Mark schemes

1

(a) Methane

1

(b) Sea levels rising

1

(c) Burning of fossil fuels

1

(d) carbon dioxide concentration stayed constant from 1850 to 1900

1

carbon dioxide concentration slowly increased from 1900

1

carbon dioxide concentration increased more rapidly from 1965

allow values from 1965 − 1975

1

[6]

2

(a) any **one** from:

- complex systems
- many different variables
- many alternative theories

1

(b) carbon dioxide allows short wavelength radiation to pass through

allow greenhouse gas(es) for carbon dioxide

1

the atmosphere to the Earth's surface

1

carbon dioxide absorbs outgoing long wavelength radiation

1

(c) general increase in temperature caused by increase in greenhouse gases

1

any **two** human activities correctly linked to a named greenhouse gas

eg

increased burning of fossil fuels causes more carbon dioxide

2

deforestation causes more carbon dioxide

more cattle production causes more methane

use of landfill causes more methane

[7]

3

(a) (i) 25 °C

1

(ii) (fractional) distillation

1

(b) (i) (fertile) land is used to grow fuel crops **or** crops are grown for fuel **or** farmers get a better price for crops for fuel **or** crops for biofuels take up space

ignore biofuels are made from food or plants

1

less food grown **or** food prices rise **or** less (fertile) land to grow food

1

(ii) (crops / plants) take in carbon dioxide (while growing / during photosynthesis)

1

so the CO_2 given out was previously taken in

*do **not** accept burning biofuels does not release CO_2 or releases less CO_2 unqualified*

*if no other mark awarded, a statement of "carbon neutral" scores **1** mark*

1

(c) Marks awarded for this answer will be determined by the Quality of Communication (QC) 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)
At least one statement about the effect of a condition on either rate **or** yield.

Level 2 (3–4 marks)
Correct statements about the effect of at least one condition on rate **and** yield.

Level 3 (5–6 marks)
Correct statements about the effect of at least one condition on rate and yield **and** at least one correct statement about compromise conditions.

Examples of the points made in the response

Temperature
- a higher temperature gives a lower yield
- a higher temperature gives a faster rate

Pressure
- a higher pressure gives a higher yield
- increase in yield gets less as pressure increases
- a higher pressure gives a faster rate
- increase in rate increases as pressure increases

Catalyst
- using a catalyst speeds up reaction
- catalysts allow a lower temperature to be used and so save energy / reduce energy costs

Compromise
- a higher pressure gives a greater yield but increases costs / (safety) risks
- a high pressure gives a faster rate but increases costs / risks
- a high temperature makes reaction faster but reduces yield
- a catalyst makes reaction faster so a lower temperature can be used which will increase the yield

6

[12]

4 (a) (i) a proton

1

(ii) nucleus

1

(iii) 12

order must be correct

1

4

1

(b) (i) 5 / five (%)

1

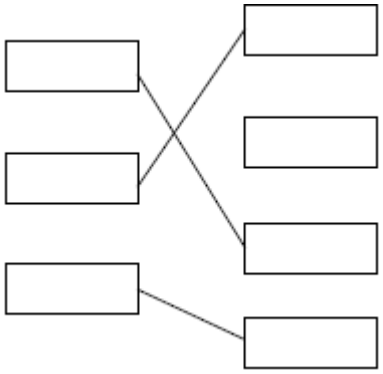
(ii) Carbon dioxide > global warming

1

Sulfur dioxide > acid rain

1

Water > no pollution



1

[8]

5 (a) (i) 2,4 drawn (as dots / crosses / e^-)

1

(ii) Water (vapour) / steam

allow hydrogen oxide / H_2O

*do **not** accept hydroxide*

1

(b) any **two** pairs from:

carbon dioxide (1)

causes global warming (1)

allow greenhouse effect / climate change / sea level rise / melting of polar ice caps

or

carbon (particles) / soot (1)

allow particulates

causes global dimming (1)

allow blocks out sunlight / smog / prevents plant growth / causes breathing difficulties

or

carbon monoxide (1)

is toxic (1)

or

sulfur dioxide (1)

causes acid rain (1)

allow kills plants / erosion / acidifies water

4

[6]

