Multichoice questions - Answers

1. What is the oxidising agent in the unbalanced equation?

$$I^- (aq) + IO_3^- (aq) + H_3O^+(aq) + HSO_4^- (aq) \rightarrow I_2(aq) + SO_4^{2-} (aq) + H_2O(l)$$

A. $I^-(aq)$ B. $IO_3^-(aq)$ C. $H_3O^+(aq)$ D. $HSO_4^-(aq)$ E. $I_2(aq)$

2. Oxalate ions ($C_2O_4^{2-}$) can be oxidized by permanganate ions (MnO_4^-) according to the following half-equations:

$$C_2O_4^{2-} \rightarrow 2CO_2 + 2e^-$$
$$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$$

How many moles of MnO_4^- are required to oxidize 1 mole of $C_2O_4^{2-}$?

A. 2.5 B. 0.4 C. 2.0 D. 1.5 E. 5.0

3. In which compound does manganese have an oxidation number +3?

A. $KMnO_4$ B. $K_2[Mn(CN)_6]$ C. $K_5[Mn(CN)_6]$ D. $MnSO_4$ E. $CsMn(SO_4)_2.12H_2O$

4. Borax (sodium borate) reacts with hydrochloric acid according to the following equation:

$$Na_2B_4O_7(aq) + 2HCl(aq) + 5H_2O(l) \rightarrow 4H_3BO_3(aq) + 2NaCl(aq)$$

By how much does the oxidation number of each boron atom CHANGE in this reaction?

A. +3 B. +1 C. 0 D. – 1 E. –3

5. Which one of the following reactions is NOT redox?

A. $Br_2 + H_2O \rightarrow HBr + HBrO$
B. $I_2 + 2Na_2S_2O_3 \rightarrow 2NaI + Na_2S_4O_6$
C. $Na_3AsO_3 + H_2O_2 \rightarrow H_2O + Na_3AsO_4$
D. $I_2 + 6NaOH \rightarrow NaIO_3 + 5NaI + 3H_2O$
E. $2K_2CrO_4 + H_2SO_4 \rightarrow K_2Cr_2O_7 + K_2SO_4 + H_2O$

6. The following equations indicate reactions that occur spontaneously.

$$Fe(s) + NiCl_2(aq) \rightarrow FeCl_2(aq) + Ni(s)$$
$$Zn(s) + FeCl_2(aq) \rightarrow ZnCl_2(aq) + Fe(s)$$
$$Ni(s) + PbCl_2(aq) \rightarrow NiCl_2(aq) + Pb(s)$$

What is the increasing order of reactivity of the metals?

A. Fe < Ni < Zn < Pb
B. Pb < Ni < Fe < Zn
C. Ni < Zn < Fe < Pb
D. Ni < Zn < Pb < Fe
E. Zn < Fe < Ni < Pb

7. Which of the following groups of molecules and ions does **NOT** contain an example with a planar geometry?

A. SO_2, SO_4^{2-}, PCl_3 B. SF_4, CO_3^{2-}, BF_3 C. NH_3, $HClO_3$, N_2H_4

D. O_3, PH_3, CO_2 E. H_2O, H_2S, H_2Se

8. Which species has the same shape as the NO_3^- ion?

A. SO_3 B. SO_3^{2-} C. ClF_3 D. ClO_3^- E. NH_3

9. Which kind of attractive forces are likely to be holding particles together in a substance that melts at 681°C and that conducts electricity when molten but not when solid?

A. Ionic bonding
B. Metallic bonding
C. Dipole-dipole interactions
D. Network covalent bonding
E. Covalent molecular bonding

10. At room temperature, fluorine is a gas (boiling point –188 °C), while bromine is a liquid (boiling point +59 °C). Which one of the following best explains the difference in the physical states of these two halogens?

A. The covalent bonds in bromine are more polar.
B. The covalent bonds in bromine are stronger.
C. The covalent bonds in bromine are weaker.
D. The intermolecular forces in bromine are stronger.
E. The intermolecular forces in bromine are weaker.

