



Name \_\_\_\_\_

**Information About This Examination**

Each of the 50 multiple choice questions is worth 4 points, for a total of 200 points.

**Instructions:** Choose the **BEST** answer (A - E) to each of the questions below and record your answer on the separate "SCANTRON" form provided.**Part 1. Questions 1-34 are based on NEW Material (Chapters 20, 21, 24, & 22)**1. What are the correct oxidation states for the underlined elements in the following four compounds: (1)  $\text{H}_3\text{PO}_4$ , (2)  $\text{Mn}O_4^{2-}$  anion, (3)  $\text{O2}F_2$ .

A. +5 +7 -2

B. +5 +6 +1

C. -5 +7 +2

D. +3 +6 -1

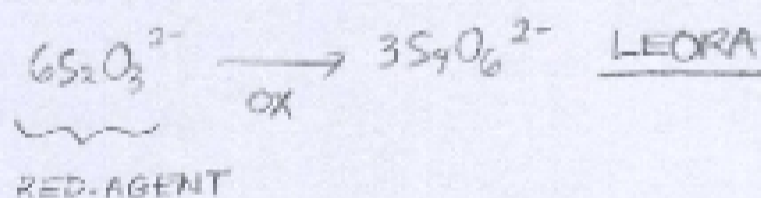
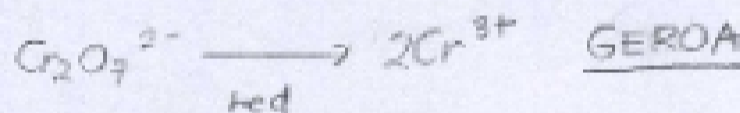
E. +3 +7 -2

$$(1) \text{H}_3\text{PO}_4 \quad 3(+1) + x + 4(-2) = 0 \quad x = +5$$

$$(2) \text{MnO}_4^{2-} \quad x + 4(-2) = -2 \quad x = +6$$

$$(3) \text{O}_2\text{F}_2 \quad 2x + 2(-1) = 0 \quad x = +1$$

2. Which species is the reducing agent in the reaction below?

A.  $\text{Cr}_2\text{O}_7^{2-}$ B.  $\text{S}_2\text{O}_3^{2-}$ C.  $\text{H}^+$ D.  $\text{Cr}^{3+}$ E.  $\text{S}_4\text{O}_6^{2-}$ 

3. What are the values for X, Y &amp; Z when the redox equation below is balanced with the smallest possible whole numbers for each of the six components?



A. X = 5, Y = 1, Z = 8

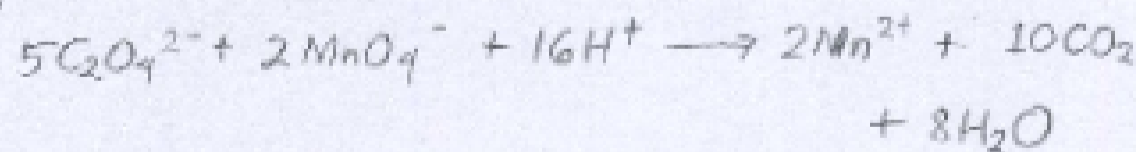
B. X = 3, Y = 1, Z = 5

C. X = 3, Y = 2, Z = 8

D. X = 5, Y = 1, Z = 4

E. X = 5, Y = 2, Z = 16

from EXP. 19 &amp; 23



4. An electrochemical cell (linked by a KCl salt bridge) is constructed from:

- An Fe electrode in 1.0M FeCl<sub>2</sub> solution ( $E_R^\circ = -0.440$  v)  $\rightarrow$  more  $(-) E_R^\circ \rightarrow$  becomes oxidation!  
 A Sn electrode in 1.0M Sn(NO<sub>3</sub>)<sub>2</sub> solution ( $E_R^\circ = -0.136$  v)

Which is only possible TRUE STATEMENT when this cell is running spontaneously?

- A. The tin electrode loses mass and the tin electrode is the cathode. X  
 B. The tin electrode gains mass and the tin electrode is the cathode.  
 C. The iron electrode gains mass and the iron electrode is the anode. X  
 D. The iron electrode loses mass and the iron electrode is the cathode. X  
 E. The iron electrode gains mass and the iron electrode is the cathode. X