6 (a) (i) H_2O

must be formula

1

CaO

must be formula

1

(ii) carbon dioxide from the air / (Earth's early) atmosphere

it = carbon (dioxide)

accept carbon dioxide from millions of years ago

1

<u>formed</u> (sedimentary) rocks **or** fossil fuels

ignore trapped / stored

1

(b) (i) decreases rapidly at first

it = carbon (dioxide)

1

then slowly **or** levels off

*allow both marks if the description is correct using either 'rapidly' **or** 'slowly'*

allow correct use of figures for either marking point

*if no other mark awarded, allow CO_2 decreased for **1** mark*

1

(ii) any **two** from:

it = carbon (dioxide)

accept photosynthesis

- used by plants
- dissolved in oceans
- 'locked up' in fossil fuels **or** formed fossil fuels
- 'locked up' in rocks **or** formed rocks

2

(c) (yes)

it = percentage of carbon (dioxide)

ignore yes or no

because the percentage of carbon dioxide is increasing

1

which causes global warming (to increase)

allow (carbon dioxide) causes greenhouse effect/climate change

1

or

(no)

because the percentage of carbon dioxide is low (1)

compared to millions of years ago (1)

allow global warming can be caused by other factors (e.g. Sun / water vapour / methane)

[10]

7 (a) (i) 42 000

*correct answer gains **2** marks with or without working*

allow 42 kJ

*if answer incorrect : correct substitution 500 x 4.2 x 20 gains **1** mark*

2

(ii) any **two** from:

- eye protection
- lab coat
- heat-proof mat
- (heat-proof) gloves
- (long) hair tied back
- stand up
- secure the beaker

2

(iii) Stir the water before measuring the temperature.

1

Place a lid on the beaker.

1

(b) the products → S

1

the activation energy → Q

1

the energy released by the reaction → P

1

(c) carbon dioxide produced

it = propane
allow converse arguments
allow greenhouse gas / global warming / atmospheric pollution

(crude oil / propane) non-renewable

1

allow crude oil running out

1

[11]

8 (a) (i) C_7H_{16}

mark answer line first
answer may be given in the table

1

(ii) C_nH_{2n+2}

1

(b) (i) carbon monoxide

*do **not** accept carbon oxide*

*do **not** accept water*

ignore CO

1

(ii) because of partial / incomplete combustion (in reaction 2) **or** complete combustion (in reaction 1)

*allow because there is less / insufficient oxygen (in reaction 2) **or** sufficient oxygen (in reaction 1) allow different amounts of oxygen used (in the reactions) **or** $19O_2$ (in reaction 1) **and** $13O_2$ (in reaction 2)*

ignore air

1

(c) (i) 15 (%)

ignore units

1

(ii) water (vapour)/steam

allow H_2O / OH_2 / hydrogen oxide

1

(iii) sulfur in petrol / crude oil (reacts with oxygen)

it = sulfur dioxide

1

(ii) because nitrogen **and** oxygen (are in the air and) react

*allow nitrogen **and** oxygen burn*

*accept nitrogen + oxygen → nitrogen oxide **or** symbol equation*

ignore air

1

at high temperature (inside a petrol engine)

allow heat / hot (engine)

1

(d) because carbon dioxide / it causes global warming **or**

allow because carbon dioxide / it causes greenhouse effect / climate change

1

because carbon dioxide / it has an impact on oceans

because this carbon dioxide / carbon / it was '<u>locked up</u>' (in fossil fuels) **or**

because the percentage/amount of carbon dioxide / it in the atmosphere is <u>increasing</u>

1

[11]

