RIVER VALLEY HIGH SCHOOL
YEAR 6 PRELIMINARY EXAMINATION

CANDIDATE NAME									
CLASS	6								
CENTRE NUMBER	S					INDEX NUMBER				

H2 CHEMISTRY **9647/01**

Paper 1 Multiple Choice **26 September 2013**

1 hour

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name, class, centre number and index number on the Answer Sheet in the spaces provided.

There are **forty** 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.

This document consists of **20** printed pages.

Section A

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

1. In an attempt to establish the formula of an oxide of nitrogen, a known volume of the pure N_xO_y gas was mixed with hydrogen and passed over a catalyst at a suitable temperature. 100% conversion of the oxide to ammonia and water was known to have taken place.

2400 cm^3 of nitrogen oxide measured at room temperature and pressure produced 7.20 g of water. The ammonia produced was neutralised by 200 cm^3 of 1.0 mol dm^{-3} of HC*l*.

What is the formula of the nitrogen oxide?

A N_2O **B** N_2O_2

C N_2O_4 **D** NO_2

2. In an experiment, 50.0 cm^3 of a 0.100 mol dm^{-3} solution of a metallic ion, M^{n+}, reacted exactly with 25.0 cm^3 of 0.100 mol dm^{-3} aqueous sodium sulfite.

The half-equation for the oxidation of sulfite ion is shown below.

SO_3^{2-} (aq) + H_2O (l) → SO_4^{2-} (aq) + $2H^+$ (aq) + $2e^-$

If the final oxidation number of the metal in the salt was +3, what would be the original oxidation number of the metal?

A +1 **B** +2 **C** +4 **D** +5

3. Titanium has the electronic structure, $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^2\ 4s^2$.

Which one of the following compounds is **unlikely** to exist?

A TiO **B** $TiCl_3$

C K_3TiF_6 **D** K_2TiO_4

4. 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 is correct?

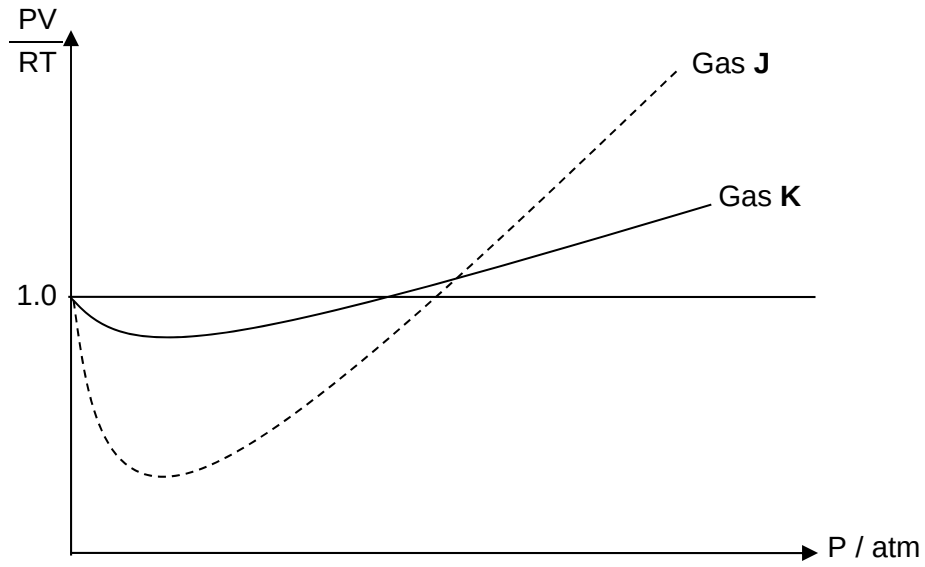
A The bond angle in N_2H_4 is smaller than that in H_2O_2.

B The boiling point of N_2H_4 is lower than that of H_2O_2.

C The N─H bond is shorter than the O─H bond.

D N_2H_4 is a weaker base than H_2O_2.

5. The graph below shows the variation in the values of PV/RT with pressure for 1 mol of Gas **J** and 1 mol of Gas **K**.



Which of the following is true of the identity of Gas **J** and Gas **K**?

