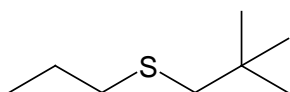


Problem Set # 2, November 2016

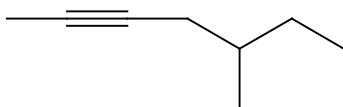
16. Consider 0.10 M solutions of the following substances. Which would have the lowest pH?
 (a) NaCl (b) NH_4NO_3 (c) Na_2CO_3 (d) KCN (e) NH_4F

17. Which of the following organic molecules can be described as being *chiral*?

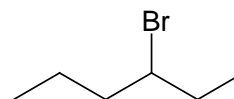
(i)



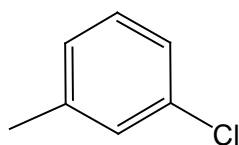
(ii)



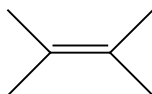
(iii)



(iv)



(v)



- (a) i, ii, iii, v (b) iii, iv, v (c) ii, iii (d) ii only (e) iii only

18. A cylinder of helium has a volume of 8.00 L. The pressure of the gas is 388 lb in^{-2} at 25°C . What volume will the helium occupy at standard atmospheric pressure (14.7 lb in^{-2}) assuming there is no temperature change?

- (a) 211 L (b) 0.333 L (c) 402 L (d) 8.30 L (e) 404 L

19. What mass of aluminium, in grams, can be heated from 24.5°C to 44.0°C by a quantity of heat sufficient to raise the temperature of 125 g H_2O through this same temperature interval?

Data: specific heat of aluminium: $0.902 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$
 specific heat of water: $4.184 \text{ J g}^{-1} \text{ }^\circ\text{C}^{-1}$

- (a) 580 g (b) $1.27 \times 10^3 \text{ g}$ (c) 26.9 g (d) 130 g (e) $2.20 \times 10^3 \text{ g}$

20. An automobile antifreeze contains equal volumes of ethylene glycol (ethane 1,2-diol, $d = 1.114 \text{ g/mL}$) and water ($d = 1.00 \text{ g/mL}$) at 25°C . The solution has a density of 1.06 g/mL . What is the molarity of ethylene glycol in the solution?

- (a) 5.88 (b) 4.50 (c) 0.323 (d) 9.00 (e) 8.87

21. Calculate the freezing point (in $^\circ\text{C}$) of a solution prepared by dissolving 1.50 moles of glycerol in 250.0 g of water ($K_f = 1.86^\circ\text{C } m^{-1}$).

- (a) -1.96 (b) -3.10 (c) 0.0 (d) -4.80 (e) -11.2

22. Calculate the pH after 10.0 mL of 0.400 M NaOH is added to 20.0 mL of 0.50 M CH_3COOH ($K_a \text{ CH}_3\text{COOH} = 1.8 \times 10^{-5}$).

- (a) 2.52 (b) 0.75 (c) 13.7 (d) 4.57 (e) 4.75

23. The organic product of the reaction between 1-methylcyclopentene and molecular bromine (using water as the solvent) can be described as
- a di-brominated cycloalkane
 - a di-brominated cycloalkene
 - a bromohydrin
 - a mono-brominated cycloalkene
 - a di-brominated alkane
24. A solution is prepared that contains 25.0 mL pyridine, C_5H_5N , $d = 0.978$ g/mL and 27.6 g pyridinium hydrochloride, $C_5H_5N \cdot HCl$. The volume of the aqueous solution is 250.0 mL. What is the pH of this buffer solution? ($K_b C_5H_5N = 1.5 \times 10^{-9}$).
- 4.68
 - 5.07
 - 5.29
 - 8.72
 - 8.91
25. HCl and NH_3 react to form a white solid, NH_4Cl . If cotton plugs saturated with aqueous solutions of each are placed at the ends of a glass tube 60.0 cm long, calculate the distance from the HCl end that the white ring will form.
- 24.3 cm
 - 35.8 cm
 - 29.4 cm
 - 19.1 cm
 - 40.9 cm
26. Which of the following is not an oxidizing agent?
- Cl^-
 - ClO^-
 - ClO_4^-
 - ClO_3^-
 - Cl_2
27. How many stereoisomers are possible for the molecule 3,4-difluorohexane?
- 0
 - 1
 - 2
 - 3
 - 4
28. Consider a concentration cell made up of two half cells consisting of the same metal in solutions of the metal ion of different concentrations. Which statement is incorrect?
- the E°_{cell} is zero
 - the cell containing the more concentrated electrolyte is the anode
 - the spontaneous reaction will proceed until the concentrations become equal
 - reduction occurs in the more concentrated solution
 - the greater the ratio in concentrations between the two cells, the greater is the initial voltage
29. The standard free energy of formation for liquid ethanol is -174.9 kJ/mol and that for gaseous ethanol is -168.6 kJ/mol. Calculate the vapour pressure of ethanol at $25^\circ C$, in mmHg.
- 13
 - 60
 - 2
 - 125
 - 7×10^{-13}
30. Which of the following is not a spontaneous process at room temperature?
- the reaction of N_2 (g) and O_2 (g) to form NO (g) (components of air)
 - H_2O (s) \rightarrow H_2O (l) at $10^\circ C$
 - CH_4 (g) + $2O_2$ (g) \rightarrow CO_2 (g) + $2H_2O$ (l) (combustion of natural gas)
 - $4Fe$ (s) + $3O_2$ (g) \rightarrow $2Fe_2O_3$ (s) (formation of rust)
 - CaO (s) + CO_2 (g) \rightarrow $CaCO_3$ (s), $K_p = 7.1 \times 10^{22}$