



Christ Church
Grammar School

Year 12 Chemistry

Redox test 2018

Time allowed:

45 minutes

Name: Answers

Mark =/45

Teacher:

KLW

CEM

JPT

NMO

Section 1 Multiple Choice

10 marks

1. In which of the following is sulfur in the highest oxidation state (oxidation number)?

- A. $\text{S}_2\text{O}_6^{2-}$ -7 5
 B. $\text{S}_2\text{O}_4^{2-}$ -4 3
 C. $\text{S}_2\text{O}_8^{2-}$ -8 7
 D. $\text{S}_4\text{O}_6^{2-}$ -2 $2\frac{1}{2}$

2. Which of the following contains nitrogen with an oxidation number of +5?

- A. N_2H_4 -2
 B. $(\text{NH}_4)_3\text{PO}_4$ -3
 C. $\text{Ba}(\text{NO}_3)_2$ $+5$
 D. $\text{Al}(\text{NO}_2)_3$ $+3$

3. Which of the following are redox reactions?

- I. $\text{Ca} + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2$
 II. $\text{CaO} + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O}$
 III. $\text{Ca}(\text{OH})_2 + 2\text{HCl} \rightarrow \text{CaCl}_2 + 2\text{H}_2\text{O}$
 IV. $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$

- A. I only
 B. II, III and IV only
 C. I and IV only
 D. all of them

The following 3 questions refer to a galvanic cell comprising a $\text{Ag}(\text{s})/\text{Ag}^+(\text{aq})$ half-cell and a $\text{Co}(\text{s})/\text{Co}^{2+}(\text{aq})$ half-cell under standard conditions

4. What will be the voltage of the galvanic cell?

- A. 0.52V
 B. 0.80V
 C. -0.28V
 D. 1.08V

5. During the operation of the cell, which of the following will occur?

- A. The mass of the cathode will decrease
 B. The concentration of $\text{Ag}^+(\text{aq})$ will increase
 C. Electrons will flow from the Ag electrode to the Co electrode
 D. Anions flow to the $\text{Co}(\text{s})/\text{Co}^{2+}(\text{aq})$ half-cell through the salt bridge.

6. If a student used aqueous sodium carbonate for his salt bridge, which of the following would you be most likely to observe?

- A. The voltage of the cell would drop and a yellow precipitate would form in one of the half cells.
 B. The voltage of the cell would drop and a pink precipitate would form in one of the half cells.
 C. The voltage of the cell would be unchanged and a yellow precipitate would form in one of the half cells.
 D. The voltage of the cell would be unchanged and a ~~yellow~~ pink precipitate would form in one of the half cells.

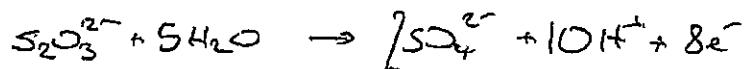
* B + D allowed
 (actually voltage will increase !!)

7. Which of the following is true of galvanic cells?

- A. The overall reaction is an endothermic process.
 B. Electrical energy is converted into chemical potential energy.
 C. Electrical energy is required to overcome the activation energy.
 D. The enthalpy of the products is lower than that of the reactants.

8. How many electrons are transferred when 2 moles of thiosulfate ions ($S_2O_3^{2-}$) are converted into sulfate ions (SO_4^{2-})

- A. 16.
 B. 8.
 C. 4.
 D. 2.



9. Which of the following is true for electrolytic cells?

- A. Cations in the electrolyte flow towards the anode.
 B. Oxidation occurs at the negative electrode.
 C. Electrons flow from the anode to the cathode through the external circuit.
 D. A salt bridge is not used because of the high temperatures.

10. Which of the following is true about 1.0molL^{-1} hydrogen peroxide solution

- I. It can decompose into water and $O_2(g)$
 II. It can be reduced by $Mn^{2+}(aq)$.
 III. It can oxidise $Mn^{2+}(aq)$.
 IV. It can be reduced by Mn.

- A. I and II
 B. III and IV
 C. II, III and IV
 D. all of them

Section 2 Written questions

35 marks

Question 11

(10 marks)

Write balanced half-equations and a full equation that account for the following observations.

- (a) A colourless solution reacts with a pale pink solution and the solution turns purple.

