

**Making ammonia – Mark scheme**

1.	(a)	pressure	1	
	(b)	nitrogen	1	
		hydrogen	1	
	(c)	cooled	1	[4]
2.	(a)	(i)	yield increases	1
			<i>two marks are linked</i>	
			because more (gaseous) reactant molecules / particles than (gaseous) product molecules / particles	1
			<i>accept 7 → 4 moles or volumes</i>	
			<i>ignore more reactants</i>	
			<i>accept fewer particles on the right</i>	
		(ii)	increased (rate) / faster / speeds up etc	1
			<i>two marks are linked</i>	
			more collisions <b>or</b> increased concentration <b>or</b> particles closer together	1
			<i>greater chance of more successful collisions</i>	
	(b)	heat / high temperatures	1	
			<i>do <b>not</b> accept burn it</i>	
			<i>ignore cracking / catalyst</i>	
3.		<u>Effect of pressure</u>		[5]
		high pressure increases yield		
		<i>for 1 mark</i>		
		either because less product molecules (Le Chatelier)		
		<u>or</u> but high pressure increases cost/safety		
		<i>for 1 mark</i>		
		<u>Effect of temperature</u>		
		low temperature increases yield		
		<i>for 1 mark</i>		
		either because exothermic reaction (Le Chatelier)		
		<i>for 1 mark</i>		
		or but at low temperature rate is slow/catalyst does not work		
		<u>Compromise</u>		
		optimum conditions to balance rate and % yield		
		<i>for 1 mark</i>		
		or rate is slow (at higher temperature) so need a catalyst		
		or low percentage conversion so recycle untreated gases		[5]