	Gas **J**	Gas **K**
A	Neon at 498 K	Neon at 298 K
B	Hydrogen gas at 298 K	Carbon dioxide at 298 K
C	Neon gas at 498K	Carbon dioxide at 498 K
D	Nitrogen gas at 298K	Nitrogen gas at 498K

6. *Use of Data Booklet is relevant in this question.*

Aluminium oxide is a stable ionic compound.

$Al\ (s) \rightarrow Al^{3+}\ (g) + 3e^{-}$ $\quad \Delta H = +5467\ kJ\ mol^{-1}$

$\frac{1}{2}\ O_2\ (g) + 2e \rightarrow O^{2-}\ (g)$ $\quad \Delta H = +897\ kJ\ mol^{-1}$

Which of the following statements is **false**?

A The enthalpy change of atomisation of aluminium is +330 kJ mol^{-1}.

B The enthalpy change of formation of aluminium oxide is –13625 kJ mol^{-1}

C The lattice energy of aluminium oxide is more exothermic than the enthalpy change of formation of aluminium oxide.

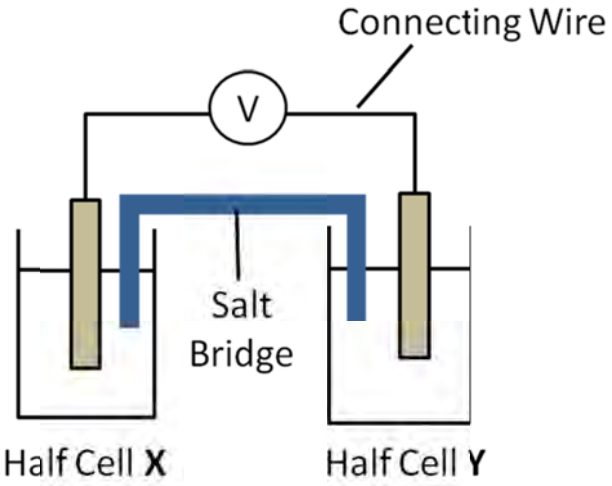
D The sum of the first and second electron affinities of oxygen is +649 kJ mol^{-1}.

7. Uranium 235 is an isotope of uranium. It is unstable and undergoes radioactive decay to form barium and other elements. This radioactive decay is a first-order reaction with a half life of 7.04×10^8 years.

A barium free rock sample was found to contain some Uranium 235. Calculate the molar proportion of uranium to barium 235 after a period of 2.11×10^9 years.

A 1:1 **B** 1:3 **C** 1:5 **D** 1:7

8. The following is a diagram set up to investigate standard cell potential ($E^{\ominus}_{cell}$)



Suggest appropriate material to make the half cell **X** and **Y**.

	Half cell X		**Half cell Y**	
	Electrode	**Electrolyte**	**Electrode**	**Electrolyte**
A	Copper	1 mol dm^{-3} $CuSO_4(aq)$	Iron	1 mol dm^{-3} $KMnO_4(aq)$ 1 mol dm^{-3} $HNO_3(aq)$
B	Graphite	1 mol dm^{-3} $FeCl_2(aq)$ 1 mol dm^{-3} $FeCl_3$ (aq)	Copper	1 mol dm^{-3} $CuSO_4(aq)$
C	Iron	1 mol dm^{-3} $FeCl_2(aq)$ 1 mol dm^{-3} $FeCl_3(aq)$	Graphite	1 mol dm^{-3} $KMnO_4(aq)$ 1 mol dm^{-3} $HNO_3(aq)$
D	Iron	1 mol dm^{-3} $FeCl_2(aq)$	Graphite	1 mol dm^{-3} $CuSO_4(aq)$

9. *Use of Data Booklet is relevant in this question.*

Which of the following will **not** produce a gaseous product at room temperature and pressure?

A Mixing aqueous chlorine with manganese(III) chloride

B Adding copper metal into concentrated nitric acid solution

C Mixing aqueous sodium chloride with acidified potassium manganate(VII)

D Adding a aqueous iron(III) chloride into a solution of acidified hydrogen peroxide

10. The contact process is an important industrial reaction which produces sulfuric acid. One of the steps of the process involves the addition of excess oxygen to sulfur dioxide to produce sulfur trioxide gas in an equilibrium reaction:

