Save My Exams

IB · DP · Chemistry

🕐 40 mins   ❓ 40 questions
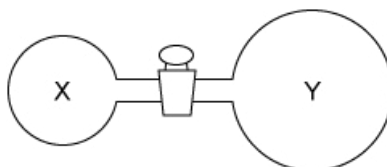
Practice Paper 1

Total Marks   **/40**

1 Excess dilute hydrochloric acid is added separately to equal masses of the four metals, calcium, zinc, magnesium and strontium. Which metal will give off the largest volume of hydrogen gas in the reaction?

A. calcium

B. zinc

C. magnesium

D. strontium

(1 mark)

2 The glass containers X and Y are connected by a closed valve.

X contains pure CO_2 gas at 25 °C and a pressure of 1×10^5 Pa. Container Y has been evacuated prior to the experiment and has a volume three times bigger than container X.

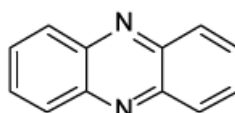During the experiment, the valve is opened, and the temperature of the whole apparatus is raised to 160 °C.

What is the final pressure in the system?

A. $\dfrac{1 \times 10^5 \times 160}{4 \times 25}$

B. $\dfrac{4 \times 10^5 \times 433}{3 \times 298}$

C. $\dfrac{1 \times 10^5 \times 433}{3 \times 298}$

D. $\dfrac{1 \times 10^5 \times 433}{4 \times 298}$

(1 mark)

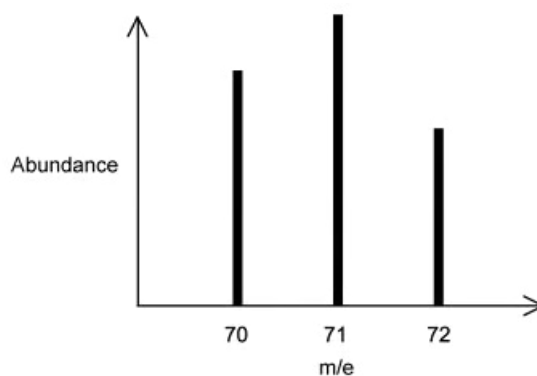**3** The diagram below shows the skeletal formula of phenazine.

Phenazine

What is the empirical formula of phenazine?

A. C_6H_6N

B. $C_{12}H_8N_2$

C. C_6H_4N

D. $C_{12}H_{12}N_2$

(1 mark)

4   The mass spectrum of element X is shown below.

Which of the following statements is correct?

A. X has a relative atomic mass between 70 and 71

B. The three isotopes of X are separated after being converted to anions

C. The most abundant isotope of X contains 71 neutrons

D. The isotope of X with mass 72 will be deflected the most

(1 mark)

5   Successive ionisation energies for an element, **Y**, are shown in the table below.

Electrons removed	1st	2nd	3rd	4th	5th
Ionisation energy / kJ mol^{-1}	736	1450	7740	10500	13600

What is the most likely formula for the ion of **Y**?

A. Y^+

B. Y^{2+}

C. Y^{3+}

D. Y^{4+}

6 A spectral line that would be found in the **visible** spectrum of the hydrogen emission spectrum would be

A. $n_1 \rightarrow n_2$

B. $n_2 \rightarrow n_3$

C. $n_3 \rightarrow n_2$

D. $n_3 \rightarrow n_\infty$

7 Use a periodic table to deduce the correct information about the element tin, Sn (Z = 50)

	Number of occupied main energy levels	Number of electrons in the highest main energy level
A	4	4
B	4	14
C	5	4
D	5	14

8 Which complex is likely to be colourless?

A. $[Zn(H_2O)_6]Cl_2$

B. $[NH_4]_2[Fe(H_2O)_6][SO_4]_2$

C. $K_3[Co(CN)_6]$

D. $[Ni(NH_3)_6][BF_4]_2$

9 Which type of bonding can be described as 'the electrostatic attraction between positive nuclei and electrons and occurs by the sharing of electrons'?

