Chemical Equilibria

Mark Scheme

Level	International A Level
Subject	Chemistry
Exam Board	Edexcel
Topic	Application of Core Principles of Chemistry
Sub Topic	Chemical Equilibria
Booklet	Mark Scheme

Time Allowed: **30 minutes**

Score: **/25**

Percentage: **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

Question Number	Correct Answer	Mark
1	D	**(1)**
	Incorrect answers A – is incorrect as there will be a change B – incorrect colour C – incorrect colour	

Question Number	Correct Answer	Mark
2	A	**(1)**
	Incorrect answers B – equilibrium position does not shift to the right with an increase in temperature C – equilibrium position does not shift to the right with a decrease in pressure D - equilibrium position does not shift to the right with a decrease in pressure and equilibrium position does not shift to the right with an increase in temperature	

Question Number	Correct Answer	Mark
3	A	**1**

Question Number	Correct Answer	Reject	Mark
4	B		1

Question Number	Correct Answer	Reject	Mark
5	D		1

Question Number	Correct Answer	Reject	Mark
6	D		1

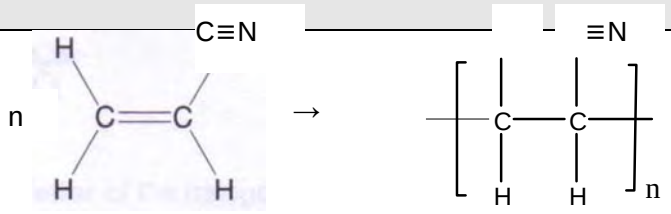
Question Number	Correct Answer	Reject	Mark
7	C		1

Question Number	Correct Answer	Reject	Mark
8(a)	B		1

Question Number	Correct Answer	Reject	Mark
8(b)	A		1

Question Number	Correct Answer	Reject	Mark
9	B		1

Question Number	Correct Answer	Reject	Mark
10	A		**1**

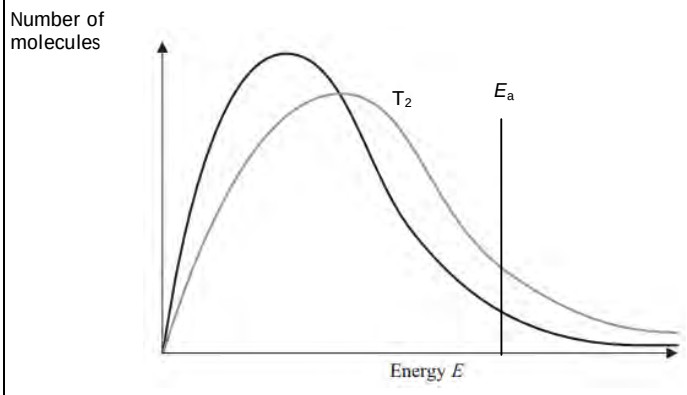
Question Number	Acceptable Answers	Reject	Mark
11 (a)	 ALLOW CN for C≡N throughout IGNORE 'connectivity' to the C≡N / CN group **First mark – M1:** Two "n" in the equation and a correct formula (molecular or structural or displayed) for propenenitrile on LHS of the equation LHS "n" must be to left of the monomer RHS "n" must be a **subscript** IGNORE Any square or round brackets around monomer on LHS **(1)** **Second mark – M2:** One correct **displayed** repeat unit (with or without a bracket or "n" shown in the equation) **(1)** **Third mark – M3:** Continuation bond at each end of the repeat unit (with or without a bracket or "n" shown in the equation) **(1)** **NOTE** M3 is awarded for the two continuation bonds, even if the repeat unit given is incorrect Polymer containing a C=C scores max **(1)** **Additional comment** Mark the three scoring points independently	No M2 mark if **more than one** repeat unit shown	**3**

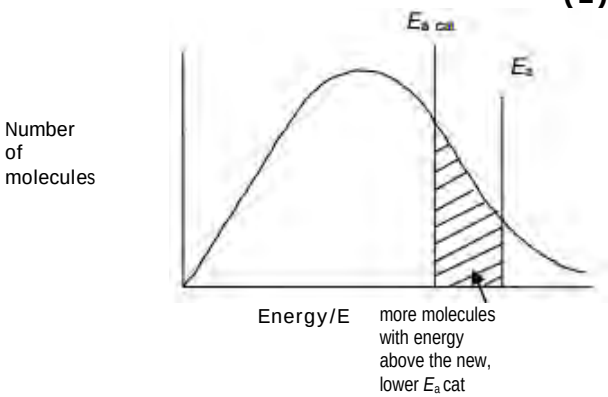
Question Number	Acceptable Answers	Reject	Mark
11 (b)	(It is an) addition reaction OR An addition polymer is made OR All the reactants are made into the desired / required product OR Only one product (is made) OR No waste products / no by-products ALLOW No 'side' products	**Just** 'all the product is useful' **Just** 'all the reactants become products' 'No product wasted'	**1**

