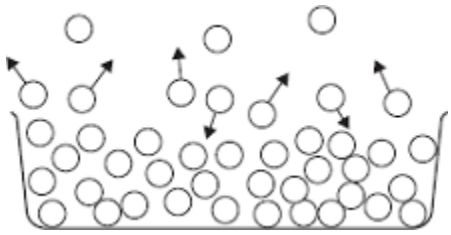
(4)

(b) **Diagram 2** shows the particles in a liquid. The liquid is evaporating.

Diagram 2



(i) How can you tell from **Diagram 2** that the liquid is evaporating?

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(1)

(ii) The temperature of the liquid in the container decreases as the liquid evaporates.

Use kinetic theory to explain why.

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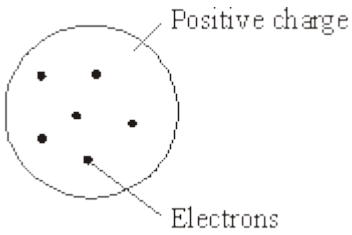
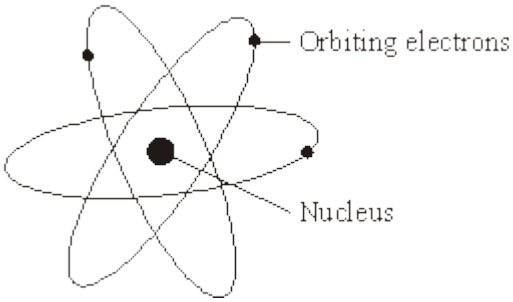
(3)
(Total 8 marks)

5 In the early part of the 20th century, scientists used the 'plum pudding' model to explain the structure of the atom.



Following work by Rutherford and Marsden, a new model of the atom, called the 'nuclear' model, was suggested.



(a) Describe the differences between the two models of the atom.

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(4)

(b) In their investigation, Rutherford and Marsden fired positively charged alpha particles at a very thin sheet of gold. Over a period of several months, the scientists made over 100 000 measurements. These measurements showed that:

- a very small number of alpha particles were deflected backwards from the gold foil.

Use the nuclear model to explain this experimental result.

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(2)

(c) Why did the work of Rutherford and Marsden convince many scientists that the 'plum pudding' model of the atom was incorrect?

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(2)
(Total 8 marks)

6 (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.

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(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.

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(2)
(Total 6 marks)

Mark schemes

1 ideas that

- direct solar radiation will provide enough energy to heat the (specially designed) buildings during the period Oct-Mar / summer
- solar cells will produce plenty of electricity in Oct-Mar / summer (when wind generators produce little)
- a couple of wind generators will produce all electricity needed (for all but heating) Apr-Oct / winter
- number required makes wind generators unsuitable for heating / buildings
- no solar energy in June and July / little in winter
- solar / wind have little effect on environment
- **or** cause no air pollution
- solar and wind complement each other
- **or** together provide energy all year
- fuel / gas / diesel can provide energy all the time / at any time
- fuel / gas / diesel needed for transport
- fuel / gas / diesel needed for heating <u>in winter</u>
- diesel has to be imported
- diesel likely to freeze
- gas wouldn't have to be imported
- drilling for gas difficult / harms environment
- but atmospheric pollution a global rather than local matter so any produced in Antarctic doesn't matter much

(deduct 1 mark (to min^{m}. zero) for incorrect claims about destroying ozone layer)

- gas produces less carbon dioxide (for the same energy released) than diesel*
- gas produces less sulphur dioxide (for the same energy released than diesel*

(* these ideas met by candidates in Q.16 so must be <u>allowed</u>, though not <u>required</u>)

any ten for 1 mark each

[10]

2

(a) m*ust give one advantage and one disadvantage of each to get 4 marks and 2 further scoring points*

Advantages and disadvantages relevant to:
(1) health risk
(5) cost
(6) environmental factors
(7) transport/ storage
e.g. common coal / nuclear – high cost of building both

<u>anti-nuclear</u> examples
nuclear fuel transported on roads/rail in region
possible effects on public health in surrounding area
high cost of de-commissioning
long life very active waste materials produced
how waste materials stored safely for a long time

<u>anti-coal</u> examples
unsightly
pollution
supplies of fuel limited
acid rain
non-renewable

<u>pro-nuclear</u> examples
fuel cheap
no foreseeable fuel shortage

<u>pro-coal</u> examples
safe
reliable
large coal reserves
disposal of solid waste is easier

to max 6

6

(b) choice 0 marks

any three valid reasons each with explanation, which may or may not be comparisons with other fuel

But

at least two of which must be relevant to this site

3

[9]

3 (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*

1

[12]

4 (a) there are strong forces (of attraction) between the particles in a solid

accept molecules / atoms for particles throughout
accept bonds for forces

1

(holding) the particles close together

particles in a solid are less spread out is insufficient

1

or

(holding) the particles in a fixed pattern / positions

but in a gas the forces between the particles are negligible

accept very small / zero for negligible
accept bonds for forces

1

so the particles spread out (to fill their container)

accept particles are not close together
gas particles are not in a fixed position is insufficient

