WJEC Physics GCSE
Topic 1.2: Generating electricity
Questions by topic

1.

There is an increasing demand for electricity but the reserves of fossil fuels are decreasing.

(a) A way to meet increasing demand for electricity is to build nuclear power stations.

(i) Give **two** reasons to support building more nuclear power stations than other types in the future. [2]

1. .....

2. .....

(ii) Nuclear waste is a problem that must be dealt with. One possible solution would be to bury the waste deep underground. State **one** disadvantage of burying nuclear waste. [1]

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(b) Electricity can also be generated using bio-fuels such as woodchip and straw. Plants for bio-fuels use carbon dioxide from the air as they grow. Explain why burning bio-fuels is more environmentally friendly than burning fossil fuels. [2]

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(c) The table below shows typical crop yields and the energy content of some bio-fuels.

Crop	Crop yield in a year from each km^2 of land (tonnes)	Energy content (units/tonne)
poplar	8	18
willow	10	20
grass	5	16

(i) Which crop would be the worst choice for using as a bio-fuel? ..... [1]

Give **two** reasons for your answer. [2]

1. .....

2. .....

(ii) A 10 MW power station needs 50 000 tonnes of willow crop a year.

I. Calculate the area of land needed to grow this amount of willow crop. [1]

Area ..... km^2

II. Calculate the energy content of 50 000 tonnes of willow crop. [1]

Energy content = ... units

(iii) An area of 2 km^2 of land is needed to produce 10 MW using wind turbines. Explain why this method of generating electricity is more environmentally friendly than using bio-fuels. [2]

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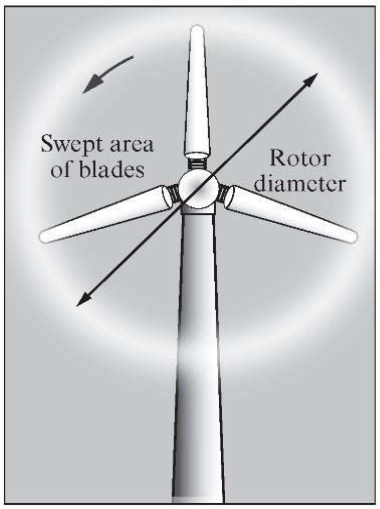
2. The table below gives information about generating electricity from wind and nuclear power.

How they compare		
	A wind turbine	A nuclear power station
Overall cost of generating electricity (p/kWh)	5.6	2.8
Maximum power output (MW)	2	3600
Lifetime (years)	15	45
Waste produced	None	Radioactive waste
Lifetime carbon footprint (g of CO_2/kWh)	4.64/5.25 (onshore/offshore)	5
Commissioning cost (£ million)	3	4000

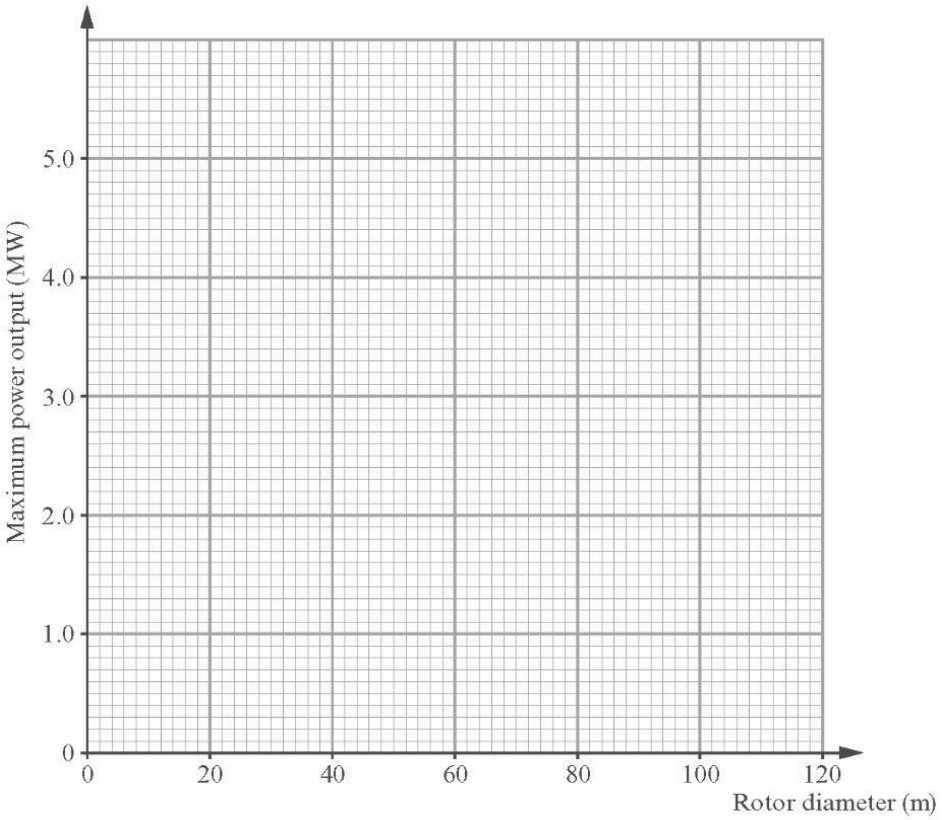
(a) Use your knowledge and information from the table to **compare** the **cost-effectiveness** and **environmental** impact of the two methods of generating electricity. [6 QWC]

