AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.9.3 COMMON ATMOSPHERIC POLLUTANTS AND THEIR SOURCES (PACK 1)

SCORE	PERCENTAGE
/320	%

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Q1.

(a) incomplete combustion

1

(because) insufficient / limited oxygen supply

1

(b) any **two** from:

- carbon monoxide toxic / poisonous

  allow description of how carbon monoxide is toxic / poisonous
  ignore carbon monoxide is harmful / dangerous / deadly

- greater public concern / awareness about pollution

  ignore comments about the effects of other pollutants

  ignore unspecified comments about carbon monoxide pollution

- more cars so otherwise there would be more carbon monoxide entering atmosphere

- improved engine technology

- catalytic converters have been introduced

2

(c) any **one** from:

- (to reduce) health problems

  allow (to reduce) specified health problems e.g. breathing difficulties, asthma, lung cancer

- (to reduce) global dimming

  allow (to reduce) the effects of global dimming e.g. reduced light levels

  allow (to reduce) smog
  allow (to reduce) the formation of particulates

  ignore global warming

  *do **not** accept to reduce soot*

1

(d) nitrogen (from atmosphere) reacts with oxygen (from atmosphere)

1

at high temperature (in engine)

ignore heat / hot

or
with a spark (from spark plug)

1

(e) **2** $NO_2 \longrightarrow N_2 + \mathbf{2}\ O_2$

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allow multiples

*if incorrect, allow N_2 for **1** mark*

2

(f) any **one** from:

- acid rain

  allow specific effects of acid rain

- respiratory problems

  allow specific respiratory problems e.g. breathing difficulties, asthma

- carbon monoxide

- global dimming **or** smog

2

***max 1** mark if global warming mentioned*

(g) transition metals

1

[12]

Q2.

(a) $C_{12}H_{26}$

1

(b) alkane

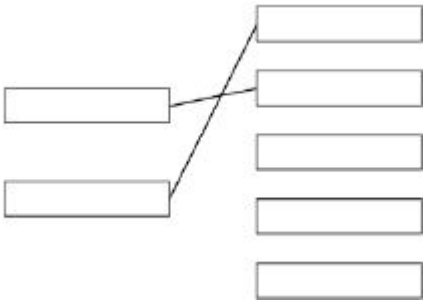
1

(c) air

allow atmosphere

1

(d)



particulates − global dimming

1

sulfur dioxide − acid rain

1

(e) carbon dioxide

1

carbon monoxide

1

(f) develop fuel efficient engines

use electric cars

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1

[9]

Q3.

(a) sulfur dioxide

1

(b) any **one** from:

- kills aquatic animals / plants
- damages limestone buildings / statues
- damage to forests

1

(c) (sample) **C**

1

contains most sulfur
or
produces most sulfur dioxide

1

(d) $1 \times \frac{66.3}{22.1}$

1

= 3 (kg)

1

*an answer of 3 (kg) scores **2** marks*

(e) any **two** from:

- not easily detected
- colourless
  allow cannot see it
- odourless
  allow cannot smell it

2

[8]

Q4.

(a) C_5H_{12}

1

(b) Alkanes

1

(c) (3) CO_2

1

(4) H_2O

1

*allow for **1** mark*
4 CO_2 + 3 H_2O

(d) contains hydrogen and carbon

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1

(hydrogen and carbon) only

1

(e) *(diesel)*
produces more oxides of nitrogen
allow converse answers in terms of petrol

