IEA - Data Enhancement Project

Questionnaire printing

Study: SC2

Population: 3

Instrument: STC_3

Student Achievement Test Chemistry (3C) Population 3

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1 The solubility of a solid in water may be expressed as the number of grams of solid that can dissolve in 100 cm3 of water. Which one of the following does the solubility depend on?

A the volume of water used
B the temperature of the water
C the density of the solid
D the mass of the solid used
E the size of the particles of the solid

P3C01

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2 The graph shows the solubility of two substances X and Y. A sample of 150 g of X and 75 g of Y is placed in a beaker containing 100 cm3 of water. Assume that the placing of the two substances together has no effect on how either dissolves. The mixture is filtered at 60 øC. What would the residue on the filter paper consist of?

[Picture]

A 95 g of X and 15 g of Y
B 55 g of X and 75 g of Y
C 95 g of X
D 75 g of Y
E 55 g of X

P3C02

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3 Which one of the following formulae represents a substance which you would *not* expect to exist?

A NaH

B H_2S

C SiO_2

D $AlCl_2$

E O_3

P3C03

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4 The following apparatus is set out on the laboratory bench:
two vacuum (thermos) flasks, two thermometers, two measuring cylinders, a beaker containing 1 M (mol.dm-3) sodium hydroxide solution and a beaker containing 1 M hydrochloric acid.

Which one of the following procedures would give data from which you could most accurately obtain a value for the heat evolved in the neutralizatlon of one mole of sodium hydroxide with hydrochloric acid?

A Take the temperatures of the acid and alkali in their respective beakers, mix them in a vacuum flask and record the rise in temperature produced.
B Mix the acid and alkali in one vacuum flask, record the temperature, transfer the contents to the second flask and record any change in temperature.
C Allow all the acid and half the volume of alkali to come to steady recorded temperatures in the respective vacuum flasks, mix them and record the temperature rise produced.
D Allow equal volumes of acid and alkali to come to steady recorded temperatures in the respective vacuum flasks, mix them and record the temperature rise produced.
E With a known volume of acid in the one vacuum flask record the temperature at regular intervals of time as alkali is added from the other flask.

P3C04

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5 During electrolysis, which of the following is produced by 1.0 faraday of electricity (1.0 mol of electrons)?

A 1.0 mol of H_2 from H_2SO_4 aqueous solution

B 1.0 mol of O_2 from H_2SO_4 aqueous solution

C 1.0 mol of Cl_2 from NaCl aqueous solution

D 1.0 mol of Cu atoms from $CuSO_4$ aqueous solution

E 1.0 mol of Ag atoms from $AgNO_3$ aqueous solution

P3C05

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6 Which of the following types of reaction is represented by the equation:

$$CH_3CH(OH)NH_2 \longrightarrow CH_3\text{-}C{=}H\text{-}N\text{-}NH_2 + H_2O$$

A addition
B polymerisation
C rearrangement
D substitution
E elimination

P3C06

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7 Copper reacts with concentrated sulphuric acid as represented by the following equation:

$$Cu + 2H_2SO_4 \longrightarrow CuSO_4 + SO_2 + 2H_2O$$

Which one of the following statements about the reaction is true?

A Copper is oxidized.
B Sulphuric acid is oxidized.
C Sulphuric acid is the reducing agent.
D Copper is reduced.
E Hydrogen is the reducing agent.

P3C07

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8 A solution of substance X is added to a solution of substance Y. No colour change is observed. Which of the following would provide evidence that a chemical reaction had taken place although there was no change in colour?

A Any product is soluble in water.
B The solutions of X and Y can be mixed in all proportions and still give the same result.
C There is a rise of temperature when the two solutions are mixed.
D The final liquid is shown to be neutral by using an indicator.
E The experiment gives the same result when different concentrations of the two solutions are used.

P3C08

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9 A compound X has the formula C_3H_8O. On partial oxidation it changes to C_3H_6O. From this information, which of the following is the most likely description of X?

