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CHEM110

Chem. 110
Exam. 1
Time : 120 min
2012 – 2013 1st term

Model (C)

Name:
Number:
Section:

Useful information
$N_A = 6.02 \times 10^{23}\ mol^{-1}$

With the best wishes

General Chemistry Team work

Directions: For each of the following questions, choose the letter that **best** answers the question and place it on your answer sheet.

تلويحات

1. There are three isotopes of hydrogen, differing with respect to:
(A) mass number
(B) atomic number
(C) number of electrons
(D) number of protons
(E) both of B and C

2. Which of the following elements belongs to the alkali metals?
(A) Cr
(B) Mg
(C) Cs
(D) Ar
(E) Si

3. Find the percent of oxygen, O, in Al_2O_3.
(A) 4.71 %
(B) 47.1 %
(C) 52.9 %
(D) 5.29 %
(E) 55.9 %

percent % = $\frac{n \times \text{Atomic mass of element}}{\text{molar mass of compound}}$

$= \frac{3 \times 15.999}{101.961} = 47.07\% \approx 47.1\%$

$M_{Al_2O_3} = (2 \times 26.982) + (3 \times 15.999) = 101.961$ g/mol

4. Which of the following organic compounds has the highest molar mass?
(A) C_3H_8 44.096
(B) $C_5H_{10}O_3$ 118.131
(C) C_2H_6O 46.068
(D) C_2H_4 28.053
(E) $C_4H_8O_4$ 120.103

O: 15.999
H: 1.0079
C: 12.011

5. Which of the following is a SI base unit?
(A) liter
(B) kilogram
(C) Celsius
(D) kilometer
(E) minute

6. 1 dm^3 = ...
(A) 1×10^{-1} m^3
(B) 1×10^{2} m^3
(C) 1×10^{-2} m^3
(D) 1×10^{-3} m^3
(E) 1×10^{6} m^3

$dm = 10^{-1}\ m$

$dm^3 = 10^{-3}\ m^3$

7. The complete symbol ${}^{A}_{Z}X$ for uranium, U, with 143 neutrons and 92 protons is
(A) ${}^{238}_{92}U$
(B) ${}^{143}_{92}U$
(C) ${}^{92}_{143}U$
(D) ${}^{92}_{212}U$
(E) ${}^{235}_{92}U$

A = neutrons + protons
= 143 + 92 = 235

Z = protons = 92

8. The formulas of the phosphate ion, hydroxide ion, and the ammonium ion are represented, respectively, as
(A) PO_3^{3-} , H^- , NH_4^+
(B) PH_3^{2-} , HO^- , NH
(C) P , OH^- , NH_3^-
(D) PO_4^{4-} , O^{2-} , NH^+
(E) PO_4^{3-} , OH^- , NH_4^+

9. What is the formula of the ionic compound formed between aluminum and sulfur ions?
(A) AlS_3
(B) Al_3S_2
(C) Al_2S_3
(D) Al_2S
(E) AlS

Al^{3+} S^{2-}

Al_2S_3

10. The correct coefficients for the balanced equation below are:

$$\overset{2}{a}\,Al + \overset{3}{b}\,H_2SO_4 \rightarrow \overset{1}{c}\,Al_2(SO_4)_3 + \overset{3}{d}\,H_2$$

(A) a=2, b=3, c=1, d=3
(B) a=2, b=1, c=2, d=3
(C) a=1, b=1, c=2, d=3
(D) a=2, b=1, c=1, d=1
(E) a=3, b=2, c=1, d=1

11. What is the chemical formula for the following compound: disilicon hexabromide?
(A) Si_2BrO_3
(B) Si_2Br_8
(C) Si_2Br_6
(D) $2SiBr_7$
(E) SBr_6

12. The diameter of an atom is approximately 1×10^{-7} mm. What is this diameter when expressed in nanometers?
(A) 1×10^{-3} nm
(B) 1×10^{6} nm
(C) 1×10^{-9} nm
(D) 1×10^{-1} nm
(E) 1×10^{2} nm

