

Answers to examination-style questions

Answers	Marks	Examiner's tips
1 (a) the rates of the forward and the backward reactions are the same	1	The 2% is a red herring! The rates of the forward and the backward reactions are always the same when equilibrium is reached.
(b) (i) yield decreases because more moles on left-hand side and equilibrium moves to increase the pressure	1 1 1 1	The last point could be obtained by simply stating 'to oppose the change'. Don't forget though if the trend is wrong you cannot score the next 2 marks.
(ii) any two points from: cost of producing high pressure cost of plant to resist high pressure correct safety factor with reason	2	
(c) no change in yield because catalyst has no effect on equilibrium position	1 1	You can say that a catalyst affects the rates of the forward and the backward reactions equally.
(d) sign of enthalpy change is negative because equilibrium moves in the exothermic direction (to the right) in order to oppose the change or to raise the temperature	1 1 1	Same marking as in previous questions. Don't get the trend wrong!
(e) the unreacted carbon dioxide and hydrogen is recycled or re-used or 'put back in'	1	
2 (a) rate of forward reaction = rate of backward reaction concentrations of reactants and products remain constant	1 1	The concentrations remain constant. They are not the same.
(b) fewer moles of gas on right-hand side therefore equilibrium moves to right side to oppose the change or reduce the applied pressure	1 1	
(c) power or energy required to provide high pressure strong pressure vessel needed (to withstand high pressure)	1 1	This is to do with the energy needed for pumping.
(d) effect: decreases explanation: reaction is exothermic system tries to lower T or remove constraint or oppose the change	1 1 1	If the effect is wrong you lose the explanation marks too.
(e) to speed up reaction	1	You could say to give more molecules $E > E_a$

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3 (a) loss of electrons	1	
(b) no change	1	If the effect is wrong in either case you will lose the explanation marks too. It is worth working out the answer by always referring to Le Châtelier's principle.
equal number of gaseous moles on either side	1	
therefore both sides affected equally	1	
increases	1	
equilibrium moves to lower the temperature or oppose the change	1	
forward reaction is endothermic	1	
4 (a) the position of equilibrium moves to oppose any change	1	
(b) (i) <i>effect on yield of hydrogen</i> : decreases	1	
<i>explanation</i> : pressure lowered or increase opposed	1	
by favouring fewer moles of gas	1	
(ii) <i>effect on yield of hydrogen</i> : increases	1	
<i>explanation</i> : equilibrium will move to the right	1	
to remove the increase in steam		
or remove the increase in pressure	1	
(c) <i>reason 1</i> : high temperature is expensive	1	Don't just say expensive. You always need to qualify this.
<i>reason 2</i> : cost of plant able to resist high temperature is too high	1	
(a) rate of forward reaction = rate of backward reaction	1	
concentrations of reactants and products are constant	1	
(b) system opposes change	1	
moves to the side with fewer moles	1	
in this case, 2 moles of NH ₃ on right side of equation < N ₂ + 3H ₂ together (4 moles) on left side of equation	1	
(c) too expensive to generate such a high pressure	1	
(d) (i) yield of ammonia increases	1	Get the yield right and the other marks follow easily. If you get the yield wrong you lose all 3 marks.
exothermic reaction favoured	1	
system moves to raise temperature or oppose decrease in temperature	1	
(ii) faster reaction	1	In actual fact it is a reasonable rate in a reasonable time. High temperatures cause faster reactions but they give a poor yield. Low temperatures cause slow reactions but the yield is high.
(iii) balance between rate and yield	1	

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6 (a) mark labelled X on curve A where curve C joins A	1	
(b) the position of equilibrium moves to oppose any change	1	
(c) B	1	
more ammonia is produced	1	
fewer moles of gas on right (<i>or</i> 4 mol goes to 2 mol)	1	
equilibrium moves to oppose increase in pressure <i>or</i> oppose change	1	
(d) C	1	
amount of ammonia unchanged	1	
reaction is faster	1	

In (c) and (d) you must get the answers B and C, respectively, to be able to score the next marks.