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

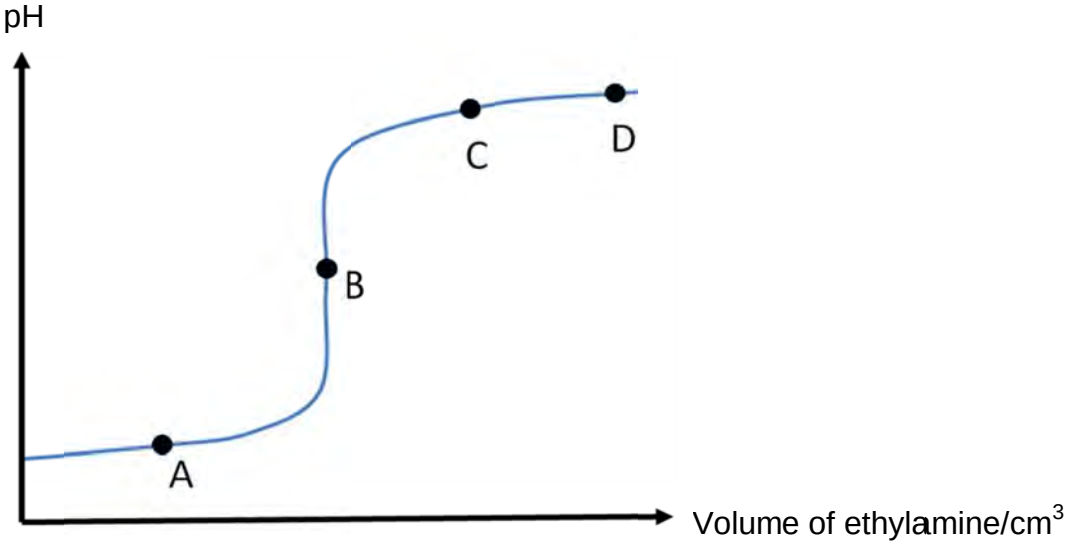
$SO_2(g)$ and $O_2(g)$ were mixed in a 1:2 ratio and the mixture was kept at a constant pressure of 5 atm. At equilibrium, it was found that 30% of the sulfur dioxide was consumed.

What is the numerical value of K_p of this reaction?

A 0.0566 **B** 0.142

C 1.75 **D** 8.35

11 When 25 cm^3 of aqueous hydrochloric acid is titrated against aqueous ethylamine of similar concentration, The following pH curve is obtained:



At which point will the mixture have maximum buffering capacity?

12. When magnesium carbonate powder is added to a solution of aqueous ethanoic acid, effervescence is observed.

Which of the following will **not** change the rate of effervescence?

A Using magnesium carbonate pellet instead of magnesium carbonate powder.

B Using hydrochloric acid instead of ethanoic acid.

C Increasing the temperature.

D Increasing the pressure.

13. Two solutions were prepared by dissolving a chloride and an oxide of elements in the third period of the Periodic Table in separate portions of water.

Both solutions prepared can be used to dissolve Al_2O_3 but only one can be used to dissolve SiO_2.

Which of the following could be the chloride and the oxide used?

A PCl_5 and Na_2O

B $NaCl$ and SO_3

C $MgCl_2$ and MgO

D $SiCl_4$ and P_4O_{10}

14. **X**, **Y** and **Z** are consecutive elements in Period 3 of the Periodic Table. **Y** has the highest first ionisation energy and the lowest melting point among the three elements.

Which of the following could be **X**, **Y** and **Z**?