13. Calculate the number of atoms of potassium (K) in 0.834 g of potassium.
(A) 1.28×10^{22} atoms
(B) 5.02×10^{23} atoms
(C) 3.26×10^{22} atoms
(D) 7.83×10^{23} atoms
(E) 7.83×10^{24} atoms

14. Name the following compound: $MnCO_3$
(A) manganese(II) carbonate
(B) manganese bicarbonate
(C) magnesium carbonate
(D) manganese(III) carbonate
(E) manganese tricarbonate

15. The titanium ion Ti^{4+} has
(A) 22 protons and 18 electrons
(B) 48 protons and 52 electrons
(C) 22 protons and 26 electrons
(D) 48 protons and 44 electrons
(E) 44 protons and 40 electrons

16. What is the mass, in grams, of one arsenic (As) atom?
(A) 5.48×10^{-23} g
(B) 33.0 g
(C) 74.9 g
(D) 1.24×10^{-22} g
(E) 3.77×10^{-24} g

17. A piece of metal with a mass of 114 g was placed into a graduated cylinder that contained 25.00 mL of water, raising the water level to 42.50 mL. What is the density of the metal?
(A) 6.51 g/cm^3
(B) 0.892 g/cm^3
(C) 2.68 g/cm^3
(D) 0.354 g/cm^3
(E) 4.25 g/cm^3

18. Ethylene glycol is a liquid organic compound freezes at −11.5 °C. Calculate the freezing temperature in degrees Fahrenheit?
(A) 11.3 °F
(B) 36.9 °F
(C) 25.6 °F
(D) 44.2 °F
(E) -15.6 °F

19. In the periodic table, the elements are arranged in _____.
(A) alphabetical order
(B) six periods and seven groups
(C) order of increasing atomic number
(D) order of increasing neutron content
(E) order of increasing metallic properties

20. For the following equation:
$2CH_3OH + 3O_2 \rightarrow 2CO_2 + 4H_2O$
Calculate the number of moles of O_2 to react with 5.8 moles of methanol CH_3OH.
(A) 10 mol
(B) 0.4 mol
(C) 6.4 mol
(D) 2.5 mol
(E) 8.7 mol

21. Which of the following is an element?
(A) water
(B) lithium
(C) benzene
(D) carbon monoxide
(E) sodium chloride

22. An example of a monatomic ion is
(A) Br_2
(B) Ca^{2+}
(C) NH_4^+
(D) O_3
(E) CO_3^{2-}

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23. A sample of a compound contains 0.36 gram of sulfur (S) and 0.64 gram of fluorine (F). What is the empirical formula of this compound?

(A) SF_3
(B) SF_6
(C) SF
(D) S_2F_3
(E) S_3F_2

$n_S = 36/32.056 = 1.12$ mol
$n_F = 64/18.998 = 3.37$ mol
S : 1.12/1.12 = 1
F : 3.37/1.12 ≈ 3
SF_3

24. The empirical formula from the following is:

(A) $C_3H_6O_3$
(B) N_2O_4
(C) $C_2H_8N_1$
(D) P_4O_{10}
(E) $C_6H_{12}O_6$

25. Which one of the following compounds is likely to be ionic compound?

(A) ICl
(B) BaF_2
(C) CCl_4
(D) NF_3
(E) OF_2

metal nonmetal
Ba(II) F (VII)

26. A 25.0 mL sample of concentrated H_3PO_4 (14.7M) is diluted to a final volume of 500 mL. What is the molarity of the final solution?

