JURONG JUNIOR COLLEGE
2015 JC 2 PRELIMINARY EXAMINATION
Higher 2

CANDIDATE NAME	
CLASS	**15S**

CHEMISTRY

9647/01

Paper 1 Multiple Choice

17 September 2015
1 hour

Candidates answer on separate paper.

Additional Materials: Multiple Choice Answer Sheet
Data Booklet

READ THESE INSTRUCTIONS FIRST

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

There are **forty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** or **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.

Section A

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

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

A 5.00 g sample of an anhydrous Group II metal nitrate loses 3.29 g in mass when heated strongly.

$$2M(NO_3)_2(s) \rightarrow 2MO(s) + 4NO_2(g) + O_2(g)$$

What is the metal?

A magnesium

B calcium

C strontium

D barium

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

Which element has an equal number of electron pairs and of unpaired electrons within orbitals of principal quantum number 2?

A oxygen **B** nitrogen **C** carbon **D** beryllium

3 Equations involving four enthalpy changes are shown.

$Na(g) \rightarrow Na^+(g) + e$ $\Delta H = w$

$Na(g) \rightarrow Na^{2+}(g) + 2e$ $\Delta H = x$

$Na(s) \rightarrow Na(g)$ $\Delta H = y$

$Na(s) \rightarrow Na^{2+}(g) + 2e$ $\Delta H = z$

Which expression represents the second ionisation energy of sodium?

A $2w$

B $x - w$

C $y + x - w$

D $z - y$

4 Which of the following exerts the highest pressure?

A 1 mol of H_2O at 27 ^oC in 1 dm^3

B 1 mol of CH_4 at 0 ^oC in 22.4 dm^3

C 1 mol of N_2 at 0 ^oC in 11.2 dm^3

D 1 mol of N_2 at 27 ^oC in 22.4 dm^3

5 *Use of the Data Booklet is relevant to this question*.
Element ***Y*** has atomic number less than 20.

The graphs below show the variation in first ionisation energy of some elements.

Figure 1 refers to the consecutive elements in the same Period as element ***Y*** and Figure 2 refers to elements in the same Group as element ***Y***.

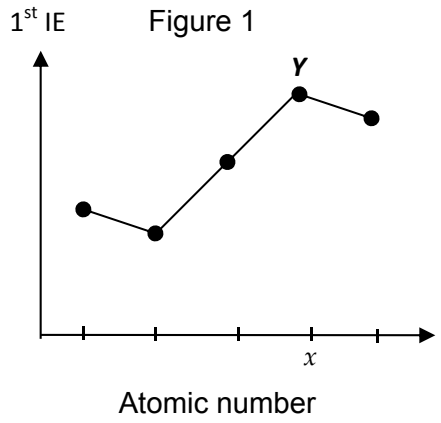


Figure 1

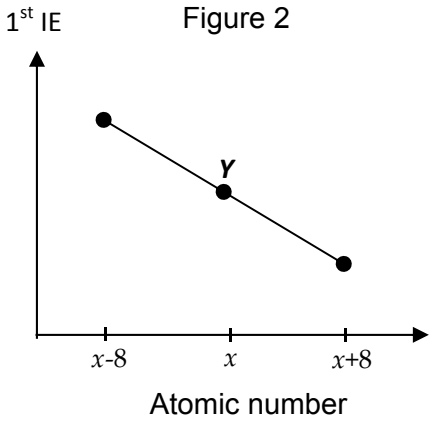


Figure 2

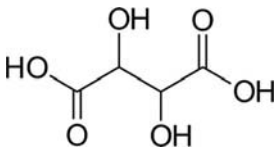
Identify ***Y***.

A carbon
B silicon
C nitrogen
D phosphorus

6 The following four statements are all true.
Which statement **cannot** be explained by reference to hydrogen bonding?

A At 0 °C, ice floats on water.
B The boiling point of 4-nitrophenol is higher than that of 2-nitrophenol.
C At 20 °C, ethanol and water mix completely.
D The amino acid glycine, $NH_2CH_2CO_2H$, is a solid at room temperature.