9 (a) (i) bar drawn between 84 and 86

1

(ii) sulfur dioxide linked to acid rain

1

carbon particles linked to global dimming

1

(b) (i) any **one** from:

- plants / trees <u>absorb</u> (carbon dioxide)
- coal ' <u>locks up</u>' (carbon dioxide)

1

(ii) it <u>increases</u> the amount (of CO_2)

1

because carbon in coal (forms carbon dioxide)

accept because carbon / coal burns / reacts <u>with oxygen</u> (to produce CO_2)

1

[6]

10 (a) (i) *use of carbon throughout = **max 1***

<u>burning biodiesel</u> releases CO_2

ignore burning trees

1

CO_2 is <u>absorbed</u> / <u>used</u> by the crops/plants (used to produce the biodiesel)

allow CO_2 <u>absorbed</u> / <u>used</u> by trees

1

(ii) *allow use of carbon for carbon dioxide throughout*

<u>increases</u> CO_2 / greenhouse effect

accept causes global warming

OR

allow causes climate change

<u>less</u> $CO_2$is absorbed (from atmosphere)

ignore other correct effects

1

because <u>burning</u> trees releases CO_2

accept <u>fewer</u> trees to absorb CO_2

***or** crops / plants do not absorb as much CO_2 as trees*

OR

because there is <u>less</u> photosynthesis

ignore habitats / biodiversity

*if no other mark awarded global dimming because of smoke / particles gains **1** mark*

1

(b) any **one** from:

ignore carbon neutral / cost / less harmful / environmentally friendly

- crude oil / fossil fuel is running out / non-renewable

  allow biodiesel is renewable / sustainable

- demand for fuels / energy is increasing

  ignore demand for biodiesel is increasing

- new legislation / protocols

1

(c) (i) uses crops / land that could be used for food

*allow destroys habitats **or** reduces biodiversity*

ignore cost

1

(ii) increases the cost of food / land

ignore cost of machinery / process

ignore cheaper to produce biodiesel

1

[7]

11 (a) carbon dioxide <u>decreased (by plants / trees)</u>

allow plants / trees absorbed carbon dioxide

1

oxygen <u>increased</u> (by plants / trees)

allow plants / trees released oxygen

if neither of these marks awarded

allow plants / trees

*photosynthesise for **1** mark*

1

because coal 'locks up' / traps / stores carbon dioxide / carbon

allow trees 'locked up' carbon dioxide / carbon

1

(b) carbon / C

hydrogen / H

sulfur / S

*all 3 correct **2** marks*
*1 or 2 correct **1** mark*
allow H_2
ignore oxygen

2

(c) (i) 2 2

balancing must be correct
*do **not** accept changed formulae*

1

(ii) <u>increases atmospheric pollution</u>

carbon dioxide / CO_2 released

1

from the (thermal) decomposition of calcium carbonate **or**
*accept causes global warming **or** CO_2 is a greenhouse gas*

description of this decomposition **or** equation
ignore sulfur dioxide and effects in this part

1

<u>decreases atmospheric pollution</u>

sulfur dioxide / SO_2 is removed
accept less acid rain produced

1

by reaction with calcium oxide **or** calcium carbonate
*accept neutralisation **or** forms calcium sulfate*

1

[10]

12 (a) (i) a reasonable attempt at a smooth curve
allow a curve which is close to but does not necessarily touch all points

1

(ii) any **two** from:

allow thicker / thinner / runny for viscous

- biodiesel is more viscous than petroleum diesel at all / lower temperatures
- biodiesel – as the temperature increases the viscosity decreases or vice versa
- petroleum diesel – the viscosity does not change

if no other mark awarded

*allow **1** mark for any correct conclusion based on time or rate of flow*

2

(iii) does not flow as easily (through pipes / engine)

allow could form a solid / block pipes / engine at low temperatures

or

needs a high temperature to flow

allow more difficult to vaporise / ignite

ignore burning

ignore references to viscosity

1

(b) (i) global dimming

allow correct description

1

(ii) 56 (%)

