



## Information

$$E_{cell}^0 = E_{red}^0(\text{cathode}) - E_{red}^0(\text{anode})$$

$$E_t^0 = E_{red}^0(\text{reduction process}) - E_{red}^0(\text{oxidation process})$$

$$\Delta G = -nFE$$

$$1F = 96,500 \text{ C/mol} = 96,500 \text{ J/V-mol}$$

$$E = E^0 - \frac{0.0592V}{n} \log Q$$

$$w = nFE_{ext}$$

$$1W = 1J/s$$

$$\text{Rate} = kN$$

$$\ln \frac{N_t}{N_0} = -kt$$

$$k = \frac{0.693}{t_{1/2}}$$

$$\Delta E = c^2 \Delta m$$

$$1J = 1kg \frac{m^2}{s^2}$$

$$1\text{amu} = 1.6605 \times 10^{-24} \text{ g}$$

$$N = 6.02214 \times 10^{23} / \text{mol}$$

$$c = 2.9979 \times 10^8 \text{ m/s}$$

(1) The gain of electrons is called

- a) reduction
  - b) oxidation
  - c) disproportionation
  - d) fractionation
  - e) sublimation
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(2) Which of the following reaction is a redox reaction?

- a)  $\text{K}_2\text{CrO}_4 + \text{BaCl}_2 \rightarrow \text{BaCrO}_4 + 2\text{KCl}$
  - b)  $\text{Pb}^{2+} + 2\text{Br}^- \rightarrow \text{PbBr}_2$
  - c)  $\text{Cu} + \text{S} \rightarrow \text{CuS}$
  - d) both of the following:  
 $\text{K}_2\text{CrO}_4 + \text{BaCl}_2 \rightarrow \text{BaCrO}_4 + 2\text{KCl}$   
 $\text{Pb}^{2+} + 2\text{Br}^- \rightarrow \text{PbBr}_2$
  - e) None of these is a redox reaction
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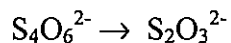
(3) What is the oxidation state of oxygen in ozone

- a) 0
  - b) -2
  - c) -1
  - d) +1
  - e) +2
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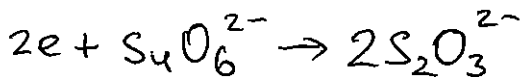
(4) What is the oxidation state of manganese in  $\text{MnO}_4^-$

- a) +1
- b) +2
- c) +5
- d) +8
- e) +7

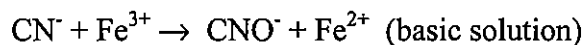
(5) How many electrons are involved in the following half-reaction when it is balanced?



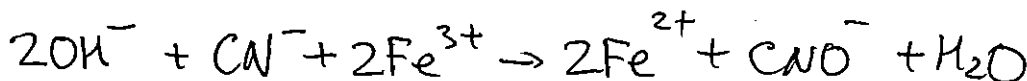
- a) 6  
b) 2  
c) 4  
d) 1  
e) 3
- 



(6) What is the coefficient of  $\text{Fe}^{3+}$  when the following equation is correctly balanced?



- a) 1  
b) 2  
c) 3  
d) 4  
e) 5
- 



(7) The electrode at which oxidation occurs is called the

- a) oxidizing agent  
b) cathode  
c) reducing agent  
d) anode  
e) voltaic cell
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(8) In a galvanic cell, electrons flow from the \_\_\_\_ to the \_\_\_\_:

- a) salt bridge, anode  
b) anode, salt bridge  
c) cathode, anode  
d) salt bridge, cathode  
e) anode, cathode

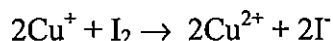
(9) From the information given, determine which halogen is the strongest oxidizing agent.

Substance	$E_{\text{red}}^{\circ}$ (V)
Br <sub>2</sub>	1.09
F <sub>2</sub>	<u>2.85</u>
I <sub>2</sub>	0.54
Cl <sub>2</sub>	1.36

- a) Cl<sub>2</sub>
- b) Br<sub>2</sub>
- c) F<sub>2</sub>
- d) I<sub>2</sub>
- e) all of the halogens have equal strength as oxidizing agents

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(10) Use the standard reduction potentials in V:  $\text{Cu}^{2+} \rightarrow 2\text{Cu}^+$ , +0.16;  $\text{I}_2 \rightarrow 2\text{I}^-$ , +0.54. Calculate the value of  $E^{\circ}$  (in V) for a cell in which the overall reaction is



a) 0.38  
b) -0.38  
c) 0.68  
d) 0.83  
e) -0.83

$$E^{\circ} = E_{\text{red}}^{\circ}(\text{red. proc.}) - E_{\text{red}}^{\circ}(\text{oxid. proc.})$$
$$2\text{Cu}^+ \rightarrow 2\text{Cu}^{2+} + 2e^- \quad (\text{oxid.})$$
$$\text{I}_2 + 2e^- \rightarrow 2\text{I}^- \quad (\text{red.})$$
$$E^{\circ} = +0.54\text{V} - 0.16\text{V} = +0.38\text{V}$$

