1. 100 cm^3 of 0·500 mol l^{-1} $AgNO_3(aq)$ is reacted with excess $CaCl_2(aq)$.
What mass of precipitate forms?

A 7.17g
B 8.95g
C 12.6g
D 14.3g

2. What volume of 0·2 mol l^{-1} potassium sulfate 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

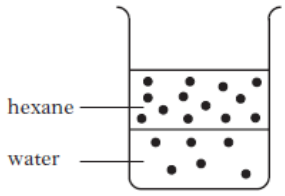
3. Caffeine can be extracted from coffee dissolved in water using the solvent dichloromethane (CH_2Cl_2).

$$\text{caffeine(aq)} \rightleftharpoons \text{caffeine}(CH_2Cl_2)$$

Which of the following, when increased, will change the value of the equilibrium constant for this process?

A Temperature
B Mass of coffee
C Volume of water
D Volume of dichloromethane

4. Substance **X** is distributed between equal volumes of two immiscible liquids as shown in the diagram. The number of dots represents the relative distribution of **X** in the two liquids at equilibrium.

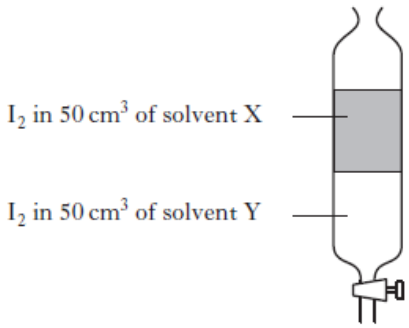


$\mathbf{X}(aq) \rightleftharpoons \mathbf{X}(hexane)$

The value of the equilibrium constant for this system is

A 0.46
B 0.50
C 2.00
D 2.17

5.



Iodine was added to 50 cm^3 of two immiscible solvents X and Y as shown. After shaking, the following equilibrium was established.

$I_2(Y) \rightleftharpoons I_2(X)$

An extra 10 cm^3 of solvent X was added, the mixture shaken and equilibrium re-established.

Which of the following statements is correct?

A The concentration of I_2 in Y increases.

B The concentration of I_2 in Y decreases.

C The equilibrium constant increases.

D The equilibrium constant decreases.

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

A a 10·0 cm^3 pipette and a 100 cm^3 measuring cylinder
B a 10·0 cm^3 pipette and a 50 cm^3 volumetric flask
C a 25·0 cm^3 measuring cylinder and a 250 cm^3 volumetric flask
D a 25·0 cm^3 pipette and a 250 cm^3 volumetric flask.

7. Using thin-layer chromatography the components of a mixture can be identified by their Rf values.
Which of the following statements is **true** about the Rf value of an individual component of a mixture?

A The type of stationary phase has no effect on the Rf value.
B The polarity of the component has no effect on the Rf value.
C The composition of the mobile phase has no effect on the Rf value.
D The distance the solvent front moves has no effect on the Rf value.

8. 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 BaSO4 = 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 BaSO4 precipitate?

A 0·032 g
B 0·055 g
C 0·269 g
D 0·302 g

9. Which of the following techniques could be used to purify an impure sample of solid benzoic acid?

A Refluxing
B Distillation
C Recrystallisation
D Mixed melting point

10. In a UK workplace, the maximum short-term exposure limit for carbon monoxide is 200 ppm in a 15 minute period.
If a person breathes in 118 g of air in a 15 minute period, what is the mass of carbon monoxide breathed in at the maximum short-term exposure limit?

A 1·49 mg
B 23·6 mg
C 1·49 g
D 23·6 g

11. 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.

12. What volume of 0·25 mol l^{-1} calcium nitrate is required to make, by dilution with water, 750 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 150 cm^3
D 200 cm^3

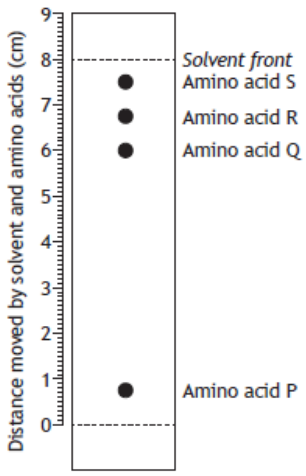
13. 0·020 moles of the salt $Pt(NH_3)xCl_2$ required 20·0 cm^3 of 4·0 mol l^{-1} nitric acid to react completely with the NH_3 ligands. The value of x is

A 2
B 4
C 6
D 8.