1

(iii) (increases) acid rain

1

because there is more nitrogen oxide(s)

ignore sulfur dioxide

if no other mark awarded

*allow **1** mark for nitrogen oxide(s) given*

1

(iv) *answer yes or no does not gain credit because the marks are for an explanation*

ignore references to petroleum diesel

allow carbon for carbon dioxide

no

because carbon dioxide (26%) is released / produced

1

this will not all be absorbed by photosynthesis / growing plants for biodiesel

accept growing plants / farming uses machinery / fossil fuels releases carbon dioxide

OR

yes

because although carbon dioxide (26%) is released / produced (1)

this was absorbed by photosynthesis / growing plants (for biodiesel) (1)

allow this will be absorbed by photosynthesis / growing plants for biodiesel

1

[10]

13

(a) crust

ignore Earth's

1

core

ignore inner and/or outer

1

(b) bar chart

1

all heights are correct

accept correctly plotted points

1

all labels are correct for nitrogen, oxygen and other / argon

1

(c) (i) decomposed

1

(ii) global warming

1

[7]

14

(a) sulfur dioxide / SO_2

allow sulfur oxide

1

(b) global dimming

1

(c) oxygen / O_2

1

(d) (oil is a) limited resource / finite / non-renewable

*accept running out of oil **or** wood is sustainable*

*accept (burning oil) increases amount of carbon dioxide in the atmosphere / global warming **or** releases locked up carbon / global dimming / acid rain*

accept the oil (may become) too expensive

1

(e) carbon dioxide produced (from burning wood)

ignore global warming

1

carbon dioxide used by plants / trees **or** for photosynthesis

if no other mark awarded

*allow carbon emissions used by plants / trees **or** for photosynthesis for **1** mark*

1

[6]

15 (a) complete diagram with 2 carbon atoms and 5 hydrogen atoms each C–C and each C–H linked by a single line (bond)

1

(b) (i) the greater the number of (carbon) atoms (in an alkane molecule) the greater its boiling point **or** vice versa

allow as the (carbon) chain gets longer the boiling point increases

ignore melting points

*do **not** accept reference to greater number of molecules*

1

(ii) *they = hydrocarbons from the graph*
it = $C_{30}H_{62}$

any **two** from:

- low boiling point / volatile
  accept they are gases or liquids
- low viscosity
- high flammability
  accept easier to burn / ignite
- small molecules
  accept short chains
  ignore number of carbon atoms
- burn completely
  ignore speed of burning

2

(c) (i) 16 (CO_2) + 18 (H_2O)

1

(ii) (carbon dioxide in the Earth's early) atmosphere
accept from volcanoes (millions of years ago)
or *from <u>dead</u> plants / animals*
allow dead sea creatures
ignore shells

1

(iii) <u>increase</u> in burning / use of fossil fuels

1

locked up carbon (carbon dioxide) is released
allow carbon / carbon dioxide from millions of years ago is released
accept extra carbon dioxide is not 'absorbed' (by the carbon cycle)

1

[8]

16

any **four** from:

*to gain **4** marks both pros and cons should be given*

Arguments for biodiesel

max **three** from:

- sustainable / renewable
- (carbon neutral) absorbs CO_2 when growing / during photosynthesis
- burning biodiesel produces low amounts particulates / carbon monoxide

  allow burning biodiesel produces little / low amount of global dimming

  ignore sulfur dioxide
- can use waste vegetable oils / fats (from food industry) **or** can use waste plant material
- can be used to conserve crude oil (instead of / mixed with petroleum diesel)
- produced by a low energy / temperature process

  accept produced by a low tech process
- biodegrades (easily)

  ignore engine effects

Arguments against biodiesel

max **three** from:

