A level Chemistry A

H432/01 Periodic table, elements and physical chemistry

Question Set 23

Multiple choice questions

Physical chemistry and transition elements

1.

What is the bonding between the ligands and the metal ion in $[Fe(H_2O)_6]^{2+}$?

    A   Metallic

    B   Ionic

    C   Hydrogen

    D   Dative covalent

Your answer

[1]

2.

Four pairs of solutions are mixed.
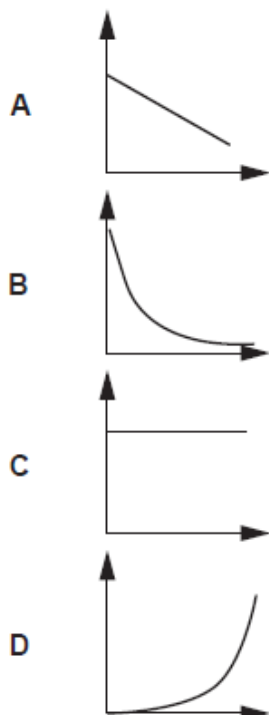
Which pair of solutions forms a white precipitate?

    A NH_4Cl(aq) and NaOH(aq)

    B   KBr(aq) and $AgNO_3$(aq)

    C $FeCl_3$(aq) and NH_3(aq)

    D $Cr_2(SO_4)_3$(aq) and $BaCl_2$(aq)

Your answer

[1]

3.

A reaction is zero order with respect to a reactant **A**.

Which concentration–time graph for reactant **A** is the correct shape?

[1]

Your answer ☐

4.

Aqueous Cr^{3+} ions are reacted with an excess of aqueous sodium hydroxide.

Which product is formed?

    A $Cr(OH)_6{}^{3-}$

    B $Cr(OH)_3$

    C $[Cr(OH)_4(H_2O)_2]^-$

    D $[Cr(OH)_4]^{3-}$

Your answer ☐

[1]

5.

HA and **HB** are two strong monobasic acids.

$25.0\,cm^3$ of $6.0\,mol\,dm^{-3}$ **HA** is mixed with $45.0\,cm^3$ of $3.0\,mol\,dm^{-3}$ **HB**. What is the $H^+(aq)$ concentration, in $mol\,dm^{-3}$, in the resulting solution?

    A 1.9

    B 2.1

    C 4.1

    D 4.5

Your answer ☐

[1]

6.

A mixture of N_2 and O_2 gases has a total pressure of 1.42 atm. The mole fraction of N_2 is 0.700.

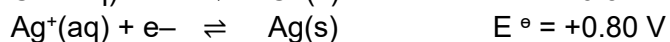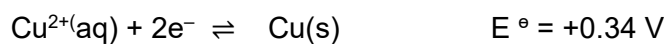What is the partial pressure, in atm, of O_2 in the mixture?

    A 0.211

    B 0.426

[1]

C   0.493

D   0.994

Your answer

7.   A cell is constructed from the two redox systems below.

$Cu^{2+}(aq) + 2e^- \rightleftharpoons Cu(s)$ $E^\ominus = +0.34$ V
$Ag^+(aq) + e^- \rightleftharpoons Ag(s)$ $E^\ominus = +0.80$ V

Which statement(s) is/are correct for the cell?

1   The cell potential is 1.14 V.
2   The reaction at the copper electrode is $Cu(s) \longrightarrow Cu^{2+}(aq) + 2e^-$
3   The silver electrode increases in mass.

A   1, 2 and 3

B   Only 1 and 2

C   Only 2 and 3

D   Only 1

Your answer

[1]

8.   Which electron configuration(s) is/are correct?

1   Cr atom: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$

2   Cu atom: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^1$

3   Fe^{2+} ion: $1s^2 2s^2 2p^6 3s^2 3p^6 3d^5 4s^1$

A   1, 2 and 3

B   Only 1 and 2
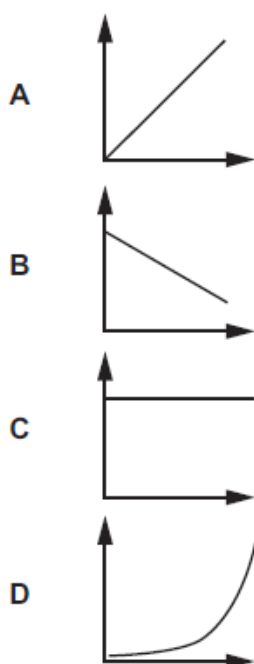
C   Only 2 and 3

D   Only 1

Your answer

[1]

9.

A reaction is first order with respect to a reactant **X**.

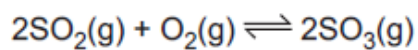Which rate–concentration graph for reactant **X** is the correct shape?

A

B

C

D

Your answer ☐

[1]

10.

The reversible reaction of sulfur dioxide and oxygen to form sulfur trioxide is shown below.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

An equilibrium mixture contains 2.4 mol SO_2, 1.2 mol O_2 and 0.4 mol SO_3. The total pressure is 250 atm.

What is the partial pressure of SO_3?

A   15 atm

B   25 atm

C   100 atm

D   200 atm

Your answer ☐

[1]

11.

A buffer solution is prepared by mixing $200\,cm^3$ of $2.00\,mol\,dm^{-3}$ propanoic acid, CH_3CH_2COOH, with $600\,cm^3$ of $1.00\,mol\,dm^{-3}$ sodium propanoate, CH_3CH_2COONa.

K_a for $CH_3CH_2COOH = 1.32 \times 10^{-5}\,mol\,dm^{-3}$

What is the pH of the buffer solution?