14. Which of the following would be most suitable as a reagent in the gravimetric analysis of silver ions?

A Sodium nitrate
B Potassium sulfate
C Barium carbonate
D Ammonium chloride

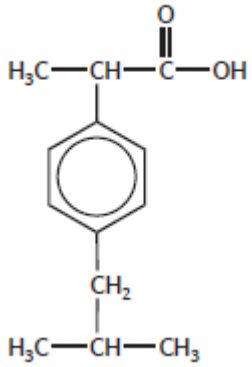
15. The diagram shows a thin layer chromatogram for a mixture of amino acids.



Which amino acid has an Rf value of approximately 0·75?

A Amino acid S
B Amino acid R
C Amino acid Q
D Amino acid P

16. Ibuprofen is used for the relief of pain, fever and inflammation. A structural formula for ibuprofen is shown below.



If one tablet contains 300 mg of ibuprofen, approximately how many tablets can be manufactured from 1 mole of ibuprofen?

A $6{\cdot}73 \times 10^{2}$
B $6{\cdot}87 \times 10^{2}$
C $6{\cdot}73 \times 10^{-1}$
D $6{\cdot}87 \times 10^{-1}$

17. The term accuracy is used to describe how close an experimental result is to the theoretical value. The term precision is used to describe how close a set of duplicate results are to each other.
Four students determined the percentage by mass of chlorine in $BaCl_2.2H_2O$.
Which of the following sets of results is both accurate and precise?

A 29·0%, 29·0%, 29·1%
B 29·1%, 28·2%, 29·9%
C 34·0%, 34·1%, 34·0%
D 34·0%, 34·3%, 33·8%

18. 400 cm^3 of water is added to 100 cm^3 of 1.5 mol l^{-1} sodium hydroxide solution. The concentration of the diluted sodium hydroxide solution in mol l^{-1}, is

A 0·4
B 0·3
C 0·2
D 0·1.

19. For solvent extraction from an aqueous solution, the solvent used should be immiscible with water and relatively unreactive.
Which of the following would be the most suitable solvent?

A $CH_3CH_2CH_2CH_2CHO$
B $CH_3CH_2OCH_2CH_2CH_3$
C $CH_3CH_2CH_2CH_2COOH$
D $CH_3CH(OH)CH_2CH_2CH_3$

20. Which of the following is **not** a step in a recrystallisation technique?

A Allow the filtrate to cool slowly.
B Filter the hot solution to remove insoluble impurities.
C Dissolve the crystals in a minimum of hot solvent.
D Test the filtrate to ensure no more precipitate forms.

21. The melting point of an impure substance was determined to be 145°C–149 °C.
After purification, the melting point should be

A higher and over a wider range
B higher and over a narrower range
C lower and over a wider range
D lower and over a narrower range.

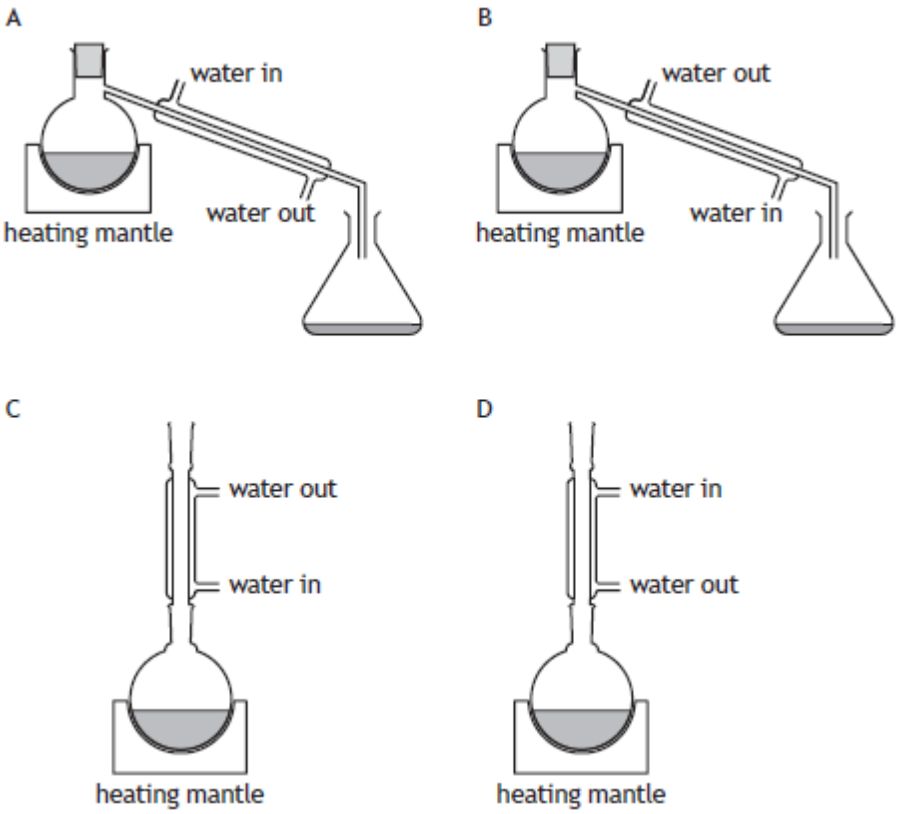
22. During the technique of heating to constant mass, the purpose of the desiccator is to