11. Consider the molecules SCl_2, SO_3, $SOCl_2$. What are the shapes of these molecules, in the order given?

A. Linear, trigonal planar, trigonal pyramidal
B. Linear, trigonal pyramidal, trigonal planar
C. Bent, trigonal planar, linear
D. Bent, trigonal planar, trigonal pyramidal
E. Bent, trigonal pyramidal, trigonal planar

12. Which one of the following molecules has the largest bond angle?

A. CH_4 B. NH_3 C. H_2O D. SO_2 E. CO_2

13. Which one of the following molecules has the greatest dipole moment?

A. H_2 B. HF C. HCl D. HBr E. HI

14. Which one of the following bonds is non-polar?

A. Carbon-oxygen bond in CH_3OCH_3
B. Carbon-carbon bond in CH_3CHO
C. Carbon-hydrogen bond in $CHCl_3$
D. Carbon-chlorine bond in CCl_4
E. Carbon-carbon bond in C_2H_4

15. Which one of the following species has only two lone pairs of electrons (in addition to bonding pairs) around the central atom?

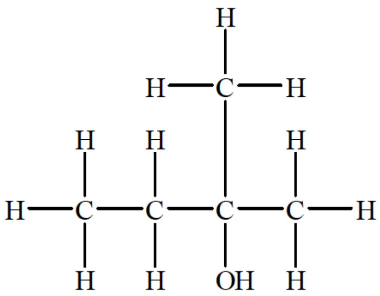
A. BF_4^- B. NF_3 C. SF_3^+ D. ClF_3 E. XeF_2

16. Which of the following are polar molecules?

1. NH_3
2. AsF_3
3. $CHCl_3$
4. BeF_2
5. $SnCl_4$

A. 1, 2 and 3 only B. 1 and 3 only C. 2, 3 and 4 only D. 2, 4 and 5 only E. all of them

17. What is the correct classification of these alcohols?



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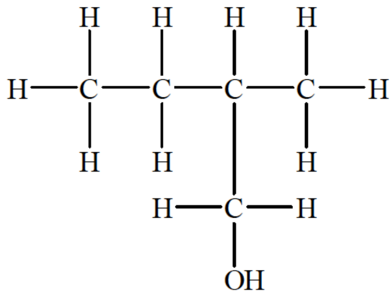

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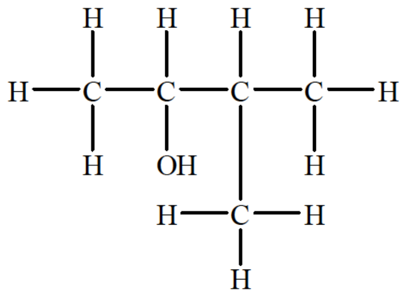


3

	1	**2**	**3**
A	tertiary	primary	secondary
B	tertiary	secondary	primary
C	tertiary	tertiary	secondary
D	secondary	primary	secondary
E	secondary	tertiary	secondary

18. Methyl-t-butyl ether, $C_5H_{12}O$, can be added to gasoline to promote cleaner burning. How many moles of oxygen gas, O_2, are required to burn 1.0 mol of this compound completely to form carbon dioxide and water?

A. 9.5 mol B. 8.0 mol C. 7.5 mol D. 6.0 mol E. 4.5 mol

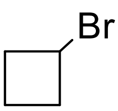
19. A hydrocarbon X of molecular formula C_6H_{14} was allowed to react with limited chlorine gas in the presence of light. The resulting mixture produced only two monochloroalkane products with different boiling points, as well as excess starting material. What is the systematic name of X?

A. 2,2-dimethylbutane B. 2,3-dimethylbutane C. 2-methylpentane

D. 3-methylpentane E. hexane

20. Constitutional isomerism and stereoisomerism should be considered in answering this question. Compound J is reacted with KOH dissolved in ethanol. Three isomeric alkenes with molecular formula C_4H_8 are formed. What is J?

A. $CH_3CH_2CH_2CH_2Br$ B. $CH_3CHBrCH_2CH_3$ C. $(CH_3)_2CHCH_2Br$

D. $(CH_3)_3CBr$ E. 

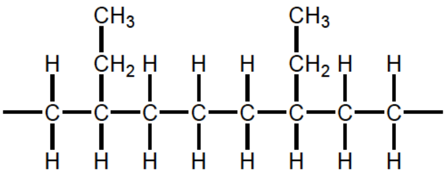
(bromocyclobutane)

21. The chief constituent of pineapple flavouring is a compound containing 62.04% carbon and 10.41% hydrogen by mass, and with relative molar mass, $M = 110 \pm 10$ g mol^{-1}. What is a possible molecular formula for this compound?

A. C_8H_{16} B. CH_3CH_2CHO C. $CH_3CH{=}CHCH_2CH_3$

D. $CH_3(CH_2)_5CH_2OH$ E. $CH_3(CH_2)_2COO\ CH_2CH_3$

22. Part of a molecule of a plastic used for food wrapping is shown below:

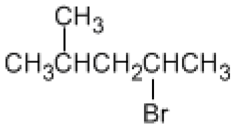


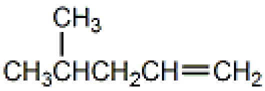
Which one of the following pairs of alkenes could be the monomers used for making this plastic, which is an addition copolymer ?