- creates food shortages

  accept price of food increases
- deforestation to plant more crops leads to loss of habitat / biodiversity **or** deforestation leads to a reduction in absorption of CO_2

  allow burning trees increases CO_2

  allow deforestation increases global warming
- burning biodiesel produces high amounts of nitrogen oxides

  allow increases acid rain
- crops takes time to grow

  allow crops can fail
- vast areas of land needed to grow crops

4

conclusion supported by the argument presented, which must give added value to the points for and against given above

1

[5]

17

(a) (thought to cause) global warming / green house (effect) / climate change

ignore other consequences of global warming

*do **not** accept acid rain / ozone layer / global dimming*

1

(b) any **three** from:

- replant trees / renewable / sustainable

  ignore reusable

- carbon (dioxide) used by trees / photosynthesis

  accept trees absorb carbon (dioxide) as they grow

  ignore respiration

- it is a (continuous / carbon) cycle

  accept burning wood is carbon neutral

  or

  carbon (dioxide) goes back into the air

  *for the **second** and **third** bullet points: accept trees use carbon dioxide which is released when (trees / wood are / is) burnt for **2** marks*

- no new carbon (dioxide) is produced

  or

  no locked up carbon (dioxide) is released

  or

  the carbon (dioxide) was absorbed millions of years ago

3

[4]

18

(a) acid rain → sulfur dioxide

1

global warming → carbon dioxide

1

global dimming → carbon particles

1

(b) (i) oxygen

1

(ii) carbon monoxide

1

(c) (i) decreasing

accept running out / none left

1

(ii) any **two** from:

it = coal

- world needs (more) energy
  accept population is increasing
  allow (greater) demand for coal / fuels / energy
- plentiful supply
  accept readily available
  allow coal will 'last longer'
- (many) countries have coal
- easy to find / extract
- oil / gas is running out
  accept need to use less oil / gas
  accept need to use it to replace oil / gas
- cheap **or** cheaper than oil

2

[8]

19 (a) (i) (thermal) decomposition

allow it breaks down

accept symbol equation or in words

allow reaction with SO_2 (to form CO_2)

1

(ii) calcium carbonate / calcium oxide / limestone / quicklime / it <u>reacts</u> with sulfur dioxide / <u>forms</u> calcium sulfate

accept it <u>neutralises</u> sulfur dioxide / <u>neutralisation</u>

ignore references to sulfur

do not accept 'calcium reacts with...'

1

(b) by incomplete / partial combustion (of the fuel)

1

insufficient oxygen / *air* (to burn fuel)

*accept insufficient oxygen / air to burn fuel completely for **2** marks*
if no other marks awarded
accept $C + CO_2 \rightarrow 2CO$ ***or***
$2C + O_2 \rightarrow 2CO$ ***or*** *in words for **1** mark*

1

(c) (i) any **two** from:

- (CO_2) from the atmosphere
- (CO_2) taken in millions of years ago **or** early (atmosphere)
  allow thousands / billions
  allow rocks formed millions of years ago
- (CO_2) was used to form the shells / skeletons of marine organisms / fossil fuels
  accept sedimentary rocks
  allow used to form correct named fossil fuel
  ignore limestone

2

(ii) any **one** from:

- (increases / enhances) global warming
  allow greenhouse gas / effect
  *do **not** accept ozone layer / acid rain / global dimming*
  ignore consequences of global warming
- is additional carbon dioxide **or** not able to be absorbed by oceans / seas **or** used by (green) plants
- acidification of sea water

1

[7]

20 (a) (i) straight line through the 'points' and extended to C_8H_{18}

*do **not** accept multiple lines*

1

(ii) 5500

range 5400 to 5600
accept ecf from their graph

1

(iii) it is a straight line graph

allow directly proportional

accept constant difference between (energy) values

accept C_5H_{12} close to values on the graph

***or** C_5H_{12} comes in middle of the graph*

ignore 'fits the pattern' unqualified

ignore 'line of best fit'

ignore 'positive correlation'