7 Tartaric acid has led the scientists to the discovery of chirality.



Based on the structure of tartaric acid shown above, which statement is correct about the structure?

A It has four trigonal planar carbon centers.
B It has a total of 13 σ bonds and 2 π bonds.
C It has a σ bond formed by sp^2-sp^2 overlap between two C atoms.
D It has a σ bond formed by sp^3-sp^3 overlap between two C atoms.

8 In a calorimetric experiment, 1.60 g of a fuel is burnt and the temperature of 200 g of water rises from 18 °C to 66 °C.

Given that 45% of the energy released is absorbed by the water, what is the total energy released per gram of fuel burnt?

[Specific heat capacity of water, c = 4.2 J $g^{-1}K^{-1}$]

A 25200 J

B 56000 J

C 89600 J

D 143360 J

9 The conversion of diamond to graphite is exothermic:

$$C(\text{diamond}) \rightarrow C(\text{graphite}) \qquad \Delta H = -3 \text{ kJ mol}^{-1}$$

However, the reaction does not occur spontaneously.

Which statement best explains the above?

A A tetrahedral configuration is always more stable than a planar one.

B Diamond has only strong covalent bonds whereas graphite has both covalent bonds and van der Waals' forces.

C The change from diamond to graphite has a high activation energy.

D The entropy change for the conversion of diamond to graphite is positive.

10 The standard enthalpy changes of combustion of carbon (graphite) and hydrogen are –394 kJ mol^{-1} and –286 kJ mol^{-1} respectively.

If the standard enthalpy change of combustion of propyne, C_3H_4, is –1938 kJ mol^{-1}, what is the standard enthalpy change of formation of propyne in kJ mol^{-1}?

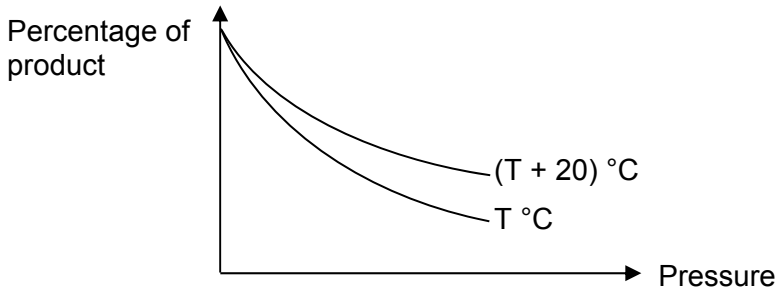
A +184

B –184

C +1258

D –1258

11 The graph below shows how the percentage of product present at equilibrium varies with temperature and pressure for a reaction.



Which reaction could the graph represent?

A $4Fe(s) + 3O_2(g) \rightleftharpoons 2Fe_2O_3(s)$ $\Delta H = -1644$ kJ mol^{-1}

B $2C(s) + O_2(g) \rightleftharpoons 2CO(g)$ $\Delta H = -222$ kJ mol^{-1}

C $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ $\Delta H = +57$ kJ mol^{-1}

D $CO(g) + Cl_2(g) \rightleftharpoons COCl_2(s)$ $\Delta H = +86$ kJ mol^{-1}

12 A solution contains 1 x 10^{-3} mol dm^{-3} of bromide, fluoride, iodide and sulfate ions.

Which lead(II) compound will be precipitated first when 0.01 mol dm^{-3} of lead(II) nitrate is added dropwise into the solution?

	compound	*numerical value of solubility product (at 25^{o}C)*
A	Lead(II) bromide	4.0 x 10^{-5}
B	Lead(II) fluoride	2.7 x 10^{-8}
C	Lead(II) iodide	7.1 x 10^{-9}
D	Lead(II) sulfate	1.6 x 10^{-8}

13 The table shows experimental results obtained for the following reaction:

$$2\boldsymbol{X}O + O_2 \rightarrow 2\boldsymbol{X}O_2$$

Experiment number	1	2	3	4
Partial pressure of ***X***O (kPa)	100	100	50	50
Partial pressure of O_2 (kPa)	100	25	100	*p*
Rate (kPa s^{-1})	10	2.5	5	1.25

Which statement is correct about the kinetics of this reaction?