A sodium, magnesium, aluminium

B magnesium, aluminium, silicon

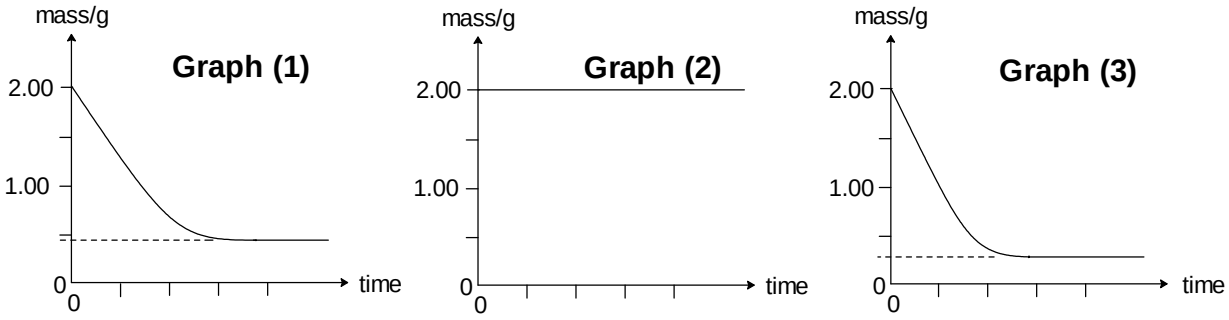
C aluminium, silicon, phosphorus

D silicon, phosphorus, sulfur

15. Group II iodates(V) can undergo thermal decomposition as shown below.

$2Mg(IO_3)_2(s) \longrightarrow 2MgO(s) + 2I_2(g) + 5O_2(g)$

The three graphs given below show the change in mass when 2.00 g each of three Group II iodates(V) were heated separately at a temperature T ^oC.



Which three Group II iodates(V) can give rise to these graphs?

	Graph (1)	Graph (2)	Graph (3)
A	$Sr(IO_3)_2$	$Ba(IO_3)_2$	$Ca(IO_3)_2$
B	$Mg(IO_3)_2$	$Ba(IO_3)_2$	$Sr(IO_3)_2$
C	$Ca(IO_3)_2$	$Mg(IO_3)_2$	$Ba(IO_3)_2$
D	$Ca(IO_3)_2$	$Mg(IO_3)_2$	$Sr(IO_3)_2$

16. Which of the following statements explains why hydrogen iodide a stronger acid than hydrogen chloride?

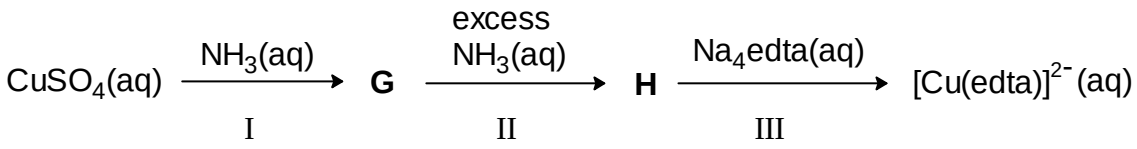
A A molecule of hydrogen chloride is more polar than a molecule of hydrogen iodide.

B The enthalpy change of formation of hydrogen iodide is greater than that of hydrogen chloride.

C The covalent bond in the hydrogen iodide molecule is weaker than that in the hydrogen chloride molecule.

D The dissociation of hydrogen chloride molecules is suppressed by the stronger hydrogen bonds between molecules.

17. A reaction scheme starting from aqueous copper(II) sulphate solution is shown below. Both **G** and **H** are copper-containing species.



Which of the following statements is correct?

A NH_3 is a ligand in reaction I.

B Reaction II is a redox reaction.

C **H** is a deep blue solution containing $[Cu(NH_3)_4(H_2O)_2]SO_4$.

D The entropy of the system decreases when reaction III occurs.

18. Assuming that only mono-chlorination takes place, which of the following will be the correct combination of the products obtained when excess 2,3-dimethylbutane is reacted with chlorine in the presence of *uv* light?

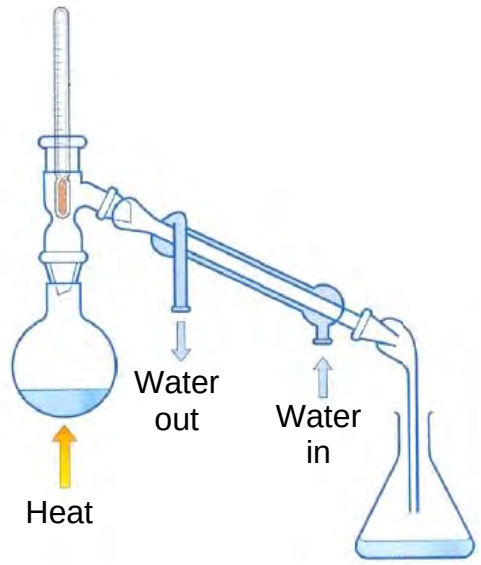
A 2 possible products in the ratio 6:1

B 3 possible products in the ratio 3:3:1

C 3 possible products in the ratio 6:3:1

D 4 possible products in the ratio 6:3:3:2

19. Which of the following **cannot** be prepared by the apparatus set-up as shown?



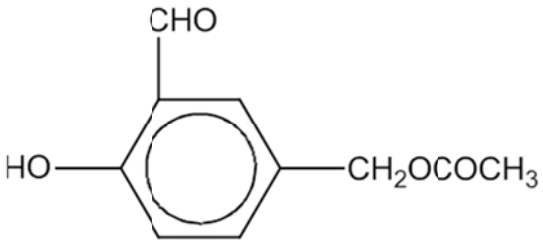
A 1,2-dibromopropene by using bromine and propene

