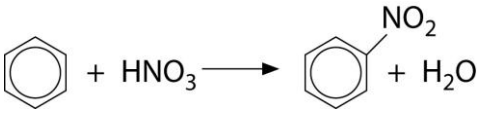
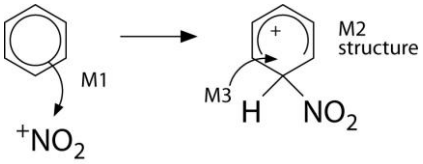
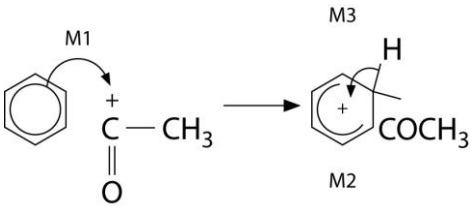
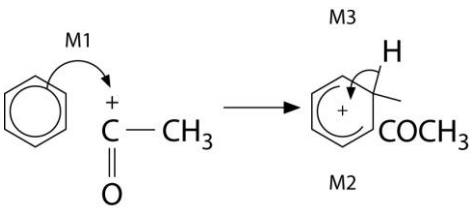
Answers to examination-style questions

Answers	Marks	Examiner's tips
1 conc HNO_3 conc H_2SO_4	**2**	If both 'conc' missing you can score one for both acids.
$HNO_3 + 2H_2SO_4 \rightarrow NO_2^+ + H_3O^+ + 2HSO_4^-$ or $HNO_3 + H_2SO_4 \rightarrow NO_2^+ + H_2O + HSO_4^-$ or $HNO_3 + H^+ \rightarrow NO_2^+ + H_2O$	**1**	This can also be done in two equations.
	**2**	Benzene can also be written as C_6H_6 and nitrobenzene as $C_6H_5NO_2$.
Electrophilic substitution	**1**	
	**3**	One mark is for the arrow from within hexagon to N or to the + on N (M1). The 'horseshoe' must not extend beyond C2 to C6. (M2) Mark 3 is for the arrow into the hexagon (M3).
2 $CH_3COCl + AlCl_3 \rightarrow CH_3^+CO + AlCl_4^-$	**2**	One mark is for the correct reactive species and 1 for the equation.
Electrophilic substitution	**1**	This cannot be F/C acylation.
	**3**	Horseshoe must not extend beyond C2 to C6. The + must be on the C of RC^+O.
3 $CH_3COCl + AlCl_3 \rightarrow CH_3^+CO + AlCl_4^-$	**2**	There is no mark for the acylium ion here. The mark is for the aluminium chloride and the second mark is for the balanced equation. You could have $FeCl_3$. The position of + on electrophile can be on O or C.
	**3**	The M1 arrow from within hexagon to C or to + on C. The + must be on C of RCO.
Electrophilic substitution	**1**	This is not F/C acylation.

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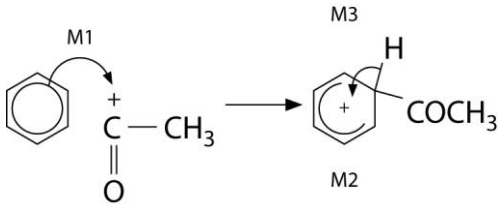
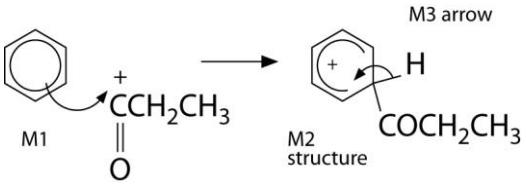
4 a) CH_3CO^+	**1**	
b) 	**3**	Horseshoe must not extend beyond C2 to C6. The + must be on the C of RC^+O.
5 $[CH_3CH_2CO]^+$	**1**	You can gain the electrophile mark from the equation if not stated separately. Therefore the correct balanced equation is worth 2 marks.
$CH_3CH_2COCl + AlCl_3 \rightarrow [CH_3CH_2CO]^+ + AlCl_4–$	**1**	In the equation, the position of the + can be on O or C or outside square brackets, however you do not need to show the square brackets.
	**3**	The arrow for M1 must be to C or to the + on C. The horseshoe should extend from C2 to C6 only.
6 Cyclohexane evolves 120 kJ mol^{-1} Therefore expect triene to evolve 360 kJ mol^{-1} ; or $3 \times 120 = 360$ kJ mol^{-1} $360 – 208 = 152$ kJ; Benzene lower in energy / more stable; due to delocalisation;	**4**	Cannot estimate 150 kJ, you must use the values in the question. Therefore 152 kJ can score first 2 marks in this part. Any mention of 'bond breaking needing energy' will not score marks.