Oxidation half equation	$Mn^{2+} + 4H_2O \rightarrow MnO_4^- + 8H^+ + 5e^-$ (x4) ✓
Reduction half equation	$H_2O_2 + 2H^+ + 2e^- \rightarrow 2H_2O$ (x5) ✓
Full redox equation	$2Mn^{2+} + 5H_2O_2 \rightarrow 2MnO_4^- + 6H^+ + 2H_2O$ ✓

(4)

- (b) When nitrate ions are added to dithionate (
- $S_2O_4^{2-}$
-) ions, sulfate ions are formed and a brown gas is given off.

Oxidation half equation	$S_2O_4^{2-} + 4H_2O \rightarrow 2SO_4^{2-} + 8H^+ + 6e^-$ (x1) ✓
Reduction half equation	$NO_3^- + 2H^+ + e^- \rightarrow NO_2 + H_2O$ (x6) ✓
Full redox equation	$S_2O_4^{2-} + 6NO_3^- + 4H^+ \rightarrow 2SO_4^{2-} + 6NO_2 + 2H_2O$ ✓

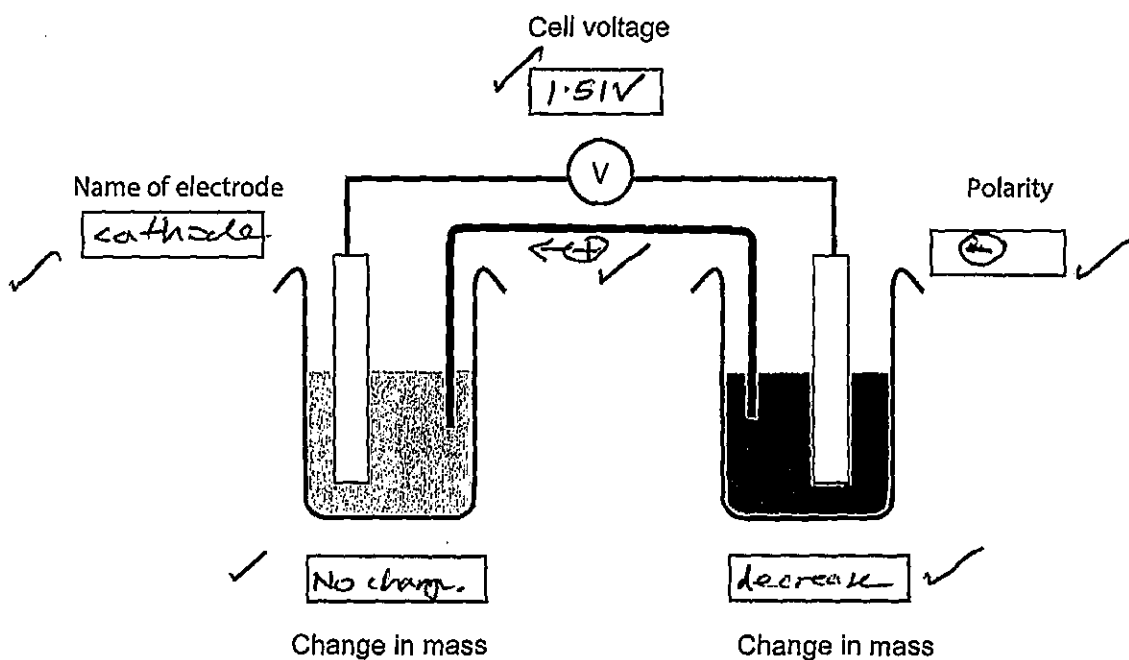
(6)

Question 12

(6 marks)

An galvanic cell is constructed as follows. In the half-cell on the left, a platinum electrode is placed into a solution that contains both $1.00\text{molL}^{-1}\text{Fe}^{2+}(\text{aq})$ and $1.00\text{molL}^{-1}\text{Fe}^{3+}(\text{aq})$. In the half-cell on the right, a chromium electrode is placed in a solution of $1.00\text{molL}^{-1}\text{Cr}^{3+}(\text{aq})$. Complete the diagram below, indicating the following in the relevant spaces provided.