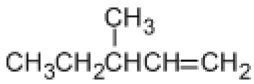
A. Ethene and propene B. Ethene and but-1-ene C. Ethene and but-2-ene

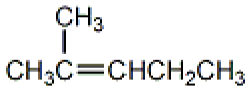
D. Propene and but-1-ene E. Propene and but-2-ene

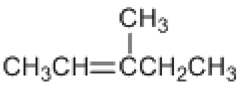
23. Choose the alkene that when reacted with HBr gives the haloalkane below as the major product.

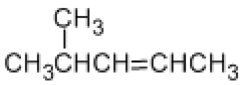


A. 

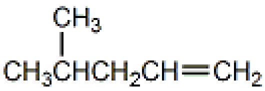
B. 

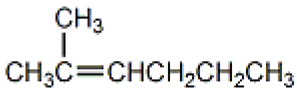
C. 

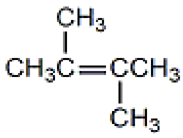
D. 

E. 

24. Which of the following alkenes can exist as *cis-trans* isomers?

A. 

B. 

C. 

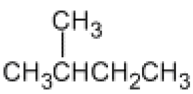
D. $CH_3CH_2CH_2CH_2CH{=}CHCH_3$

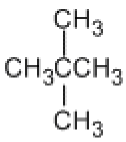
E. $CH_3CH_2CH_2CH_2CH_2CH{=}CH_2$

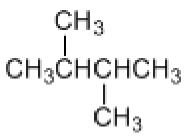
25. What is the total number of non-cyclic isomeric alkenes (including geometric isomers) with the formula C_5H_{10}?

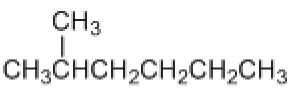
A. 4 B. 5 C. 6 D. 8 E. 10

26. Which of the following compounds is a constitutional isomer of hexane?

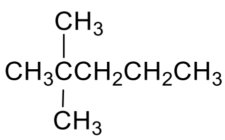
A. 

B. 

C. 

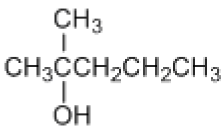


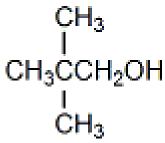
D.

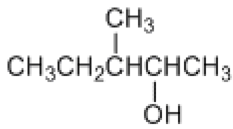


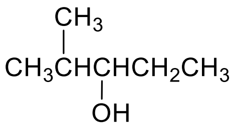
E.

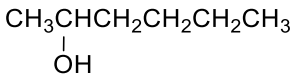
27. Which of the alcohols below would give a carboxylic acid when reacted with $K_2Cr_2O_7/H^+$?

A. 

B. 

C. 

D. 

E. 

28.

$$N_2\,(g) + O_2\,(g) \rightleftharpoons 2NO\,(g) \qquad K_1$$
$$2NO\,(g) + O_2\,(g) \rightleftharpoons 2NO_2\,(g) \qquad K_2$$
$$NO\,(g) + NO_2\,(g) \rightleftharpoons N_2O_3\,(g) \qquad K_3$$

Given the above three reactions have equilibrium constants K_1, K_2 and K_3, respectively, what would be the expression for the equilibrium constant K for the following reaction, in terms of K_1, K_2 and K_3?

$$2N_2O_3\,(g) \rightleftharpoons 2N_2\,(g) + 3O_2\,(g)$$

A. $K_1K_2K_3$ B. $1/\,K_1K_2K_3$ C . $K_1^2K_2K_3^2$ D. $1/\,K_1K_2^2K_3^2$ E. $1/\,K_1^2K_2K_3^2$

29. Consider the following reversible reaction.

$$Cr_2O_7^{2-}\,(aq) + H_2O(l) \rightleftharpoons 2CrO_4^{2-}\,(aq) + 2H^+(aq)$$

What will happen to the position of equilibrium and the value of K_c when more H^+ ions are added at constant temperature?

