Mark schemes

Q1.

(a) all five points plotted correctly

allow a tolerance of ± ½ a small square

*allow **1** mark for three or four points plotted correctly*

2

(b) 98 (°C)

allow a value in the range 92 to 104 (°C)

1

(c) the boiling point is lower than 0 (°C)

allow the graph cannot show negative temperatures

1

(d) gas

allow (g)

1

(e) C_9H_{20}

1

(f) (nonane) has a higher boiling point

allow converse for the other alkanes

1

(so nonane) condenses where the column has a higher temperature

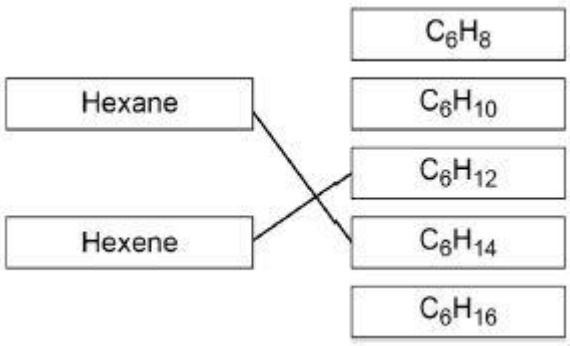
allow (so nonane) collects where the column has a higher temperature

1

[8]

Q2.

(a)



1

additional line from a box on the left negates the mark for that box

1

(b) (remains) orange

must be in this order

allow no (colour) change

1

(becomes) colourless

ignore initial colour ignore clear

1

(c) **Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar/different is made clear and (where appropriate) the magnitude of the similarity/difference is noted.

4–6

Level 1: Relevant features are identified and differences noted.

1–3

No relevant content

0

Indicative content

Structure and bonding

- both are hydrocarbons
- both contain two carbon atoms (per molecule)
- ethane contains six hydrogen atoms (per molecule)
- (but) ethene contains four hydrogen atoms (per molecule)

- both have covalent bonds
- ethane contains a single C—C bond
- (but) ethene contains a double bond
- both contain C—H bonds

- both small molecules

Reactions

- both react with oxygen in complete combustion reactions
- to produce water and carbon dioxide
- both react with oxygen in incomplete combustion reactions
- to produce water, carbon monoxide and carbon
- incomplete combustion is more likely with ethene

- ethene decolourises bromine water
- (but) ethane does not decolourise bromine water

- ethene is more reactive (than ethane)
- ethene can react with hydrogen (to produce ethane)
- ethene can react with water (to produce ethanol)
- ethene can react with halogens (to produce halogenoalkanes)
- ethene can undergo addition reactions
- ethene can polymerise (to produce poly(ethene))

ignore physical properties
ignore references to flammability

[10]

Q3.

(a) a temperature between 400 (°C) and 500 (°C) inclusive
allow a temperature range entirely within 400 (°C) and 500 (°C) inclusive

1

(b)
ignore quoted values for boiling points
ignore references to melting points
ignore references to intermolecular forces or chain length
allow temperature of vaporisation / condensation for boiling points throughout

(diesel oil has a) lower boiling point / range than heavy fuel oil

1

(but diesel oil has a) higher boiling point / range than kerosene
*allow the boiling range (of diesel oil) is between those of heavy fuel oil and kerosene for **2** marks.*

1

(c)
ignore references to cost

any **two** from:

- (too) viscous
allow references to difficulty of flow

- not (very) flammable
allow references to difficulty of ignition / burning
*do **not** accept bitumen takes more energy to burn*

- boiling point (too) high
allow not (very) volatile

2

(d) C_6H_{14}

1

(e)
ignore references to pressure

high temperature
allow a quoted temperature above 320

°C

ignore hot / heat

1

any **one** from:
- steam
- catalyst

ignore name of catalyst
allow alumina
allow aluminium oxide
allow porous pot
allow zeolite

1

(f)

allow converse argument for larger molecules

greater demand (for smaller molecules)

1

any **one** from:
(because smaller molecules are)
- more useful
- better fuels
- used to make alkenes
- used to make polymers

allow a named polymer
ignore plastics

1

(g) C_3H_6

1

[11]

Q4.

(a) wood is renewable
or
(natural) gas is finite

1

(burning) wood produces the same amount of carbon dioxide as the trees absorbed

allow wood is carbon-neutral allow wood does not add to global warming

or
(burning natural) gas increases the amount of carbon dioxide (in the atmosphere)

allow (burning natural) gas adds to global warming
allow (burning natural) gas adds greenhouse gases (to the atmosphere)
ignore references to energy / cost

1

(b) not enough oxygen

allow not enough air

*do **not** accept no oxygen / air*

1

(so) incomplete combustion

1

(c) **2**$CH_4(g)$ + **3**$O_2(g)$ → **2**$CO(g)$ + **4**$H_2O(g)$

allow correct multiples / fractions

1

(d)

*an answer of 1250 (cm^3 oxygen unreacted) scores **4** marks*

ratio of O_2 : CO_2 = 5 : 3

1

(oxygen needed = $\frac{3.60 \times 5}{3}$)
= 6.0 (dm^3)

allow correct calculation using an incorrectly determined mole ratio

1

(oxygen unreacted = 7.25 − 6.0) = 1.25 (dm^3)

allow correct subtraction of an incorrectly calculated volume of oxygen

1

(oxygen unreacted = 1.25 × 1000)
= 1250 (cm^3)

allow correct conversion to cm^3 anywhere in response

1

alternative approach for MP1 and MP2

moles CO_2 = 0.15
and
moles O_2 = 0.25 (1)
(0.25 x 24 =) 6.0 (dm^3 oxygen needed) (1)

[9]

Q5.