- Name of the left-hand electrode (anode or cathode).
- Polarity of the right-hand electrode (+ or -).
- Direction of flow of cations in the external circuit.
- Observation at each electrode
- Change in mass of each electrode (increase, decrease, no change)
- Cell voltage



"less brown,
more green"

"deep
green"

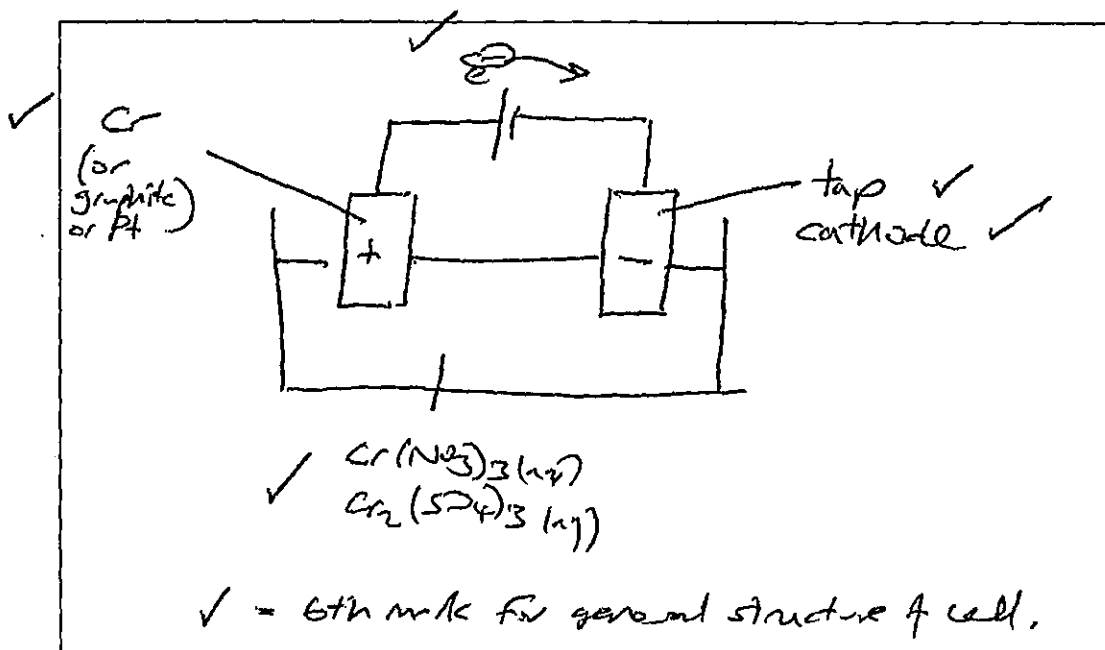
Question 13

(6 marks)

Chromium is a corrosion resistant metal and chrome plating is a method of coating iron objects with chromium. It is similar to the silver plating of cutlery.

Draw a diagram below to show a cell that would be suitable for conducting this process on a kitchen tap fitting. In addition to the general layout of the cell, clearly indicate the following

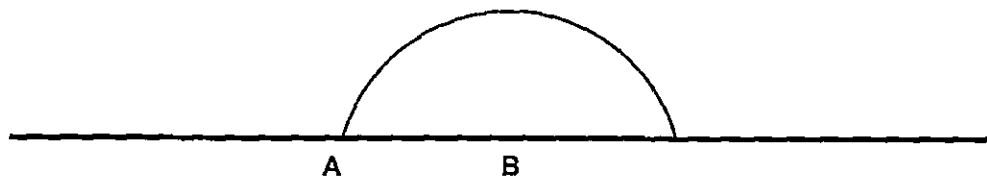
- The electrode that is the tap
- The most suitable material for the other electrode
- The anode and cathode
- The direction of flow of electrons
- A suitable solution for the electrolyte



Question 14

(5 marks)

Below is a simplified diagram of a drop of water on an iron surface.



Write 'true' or 'false' in the boxes below alongside the following statements

Statement	True or False
Loss of iron metal will most likely be seen at location A	False
B is a cathodic area	False
Electrons will flow through the iron from B to A	True
During the corrosion process, Fe(s) is oxidised to Fe ²⁺ (aq) and O ₂ (g) is reduced to OH ⁻ (aq)	True
The red/brown colour of the rust is due Fe(OH) ₂ (s)	False

