NANYANG JUNIOR COLLEGE
JC 2 PRELIMINARY EXAMINATION
Higher 1

CHEMISTRY 8873/01

Paper 1 Multiple Choice **24 September 2018**

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, class and tutor's name on the Answer Sheet in the spaces provided unless this has been done for you.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Answer Sheet.

Read the instructions on the Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this booklet.
The use of an approved scientific calculator is expected, where appropriate.

This document consists of **14** printed pages.

[Turn over

For each question there are four possible answers, **A**, **B**, **C** and **D**. Choose the **one** you consider to be correct.

1 In the discovery of an element, **A**, scientists found that it consists of 3 isotopes, ^{140}**A**, ^{142}**A** and ^{144}**A** in the ratio of 2 : 3 : 1.

What is the relative atomic mass of element **A**?

A 140.5

B 141.7

C 142.0

D 143.1

2 *Use of the Data Booklet is relevant to this question.*

How many Cl atoms are present in 1 cm^3 of chlorine gas under room conditions?

A $\frac{1 \times 24\,000}{6.02 \times 10^{23}}$

B $\frac{1 \times 6.02 \times 10^{23} \times 2}{24\,000}$

C $\frac{1 \times 6.02 \times 10^{23} \times 2}{71}$

D $\frac{1 \times 6.02 \times 10^{23}}{24}$

3 A constituent of wood preservative is manufactured by heating iron(II) chromite, $FeCr_2O_4$, with sodium carbonate in air.

$$4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \rightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$$

Which species is oxidised in this process?

A chromium only

B oxygen only

C chromium and iron

D carbon and oxygen

4 An isolated gaseous species has paired electrons in at least one of its 3d orbitals and a fully filled 4s subshell.

What could be the identity of the species?

A Cu

B Fe^{3+}

C Ni^{2+}

D Sr^{2+}

5 The elements aluminium and phosphorus each form triply charged ions.

How do the atomic radii and ionic radii of these elements compare?

A P^{3-} > Al > P > Al^{3+}

B P^{3-} > P > Al > Al^{3+}

C P > Al > P^{3-} > Al^{3+}

D P > P^{3-} > Al^{3+} > Al

6 Which one of the following species is **not** planar?

A BrF_3

B ICl_4^-

C PCl_4^+

D XeF_4

7 Hydrazine, N_2H_4, and hydrogen peroxide, H_2O_2, are both used as rocket propellants because they can produce large volumes of hot gases from a small volume of liquid.

Which of the following statements about these two compounds are correct?

1 The bond angle in N_2H_4 is larger than that in H_2O_2.

2 The N–H bond is shorter than the O–H bond.

3 Hydrazine forms stronger intermolecular hydrogen bonds than hydrogen peroxide.

4 Both hydrazine and hydrogen peroxide are polar molecules.

A 1 and 4 only

B 2 and 3 only

C 1, 2 and 4 only

D 1, 3 and 4 only

8 Three elements, **E**, **F** and **G**, have the physical properties shown in the table.

element	melting point / ^oC	boiling point / ^oC	density / g cm^{-3}
E	–7	59	3.12
F	98	883	0.97
G	649	1107	1.74

What could be the identities of **E**, **F** and **G**?

	E	**F**	**G**
A	Br_2	Al	Si
B	Br_2	Na	Mg
C	I_2	Mg	Na
D	I_2	Si	K

9 Which statement about exothermic reactions is **incorrect**?

A On the reaction pathway diagram, the products of the reaction are lower than the reactants.

B There is a net transfer of heat energy from the reacting system to the surroundings.

C The total bond energies of the products > the total bond energies of the reactants

D The activation energy for the forward reaction is the same as that for the backward reaction.

10 A student mixed 25.0 cm^3 of 3.00 mol dm^{-3} hydrochloric acid with an equal volume of 6.00 mol dm^{-3} sodium hydroxide. The initial temperature of both solutions was 15.0 ^oC. The maximum temperature recorded was 24.5 ^oC. It was found that 15 % of the heat produced during the experiment was lost to the surroundings.

Using these results, what is the enthalpy change of neutralisation?

