CaMO USNCO Local Exam Pre-Test

Local Section Diagnostic

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Rules: You have 50 minutes to complete this 27 question multiple choice exam. You may use a non programmable calculator. You are not allowed to access the internet during this exam. I will not aid you during this exam.

DO NOT TURN THE PAGE UNTIL DIRECTED TO DO SO

$$E = E^\circ - \frac{RT}{nF}\ln Q \qquad \ln K = \left(\frac{-\Delta H^\circ}{R}\right)\left(\frac{1}{T}\right) + \text{constant} \qquad \ln\left(\frac{k_2}{k_1}\right) = \frac{E_a}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

hydrogen 1 H 1.0079																	helium 2 He 4.0026
lithium 3 Li 6.941	beryllium 4 Be 9.0122											boron 5 B 10.811	carbon 6 C 12.011	nitrogen 7 N 14.007	oxygen 8 O 15.999	fluorine 9 F 18.998	neon 10 Ne 20.180
sodium 11 Na 22.990	magnesium 12 Mg 24.305											aluminium 13 Al 26.982	silicon 14 Si 28.086	phosphorus 15 P 30.974	sulfur 16 S 32.065	chlorine 17 Cl 35.453	argon 18 Ar 39.948
potassium 19 K 39.098	calcium 20 Ca 40.078	scandium 21 Sc 44.956	titanium 22 Ti 47.867	vanadium 23 V 50.942	chromium 24 Cr 51.996	manganese 25 Mn 54.938	iron 26 Fe 55.845	cobalt 27 Co 58.933	nickel 28 Ni 58.693	copper 29 Cu 63.546	zinc 30 Zn 65.38	gallium 31 Ga 69.723	germanium 32 Ge 72.64	arsenic 33 As 74.922	selenium 34 Se 78.96	bromine 35 Br 79.904	krypton 36 Kr 83.798
rubidium 37 Rb 85.468	strontium 38 Sr 87.62	yttrium 39 Y 88.906	zirconium 40 Zr 91.224	niobium 41 Nb 92.906	molybdenum 42 Mo 95.96	technetium 43 Tc [98]	ruthenium 44 Ru 101.07	rhodium 45 Rh 102.91	palladium 46 Pd 106.42	silver 47 Ag 107.87	cadmium 48 Cd 112.41	indium 49 In 114.82	tin 50 Sn 118.71	antimony 51 Sb 121.76	tellurium 52 Te 127.60	iodine 53 I 126.90	xenon 54 Xe 131.29
caesium 55 Cs 132.91	barium 56 Ba 137.33	lanthanum 57 La 138.91	hafnium 72 Hf 178.49	tantalum 73 Ta 180.95	tungsten 74 W 183.84	rhenium 75 Re 186.21	osmium 76 Os 190.23	iridium 77 Ir 192.22	platinum 78 Pt 195.08	gold 79 Au 196.97	mercury 80 Hg 200.59	thallium 81 Tl 204.38	lead 82 Pb 207.2	bismuth 83 Bi 208.98	polonium 84 Po [209]	astatine 85 At [210]	radon 86 Rn [222]
francium 87 Fr [223]	radium 88 Ra [226]	actinium 89 Ac [227]	rutherfordium 104 Rf [261]	dubnium 105 Db [262]	seaborgium 106 Sg [266]	bohrium 107 Bh [264]	hassium 108 Hs [277]	meitnerium 109 Mt [268]	darmstadtium 110 Ds [271]	roentgenium 111 Rg [272]							

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 173.05	lutetium 71 Lu 174.97
thorium 90 Th 232.04	protactinium 91 Pa 231.04	uranium 92 U 238.03	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]	lawrencium 103 Lr [262]

1. How many atoms are in 4.0×10^{-5} grams of Al?

   (a) 8.9×10^{17}
   (b) 2.4×10^{19}
   (c) 6.5×10^{20}
   (d) 2.0×10^{22}

2. Barium chloride reacts with sodium sulfate according to the following equation:

$$\mathrm{BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow BaSO_4(s) + 2\,NaCl(aq)}$$

   A student mixes a solution containing 10.0 g $\mathrm{BaCl_2}$ ($M = 208.2$) with a solution containing 10.0 g $\mathrm{Na_2SO_4}$ ($M = 142.1$) and obtains 12.0 g $\mathrm{BaSO_4}$ ($M = 233.2$). What is the percent yield of this reaction?

