

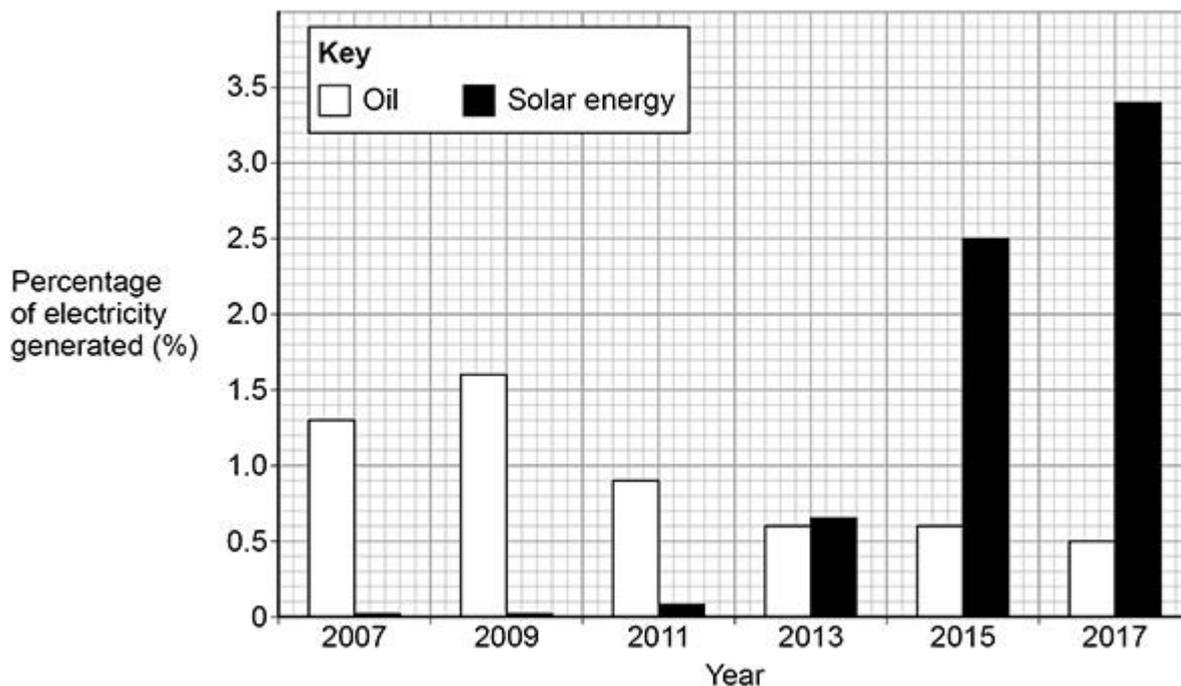
All questions are for both separate science and combined science students

Q1.

This question is about fuels and energy.

The graph below shows the percentage of electricity generated in the UK between 2007 and 2017 using:

- oil
- solar energy.



(a) Describe the changes in the percentage of electricity generated in the UK between 2007 and 2017 using:

- oil
- solar energy.

Use data from the graph above in your answer.

(3)

(b) Oil contains carbon and some sulfur.

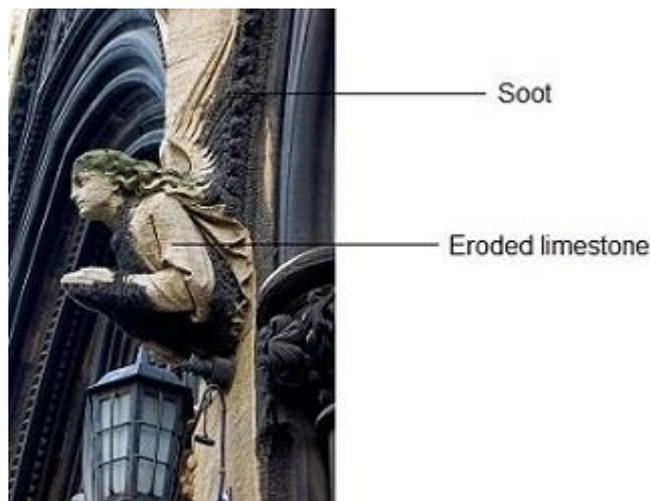
Q2.

This question is about atmospheric pollution.

The image below shows a limestone carving which has been damaged by atmospheric pollution.

The carving has been:

- blackened by soot
- eroded where the limestone has reacted with atmospheric pollutants.



(a) What reacted with the limestone to cause the erosion?

Tick (✓) one box.

- | | |
|-----------------|--------------------------|
| Acid rain | <input type="checkbox"/> |
| Ammonia | <input type="checkbox"/> |
| Carbon monoxide | <input type="checkbox"/> |
| Oxygen | <input type="checkbox"/> |

(1)

(b) Soot is produced by the incomplete combustion of diesel oil.