A –15.6 kJ mol^{-1}

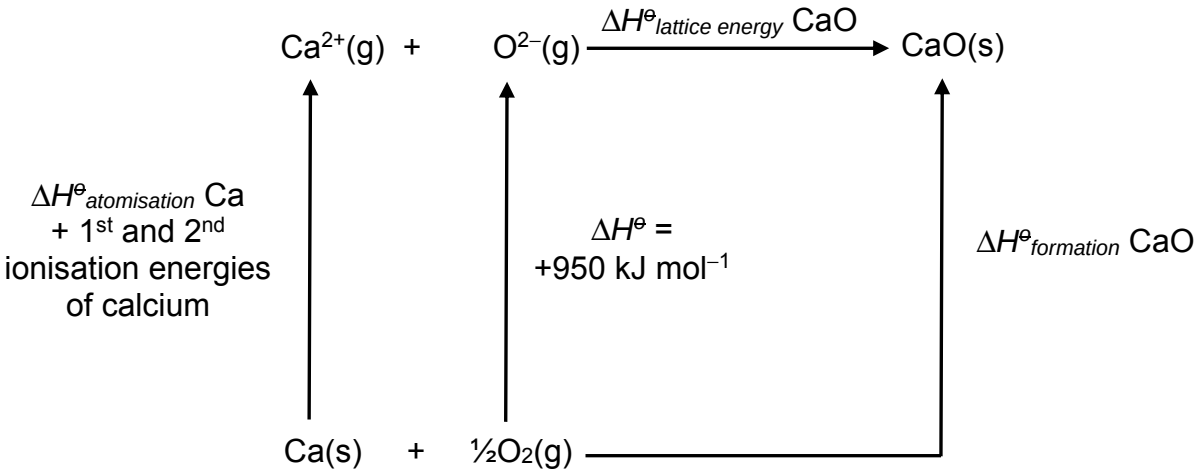
B –22.5 kJ mol^{-1}

C –31.1 kJ mol^{-1}

D –57.3 kJ mol^{-1}

11 A student calculated the lattice energy for calcium oxide using the cycle shown.

The enthalpy change of atomisation of calcium, $\Delta H^{\ominus}_{atomisation}$ Ca, is the energy needed when 1 mol of gaseous calcium atoms is formed from 1 mol of solid calcium under standard conditions.



However, the value calculated by the student for the lattice energy was **more** exothermic than the correct value.

Which errors could have been made in the calculation?

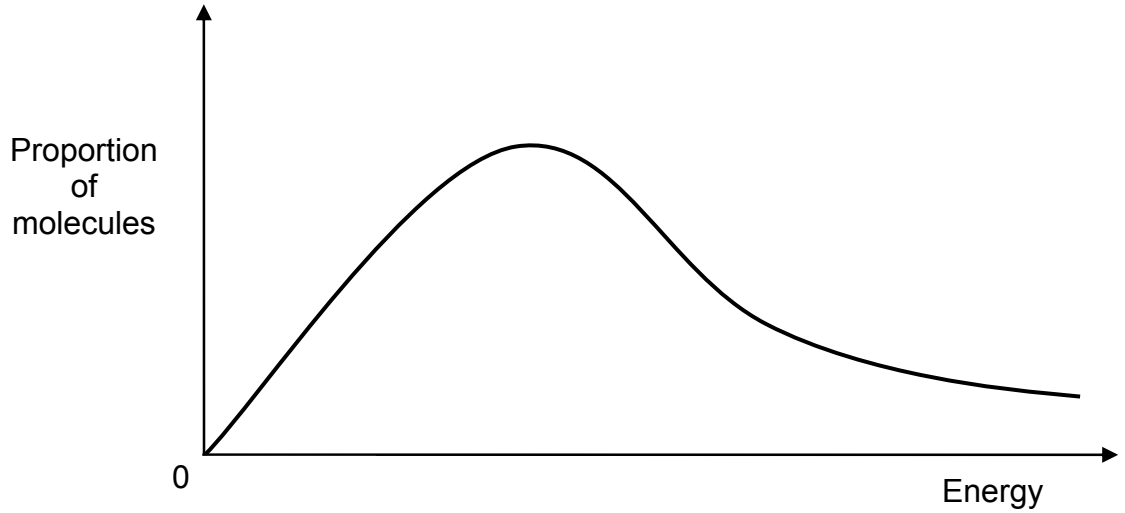
A omitting the value of +950 kJ mol^{-1}

B omitting the standard enthalpy change of formation of calcium oxide

C using the 1st and 2nd ionisation energies of magnesium instead of calcium

D using the standard enthalpy change of combustion of calcium rather than the standard enthalpy change of formation of calcium oxide

12 The graph below shows the Boltzmann distribution of molecular energies at a given temperature.



As temperature increases, which statements are correct?