   (a) 60.0%
   (b) 73.1 %
   (c) 93.3 %
   (d) The isolated barium sulfate is most likely wet, since the yield would otherwise be greater than 100%

3. A 5.73 g sample of a liquid hydrocarbon burned in excess oxygen produces 17.48 g $\mathrm{CO_2}$. What is the formula of the hydrocarbon?

   (a) $\mathrm{C_5H_{12}}$
   (b) $\mathrm{C_6H_6}$
   (c) $\mathrm{C_6H_{10}}$
   (d) $\mathrm{C_6H_{12}}$

4. A student determined the density of a solid to be 2.90, 2.91, and 2.93 g $\mathrm{cm^{-3}}$. If the actual density of this solid is 2.70 g $\mathrm{cm^{-3}}$, how should the student's results be described?

   (a) high accuracy and high precision
   (b) low accuracy and high precision
   (c) high accuracy and low precision
   (d) low accuracy and low precision

5. A flame test was performed to confirm the identity of a metal ion in solution. The result was a green flame. Which of the following metal ions is indicated?

   (a) copper
   (b) sodium
   (c) strontium
   (d) zinc

6. Which of the following is a weak electrolyte in aqueous solution?

   (a) HF
   (b) NaF
   (c) HCl
   (d) KCl

7. A sample of He gas in a flexible container at room temperature exhibits a certain pressure. What will be the new pressure when the absolute temperature and volume of the container are both halved? The pressure of the He will be

   (a) the same
   (b) doubled
   (c) halved
   (d) quadrupled

8. A gas mixture at 27 ° C and 1 atm contains equal masses of He, H_2, CO_2, and CH_4. How do their molecular velocities compare?

   (a) $He = H_2 = CO_2 = CH_4$
   (b) $He < H_2 < CO_2 < CH_4$
   (c) $H_2 < He < CH_4 < CO_2$
   (d) $CO_2 < CH_4 < He < H_2$

9. The molecules in a sample of pure liquid dichloromethane, CH_2Cl_2, experience which of the following intermolecular forces?

   I dispersion forces
   II dipole-dipole forces
   III hydrogen bonding

   (a) I only
   (b) II only
   (c) I and II only
   (d) I, II, III

10. The standard enthalpy of formationn for $NH_3(g)$ $-46.1\,kJ\,mol^{-1}$. Calculate ΔH° for the reaction:

$$2\,NH_3(g) \longrightarrow N_2(g) + 3\,H_2(g)$$

    (a) $-92.2\,kJ$
    (b) $-46.1\,kJ$
    (c) $46.1\,kJ$
    (d) $92.2\,kJ$

11. Which is a statement of the Second Law of Thermodynamics?

    (a) The energy of the universe is conserved.
    (b) The energy of the universe is decreasing.
    (c) The entropy of the universe is conserved.
    (d) The entropy of the universe is increasing.

12. A gold ring that weighs 3.81 g is heated to 84.0 °C and placed in 50.0 g of H_2O at 22.1 °C. What is the final temperature?

    (a) 22.2 °C
    (b) 24.0 °C
    (c) 26.5 °C
    (d) 53.1 °C

13. The activation energy for a reaction can be determined by measuring the reaction rate at different

    (a) temperatures.
    (b) catalyst concentrations.
    (c) reactant concentrations.
    (d) times on the reaction curve.

14. A catalyst speeds up a chemical reaction by

    (a) shifting the equilibrium.
    (b) increasing the activation energy.
    (c) decreasing the reaction enthalpy.
    (d) providing an alternate reaction pathway.

15. For the reaction:

$$(CH_3)_3CBr(aq) + OH^-(aq) \longrightarrow (CH_3)_3COH(aq) + Br^-(aq)$$

    it is found that halving the concentration of $(CH_3)_3CBr$ causes the reaction rate to be halved but halving the concentration of OH^- has no effect on the rate. What is the rate law?

