TAYLOR'S COLLEGE

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CAMBRIDGE A LEVEL PROGRAMME

AS TRIAL EXAMINATION AUGUST/SEPTEMBER 2012

(January & March 2012 Intakes)

Monday **29 August 2012** **8.30 am – 9.30 am**

CHEMISTRY 9701/13

PAPER 1 Multiple Choice 1 hour

Additional materials: Data Booklet
Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, highlighters, glue or correction fluid.
Write your name and class 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 **12** printed pages.

[Turn over

Section A

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

1 Of the following, one mole of sodium chloride, NaCl, is best represented by

A 6.02×10^{23} molecules of NaCl

B 58.5 g of NaCl

C 6.02×10^{23} atoms

D 6.02×10^{23} ions

2 In an experiment, 10 cm^3 of a hydrocarbon underwent complete combustion in 50 cm^3 of oxygen (an excess volume). The final gaseous mixture contained 20 cm^3 of carbon dioxide and 20 cm^3 unreacted oxygen. All gaseous volumes were measured under identical temperature and pressure. What is the molecular formula of the hydrocarbon?

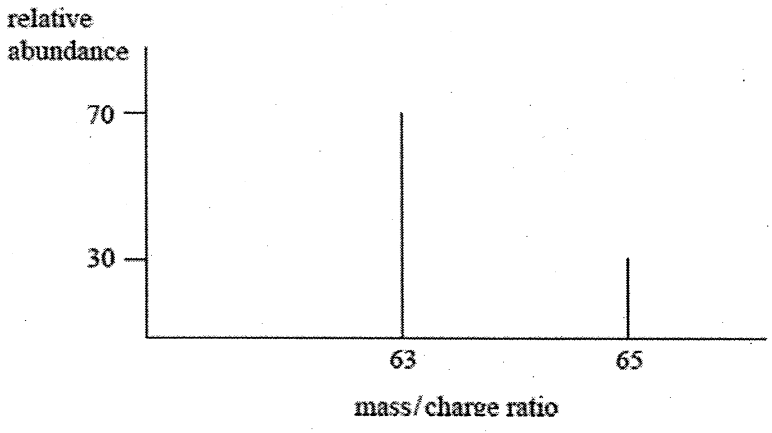
A CH_4

B C_2H_6

C C_2H_4

D C_3H_6

3 The mass spectrum for a sample of a metal is shown below.



The relative atomic mass of the metal is

A 63.2 **B** 63.4 **C** 63.6 **D** 64.0

4 Which of the following statements about SO_2 molecules is true?

A the O=S=O bond angle is 180°

B they have two lone pairs and two bond pairs

C they have one lone pair and two bond pairs

D they are trigonal planar

5 Which one of the following elements has the largest second ionization energy?

A S

B Cl

C Ar

D K

6 The complete combustion of ethanol is represented by the following equation:
C_2H_5OH (l) + $3O_2$ (g) → $2CO_2$ (g) + $3H_2O$ (l)
During this reaction,

A only covalent bonds break

B intermolecular forces and covalent bonds break

C only intermolecular forces break

D ionic bonds break

7 Consider the following reaction.
C (graphite) → C (diamond) $\Delta H = +2kJ$
From the above statement, we can conclude that

A the formation of a mole of graphite from diamond will release 2 kJ of energy

B to convert 2 moles of graphite into diamond, 2kJ of energy must be absorbed.

C the total energy of reactants is greater than the total energy of products.

D the conversion of 2 moles of diamond to graphite will absorb 4 kJ of energy

8 In the Haber process for the manufacture of ammonia, why is the heterogeneous catalyst iron in a finely divided state?

A to increase its surface area

B to produce the maximum reduction in the activation energy

C to reduce its loss during the reaction

D to reduce its surface area

9 What is the best definition of *rate of reaction*?

A The time it takes to use up all the reactants

B The rate at which all the reactants are used up

C The time it takes for one of the reactants to be used up

D The increase in concentration of a product per unit time

10 In 1999, researchers working in the USA believed that they had made a new element and that it had the following electronic structure.

[Rn] $5f^{14}$ $6d^{10}$ $7s^2$ $7p^6$

In which group of the Periodic Table would you expect to find this element?

A II **B** IV **C** VI **D** 0

11 Which of following statements about an acid is incorrect?

A It donates positive protons.

B It accepts negative ions.

C It produces hydrogen ions in water.

D It reacts with a base

12 Every year millions of tonnes each of chlorine and sodium hydroxide are manufactured by the electrolysis of brine using a 'diaphragm cell'.
What is the purpose of the diaphragm in such a cell?

A to prevent chlorine gas escaping into the factory

B to prevent the build up of pressure in the electrolysis cell

C to provide a large surface area of electrode

D to stop the products of electrolysis from reacting together

13 The value of the equilibrium constant, K*c*, for the reaction to form nitrogen dioxide from nitogen monoxide and carbon dioxide is 4.0 at 60 °C.

