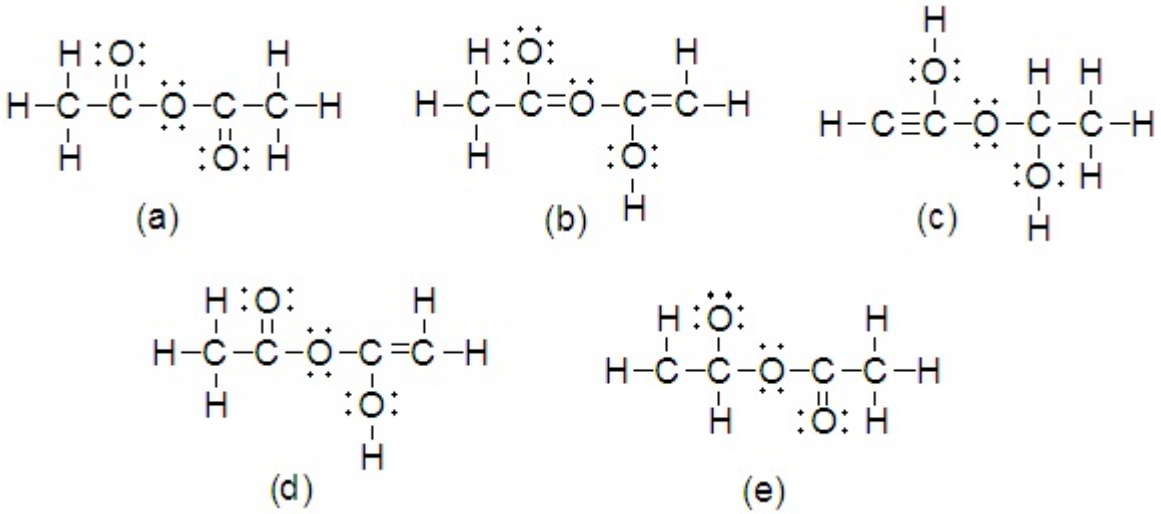
**Consider the following Lewis structures of an organic compound with molecular formula $C_4H_6O_3$ for the next 3 questions. Note that all of the structures have the same number of electrons and atoms.**

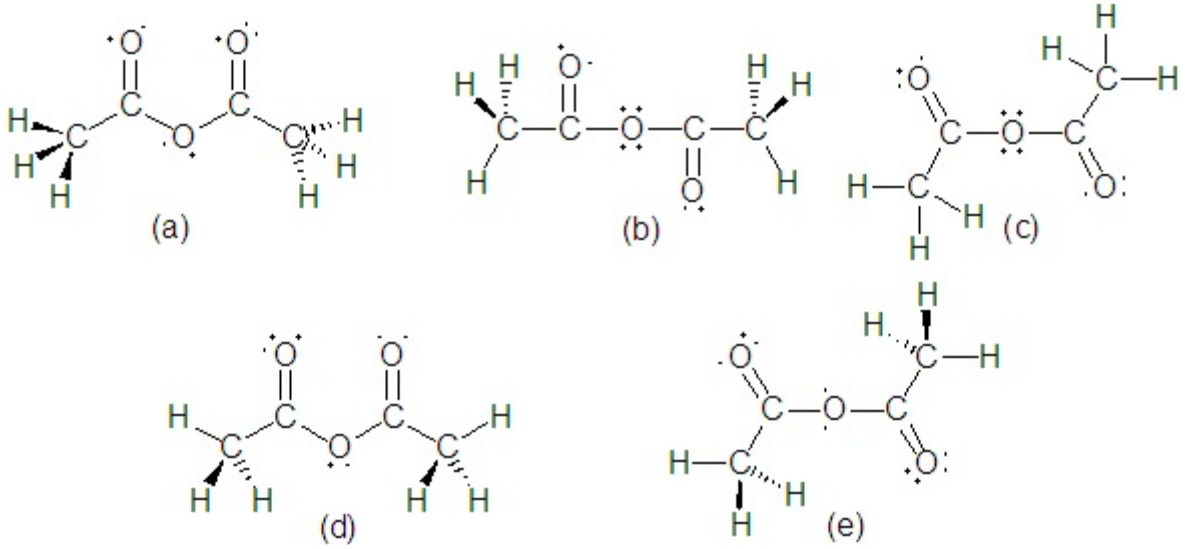



1. Which **TWO** are reasonable Lewis structures for an organic compound with molecular formula $C_4H_6O_3$? Note that all of the structures have the same number of electrons and atoms. Mark TWO answers on your scantron.

2. How are structures (a) and (e) related to each other? Choose the one Best Answer.

   (a) They are completely different compounds.
   (b) They are completely equivalent resonance structures of the same compound.
   (c) They are unequivalent resonance structures of the same compound.
   (d) They are the same compound.