A This is a single-step reaction.

B The numerical value of *p* is 25.

C The units for the rate constant can be expressed as s^{-1}.

D The rate will be 20 kPa s^{-1} if the volume of the reaction vessel in Experiment 1 is halved at constant temperature.

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

Sir Humphrey Davy showed that the corrosion of copper hulls of sea-going ships could be prevented by placing strips of 'sacrificial' metals on the hulls.

Which of the following metals is **least** likely to dissolve when attached to the copper hull of a sea-going ship?

A iron **B** magnesium

C tin **D** zinc

15 The reactivity of the Group II metals with oxygen increases down the group.

Which statement best explains this trend?

A Lattice energy of the Group II metal oxides decreases down the group.

B Ionic radius of the Group II metal cations increases down the group.

C Electronegativity of the Group II metals decreases down the group.

D Reducing power of the Group II metals increases down the group.

16 Which chlorine-containing anions are formed when chlorine is bubbled into cold aqueous potassium hydroxide?

A Cl^- and ClO^-

B Cl^- and ClO_3^-

C Cl^- and ClO_4^-

D ClO^- and ClO_3^-

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

Which statement is correct for the halogens, chlorine, bromine and iodine?

A They all oxidise Fe^{2+} to Fe^{3+}.

B They all dissolve in organic solvent to give coloured solutions.

C They all form hydrogen halides that are weak acids in aqueous solution.

D They all form insoluble silver salts that dissolve in concentrated aqueous ammonia.

18 Element **Z** is in Period 4 of the Periodic Table. The following four statements describe the properties of element **Z** or its compounds.

Three statements are correct descriptions. One of the statements is not correct because it does not fit with the other three.

Which statement is **not** correct?

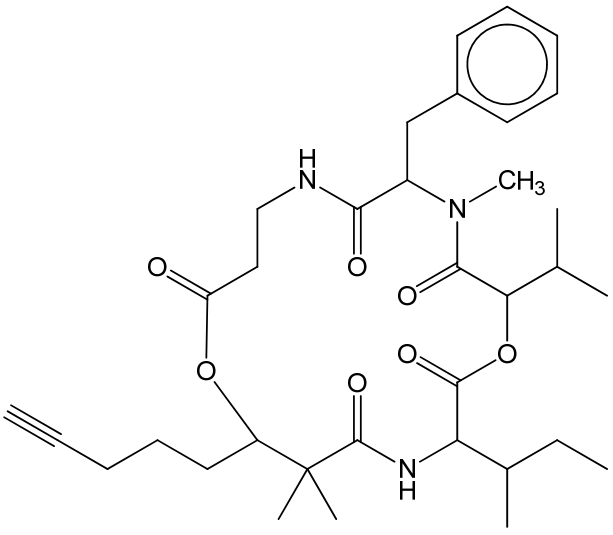
A Element **Z** is a solid at room temperature which conducts electricity.

B Element **Z** forms a chloride, **Z**Cl_3, which can act as a catalyst in some organic reactions.

C The chloride **Z**Cl_3 reacts with water to give an acidic solution.

D Adding NaOH(aq) to the solution resulting from the reaction of **Z**Cl_3 with water produces a white precipitate which is insoluble in an excess of NaOH(aq).

19 *Yanucamide B* can be extracted from marine sponge.



yanucamide B

How many optical isomers does *yanucamide B* have?

A 2^4 **B** 2^5 **C** 2^6 **D** 2^7

20 When heated with chlorine, an alkane, C_xH_y, undergoes free-radical substitution.
In a propagation step, the free radical R• is formed by the loss of one hydrogen atom.