1

(b) (i) particles are (shown) leaving (the liquid / container)

accept molecules / atoms for particles throughout

accept particles are escaping
particles are getting further apart is insufficient

1

(ii) *accept molecules / atoms for particles throughout*
accept speed / velocity for energy throughout

particles with most energy leave the (surface of the) liquid

accept fastest particles leave the liquid

1

so the mean / average energy of the remaining particles goes down

1

and the lower the average energy (of the particles) the lower the temperature (of the liquid)

1

[8]

5 (a) any **two** pairs from:

- nuclear model mass is concentrated at the centre / nucleus (1)

  plum pudding model mass is evenly distributed (1)

  accept the nuclear model has a nucleus/the plum pudding model does not have a nucleus for 1 mark

- nuclear model positive charge occupies only a small part of the atom (1)

  plum pudding model positive charge spread throughout the atom (1)

  accept electrons in shells/ orbits provided a valid comparison is made with the plum pudding model
  *do **not** accept on its own*
  *do **not** accept electrons at edge of plum pudding*

- nuclear model electrons orbit some distance from the centre / nucleus (1)

  plum pudding electrons embedded in the (mass) of positive (charge) (1)

- nuclear model the atom mainly empty space (1)

  plum pudding model is a ‘solid’ mass (1)

  to gain credit it must be clear which model is being described
  *do **not** accept simple descriptions on the diagram without comparison*

4

(b) nucleus must be positive to deflect/ repel alpha particles

answers in terms of electrons/negative charge causing deflection
negates mark answers in terms of reflection negates mark

1

nucleus (very) small so few alpha particles deflected backwards

accept most of atom empty space so most pass through

1

(c) many/ 100 000 measurements taken

accept results for measurements accept data valid / reliable

1

findings could not be explained by plum pudding model

accept a specific finding that could not be explained
eg some alpha particles were deflected backwards

1

[8]

6 (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]

Examiner reports

3

(a) (i) Three fifths of the students were able to substitute into the equation and rearrange it to find the useful power output. The main error was not selecting the equation using efficiency as a fraction rather than as a percentage.

(ii) Around half of the students answered correctly. Common incorrect responses were to subtract their answer to the previous part from 1 or from 100.

(b) (i) Around three-quarters of students scored at least one mark, usually for stating that the input power was less for the LED bulbs. Whilst many appreciated that the efficiency was also less, few explained the consequence of this in terms of less energy wasted meaning the temperature of the cabinet would increase more slowly, resulting in the cooler unit being used less often.

(ii) This was a standard demand question. Whilst the majority of answers recognised that a line graph (or scattergram) should be drawn, a small proportion gave a correct reason by saying that both variables were continuous. It would appear that many students do not think to transfer their knowledge from ISAs to this written paper.

(c) Around a fifth of students scored full marks. Good answers included clearly drawn, mathematically-based conclusions, showing all calculations. Those who chose to write a larger amount of prose often missed a vital part of the information, for instance just comparing the purchase costs and ignoring the operating costs.

4

(a) Whilst many answers referred to the arrangement of particles in solids and gases, fewer responses referred to the forces between the particles.

(b) (i) Just under half of the students answered correctly in terms of particles leaving the container / liquid. Other answers seen just referred to the particles ‘rising.’

(ii) Many answers referred to particles needing energy to escape, but often just stated ‘gaining energy’, without specifying that they had more energy than the particles that remained. Very few students gained the second marking point because they did not refer to “mean / average” energy. A fair number of students gained the third mark by linking a decrease in energy to the decrease in temperature.

5

This question was generally not well answered.

(a) The major issue with candidate responses is that few have any idea about writing an answer structured to contrast the differences. The second part of a comparison often appearing in a different part of the text. Some candidates failed to identify which model was which and many candidates merely described the two diagrams. There was a commonly expressed belief that the plum pudding model was a positively charged particle overall and often that it was a large nucleus. The position of the electrons in this structure was frequently thought to be superficial, and in a significant number of cases it was thought that the label on the model meant that the electrons were positive.

(b) Answers were often unclear, with evidence that candidates had not always read the information given in the stem of the question. Many candidates wrote about alpha particles passing through rather than about the deflections. Others wrote about electrons being deflected. Many candidates believed that the deflections were due to interaction with electrons.

(c) Most candidates were unable to link the information provided to the idea of change and the reasons why scientists may decide a scientific model is no longer acceptable.

6

(a) The term ‘nuclear fission’ was well known. However, it is alarming how many students think that nuclear fuels are burned in order to release energy. The process of generating electricity was not well described; many students seem to think that it is the turbine that generates the electricity. An advantage of nuclear fuels ‘reliability’ was often given. However, many students spent a lot of time and filled a lot of space describing numerous disadvantages of nuclear energy and / or the advantages and disadvantages of wind with no reference at all to nuclear energy.

(b) Nearly a fifth of students did not attempt this question. Many students simply repeated the stem of the question and had no idea about the storage of the carbon dioxide following its ‘capture’. A common error was the assumption that ‘carbon capture’ involves the removal of the existing carbon dioxide from the atmosphere.