3. Which one of the following is a reasonable 3-D representation of structure (a)?

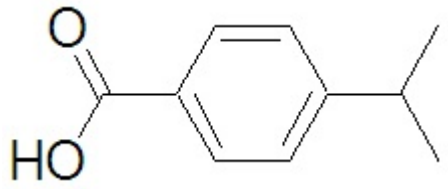


4. What is the molecular formula of the adjacent organic compound?

(a) $C_9H_{16}O_2$ (b) $C_{10}H_{12}O_2$

(c) $C_8H_{11}O_2$ (d) $C_{10}H_8O_2$

(e) $C_8H_7O_2$




5. The organic compound in the previous question is best characterized as a

(a) strong acid (b) weak acid (d) strong base (d) weak base
(e) neutral compound

6. What is the formula of magnesium nitrate?

(a) MnN (b) $Mg_3(NO_3)_2$ (c) $Mg(NO_3)_2$ (d) $MgNO_3$

(d) $Mn_3(NO_4)_2$

7. Magnesium nitrate is best characterized as a

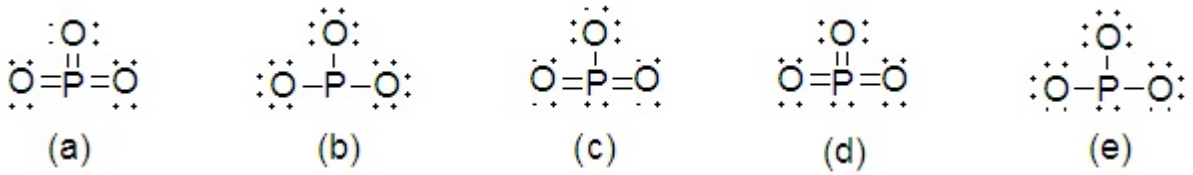
(a) strong acid (b) weak acid (d) strong base (d) weak base
(e) neutral compound

8. The concentration of iron(III) can be determined by adding excess thiocyanate to an aqueous solution. This results in the formation of the highly colored $FeSCN^{2+}$ complex ion. To do this analysis, a standard solution containing $5.00\times10^{-5}$ M $Fe^{3+}$ was prepared. After addition of excess SCN−, the absorption of the standard solution = 0.363 at 580 nm.

   To determine $[Fe^{3+}]$ in an unknown solution, 1.00 mL of the solution was diluted to 50.0 mL After addition of excess $SCN^-$, the absorption of the standard solution = 0.193 at 580 nm. What is the $[Fe^{3+}]$ in the <u>original (undiluted)</u> solution?

   (a) $3.27\times10^{-3}$ M (b) $6.54\times10^{-5}$ M (c) $1.33\times10^{-3}$ M
   (d) $4.70\times10^{-3}$ M (e) $2.66\times10^{-5}$ M

9. Which one of the following is the best Lewis structure for phosphite, $PO_3^{3-}$? (Note that not all of the structures have the correct number of electrons.)



**Consider the following unbalanced reaction equation for the next 2 questions**

$$Cr(ClO_4)_3(aq) + K_2CO_3(aq) \rightarrow Cr_2(CO_3)_3(s) + KClO_4(aq)$$

10. What is the BALANCED **net ionic** reaction?

(a) $2\ Cr(ClO_4)_3(aq) \rightarrow Cr_2(CO_3)_3(s) + 6\ ClO_4^-(aq)$

(b) $Cr^{3+}(aq) + CO_3^{2-}(aq) \rightarrow Cr_2(CO_3)_3(s)$

(c) $2\ Cr(ClO_4)_3(aq) + 3\ K_2CO_3(aq) \rightarrow Cr_2(CO_3)_3(s) + 6\ KClO_4(aq)$

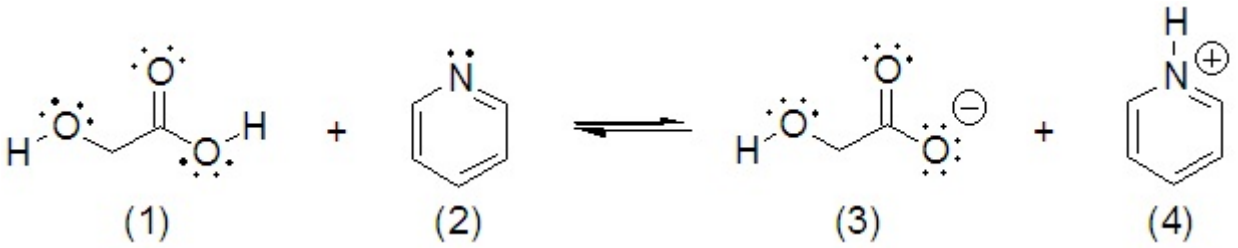
(d) $2\ Cr^{3+}(aq) + 3\ CO_3^{2-}(aq) \rightarrow Cr_2(CO_3)_3(s)$