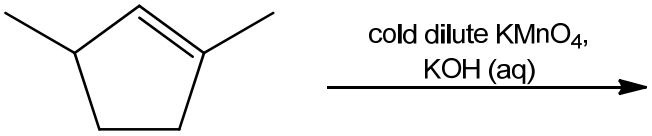
$$C_xH_y + Cl\bullet \longrightarrow R\bullet + HCl$$

How many different forms of R• are theoretically possible when 3-methylpentane is reacted with chlorine under this condition?

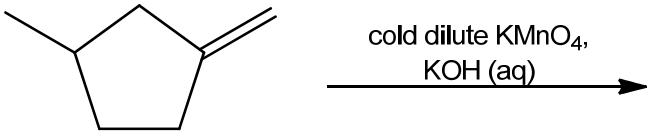
A 3 **B** 4 **C** 5 **D** 6

21 Which reaction forms a product which can be further oxidised to form a ketone?

A



B



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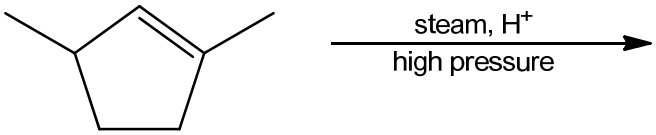
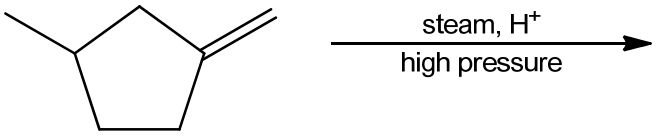
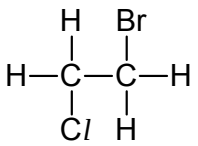


D

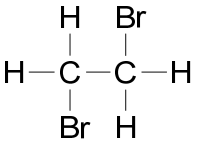


22 Which compound is **not** an addition product of the reaction between ethene with aqueous bromine in the presence of sodium chloride?

A



B



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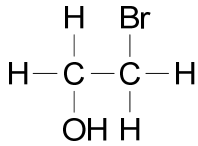
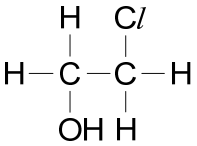
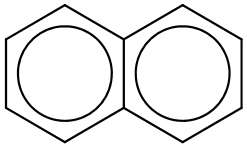


D



23 *Naphthalene* is an aromatic compound that is best known as the main ingredient of traditional mothballs.



Naphthalene

Naphthalene has similar reactions and reactivity as benzene.
Which statement about *naphthalene* is correct?

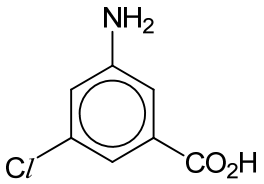
A The molecular formula of *naphthalene* is $C_{10}H_{10}$.

B There are 12 π electrons in a molecule of *naphthalene*.

C *Naphthalene* conducts electricity due to presence of delocalised electrons.

D All carbon-carbon bond lengths in *naphthalene* are intermediate between those of a C–C bond and a C=C bond.

24 A student wishes to synthesise compound **F** from benzene.



F

Which of the following routes would give the maximum yield of **F**?

A alkylation → nitration → chlorination → reduction → oxidation

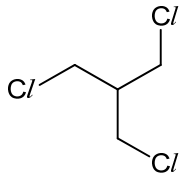
B alkylation → oxidation → nitration → reduction → chlorination

C nitration → alkylation → oxidation → chlorination → reduction

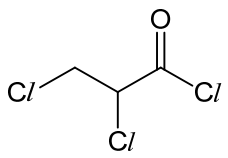
D chlorination → nitration → reduction → alkylation → oxidation

25 Aqueous silver nitrate can be used to test for the presence of halogen in organic compounds.
Which compound produces a precipitate most readily when aqueous silver nitrate is added?