1

(iv) expected ranges for working are:

accept correct numerical answer as evidence of working

(5400 to 5600) – (2800 to 2900) = (2500 to 2800)

or

their value from (a)(ii) – a value from 2800 to 2900

or

(5400 to 5600) / their (a)(ii) divided by 2

or

a value from 2800 to 2900 - 2

1

no / not quite / almost / yes

this mark is only awarded on evidence from their correct working

1

(b) (i) incorrect / no **or** partially correct

ignore references to hydrogen

1

bio-ethanol produces least energy

mark independently

or

bio-ethanol produces 29 kJ

1

(ii) *ignore incorrect / correct*

any **two** from:

- hydrogen produces only H_2O
  accept hydrogen does not produce harmful gases / CO_2 / SO_2
- coal produces SO_2
  allow coal causes acid rain / respiratory problems
- coal produces smoke
  allow coal causes global dimming
- both renewable and non-renewable fuels produce CO_2
  accept bio-ethanol and natural gas / coal produce CO_2 / global warming
- (both) the non-renewable fuels produce CO_2
  accept coal and natural gas produce CO_2 / global warming
- (both) renewable fuels produce no smoke
  accept hydrogen and bio-ethanol do not produce smoke / global dimming
- (both) renewable fuels produce no SO_2
  accept hydrogen and bio-ethanol
  do not produce SO_2 / acid rain

2

[9]

21 (a) (i) polyethene / poly(ethene)
accept polythene / polyethylene

1

(ii) needs heat / energy / high temperature / fuel (for cracking)
ignore other processes

1

produces carbon dioxide / CO_2
*ignore use of CO_2 **or** 'produces carbon'*

1

(b) any **three** from:

- use water from local sources **or** water from close to home
- recycle bottles in the UK / close to home
  accept do not recycle in other countries / Asia
- (reduction in distance travelled) would reduce CO_2 emitted by transport
  accept use of transport with low / no carbon dioxide emissions
- use tap water
- use glass bottles / waxed cartons / metal bottles
  *do **not** accept 'do not use plastic bottles' without an alternative material*
- do not put in landfill **or** recycle more
- reuse / refill plastic bottles
- tax imported water / plastic bottles (to offset carbon cost)
- make more / all plastic bottles in UK
  answers must be about the reduction of carbon cost

3

[6]

22 (a) curve of best fit drawn through

or close to all of the points

1

(b) (i) 313

1

(ii) 1989 +/– 1

1

(c) concentration / amount of carbon dioxide has increased

1

recently the rate of increase is increasing

1

[5]

23 (a) (i) acid rain

accept consequences of acid rain

allow asthma / bronchitis

ignore toxic gas

1

(ii) global dimming

accept dimming alone

1

(b) (i) **sustainable:**

maximum **two** from:

- crops (that produce oil) can be grown in most places owtte
- renewable
- use less fossil fuels / diesel
- use (refined) waste oils

low pollution:

maximum **two** from:

ignore references to CO_2 here

- most emissions are lower **or** any two named emissions from CO / SO_2 / PM_{10} are lower
- much / lot less SO_2 emissions (than the others) owtte
- accept spillages / waste is biodegradable
- less new CO_2 **or** (more) carbon neutral

3

(ii) plants / photosynthesis use carbon (dioxide) from the air*

1

it / biodiesel releases carbon (dioxide) from plants / crops / photosynthesis*

*(*) allow **1** mark for biodiesel is (more) carbon neutral*

1

(fossil) diesel releases 'locked up' / new carbon (dioxide) / doesn't absorb CO_2 / absorbed it millions of years ago

1

[8]

24 (a) (i) sulfur dioxide / SO_2

1

(ii) global dimming

1

(iii) carbon dioxide / CO_2

ignore ozone

1

increases the levels (of carbon dioxide)

*accept it is a greenhouse gas **or** causes global warming / greenhouse effect*

1

(b) gas / oil bar correct length

1

coal bar correct length

1

[6]