(A) 0.735 M
(B) 0.670 M
(C) 0.795 M
(D) 0.700 M
(E) 0.625 M

V_i: 25 mL M_i: 14.7M
V_f: 500 mL M_f: ??
$M_iV_i = M_fV_f$
$M_f = \frac{M_iV_i}{V_f} = \frac{14.7 \times 25}{500} = 0.735$M

27. An element X, has three stable isotopes:

Mass of Isotope (amu)	Percent Abundance (%)
29.974	3.10
28.977	4.67
27.977	92.23

Calculate its average atomic mass

(A) 28.1 amu
(B) 27.2 amu
(C) 30.1 amu
(D) 29.3 amu
(E) 29.0 amu

Average atomic mass = $\frac{\text{mass} \times \text{percent abundance} + \cdots}{100}$
$= \frac{(29.974 \times 3.10) + (28.977 \times 4.67) + (27.977 \times 92.23)}{100}$
$= 28.09$ amu ≈ 28.1

28. The correct equation for calculating of molarity of a given solution is:

(A) $M = \frac{n_{solute}}{d_{solution}}$
(B) $M = n_{solute} \times V_{solution}$
(C) $M = \frac{n_{solute}}{V_{solution}}$
(D) $M = \frac{n_{solute}}{m_{solution}}$
(E) none of those

29. Calculate the percent yield of iron (Fe) if 850 g of Fe_3O_4 reacted with excess carbon, and the actual yield of Fe was 435 g.

$Fe_3O_{4(s)} + 2\,C_{(s)} \rightarrow 2\,CO_{2(g)} + 3\,Fe_{(s)}$

(A) 70.7 %
(B) 25.9 %
(C) 97.5 %
(D) 42.7 %
(E) 88.3 %

The limiting reagent is Fe_3O_4
$n_{Fe_3O_4} = \frac{850}{231.531} = 3.67$ mol

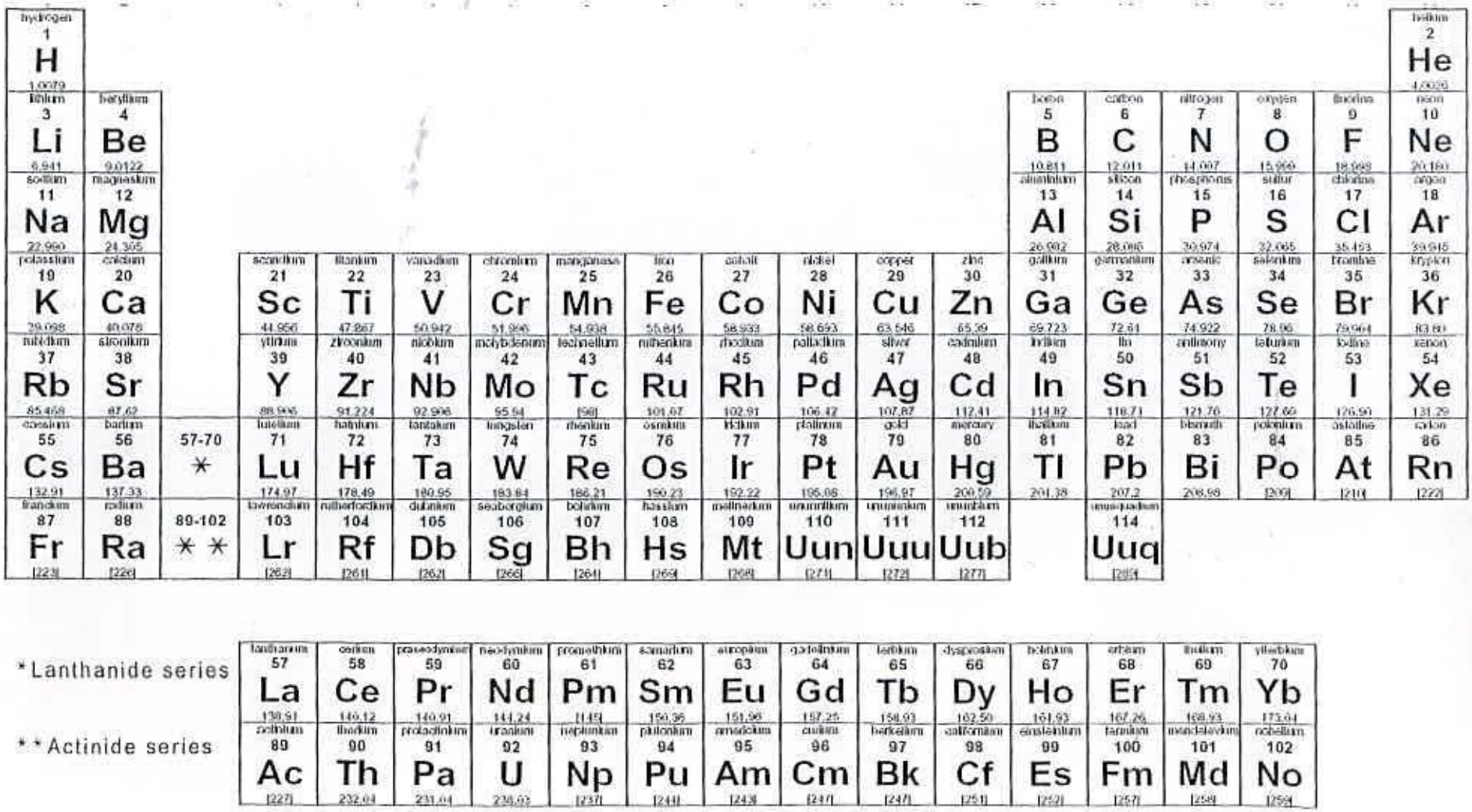
30. How many grams of methanol, CH_3OH, are required to prepare 300 ml of a 2.4 M solution?

