Eduqas Physics GCSE
Topic 1.2: Conservation, dissipation and national and global energy sources
Questions by topic

1.

Use your knowledge of the kinetic theory of matter to explain how heat energy is transferred by conduction in **metals** and by convection in **gases**. [6 QWC]

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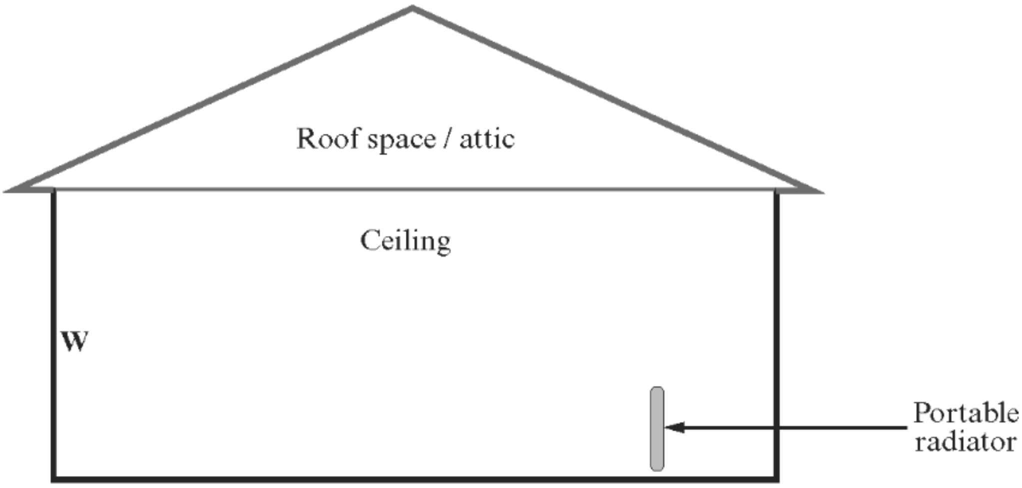
2.

A family moves into a bungalow where all the walls and ceiling are damp. They decide to dry it out using a portable oil-filled radiator that is placed in the position shown below.



(a) Heat transfer by conduction, convection or radiation is responsible for the following effects. **Circle** the correct word in each case.

(i) The wall near to the radiator dries before the wall **W** due to [1]

Conduction Convection Radiation

(ii) Heat energy, from the hot oil in the radiator, passes **through the metal** to the air outside due to [1]

Conduction Convection Radiation

(b) Explain how a convection current arises, which dries the ceiling quickly. [2]

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(c) The following table gives information about heat losses from a bungalow without insulation.

Part of the bungalow	Percentage of heat lost without insulation	Cost of insulation (£)	Saving per year (£)
Roof	50%	600	200
Walls	25%	1000	150
Floor	5%	2300	40
Doors and windows	....	3500	100

(i) Complete the table to show the percentage of heat lost through the doors and windows. [1]

(ii) Explain why insulating the attic would be the most cost-effective method of reducing heat loss. [2]

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(iii) State how heat is lost through the ceiling **and then** the attic space when the attic is not insulated. [2]

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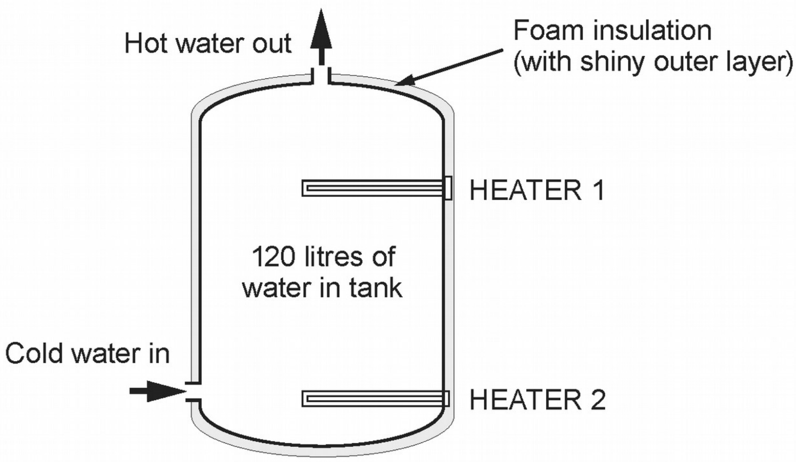
3.

