Answers to Topic 6 Exercises

Topic 6 Exercise 1

1. The system is closed; the forward and reverse reactions are taking place at the same rate; the concentrations of reactants and products are not changing

2. i) $\frac{[N_2O_4]}{[NO_2]^2}$ $mol^{-1}dm^3$ ii) $\frac{[CH_3CH_2CO_2CH_2CH_3][H_2O]}{[CH_3CH_2CO_2H][CH_3CH_2OH]}$ no units

   iii) $\frac{[HI]^2}{[H_2][I_2]}$ no units iv) $\frac{[SO_3]^2}{[SO_2]^2[O_2]}$ $mol^{-1}dm^3$

   v) $\frac{[NH_3]^2}{[N_2][H_2]^3}$ $mol^{-2}dm^6$

3. 0.042 $moldm^{-3}$
4. 1.33 x 10^{-3} $moldm^{-3}$
5. 56.3
6. 0.2 $moldm^{-3}$
7. 6.6 $mol^{-2}dm^6$
8. 1010 $mol^{-1}dm^3$
9. 3.2 x 10^{-4} $moldm^{-3}$
10. 46.3 $mol^{-2}dm^6$
11. 4.12
12. 12 $moldm^{-3}$

Topic 6 Exercise 2

1. a) equilibrium moves to right
   to replace lost water
   so $[Cl_2]$ increases and [HCl] decreases

   b) equilibrium moves to right
   to remove added oxygen
   so $[Cl_2]$ increases and [HCl] decreases

   c) pressure is increased
   so equilibrium moves to right
   in direction of fewer moles
   to reduce pressure
   so $[Cl_2]$ increases and [HCl] decreases

   d) equilibrium moves to left
   in endothermic direction
   to reduce temperature
   so $[Cl_2]$ decreases and [HCl] increases

e) equilibrium does not move
as forward and reverse reactions are getting faster
by the same amount
so $[Cl_2]$ and [HCl] remain the same

2. a) low temperature, as this will favour the exothermic direction
which is the forward direction
high pressure, as this will favour the direction decreasing the gas moles
which is the forward direction
b) high temperature, as this will favour the endothermic direction
which is the forward direction
low pressure, as this will favour the direction increasing the gas moles
which is the forward direction
c) low temperature, as this will favour the exothermic direction
which is the forward direction
any pressure, as there is no change un the number of gas moles
d) any temperature, as there is no exothermic or endothermic direction
any pressure, as there is no change in the number of moles

3. a) yield is poor at high temperatures
b) reaction is slow at low temperatures
c) expensive equipment is needed for high pressures
d) yield is poor at low pressures
reaction is slow at low pressures
e) catalyst increases the rate of the reaction
and reduces costs be allowing a lower temperature to be used

Topic 6 Exercise 1

1. a) loss of electrons
b) gain of electrons
c) electron acceptor
d) electron donor
e) a reaction in which electrons are transferred

2.

a) +4	b) -2	c) +4	d) +6	e) +5
f) +3	g) 0	h) +2	i) +1	j) +5
k) +1	l) -1	m) -1	n) +3	o) +5
p) +7	q) +2	r) +8/3	s) +2.5	t) +2

3. a) $PbO_2 + 4H^+ + 2e \rightarrow Pb^{2+} + 2H_2O$
$2Cl^- \rightarrow Cl_2 + 2e$

$PbO_2 + 4H^+ + 2Cl^- \rightarrow Pb^{2+} + Cl_2 + 2H_2O$

b) $2S_2O_3^{2-} \rightarrow S_4O_6^{2-} + 2e$

$I_2 + 2e \rightarrow 2I^-$

$2S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + 2I^-$

c) $2IO_3^- + 12H^+ + 10e \rightarrow I_2 + 6H_2O$

$2I^- \rightarrow I_2 + 2e$

$IO_3^- + 6H^+ + 5I^- \rightarrow 3I_2 + 3H_2O$

d) $ClO^- + 2H_2O \rightarrow ClO_3^- + 4H^+ + 4e$

$ClO^- + 2H^+ + 2e \rightarrow Cl^- + H_2O$

$3ClO^- \rightarrow 2Cl^- + ClO_3^-$

e) $H_2SO_4 + 2H^+ + 2e \rightarrow SO_2 + 2H_2O$

$2Br^- \rightarrow Br_2 + 2e$

$H_2SO_4 + 2H^+ + 2Br^- \rightarrow SO_2 + Br_2 + 2H_2O$

f) $H_2SO_4 + 6H^+ + 6e \rightarrow S + 4H_2O$

$2I^- \rightarrow I_2 + 2e$

$H_2SO_4 + 6H^+ + 6I^- \rightarrow S + 3I_2 + 4H_2O$

g) $H_2SO_4 + 8H^+ + 8e \rightarrow H_2S + 4H_2O$

$2I^- \rightarrow I_2 + 2e$

$H_2SO_4 + 8H^+ + 8I^- \rightarrow H_2S + 4I_2 + 4H_2O$

h) $ClO^- + 2H^+ + 2e \rightarrow Cl^- + H_2O$

$2I^- \rightarrow I_2 + 2e$

$ClO^- + 2H^+ + 2I^- \rightarrow Cl^- + H_2O + I_2$

i) $PbO_2 + 4H^+ + 2e \rightarrow Pb^{2+} + 2H_2O$

$SO_3^{2-} + H_2O \rightarrow SO_4^{2-} + 2H^+ + 2e$

$PbO_2 + 2H^+ + SO_3^{2-} \rightarrow Pb^{2+} + SO_4^{2-} + H_2O$

4.

Equation	Oxidising agent	Reducing agent
a)	PbO_2	Cl^-
b)	I_2	$S_2O_3^{2-}$
c)	IO_3^-	I^-
d)	ClO^-	ClO^-
e)	H_2SO_4	Br^-
f)	H_2SO_4	I^-
g)	H_2SO_4	I^-
h)	ClO^-	I^-
i)	PbO_2	SO_3^{2-}

5. only reaction (d) is a disproportionation reaction