1 The maximum of the curve is displaced to the right.

2 The maximum of the curve is displaced downwards.

3 The proportion of molecules with energies **above** any given value increases.

4 The proportion of molecules **with** any given energy increases.

A 1 only

B 3 only

C 1, 2 and 3 only

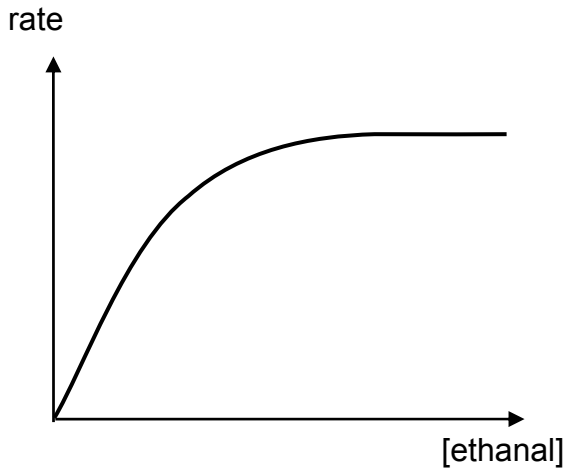
D 1, 2, 3 and 4

[Turn over

13 The enzyme *alcohol dehydrogenase* catalyses an important step in the production of ethanol by fermentation.

$$CH_3CHO + 2[H] \downarrow CH_3CH_2OH$$

The graph shows how the rate of this enzyme-catalysed reaction varies with the concentration of ethanal.



Which statement best explains the reason for the flattening off of the curve?

A As the ethanol product builds up the reaction slows down.

B All the ethanal has been used up and the reaction has finished.

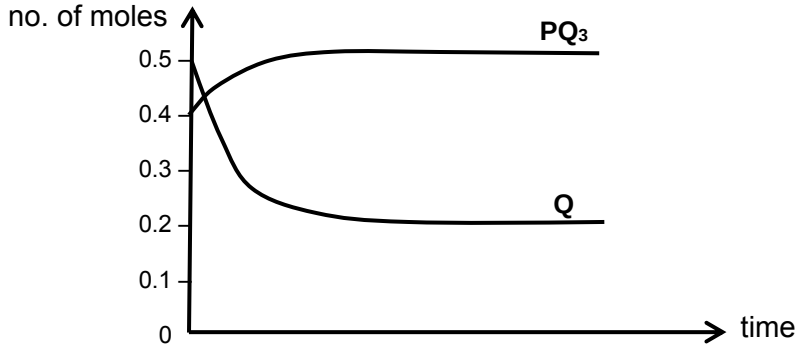
C At high ethanal concentrations the ethanal inhibits the action of the enzyme.

D At high ethanal concentration all the active sites in the enzyme molecules are occupied by ethanal molecules.

14 The system containing P, Q and PQ_3 is allowed to reach equilibrium in a 10 dm^3 vessel at a temperature of 1000 K.

$$P(g) + 3Q(g) \rightleftharpoons PQ_3(g)$$

The diagram below shows the change in number of moles of PQ_3 and Q with time. The initial amount of P was 0.2 mol.



What is the equilibrium constant K_c for the reaction?

A $\frac{0.5}{0.1\times(0.2)^3}$ **B** $\frac{0.5}{0.2\times(0.2)^3}$ **C** $\frac{0.5\times10^3}{0.1\times(0.2)^3}$ **D** $\frac{0.5\times10^3}{0.2\times(0.2)^3}$

15 Which statement is correct about a reaction for which the equilibrium constant is independent of temperature?

1 The rate constants for the forward and reverse reactions are also independent of temperature.
2 Temperature has no effect on the position of equilibrium.
3 The forward and reverse reactions have equal activation energies.
4 There is no change in number of gaseous particles during reaction.

A 1 and 2 only
B 1 and 4 only
C 2 and 3 only
D 3 and 4 only

16 Which of the following is an **incorrect** descriptor of a weak acid?

A It has high pK_a value.
B Its conjugate acid is strong.
C It donates a proton in aqueous solution.
D It has a relatively low electrical conductivity in dilute solutions.

[Turn over

17 50 cm^3 of 0.10 mol dm^{-3} of solution **X** was added to 100 cm^3 solution of 0.10 mol dm^{-3} HCO_3^- to form a buffer.

Which of the following could be the identity of **X**?