(b) The maximum power output from a wind turbine depends on the rotor diameter as shown in the table.



Rotor diameter (m)	Maximum power output (MW)
40	0.5
60	1.1
80	2.0
90	3.0
110	4.5

(i) Plot the data on the grid below and draw a suitable line. [3]



(ii) Describe the relationship between rotor diameter and maximum power output. [2]

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(c) A wind turbine, of rotor diameter 90 m, operates with an efficiency of 60%. Use an equation from page 2 to calculate the input power from the wind which produces the maximum power output. [3]

input power = ... MW

3.

(a) What is the purpose of the National Grid? [2]

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(b) A large wind turbine can supply a mean power of 0.95 MW to the National Grid. The table shows the **length of time** during a typical week when the turbine generated electricity.

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Length of time electricity generated (minutes)	495	0	1440	900	600	1440	525

(i) Using an equation from page 2 calculate the energy output (in MWh) of the wind turbine for the week. [3]

energy output = ... MWh

(ii) The cost of commissioning the wind turbine is £650000. The electricity it produces is sold to the National Grid at 5p per kWh. Calculate the expected payback time. (Payback time is the time taken to repay the £650000 cost.) [4]
Assume the energy output for a typical week is constant.

payback time = ... weeks

(c) Discuss the advantages and disadvantages of using wind turbines such as in part *(b)* for the large scale production of electricity for distribution by the National Grid. [6 QWC]

Consider the following information when writing your answer:

- power demand from the National Grid is typically 40 GW;
- a nuclear power station typically produces an output of 2.5 GW;
- reliability of output;
- environmental considerations.

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4. Drax is a large coal-fired power station with a generating capacity of 3950 MW. This power is transmitted through the National Grid to consumers with an efficiency of 92%.

(i) Explain how this high efficiency is achieved by the National Grid system. [3]

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(ii) Use an equation from page 2 to calculate the power available for use by consumers. [2]

power = ... MW

(iii) Mains electricity is supplied to a home at 230 V at a maximum current of 80 A.
Use an equation from page 2 and your answer to part (ii) to calculate the minimum number of homes that could be supplied by the Drax power station. [3]

number of homes = ...

