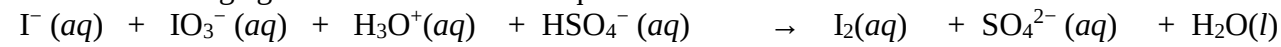
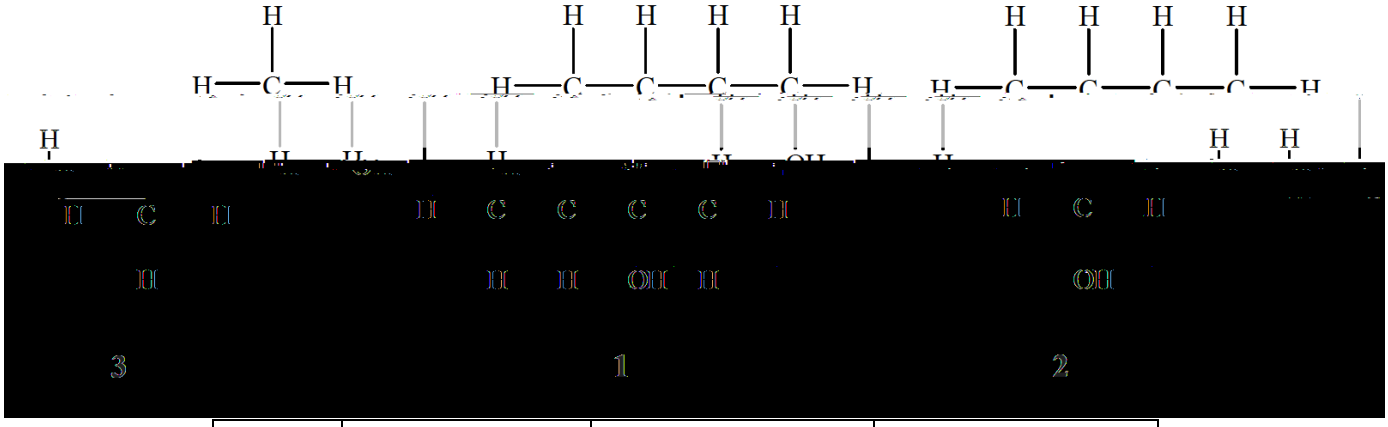
Redox

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



17. What is the correct classification of these alcohols?



	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

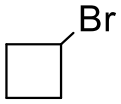
19. A hydrocarbon X of molecular formula C_6H_{14} was allowed to react with limited chlorine gas in the presence of light. The resulting mixture produced only two monochloroalkane products with different boiling points, as well as excess starting material. What is the systematic name of X?

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.

following alkenes can exist as *cis-trans* isomers?

A. B. C.

D. E.

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

A. 4 B. 58866 0 594.96 842.04 reW*nBT/F4 12 Tf1 0 0 1 96.264 315.29 Tm0 g0 Gf1 0 0 1 12

A. B. C.

CH

D. E.

Thermochemistry

28. $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$
$2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$
$NO(g) + NO_2(g) \rightleftharpoons N_2O_3(g)$

Given the above three reactions have equili
would be the expression for the equilibrium
and K_3?

$2N_2O_3(g) \rightleftharpoons 2\ N$

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

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?

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)

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

Acids and Bases

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}

Stoichiometry

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

50.