(A) 38.5 g
(B) 30.8 g
(C) 23.1 g
(D) 19.4 g
(E) 40.3 g

0.3L
m = ?? V = 300mL M = 2.4M
$m_g = M \times M \times V(L)$
$M_{CH_3OH} = (1 \times 12.011) + (4 \times 1.0079) + (1 \times 15.999)$
$= 32.042$ g/mol
$m(g) = 32.042 \times 2.4 \times 0.3 = 23.07$ g
≈ 23.1 g

$M_{Fe_3O_4} = (3 \times 55.845) + (4 \times 15.949) = 231.531$ g/mol
→ According to balanced equation
1 mol Fe_3O_4 ⟶ 3 mol Fe
3.67 mol Fe_3O_4 ⟶ ??
$n_{Fe} = \frac{3.67 \times 3}{1} = 11.01$ mol
$m = n \times M_{Fe} = 11.01 \times 55.845 = 614.85$ g → Theoretical
Yield % = $\frac{\text{Actual}}{\text{Theoretical}} \times 100 = \frac{435}{614.85} \times 100 = 70.75\%$

∴ طريقة ثانية
231.531 g Fe_3O_4 ⟶ 3 × 55.8 of Fe
850 g Fe_3O_4 ⟶ ?? X
$X = \frac{850 \times 3 \times 55.845}{231.531} = 615.06$ g Fe



* Lanthanide series	lanthanum 57 La 138.91	cerium 58 Ce 140.12	praseodymium 59 Pr 140.91	neodymium 60 Nd 144.24	promethium 61 Pm [145]	samarium 62 Sm 150.36	europium 63 Eu 151.96	gadolinium 64 Gd 157.25	terbium 65 Tb 158.93	dysprosium 66 Dy 162.50	holmium 67 Ho 164.93	erbium 68 Er 167.26	thulium 69 Tm 168.93	ytterbium 70 Yb 173.04
* * Actinide series	actinium 89 Ac [227]	thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.02	neptunium 93 Np [237]	plutonium 94 Pu [244]	americium 95 Am [243]	curium 96 Cm [247]	berkelium 97 Bk [247]	californium 98 Cf [251]	einsteinium 99 Es [252]	fermium 100 Fm [257]	mendelevium 101 Md [258]	nobelium 102 No [259]