A an aldehyde (alkanal)
B a tertiary alcohol (alkanol)
C an olefin (alkene)
D a secondary alcahol (alkanol)
E an ether

P3C09

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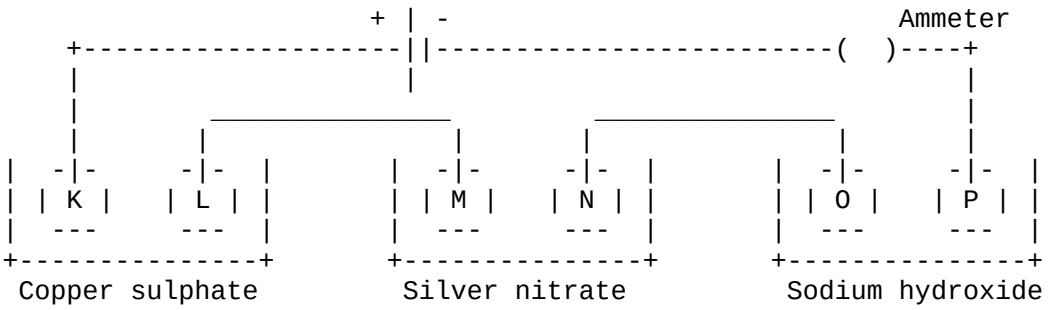
10 Copper strips K and L, silver strips M and N and platinum strips O and P, which are equal to each other in surface area and mass, are hung opposite each other in aqueous solutions of copper sulphate, silver nitrate and dilute sodium hydroxide respectively. They are connected in series as the figure shows, and a constant current of 0.5 A (amperes) is sent through for several minutes.



Approximate relative atomic masses:
H = 1 N = 14 O = 16 Na = 23
S = 32 Cu = 63.5 Ag = 108 Pt = 195

Which strip gained most weight?

A Copper strip K
B Copper strip L
C Silver strip M
D Silver strip N
E Platinum strip P

P3C10

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11 Which one of the following elements forms an oxide which turns red litmus paper blue when added to water?

A phosphorus
B carbon
C iron
D sulphur
E calcium

P3C11

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12 Which of the following represents the variation of the number of molecules or atoms, n having energy E in sample of a gas at room temperature?

n
E

[A to E are distributions of n against E]

n
E

P3C12

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13 What volume of carbon dioxide is produced by burning 3 g of carbon in excess oxygen?

Assume that the gas volume is measured at STP (0 øC, 1 atmosphere pressure). The relative atomic mass of carbon is 12. The relative atomic mass of oxygen is 16. One mole of any gas occupies 22.4 dm3 at STP.

A 0.25 dm3
B 5.6 dm3
C 11.0 dm3
D 44.8 dm3
E 67.2 dm3

P3C13

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14 One kind of stainless steel contains approximately 13 per cent chromium and 1 per cent nickel by mass; the rest is iron. Which of the following gives the closest approximation to the ratio of the number of chromium atoms to iron atoms in this stainless steel?

The relative atomic mass of chromium = 52. The relative atomic mass of iron = 56

A $\frac{13}{53} : \frac{14}{56}$

B $\frac{13}{52} : \frac{86}{56}$

C $\frac{13}{108} : \frac{86}{108}$

D $\frac{13}{(100-52)} : \frac{87}{(100-56)}$

E $\frac{13}{100} \times 52 : \frac{86}{100} \times 56$

P3C14

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15 What is the minimum mass of sodium chloride (NaCl) that is needed to prepare 7.1 g of chlorine?

The relative atomic mass of sodium = 23. The relative atomic mass of chlorine = 35.5.

A 5.9 g
B 7.1 g
C 11.7 g
D 12.7 g
E 14.2 g

P3C15

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16 Which of the following elements, when combined with a transition metal, is most likely to cause the transition metal to be in its highest oxidation state?