1

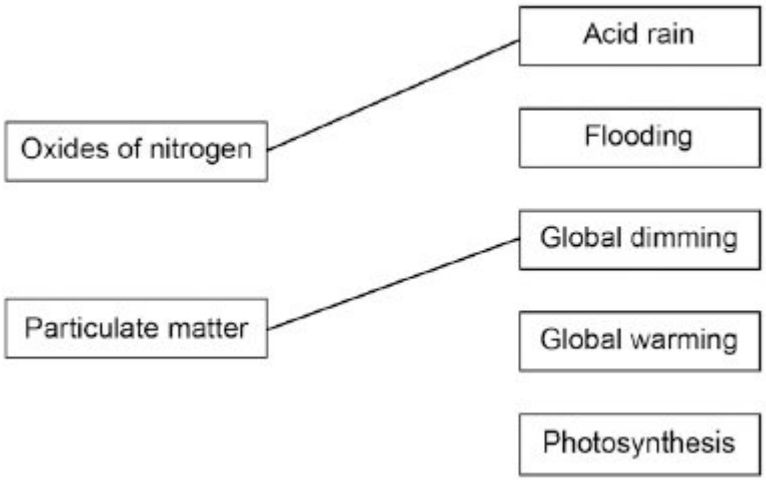
produces (more) particulate matter

1

produces less carbon dioxide

1

(f)



2

[11]

Q5.

(a) C_6H_{14}

1

(b) **A**

1

(c) **B**

1

(d) **C**

1

(e) Propanol

1

[5]

Q6.

(a) (i) high temperature
allow heating / hot / 250-900 °C

1

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catalyst or steam

allow named catalyst eg zeolite, Al_2O_3, silica, ceramic

allow in the absence of air / oxygen

ignore any references to pressure

1

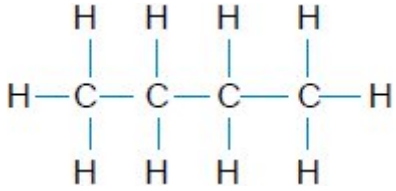
(ii) colourless

allow decolourised

ignore clear / discoloured

1

(iii)



1

(b) (i) 20.3(0) (kJ)

*if answer incorrect allow **1** mark for 24.36/1.2*

2

(ii) use a lid

allow insulate beaker or use draught shield

1

reduce energy / heat loss

ignore references to thermometer or repeats or distance of flame or loss of water vapour

allow stir (1) to distribute energy / heat (1)

allow use a metal can (1) as it's a better conductor (1)

1

(iii) carbon/soot

ignore tar, smoke

1

(produced by) incomplete combustion

allow from a limited supply of oxygen/air

1

(iv) hexane gives out the greatest energy (per 1.0 g)

ignore more energy

1

hexane produces the least smoke / carbon / soot

allow has the cleanest flame

ignore less smoke / carbon / soot

1

(c) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

Level 3 (5 – 6 marks):
Descriptions of advantages **and** disadvantages that are linked to their own knowledge.

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Level 2 (3 – 4 marks):
Descriptions of an advantage **and** a disadvantage with some use of their knowledge to add value.

Level 1 (1 – 2 marks):
Statements made from the information that indicate whether at least one statement is an advantage **or** a disadvantage
or a linked advantage or disadvantage

0 marks:
No relevant content

Examples of the added value statements and links made in the response could include:
Note that link words are in bold; links can be either way round.
Accept reverse arguments and ignore cost throughout.

Advantages of using hydrogen:
- Combustion only produces water **so** causes no pollution
- Combustion does not produce carbon dioxide **so** this does not contribute to global warming or climate change
- Combustion does not produce sulfur dioxide **so** this does not contribute to acid rain
- Incomplete combustion of petrol produces carbon monoxide **that is** toxic
- Incomplete combustion of petrol produces particulates **that** contribute to global dimming
- Petrol comes from a non-renewable resource **but** there are renewable/other methods of producing hydrogen
- Hydrogen releases more energy **so** less fuel needed or more efficient

Disadvantages of using hydrogen:
- Hydrogen is a gas **so** is difficult to store or transfer to vehicles
- Hydrogen gas is very flammable **so** leaks cause a greater risk of explosion
- Most hydrogen is produced from fossil fuels **which** are running out
- Cannot be used in existing car engines **so** modification / development or replacement is needed
- Lack of filling stations **so** difficult to refuel your vehicle

6

[18]

Q7.

(a) because sulfur dioxide causes <u>acid rain</u>

1

which kills fish / aquatic life **or** dissolves / damages statues / stonework **or** kills / stunts growth of trees

if no other mark awarded then award 1 mark for sulfur dioxide is toxic or causes breathing difficulties.