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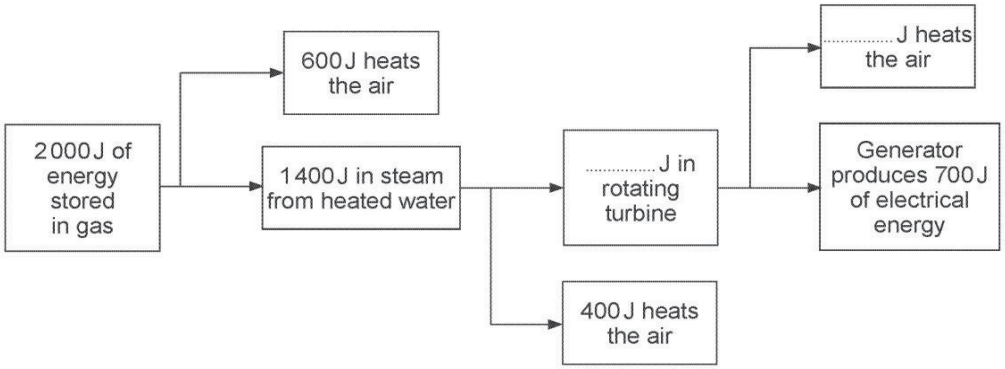
5.

Some power companies produce electricity by using gas.
Not all the energy stored in the gas is converted into electrical energy.

(a) The diagram below shows the energy flow in the process of producing electricity from gas.



(i) **Complete the flow diagram** above. [2]

(ii) State the amount of useful energy output from an input of 2 000 J. ..... J [1]

(iii) Use an equation from page 2 to calculate the % efficiency of producing electricity from gas. [2]

% efficiency = ...

(iv) Find the percentage of energy wasted in the process. [1]

% wasted energy = ...

(b) Give **two** reasons why power companies should look for other methods of producing electricity instead of using gas. [2]

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2. .....

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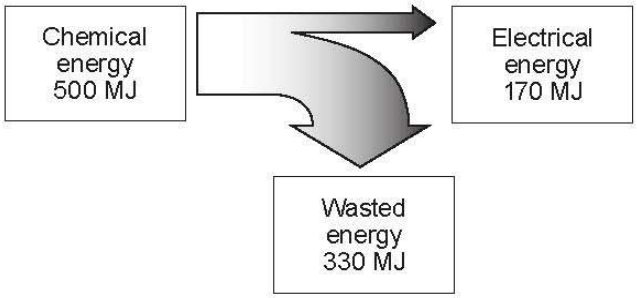
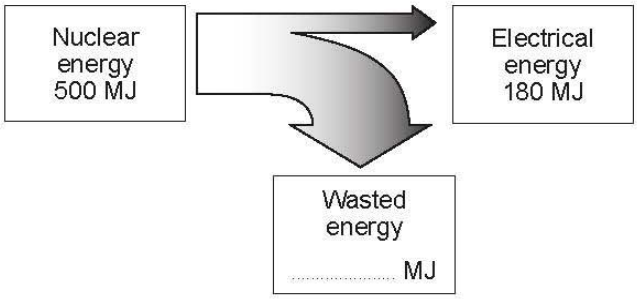
6.

The three diagrams below show the overall energy transfers in three different types of thermal power stations.

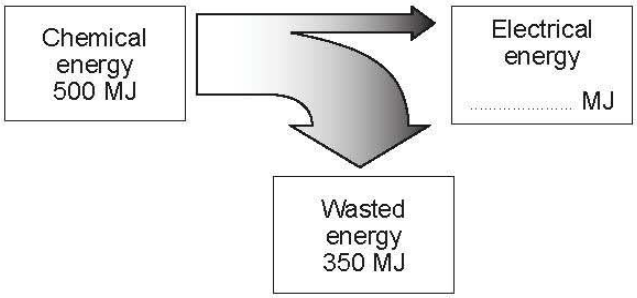
A. Oil power station



B. Nuclear power station



C. Coal power station



(a) **Complete the diagrams** above to show the missing energy values. [2]

(b) Use information from the above diagrams to answer the questions below.

(i) Which type of energy is the input energy in an oil power station? [1]

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(ii) Which type of energy is the useful output energy in each power station? [1]

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(c) (i) Name the type of power station with the biggest wasted energy. [1]

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(ii) Explain how this energy may be wasted. [2]

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(d) Use an equation from page 2 to calculate the % efficiency of the oil power station. [2]

% efficiency = ...

(e) Waste products from power stations can affect the environment.

Complete the table below to describe the **environmental problems** caused by each waste product. [3]

Type of power station	Waste product	Environmental problem
oil	carbon dioxide	....
nuclear	radioactive material	....
coal	sulfur dioxide	....