A



B



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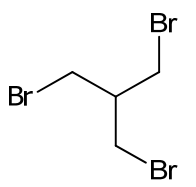
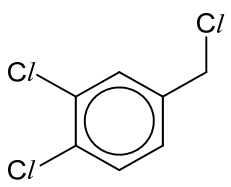


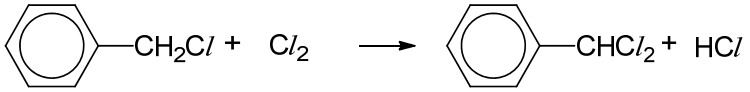
D

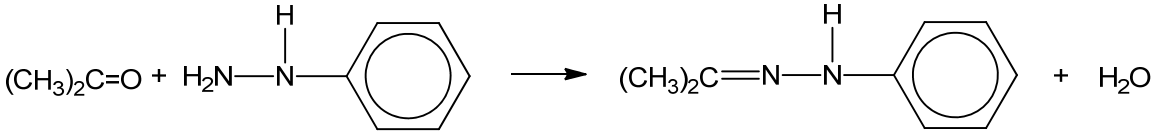


26 Which transformation does **not** involve a nucleophile?

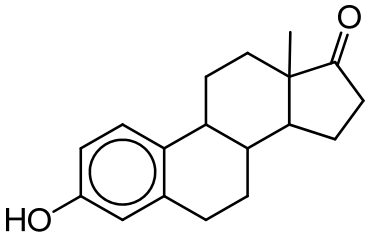
A $CH_3Br + (CH_3)_3P \longrightarrow (CH_3)_4P^+Br^-$

B $CH_3CH_2O^- + ClCH_2CO_2H \longrightarrow CH_3CH_2OCH_2CO_2H + Cl^-$

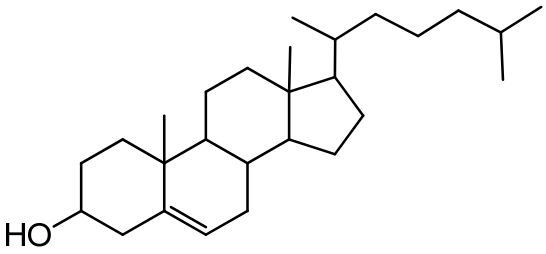
C 

D 

27 Estrone, a hormone secreted by the ovary, can be converted from cholesterol. The structures of both compounds are shown below.



estrone



cholesterol

Which reagent can be used to distinguish estrone from cholesterol?

A neutral $FeCl_3$(aq)

B hot acidified $KMnO_4$(aq)

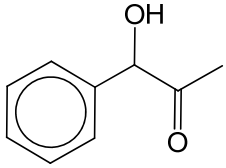
C Br_2(aq)

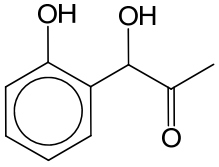
D Fehling's solution

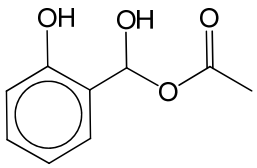
28 Compound **W** exhibits the following characteristics:

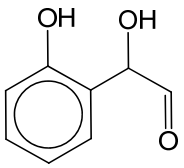
- 1 mol of **W** reacts with excess sodium metal to form 1 mol of hydrogen gas.
- Orange precipitate is formed when **W** reacts with 2,4-DNPH, but no reaction with diamminesilver(I) complex solution.
- Yellow precipitate is formed when **W** reacts with aqueous alkaline iodine.

What could compound **W** be?

A 

B 

C 

D 

29 Which sequence will give solutions of decreasing pH when equimolar quantities of the organic compounds are separately dissolved in water?