1

(b) (i) <u>electrons</u> are lost

1

(ii) $Cu^{2+} + 2e^- \rightarrow Cu$

allow $Cu^{2+} \rightarrow Cu - 2e^-$

ignore state symbols

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1

(iii) copper sulfate

allow any ionic copper compound

1

(c) (lattice of) positive ions

1

delocalised electrons

accept sea of electrons

1

(electrostatic) attraction between the positive ions and the electrons

1

electrons can move through the metal / structure **or** can flow

allow electrons can carry charge through the metal / structure

if wrong bonding named or described or attraction between oppositely charged ions then do not award M1 or M3 − MAX 2

1

(d) (copper compounds are absorbed / taken up by) plants

allow crops

1

which are burned

1

the ash contains the copper compounds

do not award M3 if the ash contains copper (metal)

1

(e)

/ A_r	55.6 / 63.5	16.4 / 56	28.0 / 32
moles	0.876	0.293	0.875
ratio	3	1	3
formula	Cu_3FeS_3		

*award **4** marks for Cu_3FeS_3 with some correct working*

*award **3** marks for Cu_3FeS_3 with **no** working*

*if the answer is not Cu_3FeS_3 award up to **3** marks for correct steps from the table apply ecf*

*if the student has inverted the fractions award **3** marks for an answer of $CuFe_3S$*

4

[16]

Q8.

(a) circle round any one (or more) of the covalent bonds

any correct indication of the bond − the line between letters

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1

(b) Methane contains atoms of two elements, combined chemically

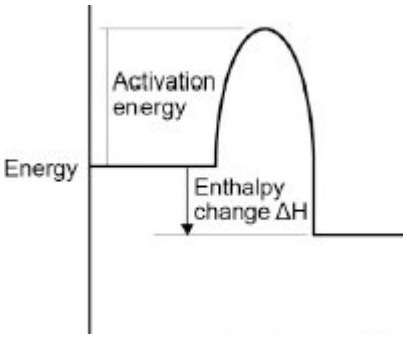
1

(c) (i) activation energy labelled from level of reagents to highest point of curve

ignore arrowheads

1

enthalpy change labelled from reagents to products



*arrowhead **must** go from reagents to products only*

1

(ii) 2 O_2

1

2 H_2O

*if not fully correct, award **1** mark for all formulae correct.*

ignore state symbols

1

(iii) carbon monoxide is made

1

this combines with the blood / haemoglobin **or** prevents oxygen being carried in the blood / round body **or** kills you **or** is toxic **or** poisonous

dependent on first marking point

1

(iv) energy is taken in / required to break bonds

accept bond breaking is endothermic

1

energy is given out when bonds are made

accept bond making is exothermic

1

the energy given out is greater than the energy taken in

this mark only awarded if both of previous marks awarded

1

(d) (i) energy to break bonds = 1895

calculation with no explanation max = 2

1

energy from making bonds = 1998

1

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1895 − 1998 (= −103)
or
energy to break bonds = 656
energy from making bonds = 759
656 − 759 (= −103)

allow:

bonds broken − bonds made =

413 + 243 − 327 − 432 = -103 for 3 marks.

1

(ii) The C — Br bond is weaker than the C — Cl bond

1

[15]

Q9.

(a) (i) mixture (of different substances)

1

(ii) boiling (points)

1

(iii) distillation

1

(b) (i) combustion

1

(ii) (reactant)

oxygen

allow correct formulae

1

(products)

products in any order

carbon dioxide

allow carbon or carbon monoxide

and

water

allow water vapour or steam or hydrogen oxide

1

(iii) (burning sulfur) produces sulfur dioxide / $S0_2$

allow it / sulfur reacts with oxygen ignore sulfur oxide

1

causes acid rain

1

(c) (i) propane is a fuel

1

(ii) double bond drawn between carbon atoms

do not allow any other bonds or symbols

1

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(iii) orange to colourless

1

(iv) poly(pentene)

allow polymer(s)

1

[12]

Q10.