Complete the sentences.

Choose answers from the box.

ammonia	carbon	methane
nitrogen	oxygen	

Incomplete combustion happens when there is not enough _____.

Incomplete combustion produces particles of _____.

(2)

(c) Complete the sentence.

Particles of soot in the atmosphere cause global _____.

(1)

(d) Carbon monoxide is produced by the incomplete combustion of methane.

Balance the equation for the reaction.



(1)

(e) Car engines work at high temperatures.

Complete the sentences.

Choose answers from the box.

air	methane	oxides of nitrogen
oxygen	petrol	sulfur dioxide

In car engines, nitrogen is present.

The nitrogen in car engines comes from _____.

At high temperatures, the nitrogen reacts with _____.

This reaction produces _____.

(3)

(Total 8 marks)

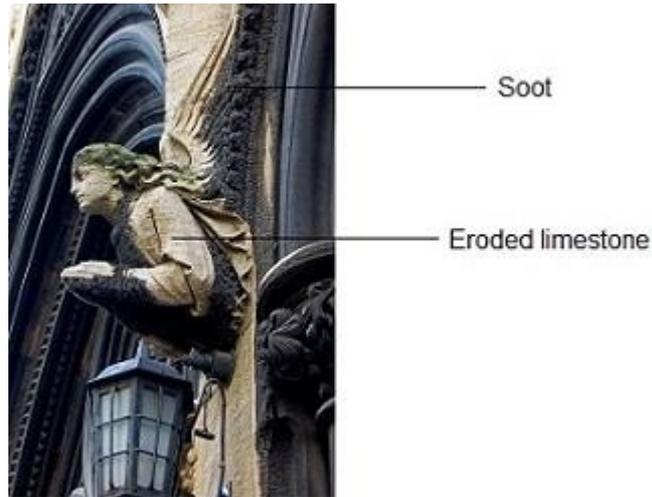
Q3.

This question is about atmospheric pollution.

The image below shows a limestone carving which has been damaged by atmospheric pollution.

The carving has been:

- blackened by soot
- eroded where the limestone has reacted with atmospheric pollutants.



- (a) Explain why soot is formed when some fossil fuels are burned.

(2)

- (b) Fossil fuels are burned in car engines.

Explain how reducing the amount of sulfur in fossil fuels reduces the erosion of limestone.

(4)

- (c) Oxides of nitrogen are atmospheric pollutants which are formed in car engines.

Explain why oxides of nitrogen are formed in car engines.

(2)
(Total 8 marks)

Q4.

Some central heating boilers use methane as a fuel.

Carbon monoxide detectors are placed near central heating boilers.

(a) Which three properties of carbon monoxide make it necessary to use carbon monoxide detectors?

Choose answers from the box.

acidic	alkaline	colourless	corrosive
	insoluble	odourless	toxic

1 _____
2 _____
3 _____

(3)

(b) Complete the sentence.

Methane produces carbon monoxide when burning in a limited supply of

_____.

(1)

(c) 8 g of methane has a volume of 12 dm³ at room temperature and pressure.

Calculate the mass of 36 dm³ of methane.

Mass = _____ g

(2)

(d) Most methane is obtained from natural gas, which is a fossil fuel.

Methane can also be produced renewably.

Which two are renewable sources of methane?

Tick (✓) two boxes.

Animal waste

Food in landfill

Nitrogen in the air

Non-biodegradable plastics

Scrap iron

(2)
(Total 8 marks)

Q5.

This question is about combustion of fuels.

(a) Some central heating boilers use wood as a fuel.

Suggest two reasons why wood is more sustainable than natural gas as a fuel for central heating boilers.

1 _____

2 _____

(2)

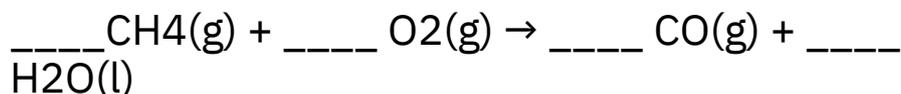
Natural gas is mainly methane.

When methane burns it can produce both carbon monoxide and carbon dioxide.

(b) Explain the process by which carbon monoxide can be produced when methane is burned.

(2)

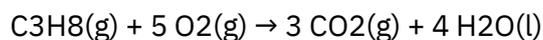
- (c) Balance the equation for the combustion of methane to produce carbon monoxide.



(1)

- (d) Propane burns to form carbon dioxide and water.

The equation for the reaction is:



3.60 dm³ carbon dioxide is produced when a sample of propane is burned in 7.25 dm³ oxygen.

Calculate the volume of unreacted oxygen.

