

Problem Set # 3, December 2016

31. Which of the following statements concerning catalysts is incorrect?
- (a) catalysts affect the reaction rate, but are not present in the rate law since their concentration remains constant
 - (b) catalysts are formed in one step of a reaction mechanism and must be consumed in another
 - (c) catalysts lower the activation energy for the reaction
 - (d) catalysts usually change the mechanism for a reaction
 - (e) catalysts may be insoluble in the reaction solvent

32. Which of the following molecules contains polar bonds, but is overall non-polar?

(a) PCl_5 (b) SF_2 (c) BrCl_3 (d) O_2 (e) SO_2

33. Which of the following is most likely to involve sp^3d^2 hybrid orbitals at the central atom?

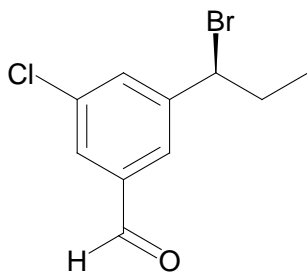
(a) O_3^- (b) ClF_4^- (c) SF_4 (d) CCl_4 (e) N_2O

34. How many stereoisomers are possible for the molecule 4,5-dichloro-2-hexene?

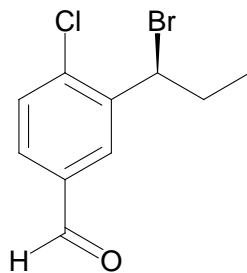
(a) 2 (b) 4 (c) 6 (d) 8 (e) 10

35. Which compound below has the IUPAC name 3-((S)-1-bromopropyl)-4-chlorobenzaldehyde?

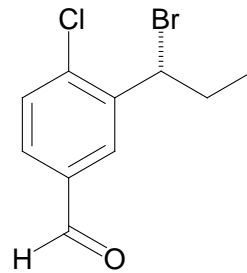
(a)



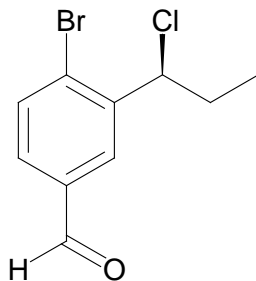
(b)



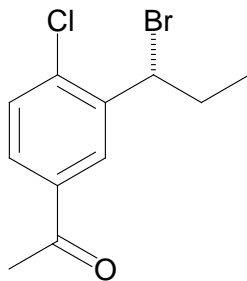
(c)



(d)



(e)

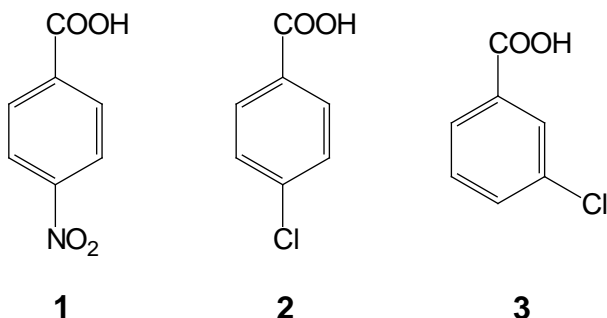


36. A piece of wood suspected of being part of a Viking sailing ship is subjected to radiocarbon dating. The decay rate for its carbon-14 content is 13.2 disintegrations per minute per g C. If each gram of carbon in living plants has a disintegration rate of 15.3 disintegrations per minute, and the half-life of carbon-14 is 5730 years, what is the age of the piece of wood in years?

(a) 7.8×10^2 (b) 8.6×10^2 (c) 9.2×10^2 (d) 1.6×10^3 (e) 1.2×10^3

37. What conditions would apply to a reaction that is not spontaneous at low temperature but becomes spontaneous at higher temperatures?
- increase in enthalpy and decrease in entropy
 - decrease in enthalpy and increase in entropy
 - increase in enthalpy and increase in entropy
 - decrease in enthalpy and decrease in entropy
 - no conditions allow for such a result

