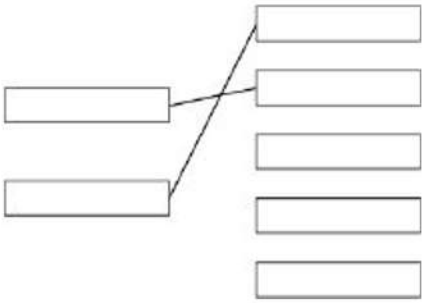
1. (a) $C_{12}H_{26}$ **1**

(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]

2. (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) $(8 \times 1) + (3 \times 12)$

1

$= 44$

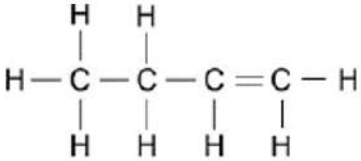
1

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

[9]

3. (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]

4. (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

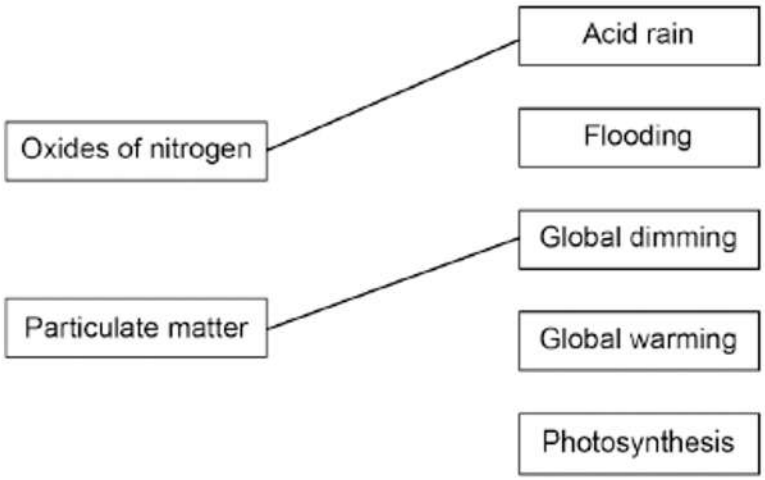
produces (more) particulate matter

1

produces less carbon dioxide

1

(f)



2

[11]

5. (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

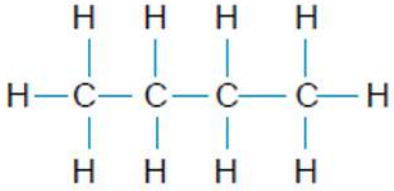
(ii) colourless

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)

(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]