A hot water tank that is covered in foam insulation contains a total of 120 litres of water. It has two electric heaters, either of which may be used to heat water to the same final temperature. Heater **1** is used during the day and heater **2** is used during the night. A simplified diagram is shown below.



(a) Explain why heater **1** does not heat all of the water in the tank. [2]

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(b) (i) Explain why foam is used to cover the hot water tank to reduce heat loss. [2]

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(ii) State how the shiny outer surface of the foam reduces heat loss. [2]

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....

(c) Explain how the foam covering benefits the environment. [2]

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(d) The following table gives information about heating water by either of the two heaters.

	Electric heater **1**	Electric heater **2**
Volume of water that is heated by the heater (litres)	40	120
Time to heat this volume of water (hours)	0.5	3
Power (kW)	4	2
Cost per unit (p)	16	5

A householder has to decide which heater (**1** or **2**) to use. She will need to use 30 litres of hot water.
Use data from the table and equations from page 2 to compare the two methods of heating in terms of: [6 QWC]

- the number of units used to heat the water;
- the cost of electricity used;
- the impact on the environment;
- advice that should be given to the householder.

Assume the water in the tank is initially cold.

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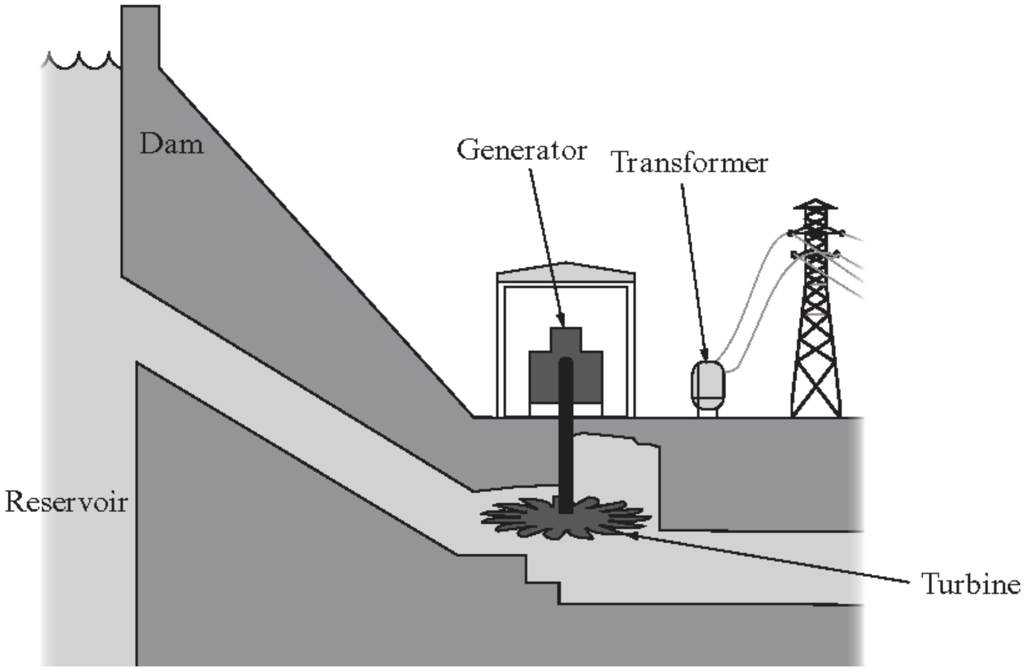
4.

The diagram shows a hydroelectric power station.



(a) The volume of water that flows past the turbine every second is $25\,m^3$.

(i) The density of water is $1\,000\,kg/m^3$.

Use the equation:

$$\text{mass} = \text{density} \times \text{volume}$$

to calculate the mass of water flowing past the turbine every second. [1]

mass = ... kg

(ii) Every 1 kg of water loses 120 J of energy as it flows down the pipe to the turbine. Calculate the **total energy lost** every second by this falling water. [2]

energy = ... J

(b) The generator provides 2 MW of power to the transformer. The output power of the transformer is 1.8 MW.
Use an equation from page 2 to calculate the % efficiency of the transformer. [2]

% efficiency = ...