38. What is the order of increasing acid strength (weakest last, strongest first) of the set of compounds given below?



- $1 > 2 > 3$
 - $1 > 3 > 2$
 - $2 > 1 > 3$
 - $2 > 3 > 1$
 - $3 > 2 > 1$
39. Benzyl chloride (C_7H_7Cl) reacts with sodium ethoxide ($C_2H_5O^-Na^+$) via a mechanism that is most accurately described as a(n)
- nucleophilic addition
 - electrophilic addition
 - nucleophilic substitution
 - electrophilic substitution
 - rearrangement
40. The organic compound geraniol, formula $C_{10}H_{18}O$ can be hydrogenated over a platinum catalyst. When this occurs, geraniol reacts to form a compound of formula $C_{10}H_{22}O$. How many double bonds, triple bonds and rings does geraniol contain?
- two double bonds, no triple bonds and no rings
 - no double bonds, one triple bond and no rings
 - one double bond, no triple bonds and one ring
 - one double bond, one triple bond and no rings
 - not possible to tell from the information provided
41. What is the radius of the largest sphere that can be placed at the centre of a face-centred cubic unit cell of a cubic closest-packed array of spheres if the spheres have diameters of 4.00×10^2 pm?
- 83.0 pm
 - 43.5 pm
 - 2.00×10^2 pm
 - 4.00×10^2 pm
 - none of these

42. Calculate the standard heat of formation for the compound ICl in kJ/mol.

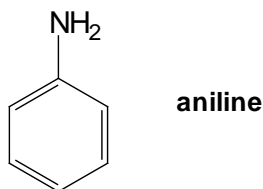
	ΔH° (kJ/mol)
$\text{Cl}_2(\text{g}) \rightarrow 2\text{Cl}(\text{g})$	242.3
$\text{I}_2(\text{g}) \rightarrow 2\text{I}(\text{g})$	151.0
$\text{ICl}(\text{g}) \rightarrow \text{I}(\text{g}) + \text{Cl}(\text{g})$	211.3
$\text{I}_2(\text{s}) \rightarrow \text{I}_2(\text{g})$	62.8

- (a) -211 (b) -14.8 (c) -16.8 (d) 245 (e) 439

43. Give the number of geometrical isomers for the octahedral compound $[\text{MA}_2\text{B}_2\text{C}_2]$, where A, B and C represent ligands.

- (a) 1 (b) 2 (c) 3 (d) 5 (e) 6

44. How many valid resonance forms can be constructed for the aromatic compound known as aniline (below)?



- (a) 3 (b) 4 (c) 5 (d) 6 (e) 7

45. For the reaction $2\text{A}(\text{g}) + \text{B}(\text{g}) \rightarrow \text{C}(\text{g}) + \text{D}(\text{g})$, the following initial rate data were obtained at 25°C.

$[\text{A}]_0$	$[\text{B}]_0$	Initial Rate
0.20 M	0.10 M	2.2×10^{-3}
0.40 M	0.10 M	4.4×10^{-3}
0.30 M	0.20 M	1.32×10^{-2}

What is the order with respect to reactant B?

- (a) 0 (b) 1 (c) 2 (d) 3 (e) 4

46. Which of the following becomes appreciably more soluble in water if NaHCO_3 is added?

- (a) an ether
(b) an alcohol
(c) a phenol
(d) a carboxylic acid
(e) an alkyne

47. A metal ion in a high-spin octahedral complex has two more unpaired electrons than the same ion does in a low-spin octahedral complex. The metal ion could be

- (a) V^{2+} (b) Cu^{2+} (c) Mn^{2+} (d) Cr^{3+} (e) Co^{2+}

48. Which is the correct mathematical expression for the molar solubility (s) in mol/L (S) of $\text{Fe}_3(\text{PO}_4)_2$?
- (a) $6S^2$ (b) $12S^3$ (c) $6S^5$ (d) $108S^5$ (e) $5S^5$
49. Which of the following has the smallest effect on the rate of a chemical reaction?
- (a) the potential energy of the reactant
(b) the potential energy of the transition state
(c) the potential energy of the product
(d) the potential energy of an intermediate
(e) none of the above significantly affect the rate of a chemical reaction
50. Which alkyl halide can give only one product from elimination of HI?
- (a) 3-iodo-2,2,4,4-tetramethylpentane
(b) 2-ethyl-1-iodocyclohexane
(c) 3-iodo-2-methylhexane
(d) 3,3-dimethyl-1-iodoheptane
(e) 2,2-dimethyl-4-iodohexane

MERRY CHRISTMAS AND A HAPPY NEW YEAR!