**M1.** (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]**

**M2.** (a) (i) *use of carbon throughout = **max 1***

burning biodiesel releases $CO_2$

*ignore burning trees*

**1**

CO2 is absorbed / used by the crops/plants (used to produce the biodiesel)

*allow CO2 absorbed / used by trees*

**1**

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

increases CO2 / greenhouse effect

*accept causes global warming*

**OR**

*allow causes climate change*

less CO2is absorbed (from atmosphere)

*ignore other correct effects*

**1**

because burning trees releases CO2

*accept fewer trees to absorb CO2*

***or** crops / plants do not absorb as much CO2 as trees*

**OR**

because there is less 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]**

**M3.** (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 H2*

*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 / CO2 released

**1**

from the (thermal) decomposition of calcium carbonate **or**

*accept causes global warming **or** CO2 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 / SO2 is removed

*accept less acid rain produced*

**1**

by reaction with calcium oxide **or** calcium carbonate

*accept neutralisation **or** forms calcium sulfate*

**1**

**[10]**

**M4.** (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**

(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]**

**M5.** (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 = C30H62*

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]**

**M6.** (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]**

**M7.** (a) (i) straight line through the 'points' and extended to C8H18

*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 C5H12 close to values on the graph*

***or** C5H12 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 H2O

  *accept hydrogen does not produce harmful gases / CO2 / SO2*

- coal produces SO2

  *allow coal causes acid rain / respiratory problems*

- coal produces smoke

  *allow coal causes global dimming*

- both renewable and non-renewable fuels produce CO2

  *accept bio-ethanol and natural gas / coal produce CO2 / global warming*

- (both) the non-renewable fuels produce CO2

  *accept coal and natural gas produce CO2 / global warming*

- (both) renewable fuels produce no smoke

  *accept hydrogen and bio-ethanol do not produce smoke / global dimming*

- (both) renewable fuels produce no SO2

  *accept hydrogen and bio-ethanol*

  *do not produce SO2 / acid rain*

**2**

**[9]**