Question 15

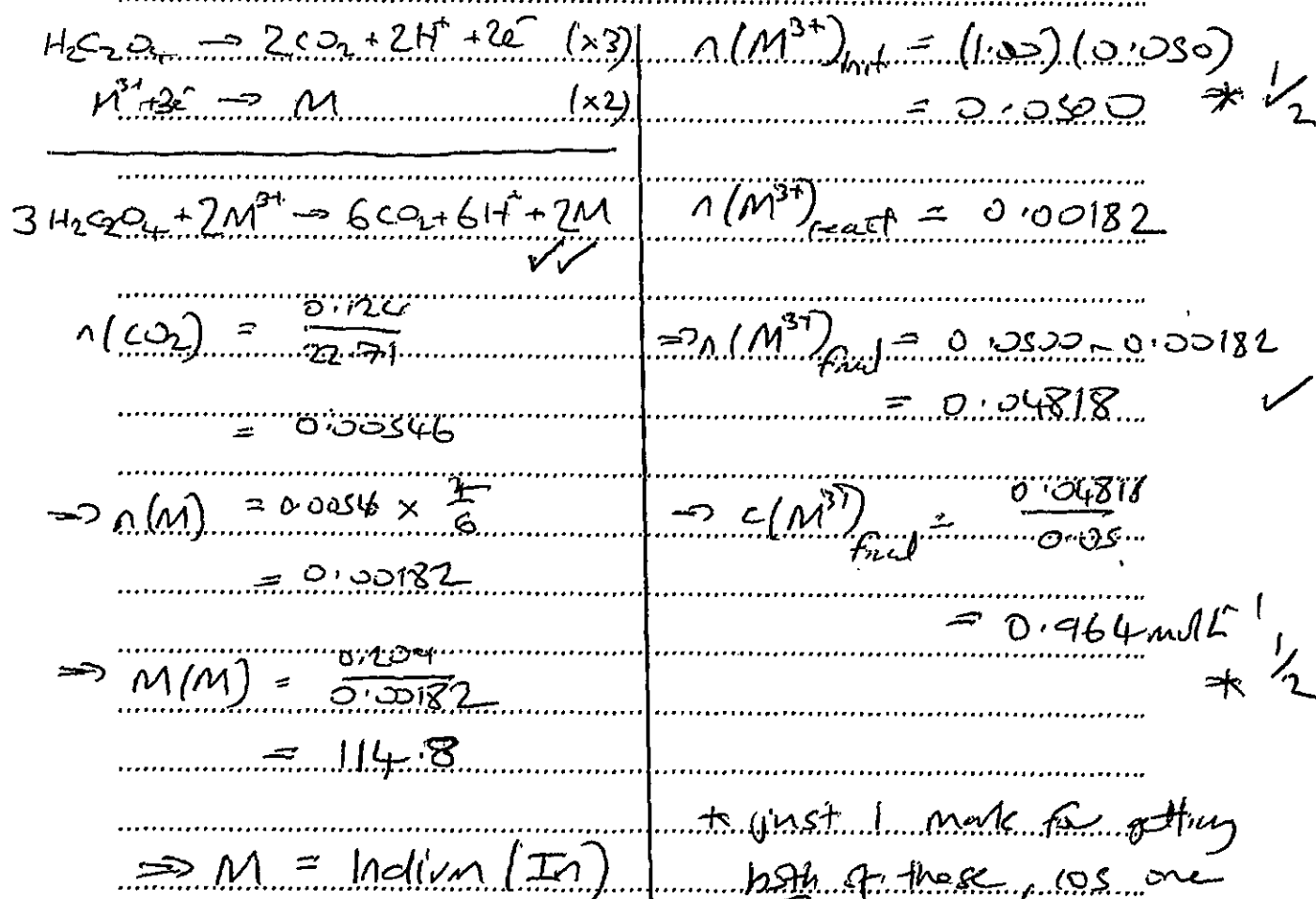
(8 marks)

A galvanic cell is set up as follows. One half cell consists of a 50.0 mL solution of 1.00 mol L^{-1} oxalic acid ($\text{H}_2\text{C}_2\text{O}_4$) and a platinum electrode. The other half cell consists of an electrode made of unknown metal (M) and 50.0 mL of a solution of its $1.00 \text{ mol L}^{-1} \text{ M}^{3+}(\text{aq})$ ions.

During operation of the cell, 124 mL (measured at STP) of a colourless gas was given off at the anode and the mass of the M electrode increased by 0.209 g.

Identify metal M and calculate the final concentration of $\text{M}^{3+}(\text{aq})$ ions in the $\text{M}^{3+}(\text{aq})/\text{M}(\text{s})$ half cell after the cell had operated. Put your answers in the boxes below, showing your working in full underneath.

Metal M	Indium (In)
Final concentration of $\text{M}^{3+}(\text{aq})$	0.964 mol L^{-1}



END OF TEST

* just 1 mark for getting both of those, cos one operation is $\div V$, the other is just the reverse, $\times V$.