B Ethyl ethanoate by using ethanol and concentrated sulfuric acid

C Bromoethane by using sodium bromide and concentrated sulfuric acid

D Propanone by using propanol, sodium dichromate(VI) and sulfuric acid

20. Which of the following reagents will **not** cause a colour change when the reagent is added to compound **X**?



Compound **X**

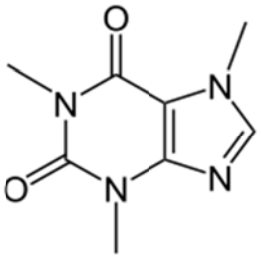
A Acidified potassium manganate(VII) solution

B Alkaline silver nitrate and ammonia solution

C Alkaline copper(II) sulfate solution

D Neutral iron(III) chloride solution

21. Caffeine is the world's most widely consumed psychoactive drug and can be found in beverages such as coffee, tea, chocolates and energy drinks. Many adults in Singapore consume caffeine daily.



caffeine

Which statement about caffeine is correct?

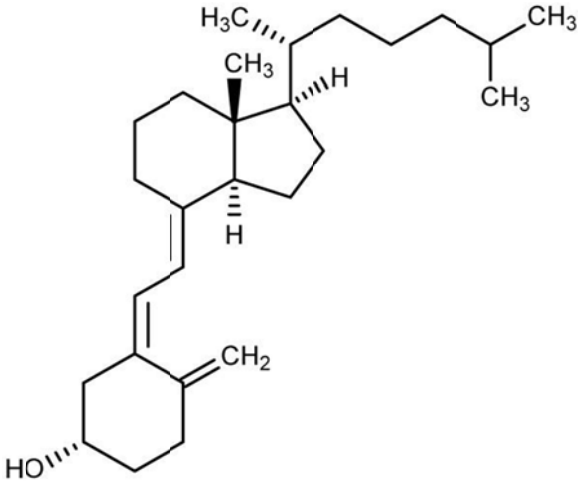
A Caffeine liberates ammonia when reacted with NaOH(aq) and heat

B Caffeine turns red litmus paper blue

C Caffeine is a planar molecule

D Caffeine has 8 π electrons

22. Cholecalciferol, also known as Vitamin D3, is generated in the skin of animals when light energy is absorbed.



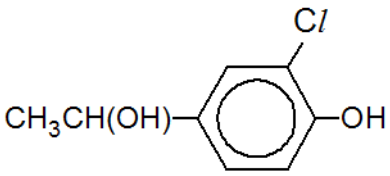
How many optical isomers does cholecalciferol have?

A 5 **B** 32 **C** 64 **D** 128

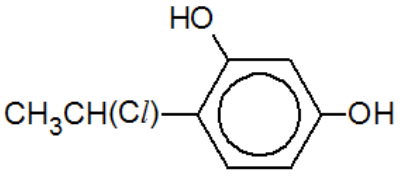
23. Compound **X**, $C_8H_9ClO_2$, gives compound **Y**, $C_8H_7ClO_2$, when heated with acidified potassium dichromate(VI). **Y** gives a pale yellow precipitate on warming with aqueous alkaline iodine and reacts with 2 moles of aqueous bromine.

Which of the following is the correct structure for **X**?

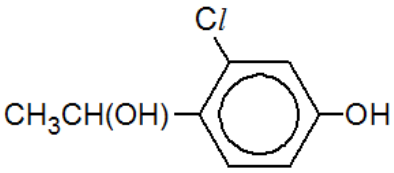
A



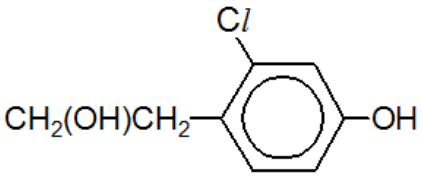
B



C



D



24. Which of the following sequence shows a decrease in pK_a values?

A $C_2H_5OH > C_6H_5OH > CH_3CO_2H > CCl_3CO_2H$

B $C_2H_5OH > C_6H_5OH > CCl_3CO_2H > CH_3CO_2H$

C $C_2H_5OH > CH_3CO_2H > CCl_3CO_2H > C_6H_5OH$

D $CCl_3CO_2H > CH_3CO_2H > C_6H_5OH > C_2H_5OH$

25. ^{18}O is an isotope of oxygen.

