

Mark schemes

Q1.

- (a) high temperatures
ignore pressure 1
 (cause) nitrogen (from air) and oxygen (from air) to react 1
- (b) less climate change
ignore references to water vapour
allow less global warming
allow an effect of climate change for climate change 1
 (because) no carbon dioxide (produced) 1
- (c) more oxides of nitrogen (produced) 1
 (so) more acid rain
or
 (so) more respiratory problems
allow an effect of acid rain for acid rain
allow a named respiratory problem for respiratory problems
MP2 cannot be linked to an incorrect gas from MP1 1
- (d) (volume of oxygen = $3.50 \times \frac{1}{2} =$
 1.75 (dm³) 1
- (volume of air =) $1.75 \times \frac{100}{20}$
allow correct use of an incorrectly determined volume of oxygen 1
- = 8.75 (dm³) 1
- (e) there is a temperature gradient in the (fractionating) column
allow the (fractionating) column gets cooler going up 1
- (so) kerosene condenses
allow (so) the hydrocarbons / vapours condense 1
- at the level (in the column) corresponding to kerosene's boiling point (range)
allow at the level (in the column) corresponding to the boiling point of the hydrocarbons / vapours
for the award of 2 marks for MP2 and MP3, a reference to kerosene must be made 1

Q2.

- (a) crude oil is heated to vaporise (the hydrocarbons) 1
- there is a temperature gradient in the (fractionating) column
allow a (fractionating) column is cooler going up 1
- (so) the gases condense at different levels
or
 (so) lubricating oil condenses below naphtha (and petroleum gases do not condense) 1
- (because of their) different boiling points 1
- (b) detergents 1
- solvents 1
- (c) $C_9H_{20} + 14 O_2 \rightarrow 9 CO_2 + 10 H_2O$
allow multiples
allow 1 mark for
 $C_9H_{20} + O_2 \rightarrow CO_2 + H_2O$ with incorrect / no multipliers 2
- (d) (when burned sulfur impurities) produce sulfur dioxide 1
- (which) causes acid rain
or
 (which) causes respiratory problems
allow specified effects of acid rain
allow specified respiratory problems 1
- (e) as molecular size increases viscosity increases 1
- (and) heavy fuel oil has larger molecules (than kerosene) 1
- allow converse statements*
- (f) (name of process) cracking 1
- (conditions) high temperature
allow a stated temperature in the range 300 to 900 °C 1
- steam / catalyst 1
- (g) C_7H_{14} and C_8H_{16} 1