	Position of equilibrium	**Value of K_c**
A	Shifts to the left	Decreases
B	Shifts to the right	Increases
C	Shifts to the right	Does not change
D	Shifts to the left	Does not change
E	Does not change	Does not change

30. Which of the following changes increase the rate of a chemical reaction?

I increase the volume of the container in which the reaction is taking place
II increase the concentration of a reactant
III increase in particle size of the same mass of a solid reactant
IV increase in temperature of the reaction mixture

A. I and II only
B. II and III only
C. II and IV only
D. I, II and III only
E. I, II and IV only

31. Consider the following equilibrium reaction:

$$CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(l) \qquad \Delta_r H = -615.5 \text{ kJ mol}^{-1}$$

Which of the following changes in conditions would DECREASE the amount of methanol produced?

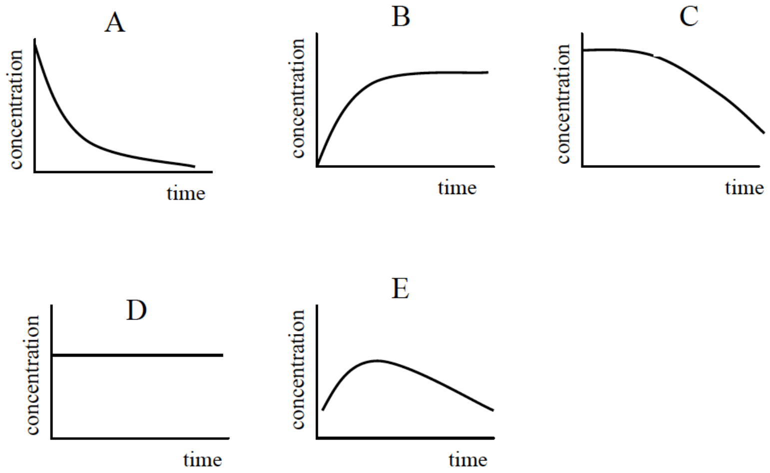
A. Increasing the proportion of carbon monoxide
B. Increasing the proportion of hydrogen
C. Increasing the pressure
D. Increasing the temperature
E. Removing the methanol as it is produced

32. Marble (calcium carbonate) reacts with hydrochloric acid according to the following equation:

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

Assuming that the marble is in the form of chips of roughly the same size and shape, which one of the following graphs best shows the change in concentration of hydrochloric acid during the course of the reaction?

Answer A



33. Which expression could be used to calculate an approximate enthalpy change of combustion of methoxymethane (CH_3-O-CH_3) from standard bond enthalpy terms (E values)?

A. 6 x E(C-H) + 2 x E(C-O) – 6 x E(O-H) – 4 x E(C=O)
B. 3 x E(O-H) + 4 x E(C=O) – 6 x E(C-H) – 2 x E(C-O) – 3 x E(O=O)
C. 6 x E(C-H) + 2 x E(C-O) + 3 x E(O=O) – 6 x E(O-H) – 4 x E(C=O)
D. 3 x E(O-H) + 4 x E(C=O) – 6 x E(C-H) – 2 x E(C-O) – 3.5 x E(O=O)
E. 6 x E(C-H) + 2 x E(C-O) + 3.5 x E(O=O) – 3 x E(O-H) – 4 x E(C=O)

34. Which of the following statements about a chemical reaction in dynamic equilibrium is TRUE?

A. Reactants form products as fast as they are formed from products
B. The position of equilibrium can be altered using a catalyst
C. Rates of the forward and reverse reactions are both zero
D. Reactants can no longer react together to form products
E. Reactants and products are present in equal amounts

35. For the reaction X $\rightleftharpoons$ Y, an initial concentration of 1.0 mol L^{-1} X is allowed to come to equilibrium. If K = 10, what is the equilibrium concentration of Y?

A. 0.10 mol L^{-1} B. 0.50 mol L^{-1} C. 0.91 mol L^{-1} D. 1.1 mol L^{-1} E. 10 mol L^{-1}

36. The C=O double bond has a bond length of 0.122 nm and a bond energy of about 740 kJ mol^{-1} in some organic compounds. Which of the following pairs of figures is most likely to be correct for a C – O single bond?

	Bond length, nm	Bond energy, kJ mol^{-1}
A	0.113	335
B	0.113	1080
C	0.116	805
D	0.143	360
E	0.143	1080

37. The ionic-product constant for water, K_W, at 45 °C is 4.0 x 10^{-14}. What is the pH of pure water at this temperature?