When propyl ethanoate is hydrolysed with dilute hydrochloric acid in the presence of $H_2{}^{18}O$, a mixture of two products is formed. Which of the following pairs gives the correct structures of the two products?

A CH_3COOH and $CH_3CH_2CH_2{}^{18}OH$

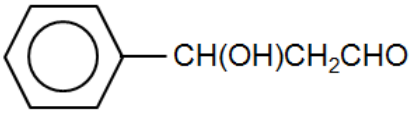
B $CH_3CO{}^{18}OH$ and $CH_3CH_2CH_2OH$

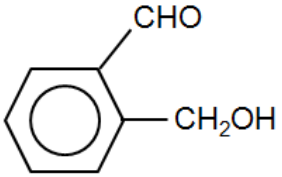
C CH_3CH_2COOH and $CH_3CH_2{}^{18}OH$

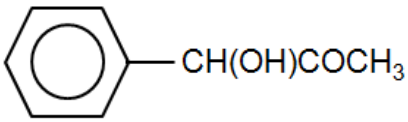
D $CH_3CH_2CO{}^{18}OH$ and CH_3CH_2OH

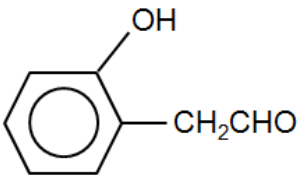
26. When phosphorus pentachloride was added to an organic compound **P**, fumes of hydrogen chloride were evolved. When **P** was warmed with Fehling's solution, a brick-red precipitate was obtained.

Which of the following is likely to be compound **P**?

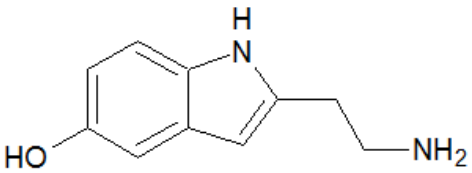
A 

B 

C 

D 

27. Serotonin is a monoamine neurotransmitter that contributes to feelings of well-being and happiness.



serotonin

How many sigma (σ) and pi (π) bonds does serotonin have?

