Q1

A student is asked to measure 30.0 g of methanol (d = 0.7914 g/mL at 25˚C) but has only a graduated cylinder with which to measure it. What volume of methanol should the student use to obtain the required 30.0 g?

(A) 23.7 mL

(B) 30.0 mL

(C) 32.4 mL

(D) 37.9 mL

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Q2

Which compound contains the highest percentage of nitrogen by mass?

(A) NH_2OH (M = 33.0)

(B) NH_4NO_2 (M = 64.1)

(C) N_2O_3 (M = 76.0)

(D) $NH_4NH_2CO_2$ (M = 78.1)

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Q3

How many neutrons are in 0.025 mol of the isotope $^{54}_{24}\mathrm{Cr}$?

(A) 1.5×10^{22}

(B) 3.6×10^{23}

(C) 4.5×10^{23}

(D) 8.1×10^{23}

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Q4

Commercial vinegar is a 5.00% by mass aqueous solution of acetic acid, CH_3CO_2H (M = 60.0). What is the molarity of acetic acid in vinegar? [density of vinegar = 1.00 g/mL]

(A) 0.833 *M*

(B) 1.00 *M*

(C) 1.20 *M*

(D) 3.00 *M*

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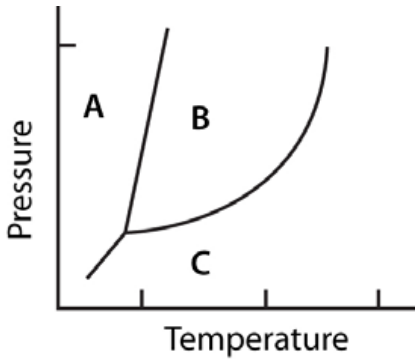
Q5

Under certain conditions CO_2 melts rather than sublimes. To which transition in the phase diagram does this change correspond?



(A) $A \rightarrow B$ **(B)** $A \rightarrow C$ **(C)** $B \rightarrow C$ **(D)** $C \rightarrow B$

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Q6

Which process is exothermic?

(A) condensation **(B)** fusion

(C) sublimation **(D)** vaporization

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Q7

Use the thermodynamic information:

$\frac{1}{2}\ N_2(g) + \frac{1}{2}O_2(g) \rightarrow NO(g)$ $\Delta H^\circ = 90.4$ kJ/mol

$\frac{1}{2}\ N_2(g) + O_2(g) \rightarrow NO_2(g)$ $\Delta H^\circ = 33.8$ kJ/mol

$2NO_2(g) \rightarrow N_2O_4(g)$ $\Delta H^\circ = -58.0$ kJ/mol

to calculate ΔH° in kJ/mol for the reaction:

$2NO(g) + O_2(g) \rightarrow N_2O_4(g)$

(A) –171.2 **(B)** –114.6 **(C)** 114.6 **(D)** 171.2

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Q8

Which substance has a non-zero standard free energy of formation?

(A) Pb(s) **(B)** Hg(l) **(C)** $Cl_2(g)$ **(D)** $O_3(g)$

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Q9

The commercial production of ammonia is represented by the equation $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$.
If the rate of disappearance of $H_2(g)$ is 1.2×10^{-3} mol/min, what is the rate of appearance of $NH_3(g)$?

(A) 2.4×10^{-3} mol/min **(B)** 1.8×10^{-3} mol/min

(C) 1.2×10^{-3} mol/min **(D)** 8.0×10^{-4} mol/min

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Q10

A reaction is endothermic with $\Delta H = 100.$ kJ/mol.
If the activation enthalpy of the forward reaction is 140. kJ/mol, what is the activation enthalpy of the reverse reaction?

(A) 40. kJ/mol **(B)** 100. kJ/mol

(C) 140. kJ/mol **(D)** 240. kJ/mol

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Q11

The first-order disappearance of a substance has a half-life of 34.0 s. How long does it take for the concentration of that substance to fall to 12.5% of its initial value?

(A) 11 s **(B)** 68 s **(C)** 102 s **(D)** 272 s

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Q12

What is the equilibrium expression, K_c, for the reaction: $2S(s) + 3O_2(g) \rightleftharpoons 2SO_3(g)$?

(A) $K_c = 2[SO_3]/(2[S]+3[O_2])$ **(B)** $K_c = 2[SO_3]/3[O_2]$

(C) $K_c = [SO_3]^2/[S]^2[O_2]^3$ **(D)** $K_c = [SO_3]^2/[O_2]^3$

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Q13

What is the percentage ionization of HCOOH molecules in a 0.10 M solution? [$K_a = 1.8 \times 10^{-4}$]

(A) 4.2% **(B)** 2.7% **(C)** 1.8% **(D)** 1.3%

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Q14

What is the pH of a solution that is 0.20 M in HF and 0.40 M in NaF? [$K_a = 7.2 \times 10^{-4}$]

(A) 1.92 **(B)** 2.84 **(C)** 3.14 **(D)** 3.44

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Q15

Which statement concerning visible light is correct?

(A) The product of wavelength and frequency is a constant for visible light in a vacuum.

(B) As the wavelength of light increases the energy of a photon increases.

(C) As the wavelength of light increases its amplitude also increases.

(D) Green light has a higher frequency than blue light.

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Q16

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

(A) Na **(B)** Cl **(C)** K **(D)** Br

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Q17

The electron configuration of cobalt (Z = 27) is $1s^2 2s^2 2p^6 3s^2 3p^6 3d^7 4s^2$. How many unpaired electrons are in a gaseous Co^{3+} ion in its ground state?

(A) 0 **(B)** 2 **(C)** 4 **(D)** 6

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Q18

The O–N–O bond angles in the nitrate ion, NO_3^-, are best described as being

(A) all 120˚ **(B)** all 109.5˚

(C) all 90˚ **(D)** two 90˚, one 180˚

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Q19

When the half-reaction $NO_3^- \rightarrow NO$ is balanced for one NO_3^- in acid solution, _____ electron(s) is (are) _____.

(A) 3 gained **(B)** 1 gained

(C) 1 lost **(D)** 3 lost

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Q20

$Ag^+(aq) + e^- \rightarrow Ag(s)$ $E^\circ = 0.80$ V

$Co^{2+}(aq) + 2e^- \rightarrow Co(s)$ $E^\circ = -0.28$ V

Use the standard reduction potentials to determine the standard potential for the reaction:

$Co(s) + 2Ag^+(aq) \rightarrow Co^{2+}(aq) + 2Ag(s)$

(A) 0.52V **(B)** 0.66V **(C)** 1.08V **(D)** 1.88V

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Answers

1. D
2. B
3. C
4. A
5. A
6. A
7. A
8. D
9. D
10. A
11. C
12. D
13. A
14. D
15. A
16. B
17. C
18. A
19. A
20. C

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