1 H_2CO_3

2 Na_2CO_3

3 H_2SO_4

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

18 A beaker contains a mixture of magnesium chloride, magnesium oxide, aluminium oxide and silicon dioxide. A student was asked to perform the following procedure to separate the compounds:

Step I: Add water to the mixture. Stir well and filter the mixture.
Step II: To the residue, add NaOH(aq) and stir well with a glass rod.
Step III: Filter the resulting mixture.
Step IV: To the residue, add HCl(aq) and stir well with a glass rod.
Step V: Filter to obtain the filtrate and residue.

Which of the following information is true about the above procedure?

1 The only starting species that remained unreacted after step V was silicon dioxide.

2 After step I, the filtrate contains only magnesium chloride.

3 After step III, the residue contains only aluminium oxide.

4 A gas was produced in step IV.

A 1 and 2 only

B 2 and 3 only

C 4 only

D None of the above

19 Which of the following is true about Period 3 elements and their compounds?

A The covalent character of oxides decreases from sodium to silicon.

B The lattice energy of nitrates become less exothermic from sodium to aluminium.

C The solubility of oxides decreases from sodium to silicon.

D The melting points of the elements generally decrease across the Period.

20 The following information is about three Period 3 elements, X, Y and Z.

- The chloride of X reacts with water to give a colourless acidic solution.
- The oxides of X and Y are insoluble in water.
- The oxides of X and Y have high melting and boiling points whereas the oxide of Z has low melting and boiling points.

What is the order of increasing ionic radius for these three elements?

A X, Y, Z

B Y, X, Z

C X, Z, Y

D Z, Y, X

21 Compound **E** has a straight−chain structure with a molecular formula of C_5H_8O.

Which functional groups may be present in any of the isomers of compound **E**?

1 Alcohol

2 Aldehyde

3 Ester

A 1, 2 and 3

B 1 and 2 only

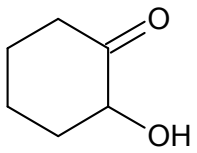
C 1 only

D 2 only

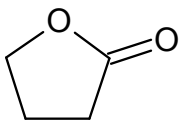
22 Hydrogen gas was passed through the following compounds in the presence of platinum.

Which compound will produce a mixture of cis-trans isomers after the reaction?

A



B



C

$CH_2=CHCH=CHCH_3$

D

$CH_3CONHCH_2CH_3$

23 Which compound does **not** have the same bond angle about all of its carbon atoms?

A benzene

B methanoic acid

C 2-ethylpentan-2-ol

D 2-bromopropene

24 $(CH_3CH_2)_3CH$ can react with chlorine under UV light to produce monochloro-compounds.

How many possible constitutional isomers of monochloro-compounds can it produce?

A 2

B 3

C 6

D 7

25 For which pair of compounds can ethanolic silver nitrate be used to distinguish between members of the pair?

A CH_3CH_2Cl and $CH_2=CHCH_2Cl$

B CH_3CH_2OH and CH_3CHO

C CH_3COCH_3 and CH_3CHO

D CH_3CH_2Cl and CH_3CH_2Br

26 Which compound will **not** produce a carboxylic acid when treated with hot acidified $KMnO_4$?

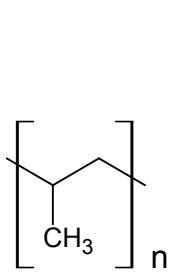
A CH_3COCH_3

B CH_3CH_2CHO

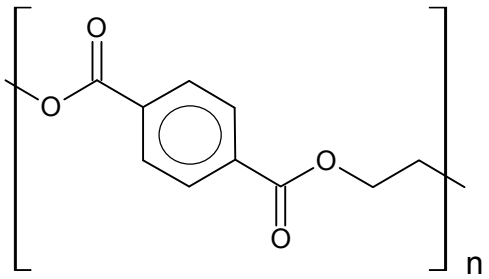
C $CH_3CH_2CH_2OH$

D $CH_3CH_2CONHCH_3$

27 Poly(propene) (PP) and poly(ethylene terephthalate) (PET) are frequently used as food grade containers.



PP



PET

Which statement is correct about their uses?

A The presence of water will dissolve PET due to the formation of hydrogen bonds.

B PP cannot be used to store oily foods as the non-polar PP will be dissolved by the non-polar oil molecules.

C PP can be used to store strong alkalis but PET will be dissolved in strong alkalis due to alkaline hydrolysis of PET.