A 20σ and 4π

B 22σ and 4π

C 26σ and 4π

D 28σ and 4π

28. Which of the following will **not** be produced when 1-bromopropane is heated with ethanolic sodium hydroxide?

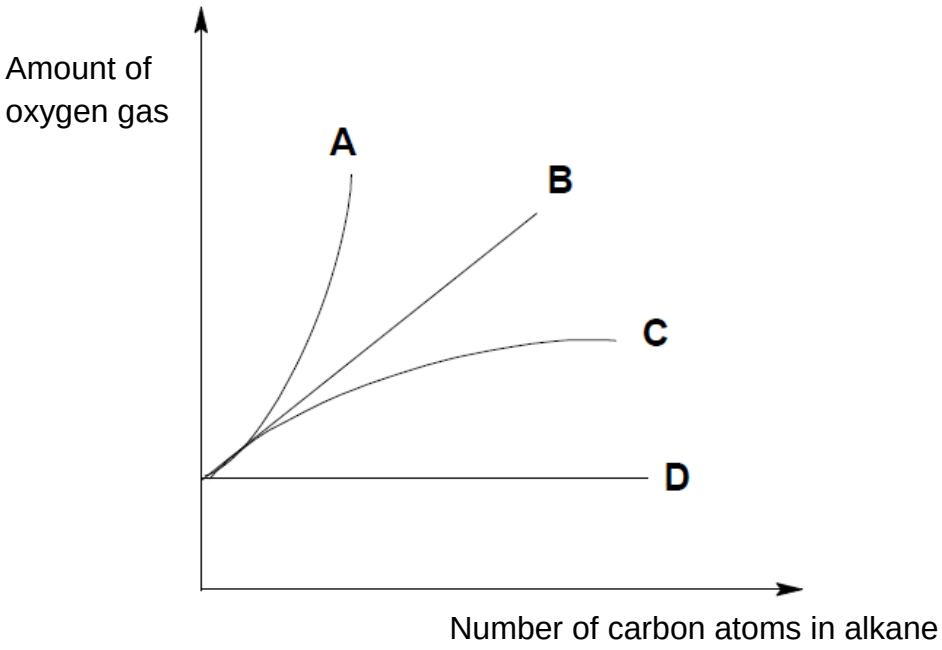
A $CH_3CH{=}CH_2$

B $CH_3CH_2CH_2OH$

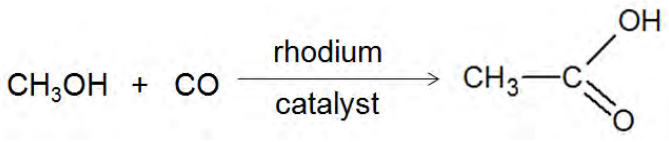
C $CH_3CH_2CH_2ONa$

D $CH_3CH_2CH_2OCH_2CH_3$

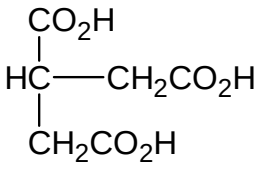
29. Which line on the graph shows the relationship between the number of carbon atoms in an alkane and the amount of oxygen gas needed for complete combustion of the alkane?



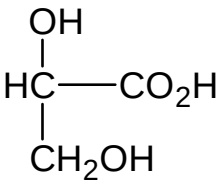
30. Ethanoic acid is prepared industrially by the direct carbonylation of methanol using a rhodium catalyst.



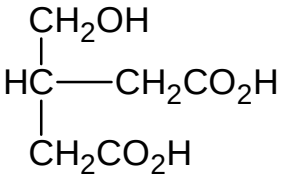
Which compound can be expected to produce the following product by this method?



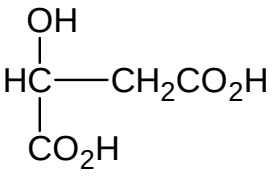
A



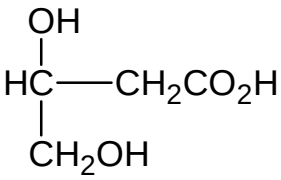
B



C



D



Section B

For each of the questions in this section, one or more of the three numbered statements **1** to **3** may be correct.

Decide whether each of the statements is or is not correct.

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

31. The electronic configurations of elements **X**, **Y** and **Z** are as follows:

X: [Ar] $3d^{10}4s^2 4p^1$

Y: [Ar] $3d^{10}4s^2 4p^4$

Z: [Ar] $3d^{10}4s^1$

Which of the following statement(s) is / are true?

1 $\mathbf{X}^{3+}$ shows the greatest deflection towards the negatively charged plate with constant electric field compared to $\mathbf{Y}^{+}$ and $\mathbf{Z}^{2+}$.

2 The first ionization energy of **X** is lower than both **Z** and **Y**.

3 Each of the $\mathbf{X}^{2+}$, $\mathbf{Y}^{2+}$ and $\mathbf{Z}^{2+}$ ions contain only one unpaired electron.

32. The table shows data about two elements, sodium and copper.

Element	Atomic Number	Melting point / ^{o}C
Sodium	11	97.8
Copper	29	1083

Which of the following can be deduced from the given data?

1 Magnesium has a melting point between 97.8 ^{o}C and 1083 ^{o}C.

2 Copper has greater number of delocalised electrons.

3 Melting point decrease with increasing atomic number.

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

33. Two separate electrolyses were performed as follows.

1. Molten iron(III) chloride was electrolysed for 5 min using a current of 2 A using inert electrodes.
2. Dilute copper(II) chloride was electrolysed for 10 min using a current of 2 A using inert electrodes.

Gas volume measurements were made under the same conditions of temperature and pressure.

Which of the following is/are correct?

1 Chlorine gas was produced from the anode of both electrolyses.

2 Electrolysis 2 produced twice as much gas as Electrolysis 1.

3 0.395 g of solid was produced in Electrolysis 2.

34. Gas reforming is a process which is used by the industries to produce hydrogen gas. The reaction is as follows:

$CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$ ΔH = positive

Which of the following is/are **false**?