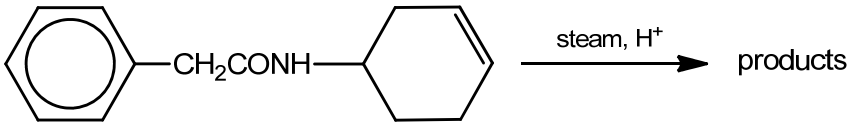
A ethanamide, ethanoic acid, ethanoyl chloride

B ethanamide, ethanoyl chloride, ethanoic acid

C ethanoyl chloride, ethanoic acid, ethanamide

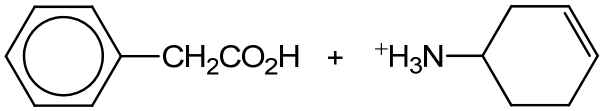
D ethanoic acid, ethanoyl chloride, ethanamide

30 The diagram shows a reaction:

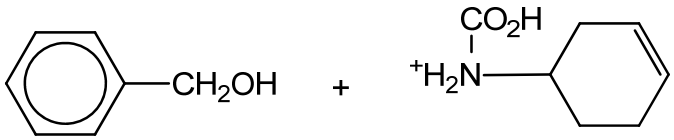


What could be the products?

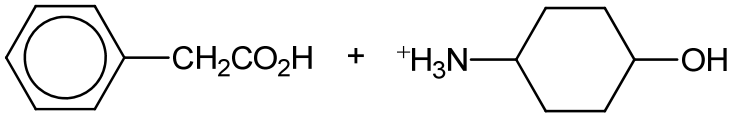
A



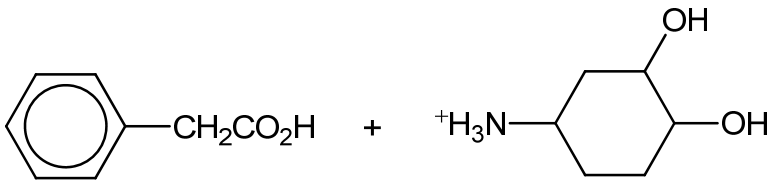
B



C



D



Section B

For each 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 (you may find it helpful to put a tick against the statements that you consider to be 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** are correct	**2** and **3** are correct	**1** only is correct

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

31 Which statements about relative atomic mass are correct?

1 It is a ratio of masses.

2 It has the same value as the mass of 1 mol of atoms.

3 It is related to the number of atoms in a molecule.

32 One suggestion for the reduction of greenhouse gas emissions from coal-fired power stations is to separate the CO_2 from the flue gases and pump it into the sea bed, where it dissolves in water under pressure.

$$CO_2(g) + nH_2O(l) \rightleftharpoons CO_2(aq)$$

During this process, hydrogen bonds are formed between $CO_2$and H_2O molecules.

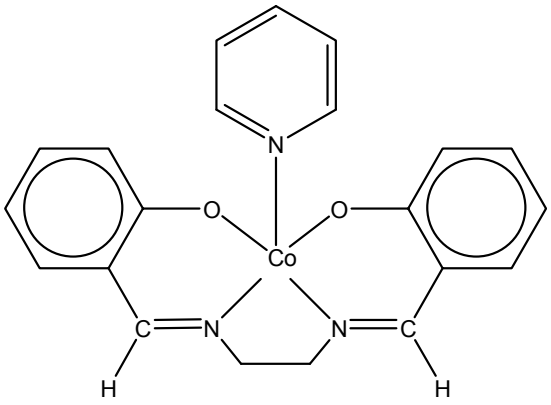
Which statements about this equilibrium for the forward reaction are correct?

1 ΔH and ΔS have the same sign.

