Question 27 (Answer: **A**)

- H^+ adds so as to leave the more stable carbocation.
- On propene that is the *secondary* cation $CH_3CH^+CH_3$, 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**)

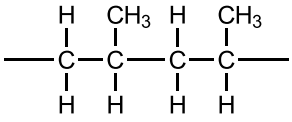
- Cold, dilute manganate(VII) adds two OH groups across the C=C.
- Pent-2-ene therefore gives the 2,3-diol.
- Hot concentrated conditions would break the C=C right open and give carboxylic acids instead.

Question 29 (Answer: **D**)

- In the dark there is no free-radical substitution, so bromine simply adds across C=C.
- Limonene has two C=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 C=C completely.
- A carbon of the C=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)	PCl_5 / PCl_3 / $SOCl_2$ **OR** KCl / $NaCl$ **AND** conc. H_2SO_4 / conc.H_3PO_4
4(a)(ii)	**M1** $C_2H_5CH_2Cl + NaOH \rightarrow C_3H_6 + H_2O + NaCl$ **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)	 **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 $[CH_2=CCH_3]^+$ / 41 is $C_3H_5^+$ **OR** 43 is $[CH_3CHCH_3]^+$ / 43 is $C_3H_7^+$ **OR X** would NOT have significant peak at 54 / $[(CH_3)_2C=C^+]$ / $C_4H_6^+$ **OR X** would NOT have significant peak at 42 due to $[(CH_3)_2C^+]$ / $C_3H_6^+$
4(c)(iii)	($[M+1]^+$ / 34.7 × 100 / 1.1 = 6) $[M+1]^+ = 2.29$