$NO\ (g) + CO_2\ (g) \rightleftharpoons NO_2\ (g) + CO\ (g)$

When 1.0 mol of nitogen monoxide and 1.0 mol of carbon dioxide are allowed to reach equilibrium at 60 °C, what is the number of moles of nitrogen dioxide formed?

A $\frac{1}{3}$ **B** $\frac{2}{3}$ **C** $\frac{1}{4}$ **D** $\frac{3}{4}$

14 Which of the following elements is the best electrical conductor?

A Iodine

B Phosphorus

C Mercury

D Diamond

15 Which of the following solids is an example of a substance with a macromolecular structure?

A Silicon(IV) oxide

B Aluminium chloride

C Sodium chloride

D Magnesium oxide

16 Which one of the following reagents, when mixed and heated with ammonium sulfate, liberates ammonia?

A Calcium oxide

B Sulfuric acid

C Nitrogen gas

D Aqueous bromine

17 In oil refineries, an important process is the recovery of any sulfur from petroleum. Sulfur compounds are converted into gas hydrogen sulfide, H_2S, by using a catalyst. The H_2S is then oxidized by using a controlled amount of air to give steam, $H_2O_{(g)}$, and sulfur, $S_{(s)}$.

The enthalpy change of formation of $H_2S_{(g)}$ is -20.5 $kJmol^{-1}$ and that of $H_2O_{(g)}$ is -243.0 $kJmol^{-1}$.

What is the enthalpy change of reaction per mole of H_2S?

A -202.5 $kJmol^{-1}$

B -222.5 $kJmol^{-1}$

C -263.5 $kJmol^{-1}$

D -445.0 $kJmol^{-1}$

18 How does concentrated sulfuric acid behave when it reacts with sodium chloride?

A as an acid only

B as an acid and oxidising agent

C as an oxidising agent only

D as a reducing agent only

19 When either chlorine or hydrogen chloride is passed over a heated metal *M*, the same chloride is produced. An aqueous solution of this chloride is acidic. Which one of the following could be *M*?

A Aluminium

B Barium

C Sodium

D Iron

20 What is the main reason why it is difficult to form nitrogen compounds from gaseous nitrogen?

A All reactions of N_2 are endothermic

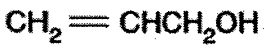
B The triple bond in nitrogen is three times as strong as N-N single bond

C The bond dissociation energy of N_2 is very high

D The first ionisation energy of nitrogen atom is very high

21 Smoke from a bonfire contains a compound that causes irritation to eyes. This compound readily decolourises aqueous bromine and produces a precipitate of silver when bubbled into Tollens' reagent.
What is a possible structure of the compound?

A



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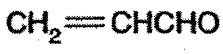

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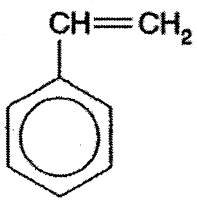

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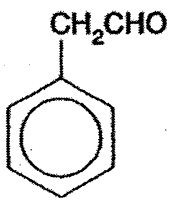


22 Which structure could be part of a chain of poly(chloroethene)?

A —$CCl_2CCl_2CCl_2$—

B —$CH_2CHClCH_2$—

C —$CHClCHClCHCl$—

D —$CCl_2CH_2CCl_2$—

23 When bromoethane is hydrolysed by aqueous sodium hydroxide, which ion brings about the first stage of substitution?

A the electrophile Na^+

B the nucleophile Na^+

C the electrophile OH^-

D the nucleophile OH^-

24 What is the product when the monomer of $—(CH_2CCl_2)—_n$ reacts with chlorine in an organic solvent?

A $CCl_2=CCl_2$

B CCl_3CCl_3

C $CHCl_2CCl_3$

D CH_2ClCCl_3

25 Which of the following is a **propagation** step in the reaction between methane and chlorine?

A $Cl_2 \rightarrow 2Cl\bullet$

B $CH_3\bullet + Cl\bullet \rightarrow CH_3Cl$

C $CH_3\bullet + HCl \rightarrow CH_3Cl + H\bullet$

D $CH_3\bullet + Cl_2 \rightarrow CH_3Cl + Cl\bullet$

26 The structures for two alarm pheromones for ants are given.
$CH_3CH_2CH_2CH=CHCHO$ and $CH_3CH_2CH(CH_3)COCH_2CH_3$
Which characteristic applied to both compounds?

A Both can be obtained by oxidation of alcohols.

B Both decolourise aqueous bromine.

C Both decolourise dilute alkaline potassium manganate (VII).

D Both show optical isomerism.

27 Some chlorobutanes were separately treated with hot ethanolic sodium hydroxide. Two of these gave the same hydrocarbon, C_4H_6.
From which pair of chlorobutanes was this hydrocarbon obtained?