A. Hydrogen bonding

B. Ionic bonding

C. Metallic bonding

D. Covalent bonding

(1 mark)

10 Which of the following are properties of transition metals?

  I. They have variable oxidation states
 II. They can behave as catalysts
III. They can have magnetic properties

A. I and II only

B. I and III only

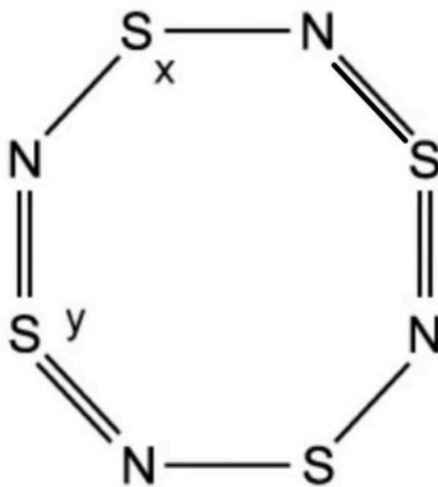**C.** II and III only

D. I, II and III

(1 mark)

11 Which is a characteristic property of sodium oxide?

A. It turns moist litmus paper blue

B. It turns moist litmus paper red

C. When it dissolves in distilled water it forms a solution with pH less than 7

D. It reacts with magnesium metal

(1 mark)

12 Sulfur forms the compound S_4N_4 with nitrogen, the structure is shown below.

Which of the following statements about S_4N_4 is correct?

A. The sulfur atom marked x has two lone pairs

B. The sulfur atom marked y has two lone pairs

C. Each N atom has two lone pairs

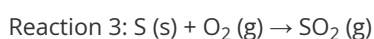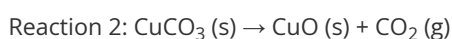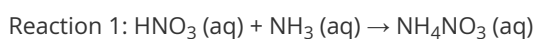**D.** The N-S-N bond angle will be larger than S=N=S bond angle

(1 mark)

13 Which combination describes the PH_4^+ ion?

	Molecular geometry	Central atom hybridisation
A	Tetrahedral	sp^3
B	Square planar	sp^3
C	Tetrahedral	sp^2
D	Square planar	sp^2

(1 mark)

14 Which enthalpy changes correctly describe the following reactions?

Reaction 1: HNO_3 (aq) + NH_3 (aq) → NH_4NO_3 (aq)

Reaction 2: $CuCO_3$ (s) → CuO (s) + CO_2 (g)

Reaction 3: S (s) + O_2 (g) → SO_2 (g)

	$\Delta H^{\ominus}_c$	$\Delta H^{\ominus}_f$	$\Delta H^{\ominus}_{neut}$	$\Delta H^{\ominus}_r$
A	2	2	1	3
B	3	2	1	2
C	3	3	1	2
D	2	3	1	3

(1 mark)

15 Bond energy calculations show the enthalpy of combustion for propene to be -1572.0 kJ mol^{-1}.

Compound	C_3H_6 (g)	CO_2 (g)	H_2O (l)	H_2O (g)
$\Delta H^{\ominus}_f$ / kJ mol^{-1}	+20.0	-393.5	-285.8	-241.8

Using the enthalpy of formation data, which calculation correctly shows the percentage error between propene's enthalpy of combustion values obtained from bond energy calculations and Hess's Law calculations, assuming the bond energy calculation value is correct?
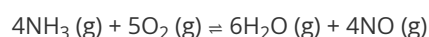
A. $\dfrac{-1572.0}{((3 \times -393.5) + (3 \times -241.8) - (20)) - 1572.0} x\ 100$

B. $\dfrac{(3 \times -393.5) + (3 \times -241.8) - (20)}{-1572.0} x\ 100$

C. $\dfrac{(3 \times -393.5) + (3 \times -241.8) + (20)}{-1572.0} \times 100$

D. $\dfrac{((3 \times -393.5) + (3 \times -241.8) - (20)) - (-1572.0)}{-1572.0} \times 100$

(1 mark)

16 The $\Delta G^{\ominus}_f$ values for the following substances are shown.

Substance	$\Delta G^{\ominus}_f$ (kJ mol^{-1})
NH$_3$ (g)	-16.4
O$_2$ (g)	0
H$_2$O (g)	-228.6
NO (g)	87.6

Which of the following is the correct calculation to determine $\Delta G^{\ominus}$?

$$4NH_3 \text{ (g)} + 5O_2 \text{ (g)} \rightleftharpoons 6H_2O \text{ (g)} + 4NO \text{ (g)}$$

A. (-228.6 + 87.6) + (-16.4)

B. (-16.4 x 4) - [(-228.6 x 6) + (87.6 x 4)]

C. [-228.6 + (87.6 x 4)] - (-16.4 x 4)

D. [(-228.6 x 6) + (87.6 x 4)] - (-16.4 x 4)

(1 mark)

17 Which statements are correct for ionic compounds?

   I. Solubility in water depends on the relative magnitude of the lattice energy compared to the hydration energy
   II. Melting points of ionic compounds increase as the size of the cation increases
   III. The enthalpy of solution for calcium chloride is represented by CaCl$_2$ (s) → CaCl$_2$ (aq)

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

(1 mark)

18 A student performs to reactions and measures the rate of product formation.

Reaction 1: 1.5g of solid calcium carbonate is added to 100 cm^3 of 0.5 M hydrochloric acid

Reaction 2: 100 cm^3 of distilled water is then added to 100 cm^3 of 0.5 M hydrochloric acid then 1.5g of solid calcium carbonate is added

The rate of reaction 1 was faster than the rate of reaction 2.

