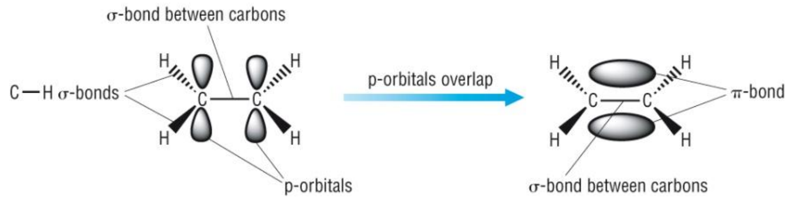
<u>**Standard answers:**</u>

1 Basic concepts, Fuels, alkanes and alkenes:

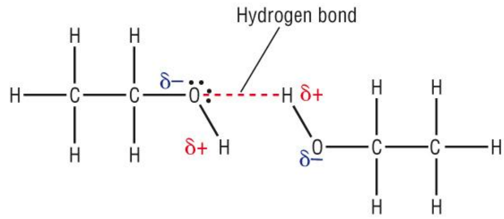
1. **Effect of chain length on boiling point / volatility**
   - **As chain length increases – boiling point increases / volatility decreases**
   - **More electrons – greater VDW forces of attraction**
2. **Effect of branching on the boiling point / volatility of the isomers**
   - **More branching decreases the boiling point / increases volatility**
   - **Same number of electrons but smaller surface area**
   - **Decreases VDW forces of attraction**
3. **Explain how fractional distillation works**
   - **Each fraction has different boiling points due to different VDW**
   - **Therefore condense at different temperatures**
4. **Explain the nature of the C = C**



5. **Explain why E/Z or trans/cis isomerism occurs in some alkenes**
   - **Tran E - a cross dresser / a cross the C=C**
   - **Double bond does not allow rotation**
   - **Each C atom of the double bond is bonded to 2 different groups**
6. **Dealing with polymer waste:**
   - **Sort and recycle**
   - **Feedstock recycling**
   - **Incinerate (emits CO_2)**
   - **Biodegradable polymers**

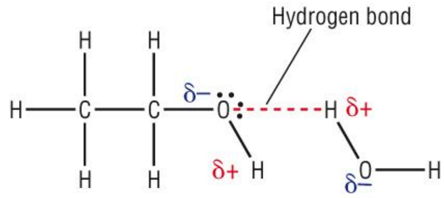
2A Alcohols and halogenoalkanes:

7. **Explain why alcohols have higher Bpts / liquids instead of gases**



   - **Has HB which is stronger than VDW**

8. **Explain the solubility of alcohols in water**



   - **Has HB like water**
   - **Chain length decreases the efficiency of HB**

9. **Oxidation of alcohols**

CH_3CH_2OH + [O] → CH_3CHO + H_2O

10. Rate of hydrolysis of the halogenoalkanes (forming alcohols and halide ion)

Polarity	Bond strength	Reaction			+ Ag^+	Rate	Conclusion
1	3	CH_3Cl	→	$CH_3OH + Cl^-$	W ppt	3	Must be due to bond strength as that ppts 1st
2	2	CH_3Br	→	$CH_3OH + Br^-$	C ppt	2	
3	1	CH_3I	→	$CH_3OH + I^-$	Y ppt	1	

11. Possible application of knowledge - Rate of hydrolysis based on structure:

	Reaction			+ Ag^+	Rate	Conclusion
1°	$CH_3CH_2CH_2I$	→	$CH_3CH_2CH_2OH + I^-$	Y ppt	3	Therefore 3° must have some reason – not in spec – about interpreting
2°	$(CH_3)_2CH_2I$	→	$(CH_3)_2CH_2OH + I^-$	Y ppt	2	
3°	$(CH_3)_3I$	→	$(CH_3)_3OH + I^-$	Y ppt	1	

2B – Analysis

12. % Yield = $\frac{\text{Actual amount (moles)}}{\text{Theoretical amount (moles)}} \times 100$
    - Is a measure of the amount of conversion

13. Atom economy = $\frac{\text{Mr of desired product}}{\text{Sum of all Mr's of all products}} \times 100$
    - Is a measure of sustainability
    - Improved by finding a use for undesired products

14. IR Spectroscopy
    - Specific bonds absorb specific IR frequencies making the bonds vibrate
    - This frequency of IR is absorbed and shown as a peak on the spectra