(c) Explain how hydroelectric power stations help to keep a reliable supply of electricity to the National Grid. [2]

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(d) (i) Give a reason why electrical power is transmitted (sent) at high voltages across the National Grid. [1]

....

(ii) Give a reason why electrical power is supplied at low voltages to consumers. [1]

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9

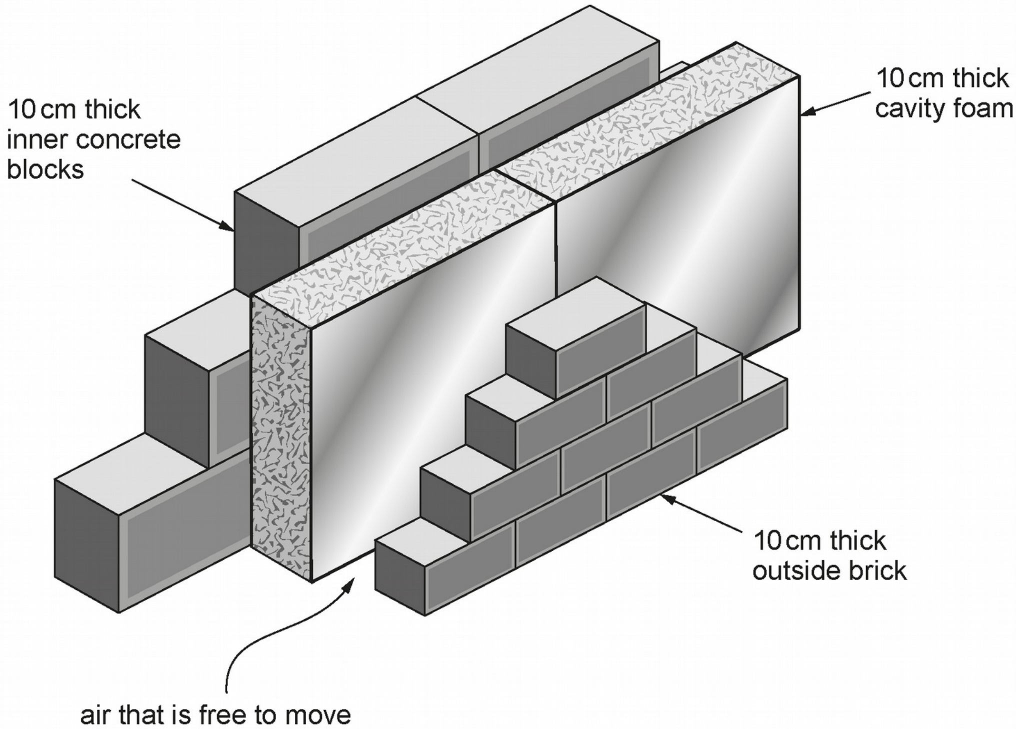
5.

The insulating effectiveness of a material is given by a quantity called its R value. The higher the R value of a section of material, the better it is at resisting the movement of heat energy.

The R values for some common materials are shown in the table below.
Where more than one type of material is used, R values are added together.

Material	R value (units)
Air that is free to move	0.02
A standard 10 cm thick brick	0.30
10 cm cavity wall insulating foam	3.60
10 cm thick inner concrete block	2.08
30 cm of attic foam	2.70

A house wall is built in the way shown below.



(a) Calculate the total R value for the wall shown. [1]

R value for wall = ... units

(b) The rate at which energy is lost through the wall is given by the following equation:

$$\text{power} = \frac{\text{wall area} \times \text{temperature difference between inside and outside}}{\text{total R value}}$$

A typical house has a total outside wall area of 150 m^2.
On a winter's day, the temperature outside is –4°C and the inside is kept at a comfortable 21°C.

