AS-LEVEL PAPER 2 AP2

**1.**       (a)     O = 74.1%

**1**

****

*If atomic numbers or molecular masses are used lose M2*

**1**

1.85       4.63  
 1            2.5  
 N2O5

**1**

*This ratio alone will not score the final mark. (It would get 2)  
Allow 3 marks for N2O5*

(b)     Toxic/poisonous/forms an acidic gas/forms NO2 which is acidic/  
respiratory irritant/forms HNO3 when NO reacts with water and oxygen/  
triggers asthma attacks/greenhouse gas/photochemical smog/  
contributes to global warming/formation of acid rain

*ignore NO is an acidic gas or NO is acidic in water  
Not references to ozone layer*

**1**

(c)     2NO + O2 → 2NO2

*Accept multiples or fractions of equation  
Ignore wrong state symbols*

**1**

(d)     Nitrogen/N2 and oxygen/O2 combine/react

*QWC (not N and O combine)  
Not nitrogen in fuel  
Allow N2 + O2 → 2NO for M1 only*

**1**

spark/high temperature/2500-4000 °C

**1**

(e)     2NO + 2CO → N2 + 2CO2

***OR***

2NO → N2 + O2

*Accept multiples or fractions of equation  
Ignore wrong state symbols*

*Allow C8H18 + 25NO → 8CO2 + 12.5N2 + 9H2O*

**1**

**[8]**

**2.** (a)    Number / proportion / percentage / fraction of molecules

*Ignore “particles”*

**1**

(b)     None ***OR*** no effect ***OR*** no change

**1**

(c)     **X**

**1**

(d)    **Answers in either order**

**M1** collision ***OR*** collide

*Mark independently*

**M2** collision / molecules / particles

*Ignore “correct” amount of energy*

      with the activation energy

***OR*** with E > Eact

***OR*** with sufficient /enough energy

***OR*** with the minimum energy

***OR*** with the correct orientation

**2**

(e)     A small increase in temperature results in many more / much higher proportion of  
/ a lot more / significantly more molecules / particles / collisions with E ≥ Eact / energy greater than the activation energy / sufficient energy / enough energy / minimum   
energy to react  
(compared with a small increase in concentration)

*Not just “more molecules with E ≥ Eact”*

*The answer must convey that the increase is* ***significant***

*Accept reference to “atoms”, “molecules”, “particles”*

*Ignore “species”*

**1**

**[6]**

**3.** (a)     (i)      Award mark for **X on the time axis** at the point where the lines just become **horizontal**

*Allow this mark if* ***X*** *is above the letters “sh” in the word “show” in part(ii) - in the range of lines 31 to 33.*

**1**

(ii)     They are equal / the same

**OR**

Forward (rate) = Reverse / backward (rate)

*Allow the word ‘speed’ in this context.*

*Ignore reference to concentration.*

**1**

(b)     Both **OR** forward and reverse reactions occur at the same time

**OR** both are occurring at once

**OR** both occur all of the time

**OR** both are ongoing

**OR** both never stop

*Ignore ‘at equal rates’.*

*Ignore reference to concentration or equilibrium.*

*The idea that both reactions occur simultaneously is essential.*

*The simple idea of ‘both reactions occurring’ is insufficient for the mark.*

**1**

(c)    (i)      **M1** No effect / no change / none / stays the same

**M2** requires correct **M1**

*In* ***M2****, ignore reference to particles or atoms.*

**M2** Equal (number of) moles / molecules on both sides

**2**

(ii)     **M1** Less time or it decreases or (equilibrium) reached faster (ie **M1** is a reference to time taken)

*If* ***M1*** *is ‘more time / it increases’ or ‘no effect’, then* ***CE=0*** *for the clip.*

*Reference to faster / increased rate / increased speed alone penalises* ***M1****, but mark on* ***M2*** *and* ***M3****.*

**M2** More particles / molecules in a given volume / space

**OR** the particles / molecules are closer together

*If* ***M1*** *is blank, then look for all three marks in the text.*

**M3** More successful / productive collisions in a given time

**OR** more collisions with E>EAct in a given time

**OR** more frequent successful / productive collisions

**OR** increased / greater successful / productive collision frequency / rate

*Ignore reference to reactants / products.*

*Penalise* ***M3*** *if an increase / decrease in the value of EAct is stated.*

**3**

**[8]**

**4.** (a)     (i)     Crude oil / oil / petroleum

*Do not allow ‘petrol’*

**1**

(ii)     Fractional distillation / fractionation / fractionating

*Not distillation alone*

**1**

(b)     (i)     5

*Allow five / V*

**1**

(ii)     Chain (isomerism)