Which of the following 3 hypotheses correctly describes the difference in the rate?

    1   Adding water reduces the frequency of collisions between reactant molecules.

    2   Adding water reduces the proportion of effective collisions between reactant molecules.

    3   Adding water reduces the proportion of reactant molecules possessing the activation energy.

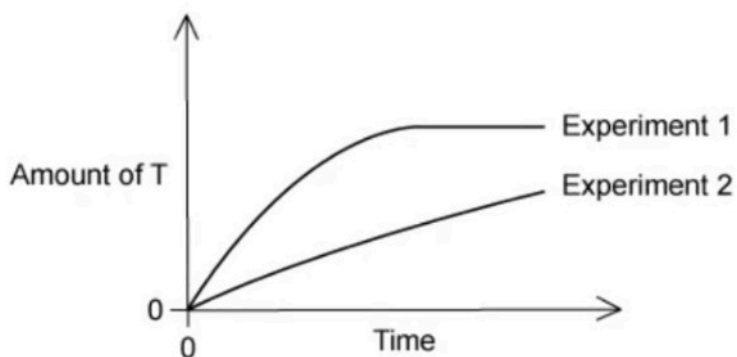**A.** 1 only

B. 1 and 2 only

C. 3 only

D. 1, 2 and 3

(1 mark)

19 The stoichiometry of a catalysed reaction is shown by the equation below.

$$R \text{ (g)} + S \text{ (g)} \rightleftharpoons T \text{ (g)} + U \text{ (g)}$$
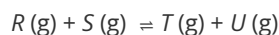
Two experiments were carried out in which the amount of product T was measured against time. The results are shown in the diagram below.

Which changes in the conditions from experiment 1 to experiment 2 might explain the results shown?

    1   product U was continuously removed from the equilibrium mixture

    2   a different catalyst was used

    3   less of reactant R was used

A. 1 only

B. 1 and 3 only
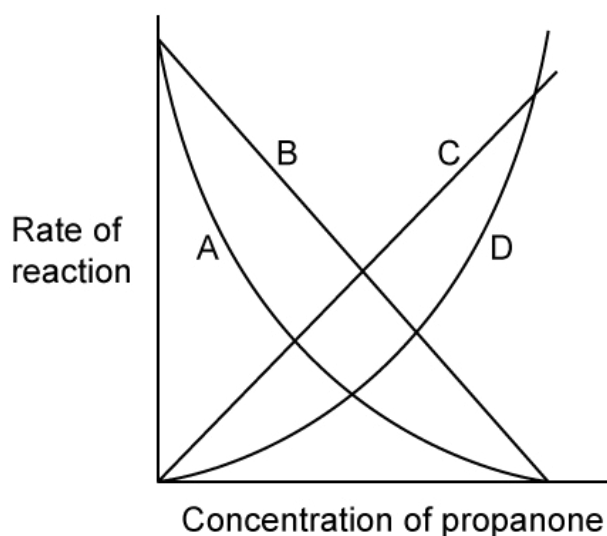
C. 2 and 3 only

D. 1, 2 and 3

(1 mark)

20 A student experimentally determined the rate expression for the reaction between iodine and propanone to be:

$$\text{Rate} = k\,[\text{H}^+]\,[\text{C}_3\text{H}_6\text{O}]$$

Which graph is consistent with this information?

(1 mark)

21 The following information was obtained for the rate constant, k, for a reaction at 25 °C

A	E_a	R
2.57×10^9 s^{-1}	96.2 kJ mol^{-1}	8.31 J K^{-1} mol^{-1}

Which expression correctly represents how to calculate the rate constant, k?

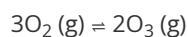**A.** $k = (2.57 \times 10^9) \times e^{(-96.2\,/\,8.31\times25)}$

B. $k = (2.57 \times 10^9) \times e^{(-96.2\,/\,8.31\times298)}$

C. $k = (2.57 \times 10^9) \times e^{(-96200\,/\,8.31\times25)}$

D. $k = (2.57 \times 10^9) \times e^{(-96200\,/\,8.31\times298)}$

(1 mark)

22 Consider the following reversible reaction:

$$3O_2 \text{ (g)} \rightleftharpoons 2O_3 \text{ (g)}$$

What is the value of K_c when the equilibrium concentrations are $[O_2]$ = 4.0 mol dm^{-3} and $[O_3]$ = 4.0 mol dm^{-3} ?