D Both are unable to store hot foods due to their weak intermolecular forces of attraction that requires small amount of energy to break.

28 Which of the following are addition polymers?

1 Polyester

2 Poly(ethene)

3 Poly(vinyl alcohol)

A 1 only

B 2 and 3 only

C 2 only

D 1, 2 and 3

[Turn over

29 Carbon nanotubes are widely researched as a potential material with many uses.

Which pairs show the correct property of carbon nanotubes with an example of their use?

	Property	Example of use
1	low density	frame of racquets
2	high tensile strength	material for building construction
3	high electrical conductivity	flat screen television
4	high porosity	material for water filtration

A 2 and 3 only

B 1, 2, 3 and 4

C 1 and 2 only

D 1, 2 and 3 only

30 Which statement about nanomaterials is correct?

A They will not pose any health risks.

B They can have a length of more than 100 nm.

C They can only be manufactured in the laboratory.

D They are all able to stick onto any type of surfaces.

Nanyang JC J2 Preliminary Exam 2018
H1 Chemistry 8873/01
Paper 1 MCQ Answers and Comments

Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans	Qn	Ans
1	**B**	6	**C**	11	**C**	16	**B**	21	**B**	26	**A**
2	**B**	7	**A**	12	**C**	17	**A**	22	**A**	27	**C**
3	**C**	8	**B**	13	**D**	18	**D**	23	**D**	28	**B**
4	**D**	9	**D**	14	**C**	19	**C**	24	**B**	29	**D**
5	**A**	10	**C**	15	**C**	20	**B**	25	**D**	30	**B**

1 B

Ar of **A**

$$= \frac{(140\times2)+(142\times3)+(144\times1)}{2+3+1} = \frac{850}{6}$$

= 141.67 = **<u>141.7</u>** (1 d.p)

2 B

2 Cl Ξ Cl_2

Amount of Cl atom = $\frac{1}{24\,000}\times 2$ mol

No. of Cl atom = amt x Avogadro constant

$$= \frac{1\times6.02\times10^{23}\times2}{24\,000}$$

3 C

Cr is oxidised from **<u>+3 to +6</u>**
Fe is oxidised from **<u>+2 to +3</u>**
Oxygen is reduced from **<u>0 to -2</u>**

4 D

Cu: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}4s^1$
Fe^{3+}: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5$
Ni^{2+}: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^8$
Sr^{2+}: $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6$

5 A

Cations are smaller than their respective atoms as cations have **one electron shell less** than neutral atoms.

Anions are bigger than their respective atoms because of the extra repulsion of the added electron(s). Since the nuclear charge **remains the same**, the outermost electrons are now less attracted to the nucleus.

Anions are bigger than cations because anions contain **one more electron shell** and the increase in screening effect outweighs the increase in nuclear charge.

Atomic radius decreases across the period.

6 C

A BrF_3 : T-shaped (3bp, 2 lp)
B ICl_4^- : square planar (4bp, 2 lp)
C PCl_4^+: tetrahedral (4 bp, 0 lp)
D XeF_4: square planar (4bp, 2 lp)

7 A (1 & 4 are correct)

1 True, bond angle in N_2H_4 is 107^O while bond angle in H_2O_2 is 105^O

2 False, the N–H bond is *longer* than the O–H bond as the O–H covalent bond in more polar. Students can also check the DB to compare the 2 bond energies.

3 False, hydrazine forms *weaker* intermolecular hydrogen bonds than hydrogen peroxide as N is less electronegative than O.

4 True, both hydrazine and hydrogen peroxide are polar molecules. In hydrazine, the shape is trigonal pyramidal shape about N, while in hydrogen peroxide, the shape is bent shape about O. The dipoles do not cancel out.

8 B

E: must be a liquid at room temperature as its mpt < room temp < boiling pt. Hence E must be Br_2. Options C and D are eliminated.

F & G have relatively low melting points, hence they are unlikely to be Al and Si. Si having a giant covalent structure will have a mpt >1000^{O}C. Option A is eliminated.

Option B is the best answer. Between Na and Mg, Na will have lower melting point and boiling point as Na has weaker metallic bonding due to lesser delocalised electrons available. Na will have lower density (mass divided by volume) as ionic radius of Na^+ is larger than that of Mg^{2+} and mass of Na^+ and Mg^{2+} is approximately constant.

9 D

The activation energy for the forward reaction is smaller than that for the backward reaction.