15. Mass Spectroscopy
    - Ionisation
    - Acceleration
    - Deflection OR Time of flight
    - Detection

16. Molecular Ion

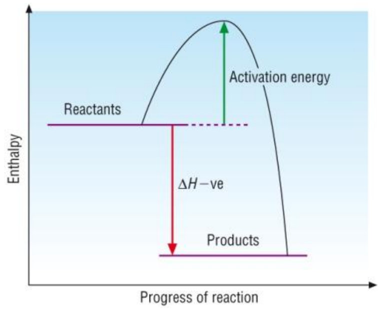
    $M + e^- \rightarrow M^+ + 2e^-$
    - The Mr of a molecule shown by the highest m/z value

17. Fragments

    $M^+ \rightarrow F^+ + F$
    - When the molecular ion fragments into a 2 smaller molecular fragments, only one with a (+)ve charge
    - Each molecule has its own unique mass spectra determined by its own fragmentation patterns

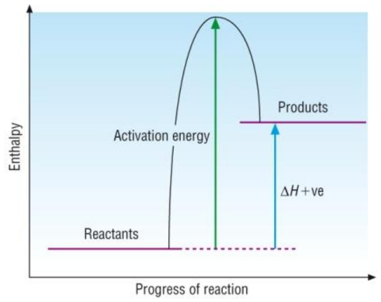
3A – Energy

18. Energy / enthalpy profile diagrams – Exothermic



- **Enthalpy content of the reactants > enthalpy content of products**

19. Energy / enthalpy profile diagrams – Endothermic



- **Enthalpy content of the products > enthalpy content of reactants**

20. Why does ?? reaction not happen?

- **It has a high activation energy**

21. Calculating ΔH – from temperature changes

i) $Q = \frac{mc\Delta T}{1000}$ **(Kj)**

REMEMBER m IS VOLUME OF LIQUID WITH THERMOMETER IN

ii) $\text{Moles} = \frac{\text{mass}}{Mr} = C \times V(dm^3)$

REMEMBER TO USE LIMITING REAGENT

iii) $\Delta H = \frac{Q\ (Kj)}{\text{moles}}$

iv) **SIGN: ↑T (-)ve ↓T (+)ve**

22. Main sources of error in Enthalpy calculation

- **Heat loss to the surroundings – insulate**
- **Not carried out under standard conditions**

23. Standard conditions

- **1atm pressure**
- **298k**
- **1 mole / molar solutions**
- **Normal physical states under above conditions**

24. Exothermic reactions in terms of bond breaking

- **More heat energy is given out when new bonds forming the products than taken in to break the bonds of the reactants**

25. **Endothermic reactions in terms of bond breaking**
    - **Less heat energy is given out when new bonds forming the products than taken in to break the bonds of the reactants**

26. **Hess' cycles**
    - **LOOK AT THE TABLE STUPID:**

i) Formation: arrows up / elements at the bottom

ii) Combustion: Arrows down / CO_2 and H_2O at the bottom (may be other oxides)

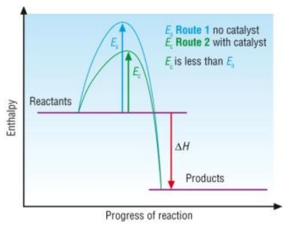
iii) Carbonates and acids: Arrows down / salt, CO_2 and H_2O at the bottom

iv) Any unfamiliar situation: Arrows likely to go down / products will be the same for each reactions

- **CHECK YOUR ROUTE AGAINST ARROWS AND CHAGE SIGN IF THEY ARE OPPOSITE**

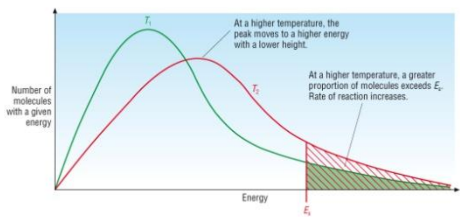
3B - Rates:

27. **Collision theory**
    - **E > Ea**
    - **Orientation upon collision**
28. **How an increase in concentration / pressure affects rate**
    - **Increases particles per volume**
    - **Increase in collision frequency**
    - **Increases rate**
29. **How an increase in pressure affects rate**
    - **Increase in pressure increases concentration**
    - **Increases particles per volume**
    - **More successful collisions**
    - **Increases rate**
30. **How an increase in surface area increases rate**
    - **Small particle size increases surface area**
    - **More area for collisions**
    - **Increases rate**
31. **How catalyst increases rate**