(a) any **four** from:

- (crude oil is) heated
- to evaporate / vaporise / boil (the substances / hydrocarbons)
- the column is hotter at the bottom or is cooler at the top
- (vapours / fractions) condense
- at their boiling points or at different levels.

marks can be taken from a diagram

max 3 marks for reference to cracking

allow fractional distillation allow vapours (enter the column)

allow temperature gradient or (vapours) cool as they rise

allow description e.g. vapour turns to liquid)

allow they have different boiling points

4

(b) acid rain is caused by

allow consequences of acid rain

1

sulfur dioxide or oxides of nitrogen

second marking point is dependent on first marking point

1

they react with / are neutralised by calcium carbonate or limestone

OR

global warming is caused by

carbon dioxide

carbon dioxide will react or dissolve in suspension of limestone

allow greenhouse effect is caused by or allow consequences of global warming

1

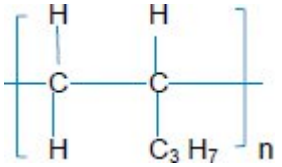
(c) (i) C_2H_4

must be formula

ignore any name

1

(ii) a single bond between carbon atoms



would score 3 marks

1

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other four bonds linking hydrogen atoms and C_3H_7 group plus two trailing / connecting bonds

1

n at the bottom right hand corner of the bracket

1

(iii) has a shape memory
or
(a smart polymer) can return to original shape (when conditions change)

1

[12]

Q11.

(a) Sulfur dioxide causes acid rain.

1

(b) red / orange / yellow
*do **not** accept any other colours*

1

because sulfur dioxide (when in solution) is an acid

1

(c) (there are) <u>weak</u> forces (of attraction)
*do **not** accept any reference to covalent bonds breaking*

1

between the molecules
*do **not** accept any other particles*

1

(these) take little energy to overcome
award third mark only if first mark given

1

(d) 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 on page 5 and apply a 'best-fit' approach to the marking.

0 marks
No relevant content

Level 1 (1 – 2 marks)
A relevant comment is made about the data.

Level 2 (3 – 4 marks)
Relevant comparisons have been made, and an attempt made at a conclusion.

Level 3 (5 – 6 marks)
Relevant, detailed comparisons made and a justified conclusion given.

examples of the points made in the response

effectiveness

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- W removes the most sulfur dioxide
- D removes the least sulfur dioxide

material used

- Both W and D use calcium carbonate
- Calcium carbonate is obtained by quarrying which will create scars on landscape / destroy habitats
- D requires thermal decomposition, this requires energy
- D produces carbon dioxide which may cause global warming / climate change
- S uses sea water, this is readily available / cheap

waste materials

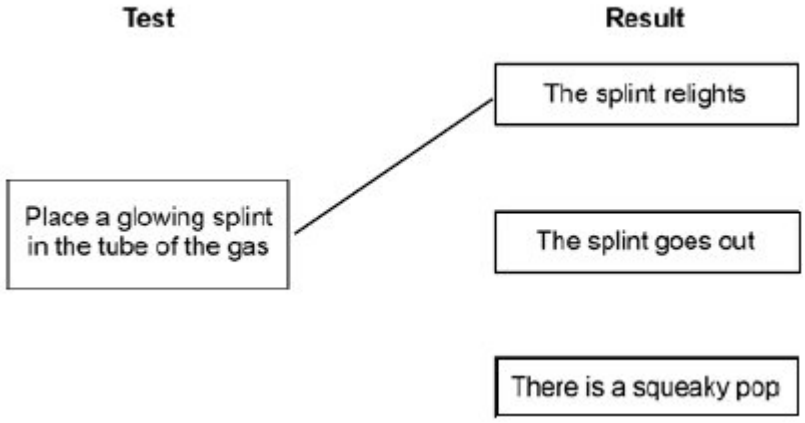
- W product can be sold / is useful
- W makes carbon dioxide which may cause global warming / climate change
- D waste fill landfill sites
- S returned to sea / may pollute sea / easy to dispose of

6

[12]

Q12.

