Calculations

2003 AH MC9 (46%) and 2011 AH MC11 (47%) and 2016 AH MC28 (44%)

9. What volume of $0.25\ mol\ l^{-1}$ calcium nitrate is required to make, by dilution with water, $500\ cm^3$ of a solution with a **nitrate** ion concentration of $0.1\ mol\ l^{-1}$?

A $50\ cm^3$

B $100\ cm^3$

C $200\ cm^3$

D $400\ cm^3$

2005 AH MC12 (25%)

12. What volume of **water** needs to be added to $25\ cm^3$ of $0.2\ mol\ l^{-1}$ calcium chloride solution to produce a solution with a **chloride** ion concentration of $0.1\ mol\ l^{-1}$?

A $25\ cm^3$

B $50\ cm^3$

C $75\ cm^3$

D $100\ cm^3$

2004 AH MC11 (52%)

11. What volume of $0.5\ mol\ l^{-1}$ sodium carbonate is required to make, by dilution with water, one litre of a solution with a **$Na^+(aq)$** concentration of $0.2\ mol\ l^{-1}$?

A $100\ cm^3$

B $200\ cm^3$

C $300\ cm^3$

D $400\ cm^3$

2013 AH MC17 (54%) and 2013 revAH MC12 (58%)

17. What volume of $0.2\ mol\ l^{-1}$ potassium sulphate is required to make, by dilution with water, one litre of a solution with a **potassium** ion concentration of $0.1\ mol\ l^{-1}$?
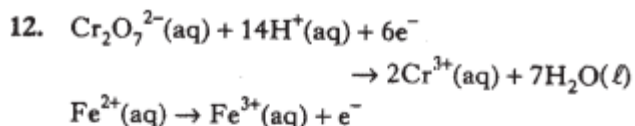
A $100\ cm^3$

B $250\ cm^3$

C $400\ cm^3$

D $500\ cm^3$

2016 AH MC30 (79%)

30. 0.020 moles of the salt $Pt(NH_3)_xCl_2$ required $20.0\ cm^3$ of $4.0\ mol\ l^{-1}$ nitric acid to react completely with the NH_3 ligands.

The value of x is

A 2

B 4

C 6

D 8.

2004 AH MC10 (77%) and 2015 AH MC10 (81%)

10. $ClO_3^-(aq) + 6H^+(aq) + ne^- \rightarrow Cl^-(aq) + 3H_2O(\ell)$

What value of n is required to balance the above equation?

A 4

B 5

C 6

D 7

2002 AH MC20 (26%)

20. Which of the following will react with 0.01 mol of hydrochloric acid so that both reactants would be used up?

A $0.50\ g$ of calcium carbonate

B $100\ cm^3$ of $0.10\ mol\ l^{-1}$ barium hydroxide solution

C $0.243\ g$ of magnesium

D $25\ cm^3$ of $0.20\ mol\ l^{-1}$ silver(I) nitrate solution

12. $Cr_2O_7^{2-}(aq) + 14H^+(aq) + 6e^-$
$$\rightarrow 2Cr^{3+}(aq) + 7H_2O(\ell)$$
$Fe^{2+}(aq) \rightarrow Fe^{3+}(aq) + e^-$

$25\ cm^3$ of $0.1\ mol\ l^{-1}$ $K_2Cr_2O_7$ was required to react completely with an acidified solution of Fe^{2+}. How many moles of Fe^{2+} did the original solution contain?

A 0·00042

B 0·0025

C 0·0075

D 0·015

9. Which of the following aqueous solutions contains the **greatest** number of **negatively** charged ions?

A $500\ cm^3$ $0.10\ mol\ l^{-1}$ $Na_2SO_4(aq)$

B $250\ cm^3$ $0.12\ mol\ l^{-1}$ $BaCl_2(aq)$

C $300\ cm^3$ $0.15\ mol\ l^{-1}$ $KI(aq)$

D $400\ cm^3$ $0.10\ mol\ l^{-1}$ $Zn(NO_3)_2(aq)$

16. When a salt, formula $Ni(H_2O)_6.K_2(SO_4)_2$, is dissolved in water, the solution contains the ions $Ni(H_2O)_6^{2+}$, K^+ and SO_4^{2-}.

The total number of moles of ions in one litre of $0.01\ mol\ l^{-1}$ solution is

A   0·01

B   0·03

C   0·05

D   0·10.

10. Solid ammonium dichromate decomposes to produce chromium(III) oxide, nitrogen and water. The complete decomposition of one mole of ammonium dichromate would give

A a total of one mole of all the products

B 3 moles of water

C 2 moles of chromium(III) oxide

D 1 mole of nitrogen.