25 (a) any **two** environmental problems with linked explanations

- global warming (1)

accept effects of global warming

caused by (formation of) carbon dioxide / greenhouse gas (1)

ignore greenhouse effect

- acid rain (1)

accept effects of acid rain
ignore respiratory problems

caused by (formation of) sulfur dioxide (1)

accept sulfur oxide
ignore sulfuric acid

- global dimming (1)

ignore respiratory problems

caused by (formation of) particles / particulates / fires / smoke / carbon / pm 10 (1)

- scarring of landscape (1)

caused by mining / quarrying of coal (1)

ignore ozone layer

max 4

(b) any **three** from:

- replant the trees / renewable / sustainable
  ignore reusable
- carbon dioxide is used by the trees / photosynthesis
  accept trees absorb carbon dioxide as they grow
  *do **not** allow respiration*
- it's a (continuous carbon) cycle
  accept 'carbon dioxide goes back into the air'
  accept trees use CO_2 which is released when trees are burnt
- no 'new' carbon (dioxide) is produced **or**
  no locked up carbon (dioxide) is released
  accept no carbon (dioxide) from fossil fuels is produced

3

[7]

26 (a) oxygen **and** nitrogen

1

20 – 21 % and 78 – 80 %
*accept any two correct responses in the correct space for **one** mark*

1

(b) (i) acid rain
accept toxic gas or consequence of acid rain

1

(ii) idea of the removal or use of sulfur dioxide gas (from the waste gases)
*do **not** accept remove sulfur from coal*

1

(iii) oxygen
accept O_2

1

water
accept H_2O
accept hydrogen oxide / steam

1

(c) any **two** from:

- it's a 'greenhouse gas' or increase greenhouse effect
  accept action of a 'greenhouse gas'
- causes global warming or increase in the Earth's temperature
- sea-levels rise or flooding
- climate change
- (polar) ice-caps melt
- extension of deserts
  *mention of ozone / acid rain / global dimming = max **1** mark*

2

(d) idea trap / store / lock the carbon dioxide

1

in the oil reservoir or under the sea bed
*do **not** accept 'into the oil' / 'under the sea'*

1

[10]

27 (a) hydrogen
ignore formulae

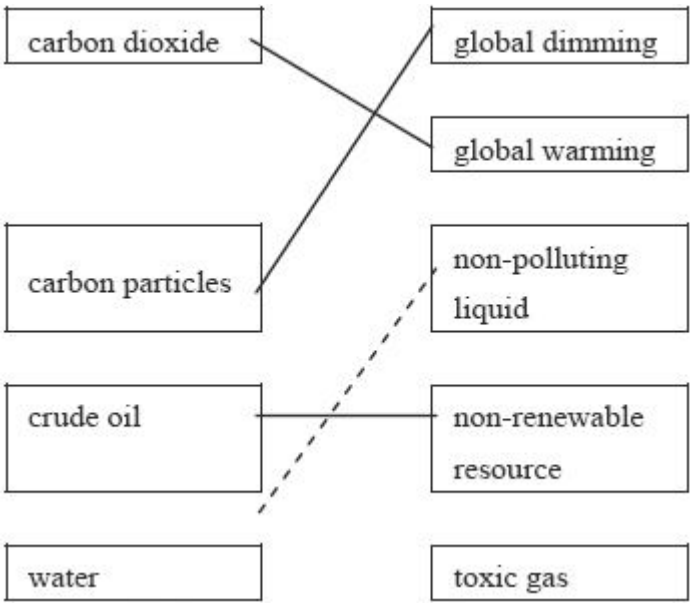
1

(b) any **two** from:

- different sized molecules / more or less (carbon) atoms (in molecules)
  ignore different densities
- fuels have <u>different</u> boiling points
- fuels condense at <u>different</u> temperatures

2

(c)



*all three correct = **3** marks*
*two correct = **2** marks*
*one correct = **1** mark*

3

[6]