1 When the pressure is increased, the K_p of the reaction will decrease.

2 The process should be carried out at a high temperature to increase the equilibrium yield of hydrogen.

3 Removing hydrogen gas from the system continually will increase the overall production of hydrogen.

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

35. Given the following reaction:

$$\mathbf{P}(g) + \mathbf{Q}(g) \rightleftharpoons \mathbf{X}(g) + \mathbf{Y}(g) \qquad \Delta H = \text{Negative}$$

Forward reaction: $(\text{Rate})_f = k_f[\mathbf{P}][\mathbf{Q}]$

Backward reaction: $(\text{Rate})_b = k_b[\mathbf{X}][\mathbf{Y}]$

Which of the following is correct?

1 Increasing the pressure will not cause k_f and k_b values to change and the equilibrium position remains the same.

2 Increasing the temperature will only increase the value of k_b, which causes the equilibrium position to shift to the left.

3 Decreasing the pressure will not cause $(\text{Rate})_f$ and $(\text{Rate})_b$ values to change and the equilibrium position remains the same.

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

The colours of various vanadium ions in aqueous solution are given in the table below.

Oxidation state	V	IV	III	II
Ion	VO_2^+	VO^{2+}	V^{3+}	V^{2+}
Colour	yellow	blue	green	violet

Which of the following reactions (if any) can produce a green solution?

1 Adding excess Sn^{4+} ions to an acidified solution containing V^{2+} ions.

2 Bubbling excess SO_2 into an acidified solution of VO_2^+ ions.

3 Adding $Na_2S_2O_8$ to an acidified solution containing VO_2^+ ions.

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

37. In which of the following pairs of organic compounds is the compound on the left more volatile than the one on the right?

1 Propylamine and propan-1-ol

2 Cyclohexylamine and aminoethanoic acid

3 Phenylethanol and phenylethanoate

38. In which of the following reactions is the inorganic reagent acting as a nucleophile?

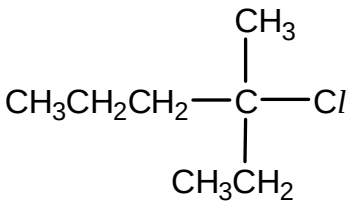
1 $CH_3CHCl + KCN \rightarrow CH_3CH_2CN + KCl$

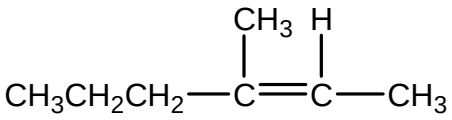
2 $CH_3COCl + NH_3 \rightarrow CH_3CONH_2 + HCl$

3 $CH_3CH_2NH_2 + HCl \rightarrow CH_3CH_2NH_3^+Cl^-$

39. Which of the following reactions will form a racemic mixture of products?

1 CH_3COCH_3 with HCN in trace amounts of NaOH

2  with NaOH(aq), heat under reflux

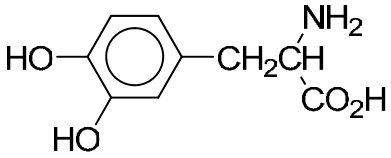
3  with HBr(g)

The responses **A** to **D** should be selected on the basis of

A	B	C	D
1, **2** and **3** are correct	**1** and **2** only are correct	**2** and **3** only are correct	**1** only is correct

No other combination of statements is used as a correct response.

40. Listening to music you enjoy releases the mood-enhancing chemical dopamine in your brain.



dopamine

Which of the following statement/s about dopamine is/are **false**?

1 It is soluble in water due to zwitterion formation.

2 It migrates to the cathode of an electrolytic cell at pH 14.

3 The acidity of dopamine will decrease when aqueous bromine is added.

Answers

1	**C**	**11**	**D**	**21**	**D**	**31**	**B**
2	**C**	**12**	**D**	**22**	**B**	**32**	**B**
3	**D**	**13**	**A**	**23**	**C**	**33**	**C**
4	**B**	**14**	**D**	**24**	**A**	**34**	**D**
5	**D**	**15**	**A**	**25**	**B**	**35**	**D**
6	**B**	**16**	**C**	**26**	**A**	**36**	**B**
7	**D**	**17**	**C**	**27**	**C**	**37**	**B**
8	**B**	**18**	**A**	**28**	**C**	**38**	**B**
9	**A**	**19**	**A**	**29**	**B**	**39**	**C**
10	**A**	**20**	**C**	**30**	**D**	**40**	**C**