Question			Answer	Marks	Guidance
18	(a)		$K_c = \frac{[NO_2]^2}{[NO]^2\,[O_2]}$ ✓ Units = $dm^3\ mol^{-1}$ ✓	2	Must be square brackets **IGNORE** state symbols **ALLOW** $mol^{-1}\ dm^3$ **ALLOW** $mol\ dm^{-3}$ as ECF from inverted K_c expression
	(b)		**FIRST CHECK THE ANSWER ON THE ANSWER LINE IF answer = 1.2 (mol) award 4 marks** **Unless otherwise stated, marks are for correctly calculated values. Working shows how values have been derived.** $[NO] = \frac{0.40}{4.0} = 0.1(0)\ (mol\ dm^{-3})$ **AND** $[O_2] = \frac{0.80}{4.0} = 0.2(0)\ (mol\ dm^{-3})$ ✓ $[NO_2]^2 = 45 \times 0.10^2 \times 0.20$ **OR** = 0.09(0) ✓ $[NO_2] = \sqrt{(45 \times 0.10^2 \times 0.20)}$ **OR** = $0.3(0)\ (mol\ dm^{-3})$ ✓ amount $NO_2 = 0.30 \times 4 = 1.2$ (mol) ✓	4	***ANNOTATIONS MUST BE USED*** For **all** parts, **ALLOW** numerical answers from 2 significant figures up to the calculator value Ignore rounding errors after second significant figure 1st mark is for realising that concentrations need to be calculated. **ALLOW ECF** **Correct numerical answer with no working would score all previous calculation marks** Making point 2 subsumes point 1 Making point 3 subsumes points 2 and 1 Common errors 9.6 = 3 marks mol of NO and O_2 used 0.36 = 3 marks mol of NO_2 calculated from $[NO_2]^2$ 2.4 = 2 marks mol of NO and O_2 used and no mol of NO_2 calculated

Question			Answer	Marks	Guidance
	(c)	(i)	Exothermic **AND** K_p decreases as temperature increases ✓	1	**ALLOW** K_c for K_p **ALLOW** Equilibrium shifts to left hand side as temperature increases
	(c)	(ii)	***Equilibrium shift*** (Equilibrium position) shifts to right / forward / towards products ✓ ***Effect of increased pressure on K_p expression*** *R*atio (in K_p expression) decreases **OR** Denominator/bottom of K_p expression increases more (than numerator/top) ✓ ***Equilibrium shift (K_p expression)*** Ratio (in K_p expression) increases **to restore K_p** **OR** Numerator/top of K_p expression increases **to restore K_p** ✓	3	**FULL ANNOTATIONS NEEDED** **ALLOW** K_c for K_p throughout the response. **ALLOW** K_p (initially) decreases for second marking point **IF** K_p is seen to be restored later in the process. **ALLOW** more NO_2 / product formed to restore K_p **ALLOW** ratio adjusts to restore K_p
			Total	10	