10 C

amount of water formed
$= \frac{25.0}{1000}$ x 3.00 = 0.07500 mol

heat produced
= (25.0 + 25.0) x 4.18 x 9.5 x $\frac{100}{85}$
= 2335 J mol^{-1}

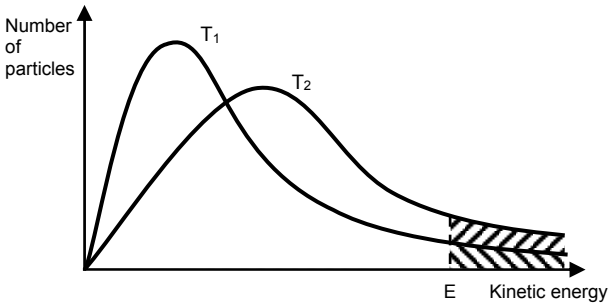
$\Delta H_n = -\frac{2335 \times 10^{-3}}{0.07500}$
$= -31.14$
$= -31.1$ kJ mol^{-1}

11 C

$\Delta H^{e}_{lattice\ energy}$ CaO
= – ($\Delta H^{e}_{atomisation}$ Ca + 1st and 2nd ionisation energies of calcium + 950)
+ $\Delta H^{e}_{formation}$ CaO

Option A: Less exothermic
Option B: Less exothermic
Option C: More exothermic as 1st and 2nd ionisation energies of magnesium are more endothermic than calcium
Option D: Standard enthalpy change of combustion of magnesium is equal to the standard enthalpy change of formation of magnesium oxide

12 C



Option 1 and 2 are correct. See peak of T2
Option 3 is correct. The area under the curve increases for energy greater than E.
Option 4 is wrong. The proportion of molecules at lower energies decreases.

13 D

At high ethanal concentration all the active sites in the enzyme molecules are occupied by ethanal molecules, hence the rate does not increase even though [ethanal] concentration increases i.e. zero order kinetics.

14 C

$[Q]_{eqm}$ = 0.2 / 10 mol dm^{-3}
$[PQ_3]_{eqm}$ = 0.5 / 10 mol dm^{-3}
Initial P = 0.2 mol

Since P and PQ_3 have the same mole ratio in the equation,
|change in P| = |change in PQ_3| = 0.1
(read off from graph)
Alternatively, you can also find change in P = 1/3 change in Q.
Hence $[P]_{eqm}$ = (0.2 – 0.1) = 0.1 / 10 mol dm^{-3}

$$K_c = \frac{[PQ_3]}{[Q]^3[P]} = \frac{(\frac{0.5}{10})}{(\frac{0.2}{10})^3(\frac{0.1}{10})} = \frac{0.5 \times 10^3}{0.2^3 \times 0.1}$$

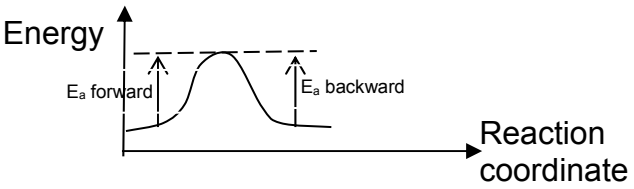
15 C

If equilibrium constant is independent of temperature, it means when temperature changes, neither forward nor backward reaction is favoured and this is only possible if ΔH is zero.

1. All rate constants are affected by temperature according to Arrhenius equation: $k = A^{-Ea/RT}$.

2. Temperature would have no effect on the position of equilibrium if ΔH is zero.

3. When ΔH is zero, activation energies for forward and backward reaction are equal as shown in the energy profile diagram below:



4. We cannot deduce any information about the number of gaseous particles unless some information about how value of equilibrium constant changes with pressure is provided.

16 B

A. A weak acid is partially dissociated in aqueous solution. A weak acid has a low K_a value hence it has a high pK_a value.

B. A weak acid has a strong conjugate <u>base</u>. Hence statement B is incorrect.

C. Acids are proton donors.

D. There is only a low concentration of ions formed as the weak acid remains mostly undissociated (as a molecule). Hence, there are few mobile ions to act as charge carriers, accounting for the low electrical conductivity.

17 A

A buffer contains a weak acid or base and its conjugate salt hence two possible buffers can be formed from HCO_3^-:
H_2CO_3 (weak acid) and HCO_3^-(conj base)
HCO_3^- (weak acid) and CO_3^{2-} (conj base)
Hence options 1 and 2 are correct.