A. 6.7 B. 7.0 C. 7.3 D. 8.5 E. 13.4

38. What is the pH of a 0.025mol L^{-1} solution of KOH?

A. 1.60 B. 3.69 C. 7.00 D. 10.31 E. 12.40

39. What is the conjugate acid of HPO_4^{2-}?

A. H_3PO_4 (*aq*) B. $H_2PO_4^-$ (*aq*) C. H_3O^+(*aq*) D. H^+(*aq*) E. PO_4^{3-} (*aq*)

40. A solution of acid A has a pH of 1 and a solution of acid B has a pH of 2. Which statement **must** be correct?

A. Acid A is stronger than acid B
B. [A] > [B]
C. The concentration of H_3O^+ ions is higher in A then in B
D. The concentration of H_3O^+ ions in B is twice the concentration of H_3O^+ ions in A
E. Acid B is a monoprotic acid while acid A is a diprotic acid

41. 200 mL of water is added to a solution of 300 mL of 0.5 mol L^{-1} sodium chloride. What is the concentration of sodium chloride in the new solution?

A. 0.05 mol L^{-1} B. 0.1 mol L^{-1} C. 0.2 mol L^{-1} D. 0.25 mol L^{-1} E. 0.3 mol L^{-1}

42. A brown-black compound of thallium was found to contain 89.5% Tl and 10.5% O. What is the oxidation number of thallium in this compound?

A. +1 B. +2 C. +3 D. +4 E. +5

43. A box of washing soda leaves the factory containing 1.50 kg of $Na_2CO_3.10H_2O$ (M= 286.1 g mol^{-1}). A customer complains because he finds that the box appears partly empty and weighs only 1.34 kg. An independent analyst says that the box contains the correct mass of sodium carbonate, but that it has lost water of crystallisation. What is the composition of the customer`s soda?

A. $Na_2CO_3.1.3\ H_2O$ B. $Na_2CO_3.1.7\ H_2O$ C. $Na_2CO_3.\ 5.2\ H_2O$

D. $Na_2CO_3.\ 8.3\ H_2O$ E. $Na_2CO_3.\ 8.9\ H_2O$

44. If the percentage of water of crystallization in $CuSO_4.xH_2O$ is 36.1%, what is the value of x?

A. 1 B. 3 C. 4 D. 5 E. 6

45. A certain element, X, reacts with sulfur to form the compound X_2S_5. If 0.274 g of the element forms 0.568 g of the compound, what is the molar mass of the element?

A. 31.0 g mol^{-1} B. 58.9 g mol^{-1} C. 65.4 g mol^{-1} D. 74.7 g mol^{-1} E. 121.8 g mol^{-1}

46. In order to determine the sulfate composition of a fertiliser, a chemist dissolved 2.00 g of fertiliser in 100 mL of water, and added barium nitrate solution. The chemist noticed the formation of a white solid, and kept adding the barium nitrate solution until no more solid formed. The white solid was filtered and, after drying, weighed 1.90 g. What is the percentage by mass of sulfate in the fertiliser?
$M(BaSO_4)$ = 233 g mol^{-1}

A. 22% B. 39% C. 41% D. 78% E. 95%

47. What is the Na^+ ion concentration in the solution formed by mixing 20 mL of 0.10 mol L^{-1} Na_2SO_4 solution with 50 mL of 0.30 mol L^{-1} Na_3PO_4 solution?

A. 0.09 mol L^{-1} B. 0.15 mol L^{-1} C. 0.24 mol L^{-1} D. 0.48 mol L^{-1} E. 0.70 mol L^{-1}

48. A student is asked to measure 12.0 mL of a liquid as precisely as possible. Which piece of equipment should she select for the task?

A. 25 mL beaker B. 25 mL graduated cylinder C. 25 mL conical flask

D. 25 mL volumetric flask E. 25 mL burette

49. When 0.1mol L^{-1} aqueous solutions of the following pairs of reagents are mixed at room temperature, which pair will NOT give a precipitate?

A. $HCl + AgNO_3$

B. $NaOH + CuSO_4$

C. $CaCl_2 + Na_2CO_3$

D. $H_2SO_4 + Ba(OH)_2$

E. $NH_4NO_3 + K_2CrO_4$

50. Bob dissolved 4.021 g of NaOH in water and made up the solution to 1 litre with water. He then pipetted 10.00 mL of this solution into a flask and titrated it with 0.0500 mol L^{-1} HCl solution from a burette. A volume of 20.42 mL of acid had been used at the endpoint. Bob's teacher deduced that:

A. the burette was rinsed with water instead of HCl
B. the analysis is as accurate as can be expected using this apparatus
C. the NaOH absorbed H_2O from the air after its mass was measured
D. the flask was rinsed with HCl instead of water
E. the pipette was rinsed with water instead of NaOH