A iodine
B sulphur
C fluorine
D phosphorus
E hydrogen

P3C16

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17 A 15.0 cm3 sample of a 1.00 M (mol.dm-3) solution of hydrochloric acid (HCl) will exactly neutralize 7.5 cm3 of a 1.00 M solution of which one of the following substances

A sodium hydrogen carbonate: $NaHCO_3$

B potassium hydroxide: KOH

C ethanol: C_2H_5OH

D barium hydroxide: $Ba(OH)_2$

E magnesium chloride: $MgCl_2$

P3C17

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18 A chemist working for a toothpaste firm wishes to prepare 250 cm3 of a 0.010 M (mol.dm-3) aqueous solution of tin (II) fluoride. Fortunately for her tin (II) fluoride is soluble in water. One mole of tin (II) fluoride weighs 156.7 g. Equipment available includes a 250 cm3 volumetric flask, a 10 cm3 pipette, a 0.01 g sensitivity balance, and a 400 cm3 beaker.

Once the appropriate amount of tin (II) fluoride has been weighed, which one of the following procedures would be best?

A Place the tin (II) fluoride in the beaker and add exactly 250 cm3 of water from the volumetric flask.

B Place the tin (II) fluoride in the beaker and add exactly 250 cm3 of water from the pipette in 10 cm3 portions.

C Place the tin (II) fluoride in the volumetric flask, dissolve it in less than 250 cm3 of water, and then dilute to the 250 cm3 mark.

D Using the beaker and balance, weigh out exactly 250 g of water and add the tin (II) fluoride to it.

E Dissolve the tin (II) fluoride in more than 250 cm3 of water in the beaker and then fill the volumetric flask to the line with the solution.

P3C18

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19 Which of the following would be described best as an oxide could only be *basic*?

A Al_2O_3

B CO

C P_2O_5

D NO_2

E CaO

P3C19

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20 Selenium (Se) is the element below sulphur in the same group of the periodic table. Which one of the following characteristics would you expect selenium to possess?

A to be a metal with a high boiling point

B to form a potassium oxy-salt of formula K_3SeO_4

C to burn in air to form an oxide SeO

D to dissolve in nitric acid to form a salt $Se(NO_3)_4$

E to form a compound H_2Se which is weakly acidic in aqueous solution

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P3C20

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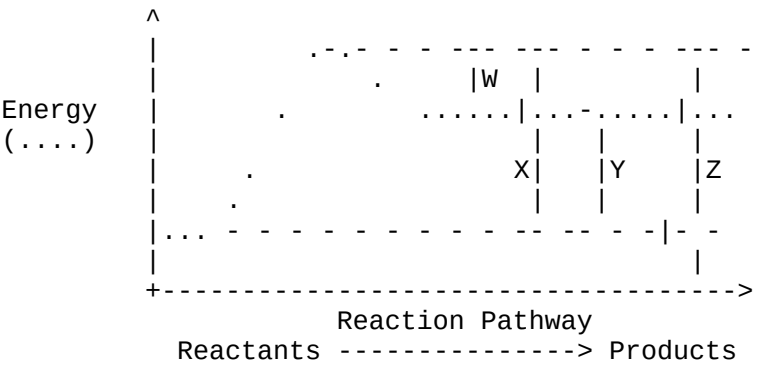
21 The following energy diagram refers to the reaction:

$$Br + H_2 \rightarrow HBr + H.$$



Which vertical distance represents the heat of reaction?

A W
B X
C Y
D Z
E Z minus W

P3C21

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22 A certain reaction does not take place in the dark but proceeds explosively as soon as it is exposed to light. Which of the following is the best explanation of this observation?

A Light provides the energy which is released as heat in the explosion.
B Light initiates the reaction which then proceeds very rapidly.
C Light acts as a catalyst, being regenerated during the explosion.
D Light heats the unstable reactant(s) which then explode.
E The total reaction is endothermic and light initiates it by supplying much more than the required energy.

P3C22

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23 The rate of reaction of two subtances X and Y is measured at different concentrations of X and Y as shown in the table.