28 **Quality of written communication:**

*for correct sequencing or linking of **two** ideas or **two** points*
annotate Q ✓ or Q ✗

1

any **three** from:

ignore superfluous statements

- **B** is least energy efficient in terms of cost (kJ per p), so **A** = **C** = **D** in terms of cost **or B** is the most expensive in terms of energy efficiency
  owtte

  *accept **B** is poor value for money / **B** is most expensive one is insufficient for mark*

- **D** is 1st, since gives only water as product **or** gives no harmful products / gases **or** there are no pollutants
  owtte

- **A** is 2nd best, since produces CO_2 owtte

- **C** is 3rd, since gives SO_2 owtte

  *if no other marks, then **D A C B** – based on energy per kJ per 100g only = **1** mark and Q mark if 2 ideas are linked*

3

[4]

29

(a) **Quality of written communication**

for any two ideas sensibly stated

1

any **three** from:

- plants take in (CO_2)

  accept photosynthesis uses (CO_2)

- converted to glucose / starch / carbohydrates

  ignore carbon compounds by itself

- CO_2 locked up in fossil fuels

  accept coal / oil / natural gas / methane for fossil fuels

- CO_2 reacts with / dissolves (sea)water

  accept ocean removes CO_2

- producing hydrogencarbonates

  accept carbonic acid

- producing carbonates

  accept named carbonates

- marine animals use carbonates to make shells

  *do **not** accept bones*

- forms sedimentary rocks

  accept limestone / chalk
  accept marble
  *do **not** accept sediments alone*

3

(b) any **two** from:

- burning of fossil fuels **or** cars / industry / air travel / power stations

  ignore increase in population
  ignore more use of electricity

- natural processes cannot absorb all the extra CO_2

- deforestation

  accept less photosynthesis
  ignore volcanic activity
  accept burn trees

2

[6]

30 (a) respiration

combustion

1 mark each **2**

(b) methane

water

1 mark each
accept steam
*do **not** accept natural gas for methane*
*do **not** accept hydrogen oxide* **2**

(c) greenhouse effect (increased)

accept (global) warming
accept polar ice caps melt
accept rising sea levels
accept problems with climatic change
*do **not** accept changes to the weather **or** acid rain* **1**

[5]

31 (a) N_2 **1**

20–21%

accept an answer in this range **1**

Ar **1**

(b) (i) compound of carbon and hydrogen only

*do **not** accept 'mixture'* **1**

(ii) Oxygen **or** O_2 **1**

(iii) exothermic

*accept combustion **or** oxidation*

1

(iv) **increases** greenhouse effect

1

global warming **or** example

1

[8]

32 (a) combustion

for one mark

1

(b) B

for one mark

1

[2]

33 (a) (i) burning / breathing / respiration / fuels / food

for 1 mark each

2

(ii) 1. rock is heated / subducted (owtte) / close to magma / melted
1. rock is decomposed / carbon dioxide released through volcanoes

for 1 mark each

2

(b) carbon dioxide reacts / dissolves in sea-water / dissolves in rain water
insoluble carbonates / calcium carbonate are / is formed carbon dioxide turned into shells / coral / limestone / chalk / sediments also soluble hydrogencarbonates (calcium / magnesium) are formed photosynthesis by plants

any three for 1 mark each

3

(c) (i) sea unable to absorb all the extra carbon dioxide being produced
more trees being cut down / deforestation increased burning of fuels / more cars / more industry (*not* more people)

any one for 1 mark

1

(ii) global warming / greenhouse effect or effects such as melting ice caps / rising sea levels / climatic change / more deserts
(*not* changes to ozone layer)
for one mark

1

[9]

34 (a) any **two** 1 mark each

burning / combustion

fossil fuels **or** (locked up) carbon
accept fuel / named fuel

oxygen used

2

(b) any **three** from

produces (calcium) carbonate

which is insoluble

produces (calcium) hydrogencarbonate

which is soluble

photosynthesis

releases oxygen

3

[5]