2 Dissolution of CO_2 in water is favoured by an increase in temperature.

3 The dissolution of CO_2 in water is spontaneous.

33 The following cobalt complex is known to be the functional model for biological oxygen carrier.



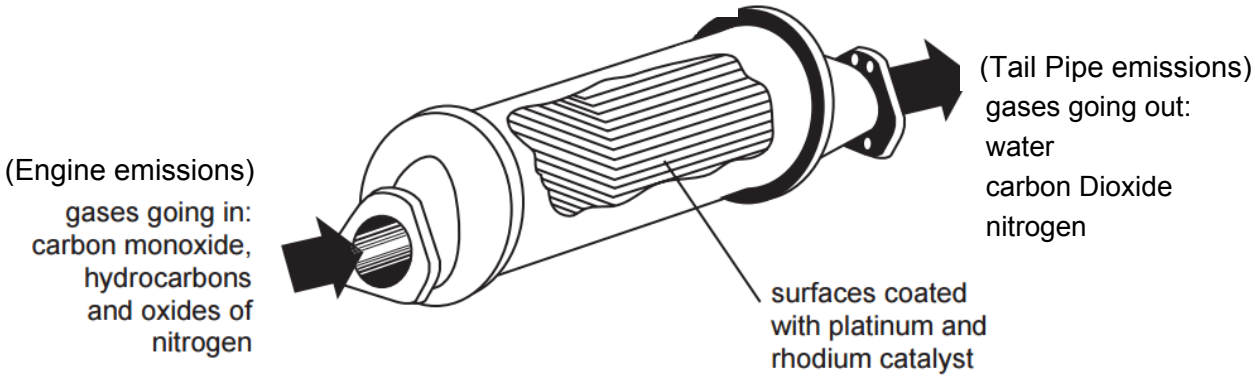
Which statements about this complex are correct?

1 The electronic configuration of cobalt cation in this complex is [Ar] $3d^7$.

2 The shape of this complex about the cobalt cation is square pyramidal.

3 This complex is likely to be insoluble in water.

34 An example of a three-way honeycomb type catalytic converter is shown below.



(This diagram is adapted from CIE Paper (9701), June 2004)

Which equations represent the reactions that took place in the catalytic converter?

1 $2CO(g) + O_2(g) \rightarrow 2CO_2(g)$

2 $2C_8H_{18}(g) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)$

3 $2NO(g) + 2CO(g) \rightarrow N_2(g) + 2CO_2(g)$

Section B

For each 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 (you may find it helpful to put a tick against the statements that you consider to be correct).

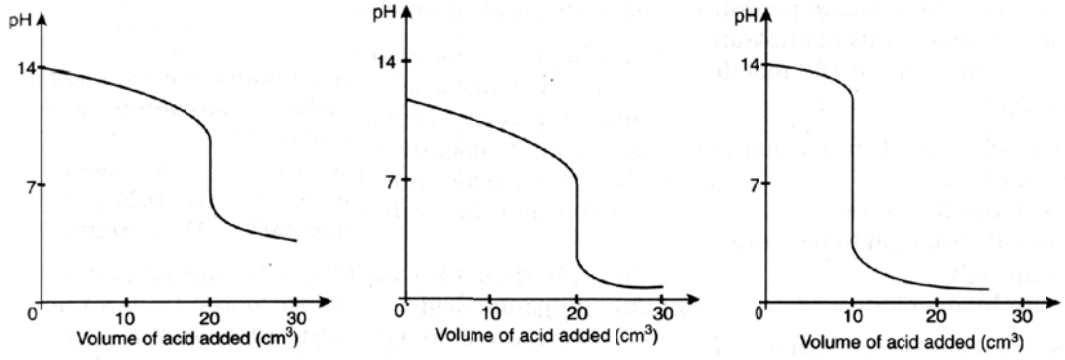
The responses **A** to **D** should be selected on the basis of