A $CH_3CH_2CH_2CH_2Cl$ and $CH_3CH_2CH_2CHCl_2$

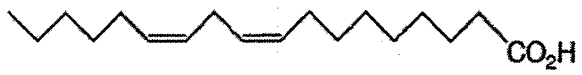
B $CH_3CHClCHClCH_3$ and $ClCH_2CH_2CH_2CH_2Cl$

C $CH_3CH_2CH_2CH_2Cl$ and $ClCH_2CH_2CH_2CH_2Cl$

D $CH_3CH_2CH_2CH_2Cl$ and $CH_3CH_2CHClCH_3$

28 It is claimed that many polyunsaturated margarines contain esters derived from cis-cis-linoleic acid, $CH_3(CH_2)_4CH{=}CHCH_2CH{=}CH(CH_2)_7CO_2H$.
Which skeletal formula of linoleic acid contains the cis-cis arrangement?

A



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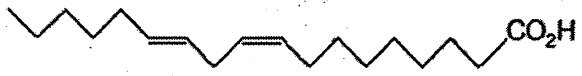

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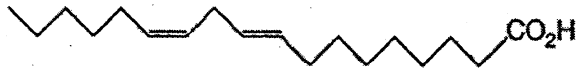

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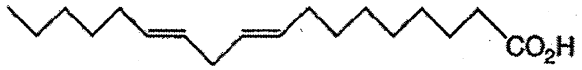
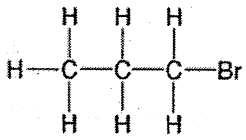


29 Propan-1-ol, C_3H_7OH, is dehydrated by passing its vapour over hot aluminium oxide to give a hydrocarbon.
Which structural formula represents the product obtained when the hydrocarbon reacts with bromine?

A



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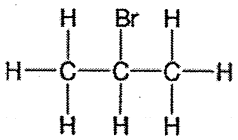

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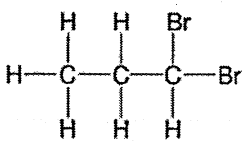

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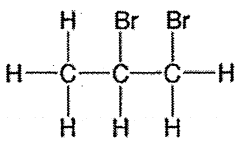
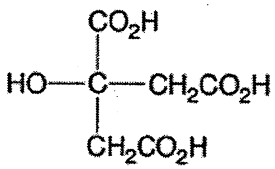


30 How many moles of hydrogen chloride are evolved when an excess of PCl_5 is added to one mole of citric acid?



citric acid

A 0 **B** 1 **C** 3 **D** 4

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 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 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 A species **R** has the following electronic configuration.

Which could **R** be?

1 Cl^+ ion **2** S atom **3** Ar^{2-} ion

32 Which statements correctly represent the behavior of an ideal gas? (p denotes pressure, V_m molar gas volume, M molar mass, c concentration, d density and T temperature)

1 $pV_m \alpha T$ **2** $pM \alpha \mathrm{dT}$ **3** $p \alpha cT$

33 Gaseous particle X has a proton number n and a charge of +1.
Gaseous particle Y has a proton number of (n+1) and is isoelectronic with (has the same number of electrons as) X.
Which statements correctly describe X and Y?

1 X has a larger radius than Y.

2 X requires more energy than Y when another electron is removed from each particle.

3 X releases more energy than Y when an electron is added to each particle.

34 Which statements about the manufacture of aluminium by electrolysis are correct?

1 The high temperature of the alumina/cryolite melt is partly maintained by the reactions on the carbon anode surface.
2 Cryolite is used so that the melting point of the electrolyte is lower.
3 Aluminium, being more dense than the molten electrolyte, sinks to the bottom of the cell.

35 Sodium reacts with ammonia to give hydrogen and sodamide which ionic.

$2Na + 2NH_3 \rightarrow 2NaNH_2 + H_2$

Which changes in oxidation number of the three elements involved occur?

1 -3 to -2
2 0 to +1
3 +1 to 0

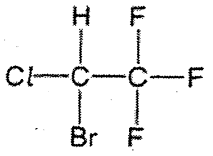
36 Many ceramic materials based on silicon (IV) oxide have recently been developed.
Which properties apply to these materials?

1 They are heated during manufacture and form solids.
2 They are heat-resistant solids.
3 They are good conductors of electricity due to delocalized electrons.

37 For the sequence hydrogen chloride, hydrogen bromide and hydrogen iodide, there is an increase in

1 Thermal stability.
2 Bond length.
3 Ease of oxidation.

38 Halothane is widely used anaesthetic.



Halothane

Which statements about Halothane are correct?

1 It is relatively unreactive.

2 The molecule has a chiral centre.

3 It may cause depletion of the ozone layer.

39 Malic acid, $HO_2CCH(OH)CH_2CO_2H$, is found in apples.

Which properties does malic acid have?

1 It can form esters both with ethanoic acids and with ethanol.

2 Its molecule contains a secondary alcohol group.

3 Its molecule has one chiral centre.

40 Which compounds may be prepared from $C_6H_5CHBrCH_3$ by the action of sodium hydroxide under different conditions?

1 $C_6H_5CO_2Na$

2 $C_6H_5CH(OH)CH_3$

3 $C_6H_5CH{=}CH_2$