- **Provides alternative route with a lower Ea**
- **More particles have E > new lower Ea**
- **More successful collisions**

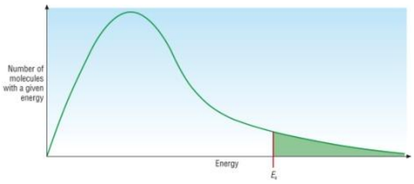
32. **How an increase in temperature increases rate**



- **Total area under curve does not change**
- **More particles have E > Ea (shaded red)**
- **Increases collision frequency**
- **More successful collisions**
- **Increases rate**

- **Curve is lower and shifts to the right**

33. **Features on the Boltzman distribution**



- **Area = number of particles**
- **No particles can have zero energy**
- **No maximum for a molecule**
- **Only E > Ea will react**

3B - Equilibria

34. **Features of an equilibrium**
    - **Closed system**
    - **Dynamic**
35. **What can be said about the forward and reverse reactions at equilibrium**
    - **The rate of the forward and reverse reactions are the same**
36. **Effect of pressure on equilibrium**
    - **Increasing P moves the eqm to the side with fewer moles of gas (and vice versa)**
37. **Effect of temperature on equilibrium**
    - **Increasing temperature moves the eqm to the endothermic side (and vice versa)**
38. **Effect of concentration on equilibria**
    - **Increasing the concentration moves the eqm to the opposite side in order to remove (and vice versa)**
39. **Discuss the conditions in the Haber process (or any other that they give)**
    - **Always discuss rate, yield (equilibria) and cost (safety)**

$N_{2(g)}$ + $3H_{2(g)}$ ⇆ $2NH_{3(g)}$ $\Delta H = -92 KjMol^{-1}$
Endothermic — Exothermic
4 high pressure — 2 low pressure

Process	**Equilibria**	**Rate**	**Compromise**
Temperature	**Decrease temperature** – will move equilibria to the exothermic side – the products	**Increase temperature** – will increase the rate of reaction as activation energy is more likely to be overcome.	Moderate temperature
Pressure	**Increase pressure** – Moves equilibrium to products with fewest moles of gas.	**Increase pressure** – will increase the rate of reaction as more particles per volume.	Cost of pumps and reaction vessel becomes very expensive
Catalyst	No effect	Increases the rate	Finely divided iron
	Remove ammonia as it is formed Recycle unreacted H_2 and N_2		

4 Resources

40. **What causes global warming**
    - **Greenhouse gases in the atmosphere**
    - **Absorb IR radiation**
    - **Emit energy as heat**
41. **3 Factors which affect global warming**
    - **Atmospheric concentration**
    - **Ability to absorb IR**
    - **Life span in the atmosphere**

42. Outline 2 ways for C storage

- Stored as a carbonate by reaction with CaO / MgO

$CaO + CO_2 \rightarrow CaCO_3$

- Stored in disused oil wells under the sea bed

43. Why is the Ozone layer important

- Absorbs harmful UV rays

44. How does ozone absorb UV

$O_3 + UV \rightarrow O_2 + O$

$O + O_2 \rightarrow$ O3 + heat

45. How is ozone formed

- O radical reacts with O molecule forming ozone

$O + O_2 \rightarrow O_3$

- Then rate of formation of ozone = decomposition

$O + O_2 \leftrightarrows O_3$

46. How does catalytic converters work

- Adsorption
- Weaker bonds allow reaction to occur
- Desorption

47. Diesel engine catalysts

- Convert CO to CO_2
- Completely combust un burnt hydrocarbons

48. Petrol engine catalysts – as above plus:

$2NO + 2CO \rightarrow N_2 + 2CO_2$

49. Green chemistry

- Increase atom economy (low = unsustainable) – find use for waste / alternative reaction with higher atom economy
- High % yield means a n efficient conversion of reactants to products, reducing waste of reactants
- Reduce toxicity of any reactants / products
- More efficient methods
- Use renewable feedstock

50. Alternative uses for CO_2

- Expanded polystyrene
- As a solvent – extraction of caffeine
- Dry cleaning