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

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

35 The following graphs show the change in pH when different pairs of acid and base were titrated against each other.

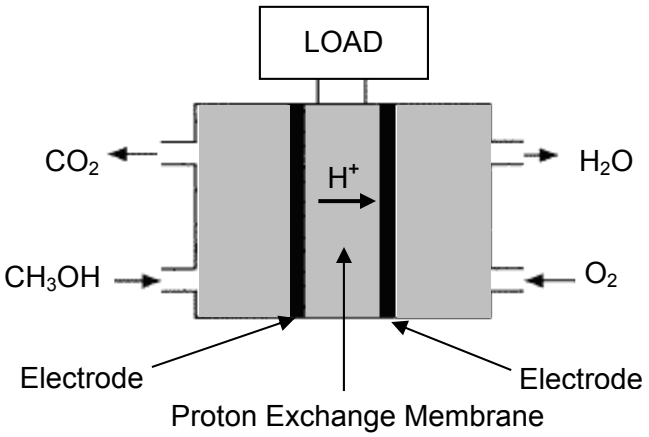
In each titration, a 1.0 mol dm^{-3} solution of the acid is gradually added to 20 cm^3 of a 1.0 mol dm^{-3} solution of the base.



Which pairs of solutions could have given any of the graphs above?

	base	*acid*
1	$Ba(OH)_2$	HC*l*
2	KOH	H_2SO_4
3	NH_3	HC*l*

36 Direct-methanol fuel cells make use of methanol as the fuel to generate energy. They are limited in the power they can produce, but can still store high energy content in a small space. The electrolyte in this fuel cell is a dilute aqueous acid.



Which statements are correct about this fuel cell?

1 The pH at the anode increases as energy is generated.

2 The proton exchange membrane functions as a salt bridge.

3 Electrons flow from the methanol/carbon dioxide half-cell to that of the oxygen/water half-cell.

37 A non-cyclic organic compound has the molecular formula $C_3H_7O_2N$.
Which pairs of functional groups could be present in this molecule?

1 one carboxylic acid group and one amine group

2 one amide group and one alcohol group

3 one ester group and one nitrile group

38 Which statements about amino acids found in the human body are always correct?

1 They exist as zwitterions at pH 7.

2 They are 2-aminocarboxylic acids.

3 They are soluble in water due to formation of ion-dipole interaction.

Section B

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

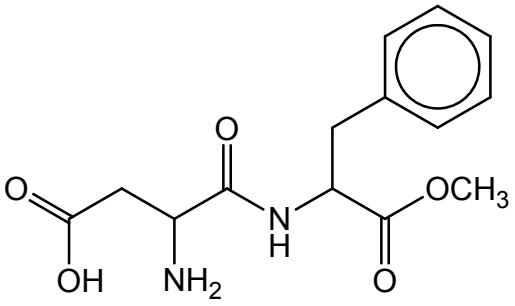
Decide whether each of the statements is or is not correct (you may find it helpful to put a tick against the statements that you consider to be correct).

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** are correct	**2** and **3** are correct	**1** only is correct

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

39 *Aspartame* is an artificial, non-saccharide sweetener used as a sugar substitute in some foods and beverages.



aspartame

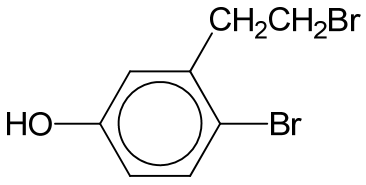
Which reactions will *aspartame* undergo?

1 On heating with NaOH(aq), three moles of NaOH are used up per mole of *aspartame*.

2 One mole of *aspartame* reacts with 2 moles of CH_3COCl.

3 *Aspartame* can be reduced by $NaBH_4$.

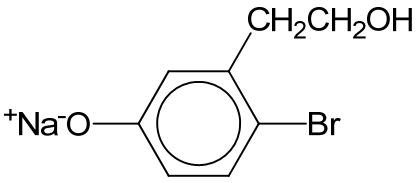
40 4-bromo-3-(bromoethyl)phenol was dissolved in an ethanol-water mixture and reacted with sodium hydroxide solution. The temperature of the reaction is then allowed to rise slowly.



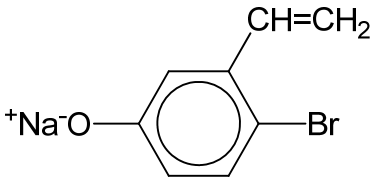
4-bromo-3-(bromoethyl)phenol

What could be a product of this reaction?

1



2



3