Question Number	Acceptable Answers	Reject	Mark
11 *(c)(i)	**First mark – M1:** (Position of equilibrium shifts/'favours') to the left OR to the reactants OR to the backward reaction/direction OR to the reverse reaction/direction OR towards C_3H_6 / NH_3 / O_2 ALLOW decreases yield of products / decreases yield of CH_2CHCN / decreases yield of H_2O **(1)** **Second mark – M2:** **This mark is dependent on the correct change in THE position of equilibrium** **(i.e. (0) overall for question if states that eq'm shifts to the RIGHT)** (Forward) reaction is exothermic OR (Forward) reaction gives out heat OR Backward reaction is endothermic / takes in heat OR Reverse reaction is endothermic / takes in heat IGNORE References to just "decreasing the temperature" / "opposes the increase in temperature" **(1)** **Additional comment** JUST a statement that it "moves in / favours the endothermic direction" can get M1 ONLY IF M2 has already been awarded (as it is then clear that the candidate realises that from right to left **is** the endothermic direction).		**2**

Question Number	Acceptable Answers	Reject	Mark
11 *(c)(ii)	**First mark – M1:** (Position of equilibrium shifts/'favours') to the left OR to the reactants OR to the backward reaction/direction OR to the reverse reaction/direction OR towards C_3H_6 / NH_3 / O_2 ALLOW decreases yield of products / decreases yield of CH_2CHCN / decreases yield of H_2O **(1)** **Second mark – M2:** **This mark is dependent on the correct change in THE position of equilibrium** **(i.e. (0) overall for question if states that eq'm shifts to the RIGHT)** Right-hand side has more moles/molecules (of gas) OR Products have more moles/molecules (of gas) OR Left-hand side has fewer moles/molecules (of gas) OR Reactants have fewer moles/molecules (of gas) **NOTE:** 2nd mark awarded if mentions: **3½** moles/molecules (of gas) on LHS **and** **4** moles/molecules (of gas) on RHS **(1)**	References to ATOMS/PARTICLES, if chooses to refer to these, (instead of molecules) no 2nd mark	**2**

Question Number	Acceptable Answers	Reject	Mark
11 (d)(i)	(*y*-axis:) Fraction of molecules / number of molecules ALLOW Proportion of molecules ALLOW 'particles' instead of molecules for the label on the *y*-axis **and** (*x*-axis:) Energy / *E* / kinetic energy NOTE: **BOTH** graphs' axes (on p14 and p15 of script) need to be labelled correctly for this mark	'**atoms**' instead of molecules/particles	**1**

Question Number	Acceptable Answers	Reject	Mark
***11 (d)(ii)**	**First mark – M1:** Correct drawing of Maxwell-Boltzmann distribution at T_2 clearly identified NOTE As long as it is clear which curve the candidate has drawn, if it is correctly drawn award this mark, even if their curve is not actually labelled "T_2" **NOTE** **Peak** of candidate's curve (at the higher temperature) should be clearly **lower and** to the **right** of that at the lower temperature **(1)** **Second mark – M2:** Suitable E_a shown on graph **(1)** **Third mark – M3:** (At higher temperature) more molecules/more collisions / more particles have **energy greater than the activation energy** NOTE: Must refer to activation energy / E_a for M3 IGNORE 'more frequent collisions' **(1)**  Only M1 can be awarded if **two** E_a values drawn on graph for this part	E_a shown at peak or to the left of peak "More **atoms**"	**3**

Question Number	Acceptable Answers	Reject	Mark
11 *(d)(iii)	**First mark – M1:** E_a for the **catalysed reaction** shown to the **left** of E_a for the **un-catalysed reaction** NOTE Do not penalise again the actual position of either E_a if M2 was not awarded in Q22(d)(ii) for the same reason **(1)** **Second mark – M2:** **EITHER** (With catalyst) more molecules / more collisions / more particles have energy greater than the (new, lower) activation energy **OR** Diagram labelled as shown below NOTE If a shaded area is shown between the two E_a lines, even if it is unlabelled, award M2 NOTE ALLOW alternatives for **M2** such as "More molecules have enough energy to react (with the catalyst)" OR "More molecules are able to react at lower energies (with the catalyst)" [Unlike in Q22(d)(i), E_a doesn't HAVE to be mentioned.] **(1)**  IGNORE **Just** a statement that "a catalyst provides an alternative reaction route/pathway of lower activation energy"	Two curves shown (no M1) "More **atoms**"	**2**

(Total for Question 11 = 14 marks)