For option 3:
$n(H^+) = 2 \times n(H_2SO_4) = n(HCO_3^-)$.
H_2SO_4 reacts completely with HCO_3^- to form H_2CO_3. No excess HCO_3^- is left hence a buffer is not formed.

18 D

Properties of:
MgO – basic oxide. Slightly soluble in water. It reacts with acid to form salt and water.
SiO_2 – insoluble in water and unreactive to dilute acids and bases.
$MgCl_2$ – soluble in water to give a weakly acidic solution.
Al_2O_3 – insoluble in water. Amphoteric in nature and reacts with both acids and bases to give salt and water.

I: <u>Add water to the mixture. Stir well and filter the mixture.</u>
Residue contains: MgO, Al_2O_3, SiO_2
Filtrate contains: $MgCl_2$, MgO as $Mg(OH)_2$

II: <u>To the residue, add NaOH(aq) and stir well with a glass rod.</u>
Only Al_2O_3 reacts with NaOH(aq)
$Al_2O_3(s) + 2OH^-(aq) + 3H_2O(l) \rightarrow 2[Al(OH)_4]^-(aq)$

III: <u>Filter the resulting mixture.</u>
Residue contains: SiO_2, MgO
Filtrate contains: $[Al(OH)_4]^-(aq)$

IV: <u>To the residue, add HCl(aq) and stir well with a glass rod.</u>
Only MgO reacts with HCl.
$MgO(s) + 2H\ (aq) \rightarrow Mg^2\ (aq) + H_2O(l)$

V: <u>Filter to obtain the filtrate and residue.</u>
Residue contains: SiO_2
Filtrate contains: $Mg(OH)_2(aq)$

1 – No. Both SiO_2 and $MgCl_2$ remained unreacted. $MgCl_2$ only dissolved in water in step I therefore remained unreacted.

2 – No. Filtrate contains both $Mg(OH)_2$ and $MgCl_2$.
3 – No. The residue contains SiO_2 and MgO.
4 – No gas was produced throughout the separation procedure.

19 C

A – From Na_2O to Al_2O_3, the covalent character increases due to the increasingly higher charge density of the cation.

B – $|LE| \propto \frac{|z_+ z_-|}{r_+ + r_-}$

When the anion is large, the changes in the sum of ionic radii becomes negligible. The product of ionic charges increases from sodium to aluminium, thus lattice energy become more exothermic.
C – The oxides become less soluble across the Period from sodium to silicon. (See Periodicity notes – Reaction of oxides with water)
D – Melting points increases from sodium to silicon and decreases from silicon to argon. (Giant metallic structure → Giant molecular structure → simple molecular structure) (See Periodicity notes for full explanations on melting points)

20 B

The chloride of X react with water to give a colourless acidic solution.
The chlorides which are acidic in water are $MgCl_2$, $AlCl_3$, $SiCl_4$ and PCl_5.
$SiCl_4$ reacts with water to form a solid SiO_2.
⇒X can be Mg, Al or P.

The oxides of X and Y are insoluble in water.
Only 2 oxides in Period 3 are insoluble in water, Al or Si.
⇒ X must be Al (agree with first point)
⇒ Y must be Si

Oxides of X and Y have high melting and boiling points. Oxide of Z has low melting and boiling points.
Across Period 3, the oxides change from giant ionic structures to giant covalent structures to simple molecular structures.
⇒ Element Z has a simple molecular structure, so it is either phosphorus, sulfur or chlorine.
⇒ Element Z forms anions and has the largest ionic radius.

Order of increasing ionic radius:
Si^{4+}, Al^{3+}, P^{3-}(or S^{2-} or Cl^-)

21 B

An unsaturated 5–carbon alcohol would have molecular formula, $C_5H_{12}O$, e.g. $CH_3CH_2CH_2CH_2CH_2OH$

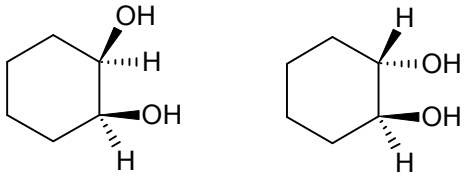
E has 4 less H atoms which implies that there is presence of 2 multiple bonds which could be C=C or C=O bond.

Hence, the possible isomers are
CH_2=CHCH=CHCH_2OH,
CH_2=CHCH_2COCH_3 and
CH_2=CHCH_2CH_2CHO.
Hence, there can be alkene, alcohol, ketone and aldehyde present in the isomers of C_5H_8O. (1 and 2 only)

An ester is not possible as there is only 1 oxygen atom present in E.