Give your answer in cm³

Volume of unreacted oxygen = _____ cm³

(4)

(Total 9 marks)

Q6.

This question is about fuels.

Octane (C₈H₁₈) is a hydrocarbon in petrol.

- (a) Cracking breaks down large hydrocarbon molecules into smaller hydrocarbon molecules.

Which hydrocarbon molecule can be cracked to produce octane, C₈H₁₈?

Tick one box.

C₄H₈

C₄H₁₀

C₈H₁₆

C₁₂H₆

(1)

(b) What type of carbon compound is octane, C₈H₁₈?

Tick one box.

Alcohol

Alkane

Carboxylic acid

Ester

(1)

(c) Oxygen is needed to burn fuels.

Name the source of the oxygen needed to burn fuels.

(1)

(d) Particulates and sulfur dioxide are pollutants produced when some fuels burn.

Draw one line from each pollutant to the polluting effect.

Pollutant

Polluting effect

Acid rain

Particulates

Global dimming

Global warming

Sulfur dioxide

Landfill

Sewage sludge

(2)

(e) Which two gases are produced when fuels burn in car engines?

Tick two boxes.

Ammonia

Carbon dioxide

Carbon monoxide

Nitrogen

Oxygen

(2)

(f) Vehicles produce most of the atmospheric pollution in cities.

How could the atmospheric pollution in cities be reduced?

Tick two boxes.

Build more roads in cities

Build new car factories

Develop fuel efficient engines

Make car tax cheaper

Use electric cars

(2)
(Total 9 marks)

Q7.

Older cars are tested each year to measure the amount of pollutants contained in exhaust fumes.

The table below shows the maximum allowed percentages of exhaust pollutants for petrol cars.

Age of car in years	Maximum allowed percentage (%) of exhaust pollutant	
	Carbon monoxide	Unburned hydrocarbons
16–24	0.30	0.02
3–16	0.20	0.02

- (a) Explain how carbon monoxide is produced when petrol is burned in car engines.

(2)

- (b) Suggest two reasons why the maximum allowed percentage of carbon monoxide has been decreased for newer cars.

1. -----

2. -----

(2)

- (c) Give one reason for having a maximum allowed percentage of unburned hydrocarbons in exhaust fumes.

(1)

Oxides of nitrogen are also pollutants contained in exhaust fumes.

- (d) Describe how oxides of nitrogen are produced when petrol is burned in car engines.

(2)

Catalytic converters are fitted to car exhausts to reduce the amount of pollutants released into the atmosphere.

- (e) Nitrogen dioxide is an oxide of nitrogen.

Nitrogen dioxide reacts to produce nitrogen and oxygen in catalytic converters.

Complete the equation for this reaction.

The equation should be balanced.



(2)

- (f) Give two effects of atmospheric pollution which are reduced by using catalytic converters.

1. -----

2. -----

(2)

- (g) The catalyst in catalytic converters is a mixture of three elements.

Where in the periodic table are these elements most likely to be found?

Tick one box.

Alkali metals

Halogens

Noble gases

Transition metals

(1)
(Total 12 marks)

Q8.

Coal is used as a fuel in power stations.

The table shows the percentage of carbon and sulfur in four different coal samples.

Sample	Percentage (%) by mass in coal	
	Carbon	Sulfur
A	22.1	0.4
B	46.8	0.6
C	66.3	0.9
D	92.0	0.7

(a) Sulfur produces a gas that causes acid rain.

Name the gas.

(1)

(b) Give one environmental effect caused by acid rain.

(1)

(c) Which coal sample produces the most acid rain from 1 kg of coal?

Use the table above.

Give a reason for your answer.

Sample _____

Reason _____

(2)

(d) Calculate the mass of coal sample A that would produce the same amount of carbon dioxide as 1 kg of coal sample C.

Mass of coal sample A = _____ kg

(2)

- (e) Incomplete combustion of coal can produce carbon monoxide.

Carbon monoxide is a toxic gas.

Give two reasons why people may be unaware of the presence of carbon monoxide.

1. _____

2. _____

(2)

(Total 8 marks)

Q9.

This question is about hydrocarbons.

- (a) The names and formulae of three hydrocarbons in the same homologous series are:

Ethane	C ₂ H ₆
Propane	C ₃ H ₈
Butane	C ₄ H ₁₀

The next member in the series is pentane.

What is the formula of pentane?

(1)

- (b) Which homologous series contains ethane, propane and butane?

Tick one box.

Alcohols

Alkanes

Alkenes

Pollutant	Environmental impact caused by the pollutant
	Acid rain
Oxides of nitrogen	Flooding
	Global dimming
Particulate matter	Global warming
	Photosynthesis

(2)
(Total 11 marks)