*Allow branched chain / chain branched / side chain (isomerism)*

*Ignore position (isomerism)*

*Do not allow straight chain / geometric / branched / function*

**1**

(c)     (i)     C12H26 / H26C12

*Only*

**1**

(ii)     Thermal cracking

*If not thermal cracking, CE = 0/2*

*If blank mark on*

**1**

High temperature

*Allow ‘high heat’ for ‘high temperature’*

(400°C < T < 900°C) or (650 K < T < 1200 K)

*Not ‘heat’ alone*

*If no T, units must be 650 – 900*

**and**

High pressure (> 10 atm, > 1 MPa, >1000 kPa)

**1**

(iii)    To produce substances which are (more) in demand / produce products with a  
high value / products worth more

*Ignore ‘to make more useful substances’*

**1**

(d)     (i)     Corrosive or diagram to show this hazard symbol

*Ignore irritant, acidic, toxic, harmful*

**1**

(ii)     (  120.5     × 100)(86 + 71             )

=76.75(%) or 76.8(%)

*Allow answers > 3 sig figs*

**1**

(e)     2,2-dichloro-3–methylpentane

*Ignore punctuation*

*Any order*

**1**

C3H6Cl

**1**

**[12]**

**5.** (a)     **Initiation**Cl2   2Cl•

*Penalise absence of dot once only.*

**First propagation**Cl• + CH3Cl   •CH2Cl + HCl

*Credit the dot anywhere on the radical.*

**Second propagation**Cl2 + •CH2Cl   CH2Cl2 + Cl•

**Termination (must make 1,2-dichloroethane)**2 •CH2Cl   CH2ClCH2Cl

*Penalise C2H4Cl2*

**4**

(b)     (i)      (chlorine free) radical

*Ignore formula.*

**1**

(ii)     M1      Cl• + O3   ClO• + O2

M2      ClO• + O3   Cl• + 2O2

***M1*** *and* ***M2*** *could be in either order.*

*Credit the dot anywhere on the radical.*

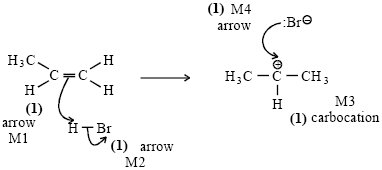
*Penalise absence of dot once only.*

*Individual multiples acceptable but both need to be doubled if two marks are to be awarded.*

**2**

**[7]**

**6.** (a)     (i)



         If wrong carbocation, lose structure mark  
If wrong alkene, lose structure mark  
Can still score ¾ i.e. penalise M3  
Penalise M2 if polarity included incorrectly  
no bond between H and Br  
bond is shown as  or 

**4**

(ii)       
CH3CH2CH2credit secondary carbocation here if primary carbocation has  
been used in (i)

*Ignore attack on this carbocation by ~~o~~*

**1**

(b)     (i)      *Structure*: 

**1**

*Name*: propan-2-ol

*Not 2-hydroxypropane*

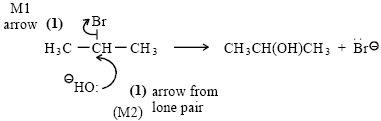
**1**

(ii)     *Name of mechanism*: nucleophilic substitution **(both words)**

*(NOT SN1 or SN2)*

**1**

*Mechanism:*

**

*penalise incorrect polarity on C-Br (M1)  
Credit the arrows even if incorrect haloalkane  
If SN1, both marks possible*

**2**

(c)     (i)      elimination

**1**

(ii)     base

*OR proton acceptor*

*NOT nucleophile*

**1**

**[12]**

|  |  |
| --- | --- |
| **7.** (a)  (b)  (c)  (d) |  |

|  |  |
| --- | --- |
| (e)  (f)  (g)  (h) |  |

**8.** C

**9.** D

**10.** D

**11.** B

**12.** D

**13.** C

**14.** C

**15.** D

**16.** D

**17.** B

**18.** C

**19.** C

**20.** C