(i) Use the equation above to calculate the rate at which energy is lost from the walls of the house. [2]

power = ... W

(ii) **An extra 475 W is lost** from other parts of the house such as windows, floor, roof and draughts. Use equations from page 2 to calculate the cost of maintaining the inside temperature at 21°C for 16 hours if the cost of a unit of electricity is 15p. [3]

cost = ...

(iii) Why would a semi-detached house prove to be cheaper to heat than a detached house of a similar size? [1]

....

....

(c) The blocks of foam that are built into the walls are coated on both sides with shiny aluminium foil. Explain how the foil near the inner **warm** wall of the house and the foil on the outer **cooler side** (next to the air in the cavity) reduce heat loss. [3]

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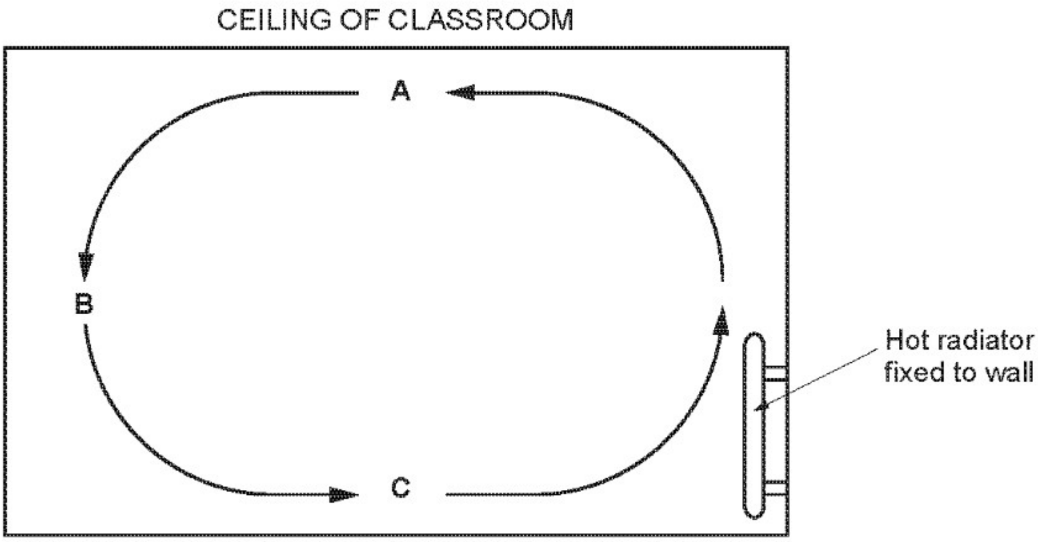
6.

(a) A classroom has a volume of 80 m^3 and contains 104 kg of air. Use an equation from page 2 to calculate the density of the air in the room and state the unit. [3]

Density = ...

Unit ....

(b) The classroom is now heated by a radiator. This sets up a convection current in the air as shown in the diagram below.



(i) At which point **A**, **B** or **C** is the air in the classroom the hottest? .... [1]

(ii) At which point **A**, **B** or **C** is the air in the classroom least dense? .... [1]

(iii) Give a reason for your answer to *(b)*(ii). [1]

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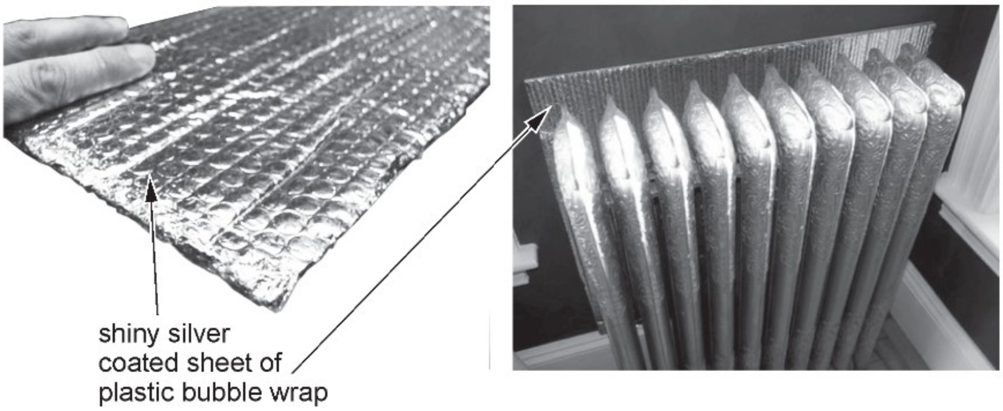
(c) A shiny silver coated sheet of plastic bubble wrap is placed on the wall behind the radiator. Explain how this can reduce heat loss from the classroom by conduction, convection and radiation. [6 QWC]



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7.