    (a) Rate $= k\left[(CH_3)_3CBr\right]^{\frac{1}{2}}\left[OH^-\right]$
    (b) Rate $= k\left[(CH_3)_3CBr\right]^2\left[OH^-\right]$
    (c) Rate $= k\left[(CH_3)_3CBr\right]^{\frac{1}{2}}$
    (d) Rate $= k\left[(CH_3)_3CBr\right]$

16. What is the pH of a 0.0015 M solution of HNO_3?

    (a) 1.41
    (b) 2.82
    (c) 5.65
    (d) 11.18

17. In a solution of formic acid ($K_a = 1.7 \times 10^{-4}$), the $[H^+] = 2.3 \times 10^{-3}$. What is the concentration of formic acid in $\mathrm{mol\,L^{-1}}$?

    (a) 7.2×10^{-2}
    (b) 3.1×10^{-2}
    (c) 5.3×10^{-6}
    (d) 3.9×10^{-7}

18. For the equilibrium system:

$$\mathrm{CO(g) + 2\,H_2(g) \rightleftharpoons CH_3COH(l)}$$

    what is K_c?

    (a) $K_c = \dfrac{[CH_3OH]}{2[CO][H_2]}$
    (b) $K_c = \dfrac{[CH_3OH]}{[CO][H_2]^2}$
    (c) $K_c = \dfrac{1}{2[CO][H_2]}$
    (d) $K_c = \dfrac{1}{[CO][H_2]^2}$

19. Which change represents an oxidation?

    (a) $NO_2^- \longrightarrow N_2$
    (b) $VO^{2+} \longrightarrow VO_3^-$
    (c) $ClO^- \longrightarrow Cl^-$
    (d) $CrO_4^{2-} \longrightarrow Cr_2O_7^{2-}$

20. Which is a consistent set of values for a specific redox reaction carried out under standard conditions?

	E°	ΔG°	Description
(a)	+	−	spontaneous
(b)	−	+	spontaneous
(c)	+	+	nonspontaneous
(d)	−	−	nonspontaneous

21. For a galvanic cell involving the half-reactions at standard conditions,

$$\mathrm{Au^{3+} + 3\,e^- \longrightarrow Au} \qquad E^\circ = 1.50\,\mathrm{V}$$
$$\mathrm{Tl^+\,e^- \longrightarrow Tl} \qquad E^\circ = -0.34\,\mathrm{V}$$

    what is E°_{cell}?

    (a) 0.48 V
    (b) 1.16 V
    (c) 1.84 V
    (d) 2.52 V

22. Which set of quantam numbers is not possible?

    (a) $n = 2$, $l = 1$, $m_l = +1$, $m_s = -\frac{1}{2}$
    (b) $n = 3$, $l = 2$, $m_l = +1$, $m_s = +\frac{1}{2}$
    (c) $n = 4$, $l = 4$, $m_l = -1$, $m_s = +\frac{1}{2}$
    (d) $n = 5$, $l = 2$, $m_l = 2$, $m_s = -\frac{1}{2}$

23. In which list are the ions arranged in order of decreasing size?

    (a) S^{2-}, Br−, K^{+}, Ca^{2+}
    (b) Br−, S^{2-}, K^{+}, Ca^{2+}
    (c) K^{+}, Ca^{2+}, S^{2-}, Br^{-}
    (d) Ca^{2+}, K^{+}, S^{2-}, Br^{-}

24. The removal of an electron from which gaseous atom requires the greatest amount of energy?

    (a) Na
    (b) Cl
    (c) K
    (d) Br

25. Which ionic solid has the greatest lattice energy?

    (a) NaCl
    (b) MgO
    (c) KBr
    (d) SrS

26. What is the shape of the ClF_3 molecule?

    (a) trigonal planar
    (b) trigonal pyramidal
    (c) T-shaped
    (d) tetrahedral

27. Which molecule has no permanent dipole moment?

    (a) BCl_3
    (b) NCl_3
    (c) $CHCl_3$
    (d) PCl_3

END OF TEST