(a)



more than one line from test negates the mark

1

(b) (i) place a lighted splint at the mouth of the tube

1

there is a squeaky pop

dependent on correct test

1

(ii) hydrogen is less reactive than magnesium

accept converse

accept magnesium is too reactive

1

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

- to improve appearance or make it look nice

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- to prevent corrosion
- to make it more durable
- cheaper than solid silver

1

(ii) solution must be silver nitrate **or** contain silver ions

1

otherwise copper will be deposited **or** silver will not be deposited

1

spoon must be the negative electrode / cathode

1

because silver ions have a positive charge **or** go to negative electrode **or** are discharged at the negative electrode.

1

(iii) because (plastic is an) insulator **or** does not conduct electricity

accept does not contain mobile electrons

1

[10]

Q13.

(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

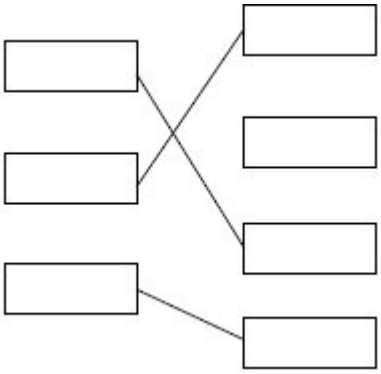
1

Sulfur dioxide > acid rain

1

Water > no pollution

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1

[8]

Q14.

(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]

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Q15.

(a) (i) CH_4

allow H_4C

*do **not** allow lower-case h*

*do **not** allow superscript*

1

(ii) single

1

(iii) alkanes

1

(b) (i) carbon / C

any order

1

hydrogen / H

allow phonetic spelling

1

sulfur / sulphur / S

1

(ii) air / atmosphere

1

(iii) acid rain

1

damages trees / plants **or** kills aquatic organisms **or** damages buildings / statues **or** causes respiratory problems

allow harmful to living things

1

(c) carbon / C

accept soot / particulates / charcoal

1

(d) any **four** from:

- (supports hypothesis) because when the fuel contained more carbon the temperature of the water went up more / faster (in 2 minutes)
- (does not support hypothesis as) temperature change per gram decreases as the number of carbons increases
- (does not support hypothesis) because the more carbon in the fuel the more smoke **or** the dirtier / sootier it is
- only tested hydrocarbons / alkanes / fuels with between 5 and 12 carbon atoms
- valid, justified, conclusion

accept converse statements

4

(e) (i) 0.15

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

*if answer incorrect, M_r carbon dioxide = 44 gains **1** mark*

*allow 0.236 / 0.24 / 0.2357142 (ecf from M_r of 28) for **1** mark*

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2

(ii) 0.4(0)

1

(iii) C_3H_8

*correct formula with or without working scores **2** marks*

0.15 / 0.05 = 3

*allow ecf from **(e)(i)***

and

0.4 / 0.05 = 8 (1)

*allow ecf from **(e)(ii)***

*allow **1** mark for correct empirical formula from their values*

If use 'fall-back-values:

0.50 / 0.05 = 10

and

0.20 / 0.05 = 4

1 mark

C_4H_{10}

1 mark

if just find ratio of C to H using fall-back values, get C_2H_5
*allow **1** mark*

2

[19]

Q16.

(a) (i) exothermic

accept combustion
*allow burning **or** oxidation **or***
redox

1

(ii) carbon monoxide / *CO* (is produced)

allow monoxide (is produced) ignore carbon oxide

1

because there is incomplete / partial combustion (of the fuel)

accept because there is insufficient oxygen / air (to burn the fuel)

1

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also refer to the information in the Marking guidance.

0 marks
No relevant content.

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Level 1 (1-2 marks)
There is a statement that crude oil is heated **or** that substances are cooled. However there is little detail and any description may be confused or inaccurate.

Level 2 (3-4 marks)
There is some description of heating / evaporating crude oil **and either** fractions have different boiling points **or** there is an indication of a temperature difference in the column.

Level 3 (5-6 marks)
There is a reasonable explanation of how petrol is or fractions are separated from crude oil using evaporating **and** condensing.

If cracking is given as a preliminary or subsequent process to fractional distillation then ignore.

However, if cracking / catalyst is given as part of the process, maximum is **level 2**.