22 A

The product after addition reaction with H_2 is as follows:



cis trans

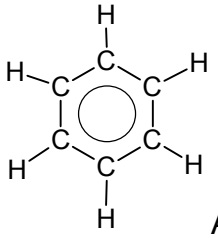
A:

B: It is an ester and esters do not react with H_2.

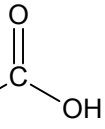
C: $CH_3CH_2CH_2CH_2CH_3$ do not exhibit cis-trans isomerism.

D: It is an amide and amides do not react with H_2.

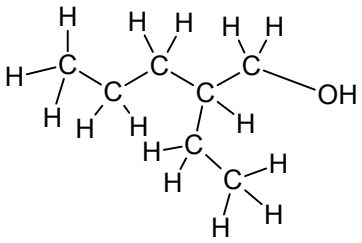
23 D



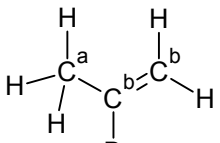
A: All of its carbons have 3 bond pairs and 0 lone pair. Bond angle: 120°.



B: Its carbon have 3 bond pairs and 0 lone pair. Bond angle: 120°.

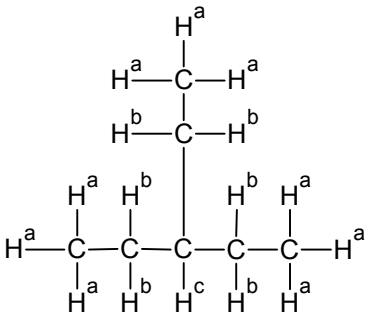


C: All of its carbons have 4 bond pairs and 0 lone pairs. Bond angle: 109.5°.



D: C^a have 4 bond pairs and 0 lone pair. Bond angle about C^a: 109.5°. Both C^b have 3 bond pairs and 0 lone pair. Bond angle about C^b: 120°.

24 B



The chlorine atom can substitute once with H^a, H^b or H^c. (i.e. there are 3 types of hydrogen atoms - H^a, H^b and H^c, with different chemical environments) Hence, there can only be 3 possible structural isomers of monochloro-compounds.

25 D

A: Both compounds are able to liberate Cl^- to give white ppt of AgCl with ethanolic $AgNO_3$.

B: Solution remains colourless for both compounds.

C: Solution remains colourless for both compounds.

D: CH_3CH_2Cl will liberate Cl^- to give white ppt of AgCl with ethanolic $AgNO_3$ whereas CH_3CH_2Br will liberate Br^- to give cream ppt of AgBr with ethanolic $AgNO_3$.

26 A

A: CH_3COCH_3 will not get oxidised or undergo acidic hydrolysis.

B: CH_3CH_2CHO will get oxidised to CH_3CH_2COOH (propanoic acid).

C: $CH_3CH_2CH_2OH$ will get oxidised to CH_3CH_2COOH (propanoic acid).

D: $CH_3CH_2CONHCH_3$ will undergo acidic hydrolysis to give CH_3CH_2COOH (propanoic acid) and $CH_3NH_3^+$.

27 C

A: The non-polar regions of the polymer is too large to be dissolved in water.

B: PP has a giant molecular structure such that the non-polar oil molecules are unable to form favourable intramolecular forces of attraction to provide sufficient energy to overcome the extensive intermolecular forces of attraction within the PP polymer.

C: PP is unable to undergo alkaline hydrolysis but the ester groups in PET can undergo strong alkaline hydrolysis.

D: Both are able to store hot foods as they have extensive intramolecular forces of attraction that are strong enough to withstand such heat.

28 B

1: Polyesters are condensation polymers.
2: Poly(ethene) are addition polymers.
3: poly(vinyl alcohol) are addition polymers.
(2 & 3 only)

29 D

It is the low porosity of the carbon nanotubes that made them to be a suitable material for water filtration. The size of the hexagonal 'holes' in carbon nanotubes are small enough to allow water molecules to pass through but not for other larger species (e.g. other ions, particles etc).

30 B

A: Their health risks are poorly understood. They may pose potential health risks.

B: Nanomaterials can have a length of more than 100 nm as they just need at least one dimension in the size of 1 to 100 nm.

C: Nanomaterials can be both man-made and exist biologically.

D: Not all nanomaterials can stick onto surfaces (e.g. catalytic converter).