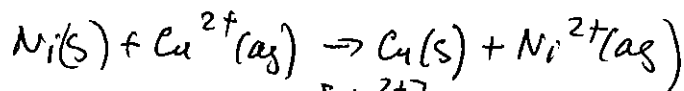
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(11) A nonspontaneous electrochemical reaction has

- a)  $\Delta G=0$ ,  $E=0$ ,  $K>1$
- b)  $\Delta G<0$ ,  $E>0$ ,  $K>1$
- c)  $\Delta G>0$ ,  $E<0$ ,  $K<1$
- d)  $\Delta G>0$ ,  $E<0$ ,  $K>1$
- e)  $\Delta G<0$ ,  $E=0$ ,  $K>1$

(12) Given the following information

Half-reaction	$E_{red}^{\circ}$
$\text{Cu}^{2+}(\text{aq}) + 2e \rightarrow \text{Cu}(\text{s})$	+0.337 V
$\text{Ni}^{2+}(\text{aq}) + 2e \rightarrow \text{Ni}(\text{s})$	-0.280 V



$$Q = \frac{[\text{Ni}^{2+}]}{[\text{Cu}^{2+}]} = 0.440$$

cathode

$$E_{cell}^{\circ} = E_{red}^{\circ}(\text{cathode}) - E_{red}^{\circ}(\text{anode}) = 0.617$$

$$E = E^{\circ} - \frac{0.0592\text{V}}{2} \log Q = 0.617 + 0.013 = 0.630\text{V}$$

determine the potential (in V) of an electrochemical cell in which the concentration of nickel (II) is 0.155 M and the concentration of copper (II) is 0.352 M. (T=298 K)

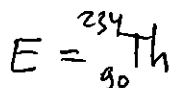
- a) 0.64
- b) 0.61
- c) 0.068
- d) 0.63
- e) 0.60

(13) All atoms of a given element have the same

- a) mass number
- b) number of nucleons
- c) atomic mass
- d) number of neutrons
- e) atomic number

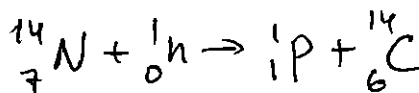
(14) In balancing the nuclear reaction  ${}_{92}^{238}\text{U} \rightarrow {}_{90}^{234}\text{E} + {}_2^4\text{He}$ , the identity of element E is:

- a) Pu
- b) Np
- c) U
- d) Pa
- e) Th



(15) In the nuclear transmutation represented by  ${}_{7}^{14}\text{N}({}_0^1n, {}_1^1\text{p})?$ , what is the product?

- a) carbon-12
- b) carbon-16
- c) carbon-14
- d) nitrogen-16
- e) nitrogen-15



(16) A wooden object from an archeological site is subjected to radiocarbon dating. The activity of the sample due to  $^{14}\text{C}$  is measured to be 10.5 disintegrations per second. The activity of a carbon sample of equal mass from fresh wood is 15.2 disintegrations per second. The half-life of  $^{14}\text{C}$  is 5715 years. What is the age of the archeological sample?

- a) 3050
- b) 2230
- c) 2050
- d) 3550
- e) 5715

$$\text{rate}_0 = kN_0 \quad \text{rate}_t = kN_t \quad \ln \frac{N_t}{N_0} = -kt \quad k = \frac{0.693}{t_{1/2}}$$

$$t = -\frac{1}{k} \ln \frac{N_t}{N_0} = -\frac{t_{1/2}}{0.693} \ln \frac{10.5}{15.2} = 3050.5$$

(17) The respective masses in amu of the proton, the neutron, and the cobalt-60 atom are 1.00728, 1.00867, and 59.9338. What is the binding energy in J of  $^{60}_{27}\text{Co}$  nucleus?

- a)  $2.735 \times 10^{-19}$
- b)  $9.117 \times 10^{-28}$
- c)  $4.940 \times 10^{-13}$
- d)  $8.190 \times 10^{-11}$
- e)  $2.735 \times 10^{-16}$

$$27p + 33n = 27(1.00728) + 33(1.00867) = 60.48267$$

$$- 59.9338$$

$$\hline 0.54884$$

$$\Delta E = c^2 \Delta m = (2.9979 \times 10^8 \frac{\text{m}}{\text{s}})^2 (0.54884 \text{ amu} \cdot 1.6605 \times 10^{-24} \frac{\text{kg}}{1000 \text{g}}) = 8.190 \times 10^{-11} \text{ J}$$

(18) What exposure level to radiation is fatal to most humans?