Examples of chemistry points made in the response could include:

- Some / most of the hydrocarbons (or petrol) evaporate / form vapours or gases
- When some of / a fraction of the hydrocarbons (or petrol) cool to their boiling point they condense
- Hydrocarbons (or petrol) that have (relatively) low boiling points and are collected near the top of the fractionating column or hydrocarbons with (relatively) high boiling points are collected near the bottom of the fractionating column
- The process is fractional distillation
- Heat the crude oil / mixture of hydrocarbons or crude oil / mixture is heated to about 350°C
- Some of the hydrocarbons remain as liquids
- Liquids flow to the bottom of the fractionating column
- Vapours / gases rise up the fractionating column
- Vapours / gases cool as they rise up the fractionating column
- The condensed fraction (or petrol) separates from the vapours / gases and flows out through a pipe
- Some of the hydrocarbons remain as vapours / gases
- Some vapours / gases rise out of the top of the fractionating column
- There is a temperature gradient in the fractionating column or the fractionating column is cool at the top and hot at the bottom

6

[9]

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Q17.

(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>' (fossil fuels) **or**

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

1

[11]

Q18.

(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 absorb (carbon dioxide)
- coal 'locks up' (carbon dioxide)

1

(ii) it increases the amount (of CO_2)

1

because carbon in coal (forms carbon dioxide)

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

1

[6]

Q19.

(a) carbon dioxide decreased (by plants / trees)

allow plants / trees absorbed carbon dioxide

1

oxygen increased (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*

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*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]

Q20.

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

if no other mark awarded
*allow **1** mark for any correct conclusion based on time or rate of flow*

2

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(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 <u>more</u> 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 <u>not</u> 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]

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Q21.

(a) carbon / diesel / it reacts / burns in oxygen / air

1

limited supply (of oxygen / air)

accept incomplete combustion

$2C + O_2 \rightarrow 2CO$ ***or***

$C + CO_2 \rightarrow 2CO$ *gains* ***2*** *marks*

1

(b) any **four** from:

accept converse statements for fossil diesel.

ignore cost / ease of manufacture / usage issues

for biodiesel:

- less global dimming (because fewer carbon particles)
- less acid rain (because less sulfur dioxide)

  if neither point awarded, fewer carbon particles and less sulfur dioxide = ***1*** *mark*
- renewable resource / sustainable

  accept fossil fuel / diesel supplies are limited
- use <u>waste</u> vegetable oils / fats
- vegetables / plants absorbed carbon dioxide / carbon neutral

  accept fossil fuel / diesel releases locked up carbon / is not carbon neutral
- uses land which could be used to produce food
- third world countries can produce bio diesel
- biodegrades easily
- more NOx released

4

justified conclusion

1

[7]

Q22.

(a) (i) increase

1

(ii) energy is given out to the surroundings

1

(b) (i) NO

allow 2NO

ignore nitrogen oxide

do ***not*** *allow equations*

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1

(ii) harmful / poisonous (owtte)

allow dangerous

ignore reference to pollution / global warming

*do **not** accept references to ozone layer*

1

(c) a catalyst can speed up a chemical reaction

1

different reactions need different catalysts

1

(d) (i) smaller

accept less / tiny / very small

allow 10^{-9}

*do **not** allow small unless qualified*

1

(ii) reduce cost (owtte) **or**

ignore references to energy

save resources / raw materials (owtte)

1

[8]

Q23.

(a) gives out heat / energy

allow release / loses

allow the products have less energy

or

energy / heat transferred to the surroundings

ignore temperature rises

allow more energy given out in forming bonds than taken in to break bonds

1

(b) (i) speed up the reaction (owtte)

accept changes the rate

accept lowers activation energy

accept increases successful collisions

accept allows reaction to take place at a lower temperature

1

(ii) nitrogen (N_2) / oxygen (O_2) / products are safe **or** not harmful / pollutant / toxic / dangerous / damaging

ignore releases nitrogen / oxygen unless qualified

or

(harmful) nitrogen monoxide / NO is not released into the air.