A. 0.25

B. 4

C. 16

D. 64

(1 mark)

23 Which of the following equations is used when calculating the temperature, in Kelvin, at which a reaction becomes feasible if $\Delta H^\ominus = x$ and $\Delta S^\ominus = y$.

A. $T = \dfrac{x}{y}$

B. $T = x\, y$

C. $T = x + y$

D. $T = \dfrac{y}{x}$

(1 mark)

24 In the Brønsted–Lowry theory of acids and bases, the difference between a conjugate acid and its conjugate base is the presence of which of the following?

A. a positive charge

B. a pair of electrons

C. a proton

D. a hydrogen atom

(1 mark)

25 How many different types of ions can be found in acid rain, assuming it contains a mixture of sulfuric, sulfurous, nitric and nitrous acids?

A. 4

B. 5

C. 6

D. 7

(1 mark)

26 Which of the following statements are correct for a titration between 0.10 mol dm^{-3} propanoic acid and 0.10 mol dm^{-3} potassium hydroxide?

A. The equivalence point will be at pH 7

B. The salt formed will hydrolyse to form an acidic salt

C. The salt formed will be CH_3COOK

**D.** At half equivalence point [CH_3CH_2COOH (aq)] = [$CH_3CH_2COO^-$ (aq)]

(1 mark)

27 Which of the following statements is correct?

A. As temperature increases, the pH value of pure water decreases

B. As temperature decreases, the pH value of pure water decreases

C. The pH of water is unaffected by temperature

D. Pure water is not neutral

(1 mark)

28 Below is a diagram of a voltaic cell. When the cell is running, what is happening in the salt bridge?
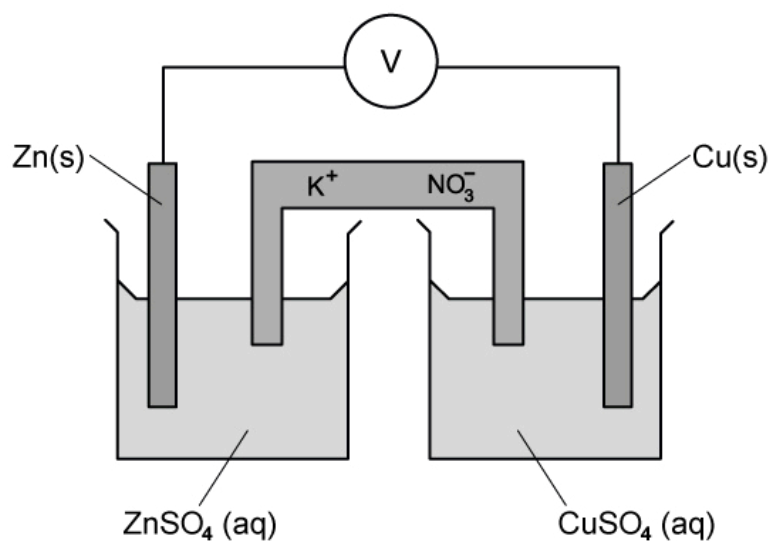
A. K$^+$ ions flow to the zinc half-cell and NO$_3^-$ ions flow to the copper half-cell

B. K$^+$ ions flow to the copper half-cell and NO$_3^-$ ions flow to the zinc half-cell

C. K$^+$ and NO$_3^-$ ions flow to the copper half-cell

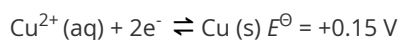**D.** K$^+$ and NO$_3^-$ ions flow to the zinc half-cell

(1 mark)

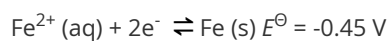29 Which of the following reactions could take place at the positive electrode (cathode) in a voltaic cell?

   I. Cu^{2+} (aq) to Cu (s)
  II. Br$_2$ (g) to Br$^-$ (aq)
 III. Co^{3+} (aq) to Co^{2+}(aq)

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

(1 mark)

30 Consider these standard electrode potentials.

$$Fe^{2+} \text{ (aq)} + 2e^- \rightleftharpoons Fe \text{ (s) } E^\ominus = \text{-0.45 V}$$

$$Cu^{2+} \text{ (aq)} + 2e^- \rightleftharpoons Cu \text{ (s) } E^\ominus = \text{+0.15 V}$$

Which is the correct working to determine $E^\ominus_{cell}$?