- a) 100 rem
- b) 200 rem
- c) 600 rem
- d) 300 rem
- e) 50 rem

(19) The least electronegative of the elements below is \_\_\_\_.

- a) I
- b) Cl
- c) Si
- d) F
- e) Br

(20) What is the oxidation state of xenon in  $\text{XeO}_2\text{F}_2$ ?

- a) 0
  - b) +4
  - c) +8
  - d) +2
  - e) +6
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(21) Which element can react with fluorine to form the compound  $\text{XF}_6$ ?

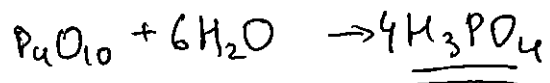
- a) silicon
  - b) arsenic
  - c) boron
  - d) xenon
  - e) selenium
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(22) Which one of the following compound is a peroxide?

- a)  $\text{H}_2\text{O}_2$
  - b)  $\text{CaO}$
  - c)  $\text{CaO}_2$
  - d)  $\text{NaO}_2$
  - e)  $\text{Al}_2\text{O}_3$
- 

(23)  $\text{P}_4\text{O}_{10}$  is the anhydride of

- a)  $\text{H}_3\text{PO}_3$
- b)  $\text{H}_3\text{PO}_4$
- c)  $\text{P}_4\text{O}_6$
- d) white phosphorus
- e) red phosphorus.



(24) Which group 3A element is a metalloid?

- a) B
  - b) Al
  - c) Ga
  - d) In
  - e) Tl
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(25) The molecular shape of the SF<sub>6</sub> molecule is \_\_\_\_\_.

- a) tetrahedral
- b) trigonal bipyramidal
- c) octahedral
- d) trigonal pyramidal
- e) T-shape

**PERIODIC TABLE OF THE ELEMENTS**

Main groups		Transition metals										Main groups									
1A <sup>a</sup>	2A	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	3A	4A	5A	6A	7A	8A				
1 1.00794 H	2 4.002602 He	3 6.941 Li	4 9.012182 Be	5 22.989770 Na	6 24.304 Mg	7 26.981538 Al	8 27.976927 Si	9 28.0855 P	10 30.973762 S	11 32.06 Cl	12 35.453 Ar	13 10.811 B	14 12.0107 C	15 14.00674 N	16 15.9994 O	17 18.998403 F	18 20.1797 Ne				
19 39.0983 K	20 39.0983 Ca	21 50.9415 Sc	22 47.867 Ti	23 50.9415 V	24 50.9415 Cr	25 51.9961 Mn	26 54.938045 Fe	27 58.933200 Co	28 58.933200 Ni	29 63.546 Cu	30 63.546 Zn	31 69.723 Ga	32 72.61 Ge	33 74.92160 As	34 78.96 Se	35 79.904 Br	36 83.80 Kr				
37 85.4678 Rb	38 87.62 Sr	39 88.90585 Y	40 91.224 Zr	41 92.90638 Nb	42 92.90638 Mo	43 95.94 Tc	44 97.907 Ru	45 101.07 Rh	46 101.07 Pd	47 102.90550 Ag	48 106.42 Cd	49 114.818 In	50 118.710 Sn	51 121.760 Sb	52 127.60 Te	53 126.90447 I	54 131.29 Xe				
55 132.90545 Cs	56 137.27 Ba	57 138.9055 La	58 178.49 Ce	59 180.9479 Pr	60 187.04 Nd	61 188.90784 Pm	62 190.23 Sm	63 192.227 Eu	64 195.078 Gd	65 200.59 Tb	66 207.2 Dy	67 208.98038 Ho	68 208.98038 Er	69 208.98038 Tm	70 208.98038 Yb	71 208.98038 Lu					
87 [223] Fr	88 [226] Ra	89 [227] Ac	90 [261] Th	91 [262] Pa	92 [265] U	93 [269] Np	94 [271] Pu	95 [272] Am	96 [273] Cm	97 [274] Bk	98 [277] Cf	99 [285] Es	100 [286] Fm	101 [287] Md	102 [288] No	103 [289] Lr					

<sup>a</sup>The labels on top (1A, 2A, etc.) are common American usage. The labels below these (1, 2, etc.) are those recommended by the International Union of Pure and Applied Chemistry.  
 The names and symbols for elements 110 and above have not yet been decided.  
 Atomic weights in brackets are the masses of the longest-lived or most important isotope of radioactive elements.  
 Further information is available at <http://www.nist.gov/pml/chemistry/web-elements/>  
 The production of elements 116 and 118 was reported in May 1999 by scientists at Lawrence Berkeley National Laboratory.