Rate of reaction (mol.dm^{-3} .s^{-1})	Concentration X (mol.dm^{-3})	Concentration Y (mol.dm^{-3})
12×10^{-3}	5	5
36×10^{-3}	15	5
24×10^{-3}	10	10

Which one of the following statements describes the rate of reaction?

A It is proportional to the concentration of X but independent of the concentration of Y.
B It is proportional to the concentrations of X and Y.
C It is proportional to the concentration of Y but independent of the concentration of X.
D It is dependent on the concentrations of X and Y but not satisfactorily expressed in A, B or C.
E It is dependent on some unspecified factors other than concentration.

P3C23

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24 A mixture of nitrogen, hydrogen and ammonia gases reach equilibrium in a thermally insulated stainless steel container.

The equilibrium is symbolised by the following equation, in which the reaction to the right is exothermic:

$$N_2 + 3H_2 \leftrightarrow 2NH_3 + \text{heat}$$

Which of the following is the best description of the effect of increasing the concentration of hydrogen and allowing a new equilibrium to be reached?

A There is a decrease in the yield of ammonia but no rise in temperature.
B There is a decrease in the yield of ammonia and a rise in temperature.
C There is an increase in the yield of ammonia but no rise in temperature.
D There is an increase in the yield of ammonia and a rise in temperature.
E The equilibrium concentrations remain unchanged.

P3C24

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25 The following equation represents an equilibrium reaction in a closed container:

$$2CO + O_2 \leftrightarrow 2CO_2$$

The heat of reaction (dH) = $-585\ kJ.mol^{-1}$ indicating that the reaction is exothermic.

Which one of the following disturbances will produce a greater equilibrium yield of carbon dioxide?

A raising the temperature and pressure
B lowering the temperature and pressure
C raising the temperature and lowering the pressure
D lowering the temperature and raising the pressure
E adding a catalyst and lowering the pressure

P3C25

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26 How is aluminium extracted from alumina?

A by heating alumina in a plentiful supply of air
B by reducing alumina with coke in a furnace
C by reducing alumina with water gas in a furnace
D by electrolysing alumina dissolved in sulphuric acid
E by electrolysing alumina dissolved in molten cryolite

P3C26

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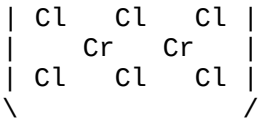
27 Chromic chloride hexahydrate has the empirical formula $CrCl_3.6H_2O$.
It exists in several isomeric forms. When one of these isomers is allowed to react with excess of silver nitrate in aqueous solution, 2 mol of silver chloride are precipitated for every 1 mol of the chromium salt. Which one of the following represents most accurately the ionic dissociation of the salt?

A $Cr(H_2O)_6^{3+} + 3Cl^-$

B $CrCl_3(H_2O)_3 + 3H_2O$

C $(CrCl_2(H_2O)_5)^{2+} + 2Cl^- + H_2O$

D $(CrCl_2(H_2O)_4)^{+} + Cl^- + 2H_2O$

E 

P3C27
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28 How is the presence of ions in an aqueous (water) solution of a substance most directly detected?

A by measuring its electrical conductivity
B by measuring the density of the solution and comparing it with those of the pure solute and water
C by checking if the solution has an electric charge
D by evaporating the solution and testing the residue for conductivity
E by adding an ionic substance and seeing if there is a reaction

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P3C28
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29 The half life of the radioactive isotope potassium ^{42}K is 12.4 hours. What is the estimated time to reduce the activity of a sample to about 3 per cent of its original value?

A about 12.4 hours
B about 37 hours
C about 50 hours
D about 62 hours
E about 124 hours

P3C29
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30 An atom of a radioactive element first emits an alpha particle and then emits a beta particle. What happens to the nuclear charge?

A It decreases by 1 unit.
B It increases by 1 unit.
C It decreases by 2 units.
D It decreases by 3 units.
E It decreases by 4 units.

P3C30
