

Question 27 (Answer: **A**)

- H^+ adds so as to leave the more stable carbocation.
- On propene that is the *secondary* cation $\text{CH}_3\text{CH}^+\text{CH}_3$, stabilised by two alkyl groups.
- The primary cation is far less stable, so much less of it forms.

Question 27 (Answer: **B**)

- Markovnikov: the bromine ends up on the carbon that gives the more stable carbocation.
- Adding H^+ to C3 leaves a *tertiary* cation at C2.
- Br^- then attacks there, giving 2-bromo-2-methylpentane.

Question 28 (Answer: **A**)

- Cold, dilute manganate(VII) adds two OH groups across the $\text{C}=\text{C}$.
- Pent-2-ene therefore gives the 2,3-diol.
- Hot concentrated conditions would break the $\text{C}=\text{C}$ right open and give carboxylic acids instead.

Question 29 (Answer: **D**)

- In the dark there is no free-radical substitution, so bromine simply adds across $\text{C}=\text{C}$.
- Limonene has two $\text{C}=\text{C}$ bonds, one in the ring and one in the side chain.
- With bromine in excess both add, so four bromine atoms are taken up.

Question 29 (Answer: **A**)

- Hot concentrated manganate(VII) cleaves each $\text{C}=\text{C}$ completely.
- A carbon of the $\text{C}=\text{C}$ that carries an alkyl group becomes a ketone; one carrying a hydrogen becomes a carboxylic acid.
- The two pinenes have their double bonds in different places, so their products have different formulae.

4(a)(i)	reduction
4(a)(ii)	$\text{PCl}_5 / \text{PCl}_5 / \text{SOCl}_2$ OR KCl / NaCl AND conc. H_2SO_4 / conc. H_3PO_4
4(a)(ii)	M1 $\text{C}_2\text{H}_5\text{CH}_2\text{Cl} + \text{NaOH} \rightarrow \text{C}_3\text{H}_6 + \text{H}_2\text{O} + \text{NaCl}$ M2 ethanol (solvent) AND heat / reflux
4(a)(iv)	conc. H_2SO_4 OR conc. H_3PO_4 OR Al_2O_3 AND heat
4(b)(i)	addition
4(b)(ii)	M1 (molecules that have the) same structural formula (and same molecular formula) M2 but different 3D / spatial arrangement of atoms / groups
4(b)(iii)	$\begin{array}{cccc} \text{H} & \text{CH}_3 & \text{H} & \text{CH}_3 \\ & & & \\ -\text{C} & -\text{C} & -\text{C} & -\text{C}- \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array}$ M1 M2 optical isomerism M3 the methylated carbon has four different groups attached
4(b)(iv)	M1 non-biodegradability M2 harmful combustion products
4(c)(i)	2,3-dimethylbut-1-ene
4(c)(ii)	(The spectrum is of) X AND 41 is $[\text{CH}_2=\text{CCH}_3]^+ / 41$ is C_3H_5^+ OR 43 is $[\text{CH}_3\text{CHCH}_3]^+ / 43$ is C_3H_7^+ OR X would NOT have significant peak at 54 / $[(\text{CH}_3)_2\text{C}=\text{C}^+] / \text{C}_4\text{H}_6^+$ OR X would NOT have significant peak at 42 due to $[(\text{CH}_3)_2\text{C}^+] / \text{C}_3\text{H}_6^+$
4(c)(iii)	$([\text{M}+1]^+ / 34.7 \times 100 / 1.1 = 6)$ $[\text{M}+1]^+ = 2.29$