A prevent reaction with oxygen in the air
B remove water from the compound
C prevent reabsorption of water
D prevent decomposition.

23. Using thin-layer chromatography, the components of a sample can be identified by Rf values.
Which of the following affects the Rf value for an individual component?

A The distance moved by the solvent.
B The concentration of the sample.
C The length of TLC plate.
D The solvent used.

24. Which of the following diagrams shows the apparatus correctly set up for heating under reflux?



25. Which of the following reagents would be most suitable for the gravimetric determination of magnesium ions in water?

A Sodium nitrate
B Silver(I) nitrate
C Sodium carbonate
D Silver(I) carbonate

26. Which of the following techniques could be used to purify an impure sample of solid caffeine?

A Thin layer chromatography
B Heating under reflux
C Recrystallisation
D Distillation

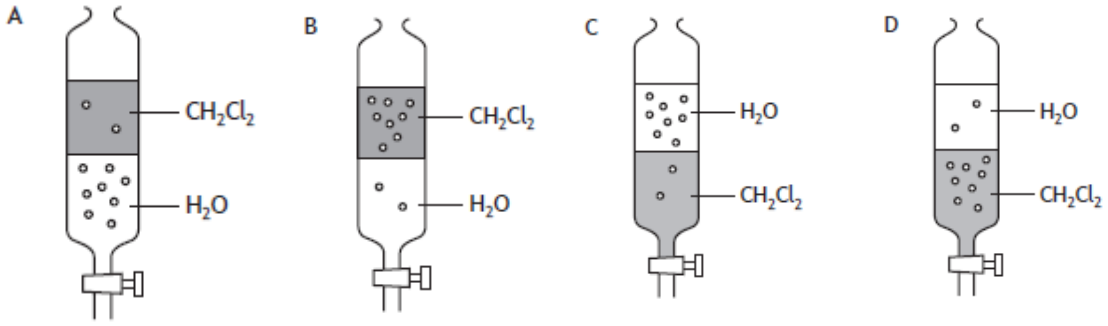
27. A complexometric titration can be used to determine the concentration of

A calcium ions in milk
B chloride ions in sea water
C ethanoic acid in vinegar
D ethanol in wine.

28. When substance **X** is distributed between equal volumes of two immiscible solvents, water and dichloromethane, an equilibrium will be established.

$X(H_2O) \rightleftharpoons X(CH_2Cl_2)$ K = 0.25

In the diagrams below, the number of dots represents the relative distribution of **X** in the two solvents. Water is less dense than dichloromethane.
Which of the following shows the correct distribution of **X** between the two solvents at equilibrium?



29. 1.204g of a metal sulfate was dissolved in water. Addition of excess barium chloride solution resulted in the precipitation of 2.334g of barium sulfate.
The original metal sulfate wasd

A calcium sulfate
B copper(II) sulfate
C magnesium sufate
D sodium sulfate

30. $Cr_2O_7^{2-} + 14H^+ + 6e \rightarrow 2Cr^{2+} + +7H_2O$
$Fe^{2+} \rightarrow Fe^{3+} + e$

25cm^3 of 0.1 mol l^{-1} K_2CrO_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

Total marks 30