The boxes in the left column show four energy sources.
Draw a single line from each energy source to the correct statement on the right. [3]

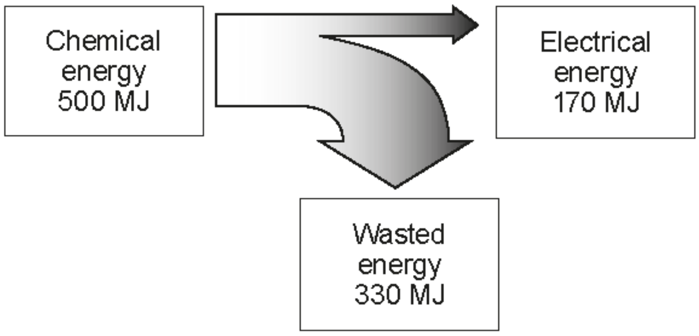
Energy source	Statement
Coal	An energy source used in power stations that have high decommissioning costs.
Nuclear fuel	An energy source that is burned in power stations.
The Sun	An energy source that drives turbines directly.
Wind	An energy source that supplies solar panels.

3

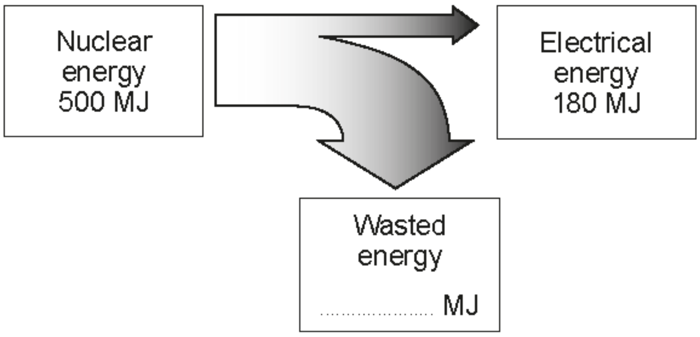
8.

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

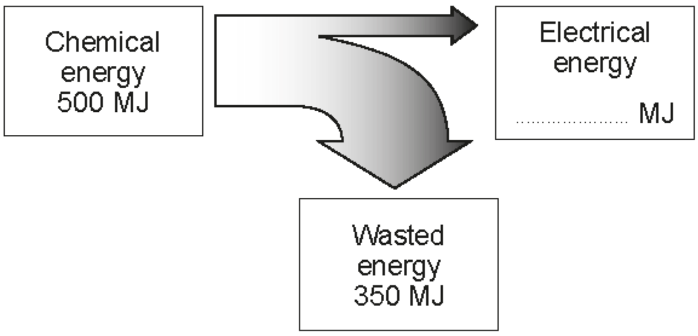
A. Oil power station



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]

....

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

....

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

....

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

....

....

....

(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	....

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9.

The table gives some information about a nuclear power station and a wind turbine.

	How they compare	
	wind turbine	a nuclear power station
expected lifetime (years)	20	60
mean power output (MW)	2	2000
land area needed (km^2)	0.7	4.5
cost to commission (£)	3 million	4000 million
waste produced	none	radioactive waste
lifetime carbon footprint (g of CO_2/kWh)	4.6	5

Use data from the table to answer the following questions.

(a) (i) Calculate the number of wind turbines that would be needed to produce the same power as one nuclear power station. [1]

number of wind turbines = ...

(ii) Calculate the land area needed by a wind farm in order to produce the same power as one nuclear power station. [2]

area = ... km^2

(iii) How many wind turbines would need to be built every 60 years to provide the same power as one nuclear power station? [2]

number of wind turbines = ...

(b) State **one** advantage of producing electricity by nuclear power compared with wind turbines. [1]

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