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accept prevents / less acid rain
ignore greenhouse gas / ozone layer

1

(iii) 2 and 2
accept correct multiples or fractions

1

(iv) idea of catalyst not being used up
allow not changed by reaction
ignore catalyst does not take part
ignore catalyst not used in the reaction

1

(v) idea of different reactions (require different catalysts)
accept catalysts work for specific reactions
allow different gases

1

(c) • smaller / very small / or any indication of very small / 1–100 nanometres / a few (hundred) atoms
ignore just small
ignore size of the converter

1

• big(ger) surface area

1

• less (catalyst) needed / small amount of catalyst needed

1

[9]

Q24.

(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

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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]

Q25.

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

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- 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]

Q26.

(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]

Q27.

(a) (i) (thermal) decomposition

allow it breaks down

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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 <u>additional</u> carbon dioxide **or** not able to be absorbed by oceans / seas **or** used by (green) plants
- acidification of sea water

1

[7]

Q28.

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

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*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:

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- 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]

Q29.

(a) good (electrical) conductor
allow low reactivity / resistance to corrosion
*do **not** accept heat conductor*

1

(b) a mixture of metals
accept contains more than one type of metal

1

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

- eyesore
- destruction of habitats
- pollution of water
- dust pollution
- noise
- traffic pollution

1

(ii) acid rain
allow sulfur dioxide is a pollutant

1

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(d) (i) running out of copper (ores)

1

(ii) any **two** from:

- any specific example of using less copper
- reuse / recycle
  *allow do **not** throw copper / brass away*
- use low-grade copper ores
- use other metals / materials in place of copper

2

[7]

Q30.

(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

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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

Q31.

(a) either:
calculations: all correct (ethanol = 6, methanol = 3, peanut oil = 10, vegetable oil = 15)

ignore repetition of data from table unqualified

or

implication of correct calculation

(vegetable oil) gives largest temperature / heat increase <u>per gram</u> (owtte)

allow 'produced most heat in proportion to the fuel used'
*owtte for **1** mark*

2

(b) any **one** from:

owtte

- smoke

  ignore references to crops/food

- soot
- carbon
- carbon monoxide
- carbon dioxide
- global warming / climate change / greenhouse gases
- (air) pollution
- harmful/poisonous

1

scrub / wash the gases owtte

filter / remove (gases / fumes / appropriate named substance) owtte

(add extra oxygen) can burn more efficiently owtte

use a cleaner fuel owtte
plant more trees or similar linked to CO_2

any sensible answer

'don't burn so much fuel' insufficient alone

ignore extractor fans / air conditioning

1

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(c) (i) A

1

(ii) B

1

[6]

Q32.

(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]

Q33.

(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)

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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]

Q34.

(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'

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- 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]

Q35.

(a) hydrogen

ignore formulae

1

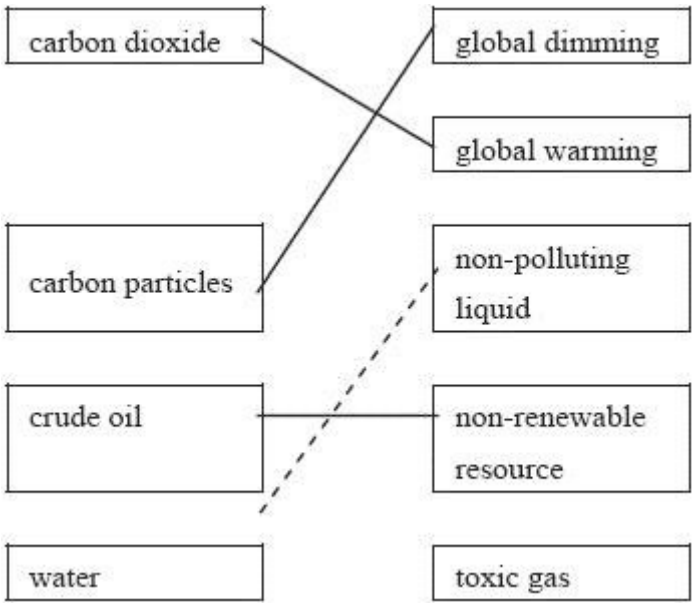
(b) any **two** from:

- 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)



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

3

[6]

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