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

1

(b) alkane

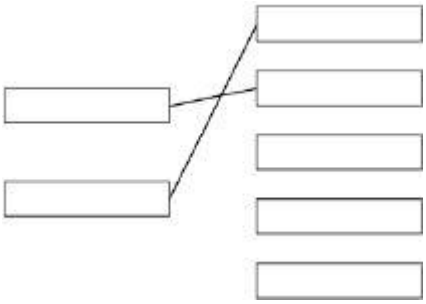
1

(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

1

[9]

Q6.

(a) C_5H_{12}

1

(b) 2:5

1

(c) **A**

1

(d) **A**

1

(e) carbon dioxide

1

water

1

(f) propane

1

(g) (8 × 1) + (3 × 12)

1

= 44

1

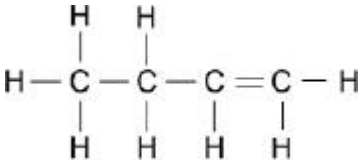
*an answer of 44 scores **2** marks*

[9]

Q7.

(a) C_5H_{10}

1

(b) 

1

(c) bar labelled petrol to 28.6 (%)

allow a tolerance of $\pm \frac{1}{2}$ *a square*

1

(d) 100 tonnes

1

(e) 7.1 + 11.1 + 17.2 = 35.4

1

$$\frac{2000 \times 35.4}{100}$$

allow ecf from step 1

1

= 708 (kg)

*an answer of 1276 (kg) gains **2** marks*

1

(f) higher percentage (by mass) of heavier fractions
or
higher percentage of larger molecules

1

(g) **Level 3 (5-6 marks):**
Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.

Level 2 (3-4 marks):
Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

Level 1 (1-2 marks):
Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

Level 0
No relevant content.

Indicative content

fractional distillation
- oil heated / boiled / vaporised
- fractionating column used
- fractions have different boiling ranges / temperatures

- column hotter at bottom

or

column cooler at top

- fractions condense at different levels
- heavy fractions collect at bottom

or

light fractions collect at top

cracking

- high temperature
- catalyst or steam
- large molecules split into small molecules
- mixture of alkanes and alkenes produced

6

[14]

Q8.

(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

1

(hydrogen and carbon) only

1

(e) *(diesel)*

produces more oxides of nitrogen

allow converse answers in terms of petrol

1

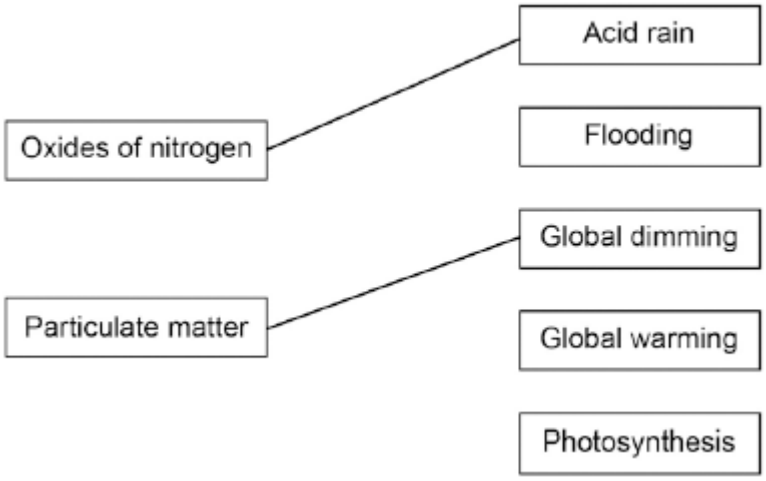
produces (more) particulate matter

1

produces less carbon dioxide

1

(f)



2

[11]

Q9.

(a) C_6H_{14}

1

(b) **A**

1

(c) **B**

1

(d) **C**

1

(e) Propanol

1

[5]

Q10.

(a) (i) high temperature

allow heating / hot / 250-900 °C

1

catalyst or steam

allow named catalyst eg zeolite, Al_2O_3, silica, ceramic

allow in the absence of air / oxygen

1

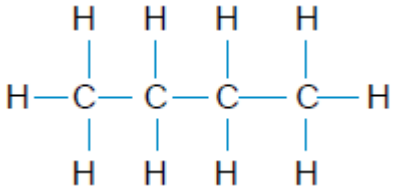
ignore any references to pressure

(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.

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]