11. Which of the following is present in one mole of $BaCl_2(s)$?

A 3 moles of atoms

B 1 mole of molecules
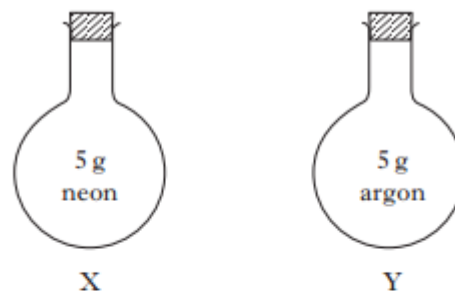
C 1 mole of positive ions

D 2 moles of positive ions

10. One mole of barium chloride $(BaCl_2)$ contains

A 1 mole of positive ions

B 1 mole of molecules

C 2 moles of atoms

D 2 moles of ions.

12.

X   Y

The number of atoms of gas in flask Y is approximately

A equal to the number of atoms of gas in flask X

B twice the number of atoms of gas in flask X

C one half the number of atoms of gas in flask X

D one quarter the number of atoms of gas in flask X.

29. 1·60 g of an anhydrous metal sulfate were dissolved in water. Addition of excess barium chloride solution resulted in the precipitation of 2·33 g of barium sulfate.

The original substance was

A   copper(II) sulfate

B   magnesium sulfate

C   sodium sulfate

D   calcium sulfate.

30. An excess of sodium sulfate was added to a solution of a barium compound to precipitate all the barium ions as barium sulfate, $BaSO_4$. (GFM of $BaSO_4$ = 233·4 g).

How many grams of barium are in 0·458 g of the barium compound if a solution of this sample gave 0·513 g of $BaSO_4$ precipitate?

A   0·032 g

B   0·055 g

C   0·269 g

D   0·302 g

11. Which of the following would be most useful as a reagent in the gravimetric analysis of silver?

A   Sodium nitrate

B   Barium carbonate

C   Potassium sulphate

D   Ammonium chloride

Questions 8 and 9 refer to the analysis of a salt whose formula is Pt(NH₃)ₓClᵧ.

8. 0·02 moles of this salt required 40·0 cm³ of 2·0 mol l⁻¹ nitric acid for exact neutralisation.

The number of moles of NH_3 per mole of salt is

A   2

B   4

C   6

D   8.

9. 0·02 moles of the salt were dissolved in nitric acid and excess silver(I) nitrate solution was added. The precipitate formed was filtered, washed and dried. It weighed 5·74 g.

The number of moles of chloride ions per mole of the salt is

A   1

B   2

C   3

D   4.

15. 100 cm³ of 0·500 mol l⁻¹ $AgNO_3$(aq) is reacted with excess $CaCl_2$(aq).

What mass of precipitate forms?

A   7·17 g

B   8·95 g

C   12·6 g

D   14·3 g

13. In a gravimetric analysis of silver, a precipitate of silver(I) chromate was produced by adding excess potassium chromate to a solution containing silver(I) ions.

If 5·795 g of Ag_2CrO_4 was produced, the mass of silver in the solution was

A   1·884 g

B   3·318 g

C   3·769 g

D   8·910 g.

27. Sodium hydroxide is unsuitable for use as a primary standard because it

    A   is corrosive

    B   is readily soluble in water

    C   is available in a high degree of purity

    D   readily absorbs water from the atmosphere.

27. Which one of the following is **not** suitable for the preparation of a primary standard in volumetric analysis?

    A   Anhydrous sodium carbonate

    B   Sodium hydroxide

    C   Oxalic acid

    D   Potassium iodate

28. The most appropriate pieces of equipment to use when diluting a solution by a factor of 10 would be

    A   a $10 \cdot 0\,cm^3$ pipette and a $100\,cm^3$ measuring cylinder

    B   a $10 \cdot 0\,cm^3$ pipette and a $50\,cm^3$ standard flask

    C   a $25 \cdot 0\,cm^3$ measuring cylinder and a $250\,cm^3$ standard flask

    D   a $25 \cdot 0\,cm^3$ pipette and a $250\,cm^3$ standard flask.

10. A solution of a weak base is to be standardised.

Which of the following properties must be possessed by an acid to be suitable as a primary standard for this purpose?

    A   It must have exactly the same concentration as the base.

    B   It must have a high purity and stability.

    C   It must have about the same strength as the base.

    D   One mole of the acid must neutralise one mole of the base.

29. Using thin-layer chromatography the components of a mixture can be identified by their R_f values.

Which of the following statements is **true** about the R_f value of an individual component of a mixture?

    A   The type of stationary phase has no effect on the R_f value.

    B   The polarity of the component has no effect on the R_f value.

    C   The composition of the mobile phase has no effect on the R_f value.

    D   The distance the solvent front moves has no effect on the R_f value.