A. $E^{\ominus}_{cell}$ = 0.15 - (-0.45)

B. $E^{\ominus}_{cell}$ = 0.15 + (-0.45)

C. $E^{\ominus}_{cell}$ = (-0.45) - 0.15

D. $E^{\ominus}_{cell}$ = 0.15 x (-0.45)

(1 mark)

31 What types of isomerism can the following molecule show?
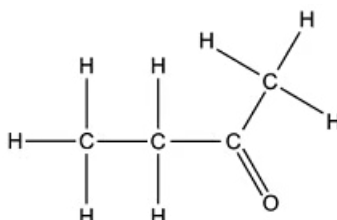
   I.   Branch-chain
   II.   Positional
   III.   Functional group

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

(1 mark)

32 Which factors affect the rate of nucleophilic substitution in halogenoalkanes?

   I. The nature of the attacking nucleophile
  II. The structure of the halogenoalkane
  III. The identity of the halogen

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

(1 mark)

33 Compound **Q** has the formula $CH_3CH_2CO_2CH_3$

What is the name of compound **Q** and how does its boiling point compare with that of butanoic acid?

	name of Q	boiling point compared to butanoic acid
A	methyl propanoate	lower
B	propyl methanoate	lower
C	methyl propanoate	higher
D	propyl methanoate	higher

(1 mark)

34 An alkene, X, undergoes electrophilic addition with hydrogen bromide to form a halogenoalkane, Y, as the minor product.
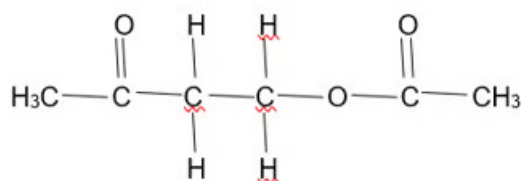
The halogenoalkane, Y , can react with sodium hydroxide in aqueous conditions to form butan-1-ol.

What is the correct identity of the alkene, X?

A. 2-methylpropene

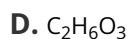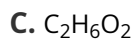**B.** But-1-ene

C. But-2-ene

D. Pent-1-ene

(1 mark)

35 In the presence of an H$^+$ catalyst, compound X reacts with ethanoic acid to produce the compound below.
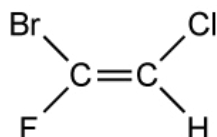

What is the molecular formula of compound X?

A. C_4H_8O

B. $C_4H_8O_2$

C. $C_2H_6O_2$

D. $C_2H_6O_3$

36 What is this molecule called?

A. *Z*-2-bromo-1-chloro-2-fluoroethene
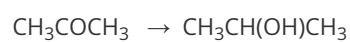
B. *E*-2-bromo-1-chloro-2-fluoroethene

C. *Z*-1-bromo-2-chloro-1-fluoroethene
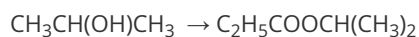
D. *E*-1-bromo-2-chloro-1-fluoroethene

37 The synthesis of 2-propyl propanoate can be carried out in two steps:

I

$CH_3COCH_3 \rightarrow CH_3CH(OH)CH_3$

II

$CH_3CH(OH)CH_3 \rightarrow C_2H_5COOCH(CH_3)_2$

What are the reagents needed in **I** and **II**?

	I	II
A	potassium dichromate(VI)	sulfuric acid, propanoic acid
B	sodium borohydride	sulfuric acid, propanoic acid
C	sodium borohydride	sulfuric acid, ethanoic acid
D	potassium dichromate(VI)	sulfuric acid, ethanoic acid

38 Which molecule has an index of hydrogen deficiency (IHD) = 1?

    A. C_6H_{10}

    B. C_2Br_2

    C. C_4H_9N

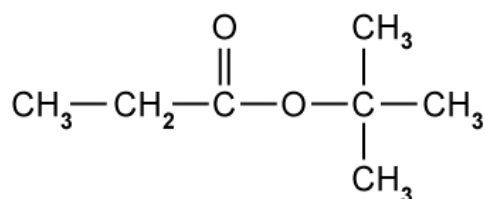   **D.** C_3H_8O

(1 mark)

39 The ^{1}H NMR spectrum of CH_3CHCl_2 shows two signals.

What is the correct assignment of splitting patterns for these signals?

	CH_3 group	CH group
A	doublet	quartet
B	quartet	doublet
C	singlet	singlet
D	triplet	singlet

(1 mark)

40 Which row correctly describes the splitting pattern observed on the ^{1}H NMR spectrum for each labelled hydrogen?

    A. One doublet and four triplets

    B. One triplet, one quartet and one singlet

    C. One triplet, one doublet and three singlets

    D. One triplet, one quartet and three singlets

(1 mark)