$$E_{\text{ox}}^\circ = +0.440\text{V}$$

$$+ E_{\text{red}}^\circ = -0.136\text{V}$$


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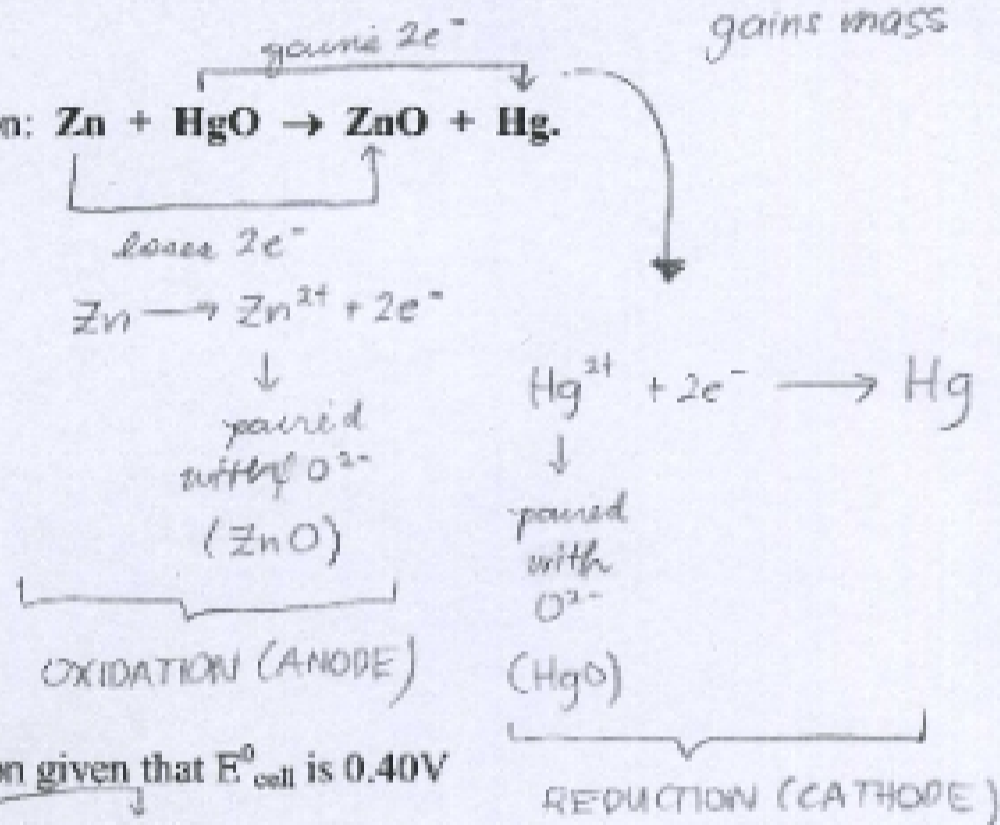

$$E^\circ = +0.304$$

Fe  $\rightarrow$  anode  
 loses mass  
 Sn  $\rightarrow$  cathode  
 gains mass

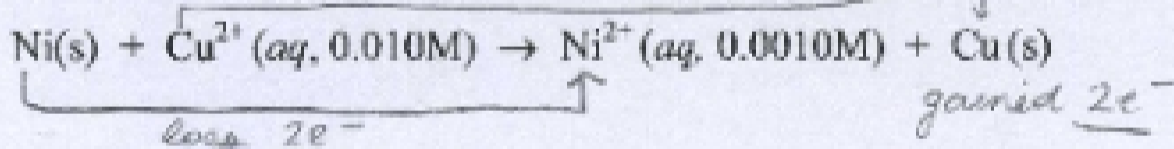
5. An electrochemical cell is based on the reaction:  $\text{Zn} + \text{HgO} \rightarrow \text{ZnO} + \text{Hg}$ .

Which half-reaction occurs at the anode?

- A.  $\text{HgO} + 2e^- \rightarrow \text{Hg} + \text{O}^{2-}$   
 B.  $\text{Zn}^{2+} + 2e^- \rightarrow \text{Zn}$   
 C.  $\text{Zn} \rightarrow \text{Zn}^{2+} + 2e^-$   
 D.  $\text{ZnO} + 2e^- \rightarrow \text{Zn}$   
 E.  $\text{Hg} \rightarrow \text{Hg}^{2+} + 2e^-$



6. Calculate the cell emf for the following reaction given that  $E^\circ_{\text{cell}}$  is 0.40V



- A. 0.49V  
 B. -0.43V  
 C. 0.37V  
 D. 0.34V  
 E. 0.43V

$$E(\text{emf}) = E^\circ_{\text{cell}} - \frac{0.05916\text{V}}{n} \log \frac{[\text{Ni}^{2+}]}{[\text{Cu}^{2+}]}$$

$$= 0.40\text{V} - \frac{0.05916\text{V}}{2e^-} \log \frac{(0.0010\text{M})}{(0.010\text{M})}$$

$$= 0.42958\text{V}$$