    A   4.58

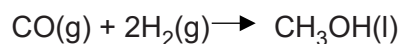   **B**   4.70

    C   5.06

    D   5.18

Your answer

[1]

12.

The table below shows standard entropies, $S^{\ominus}$.

Substance	$CO(g)$	$H_2(g)$	$CH_3OH(l)$
$S^{\ominus}/J\,mol^{-1}\,K^{-1}$	197.6	130.6	239.7

What is the entropy change, $\Delta S^{\ominus}$, in $J\,mol^{-1}\,K^{-1}$, for the following reaction?

$$CO(g) + 2H_2(g) \longrightarrow CH_3OH(l)$$

    A   −219.1

    B   −88.5
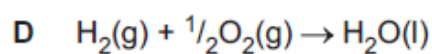
    C   +88.5

    D   +219.1

Your answer

[1]

13.

The redox equilibria for a hydrogen–oxygen fuel cell in alkaline solution are shown below.

$$2H_2O(l) + 2e^- \rightleftharpoons H_2(g) + 2OH^-(aq) \qquad E^{\ominus} = -0.83\,V$$

$$\tfrac{1}{2}O_2(g) + H_2O(l) + 2e^- \rightleftharpoons 2OH^-(aq) \qquad E^{\ominus} = +0.40\,V$$

What is the equation for the overall cell reaction? [1]

A $H_2(g) + 4OH^-(aq) \rightarrow 3H_2O(l) + \frac{1}{2}O_2(g)$

B $3H_2O(l) + \frac{1}{2}O_2 \rightarrow H_2(g) + 4OH^-(aq)$

C $H_2O(l) \rightarrow H_2(g) + \frac{1}{2}O_2(g)$

D $H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$
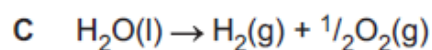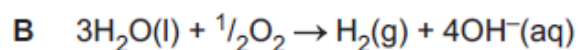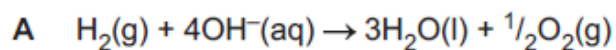
Your answer ☐

14.

Which enthalpy change(s) is/are endothermic?

1   The bond enthalpy of the C–H bond

2   The second electron affinity of oxygen

3   The standard enthalpy change of formation of magnesium

A   1, 2 and 3

B   Only 1 and 2

C   Only 2 and 3

D   Only 1

Your answer ☐

[1]

15.

Which statement(s) is/are correct for the complex $Pt(NH_3)_2Cl_2$?

1   One of its stereoisomers is used as an anti-cancer drug.

2   It has bond angles of 109.5°.

3   It has optical isomers.

A   1, 2 and 3

B   Only 1 and 2

C   Only 2 and 3

D   Only 1

Your answer ☐

[1]

16.

Which statement about the reactions of halogens with halide ions is correct?

A $I_2(aq)$ can oxidise $Br^-(aq)$. **B**

 $Cl_2(aq)$ can reduce $Br^-(aq)$.

C $Br^-(aq)$ can reduce $Cl_2(aq)$.

D $Cl^-(aq)$ can oxidise $I_2(aq)$.

Your answer ☐

[1]

17.

A graph of $\ln k$ against $\frac{1}{T}$ $(T$ in K) for a reaction has a gradient with the numerical value of −4420.
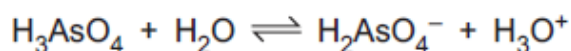
What is the activation energy, in $kJ\,mol^{-1}$, for this reaction?

A   −532

B   −36.7

C   +36.7

D   +5.32 × 10^5

Your answer ☐

[1]

18.

The equation shows the dissociation of the acid H_3AsO_4 in water.

$$H_3AsO_4 + H_2O \rightleftharpoons H_2AsO_4^- + H_3O^+$$

Which pair is a conjugate acid–base pair?

A H_3AsO_4 and H_2O
B H_2AsO^- and H_3O^+
C H_3AsO_4 and H_3O^+
D H_3O^+ and H_2O

Your answer ☐

[1]

19.

What is the number of stereoisomers that $Ni(H_2NCH_2CH_2NH_2)_2Cl_2$ can form?

A   2

B   3

C   4

[1]

D   6

Your answer

20.

Which property/properties is/are correct for a transition element?

   1   The element has atoms with a partially filled d sub-shell.

   2   The existence of more than one oxidation state in its compounds.

   3   The formation of coloured ions.

A   1, 2 and 3

B   Only 1 and 2

C   Only 2 and 3

D   Only 1

Your answer

[1]

21.

Four redox systems relevant to hydrogen–oxygen fuel cells are shown below.

			$E^{\ominus}/V$
$H_2O(l) + e^-$	$\rightleftharpoons$	$OH^-(aq) + \tfrac{1}{2}H_2(g)$	−0.83
$H^+(aq) + e^-$	$\rightleftharpoons$	$\tfrac{1}{2}H_2(g)$	0.00
$\tfrac{1}{2}O_2(g) + H_2O(l) + 2e^-$	$\rightleftharpoons$	$2OH^-(aq)$	+0.40
$\tfrac{1}{2}O_2(g) + 2H^+(aq) + 2e^-$	$\rightleftharpoons$	$H_2O(l)$	+1.23

Which statement(s) is/are correct for an alkaline hydrogen–oxygen fuel cell?

   1   The reaction at the positive electrode is: $\tfrac{1}{2}O_2(g) + 2H^+(aq) + 2e^- \longrightarrow H_2O(l)$.

   2   The overall cell reaction is: $H_2(g) + \tfrac{1}{2}O_2(g) \longrightarrow H_2O(l)$

   3   The cell potential is 1.23 V.

A   1, 2 and 3

B   Only 1 and 2

C   Only 2 and 3

D   Only 1

Your answer

[1]

Total Marks for Question Set MC Module 5: 21