(e) $Cr^{3+}(aq) + 3\ K_2CO_3(aq) \rightarrow Cr_2(CO_3)_3(s) + 6\ K^+(aq)$

11. Assuming the reaction goes to completion, if 10.0 mL of a 0.200 M solution of $Cr(ClO_4)_3(aq)$ is mixed with 25.0 mL of a 0.100 M solution of $K_2CO_3(aq)$ , how many moles of $Cr_2(CO_3)_3(s)$ will be made?

(a) $8.33\times10^{-4}$ mol (b) $2.50\times10^{-3}$ mol (c) $7.50\times10^{-3}$ mol (d) $2.00\times10^{-3}$ mol
(e) $1.00\times10^{-3}$ mol

**Consider the following acid base reaction for the next 2 questions:**




12. Fill in the blanks. The base for the forward reaction (left to right) is _____, and the base for the reverse reaction (right to left) is _____. The answers in order are:

(a) (1), (3) (b) (1), (4) (c) (2), (3) (d) (2), (4)

13. Lets say you have a mixture of 0.50 M (1), 0.50 M (2), 0.075 M (3), and 0.075 M (4). What is the value of the reaction quotient, Q, for this mixture? If K for this reaction = 25, which direction will the reaction proceed to reach equilibrium?

(a) Q = 44, right to left
(b) Q = 44, left to right
(c) Q = 0.022, right to left
(d) Q = 0.022, left to right
(e) Q = 6.7, right to left
(ab) Q = 6.7, left to right

14. What is the conjugate base of $HSO_4^-$

(a) $SO_4^{2-}$ (b) $H_2SO_4$ (c) $H_2SO_4^-$ (d) $H_2SO_4^{2-}$ (e) $SO_4$

15. Which one of the following solutions would be basic?

(a) pH = 4.00 (b) pOH = 10.00 (c) $[H_3O^+] = 1.0\times10^{-10}$ M
(c) $[OH^-] = 1.0\times10^{-10}$ M (e) $[H_3O^+] = 1.0\times10^{-7}$ M

16. What is the pH to the correct number of significant figures for a $4.82\times10^{-4}$ M solution of NaOH?

(a) 3.317 (b) 3.32 (c) 3.3 (d) 10.680 (e) 10.68 (ab) 10.7

17. 5.00 mL of a $7.5\times10^{-3}$ M solution of $HNO_3$ is diluted to 200. mL. What is the pH of the resulting solution?

(a) 0.52 (b) 10.27 (c) 2.12 (d) 11.87 (e) 3.73

18. Ethanolamine , $HOCH_2CH_2NH_2$, is a weak base. What is the $K_b$ expression for $HOCH_2CH_2NH_2$?

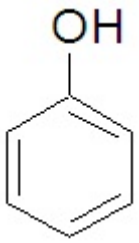
(a) $\dfrac{[HOCH_2CH_2NH_2]}{[HOCH_2CH_2NH_3^+][OH^-]}$ (b) $\dfrac{[HOCH_2CH_2NH_3^+][OH^-]}{[HOCH_2CH_2NH_2]}$ (c) $\dfrac{[HOCH_2CH_2NH_2]}{[HOCH_2CH_2NH_2][H_3O]}$

(d) $\dfrac{[HOCH_2CH_2NH_3][OH]}{[HOCH_2CH_2NH_2]}$ (e) $\dfrac{[HOCH_2CH_2NH_2^-][H_3O^+]}{[HOCH_2CH_2NH_2]}$

19. What is the pH of a 0.25 M solution of $HOCH_2CH_2NH_2$,? $K_b$ of $HOCH_2CH_2NH_2$ = $3.2\times10^{-5}$

(a) 11.45 (b) 2.55 (c) 13.39 (d) 11.08 (e) 2.92

20. Phenol, structure shown to the right, is a weak organic acid with $K_a$ = 1.0 $\times10^{-10}$. How many grams of phenol do you need to add to 500. mL of water to make a pH = 5.75 solution?




(a) 0.19 g (b) 1.1 g (c) 0.83 g (d) 1.5 g (e) 0.074 g

Answers:
1. ad, 2 a, 3 d, 4 b, 5 b, 6 c, 7 e, 8 c, 9 e, 10 d, 11 a, 12 c, 13 d, 14 a, 15 c, 16 d, 17 e, 18 b, 19 a, 20 d.