Name:	Index No.:	CT Group: 12

H

PIONEER JUNIOR COLLEGE

JC2 PRELIMINARY EXAMINATION
HIGHER 2

CHEMISTRY 9647/01

Paper 1 Multiple Choice **27 September 2013**

1 hour

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, Centre number and 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** 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.

Section A

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

1 Carbon disulfide, CS_2, is a volatile flammable liquid used in the manufacture of cellophane.

On combustion, CS_2 is oxidised as follows.

$$CS_2(g) + 3O_2(g) \rightarrow CO_2(g) + 2SO_2(g)$$

A 20 cm^3 sample of carbon disulfide is ignited with 100 cm^3 of oxygen. The final volume of gas after burning is treated with an excess of aqueous alkali.

What percentage of this final volume remains after treatment with the alkali?

A 20% **B** 40% **C** 60% **D** 80%

2 25.0 cm^3 of 0.05 mol dm^{-3} $KClO_4$(aq) required 50.0 cm^3 of 0.20 mol dm^{-3} $TiCl_3$ (aq) to reach end-point.

Given that titanium(III) is oxidised to titanium(IV) in this reaction, which of the following formulae correctly represents the reduction product of the ClO_4^- ion?

A Cl^- **B** ClO_2^- **C** ClO_3^- **D** OCl^-

3 The successive ionisation energies, in kJ mol^{-1}, of an element **X** are given below.

870 1800 3000 3600 5800 7000 13200

Which of the following can be inferred from the data provided?

A **X** has no unpaired valence electrons in its atomic structure.

B **X** has a lower first ionisation energy than the element preceding it in the Periodic Table.

C **X** is likely to form an ionic compound with a non-metallic element.

D **X** would achieve noble gas configuration after removing all its first seven electrons.

4 A 2 g sample of hydrogen at temperature *T* and of volume *V* exerts a pressure *p*. Deuterium, $^{2}_{1}H$, is an isotope of hydrogen.

Which of the following would also exert a pressure of *p* at the same temperature *T*?

A a mixture of 1 g of hydrogen and 1 g of deuterium of total volume *V*

B a mixture of 1 g of hydrogen and 2 g of deuterium of total volume 2*V*

C a mixture of 2 g of hydrogen and 2 g of deuterium of total volume 2*V*

D a mixture of 2 g of hydrogen and 4 g of deuterium of total volume 2*V*

5 In which of the following pairs is the bond angle of the second molecule or ion greater than that of the first?

A NO_2^+, NO_2^-

B SO_4^{2-}, SO_3^{2-}

C BrF_3, ClF_3

D PH_3, AsH_3

6 Which of the following statements about the properties associated with ionic and covalent bonds is correct?

A A covalent compound can be an electrolyte.

B The only covalent compounds with high melting points are those in which hydrogen bonds occur.

C Ionic bonds and covalent bonds cannot both occur in the same compound.

D Any covalent compound that contains both oxygen and hydrogen in its molecules forms hydrogen bonds.

7 The enthalpy change of formation of $H_2S(g)$ and $H_2O(l)$ are -21 kJ mol^{-1} and -286 kJ mol^{-1} respectively and the enthalpy change of vaporisation of water is +41 kJ mol^{-1}.

What is the enthalpy change of reaction for the following process?

$$H_2S(g) + ½O_2(g) \longrightarrow H_2O(g) + S(s)$$

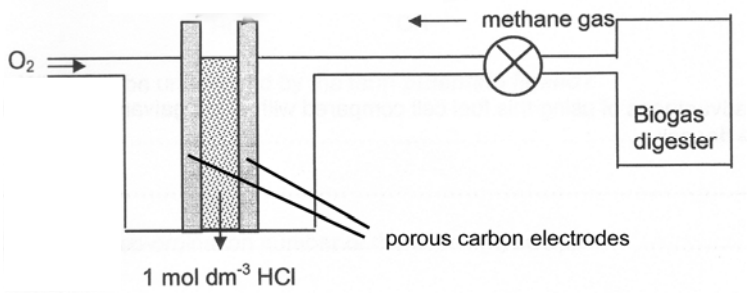
A -224 kJ mol^{-1}

B -266 kJ mol^{-1}

C -306 kJ mol^{-1}

D -348 kJ mol^{-1}

8 A methane-oxygen fuel cell is built using a 1 mol dm^{-3} hydrochloric acid as the electrolyte.



The overall equation for the reaction occurring in the fuel cell is:

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$$

What would be the change in pH of the solution around each electrode when current flows?

	cathode	*anode*
A	increases	increases
B	increases	decreases
C	decreases	increases
D	decreases	decreases

9 A voltaic cell is made up of the Mg^{2+}/Mg half-cell and the Fe^{3+}/Fe^{2+} half-cell.

Which one of the following statements is correct?

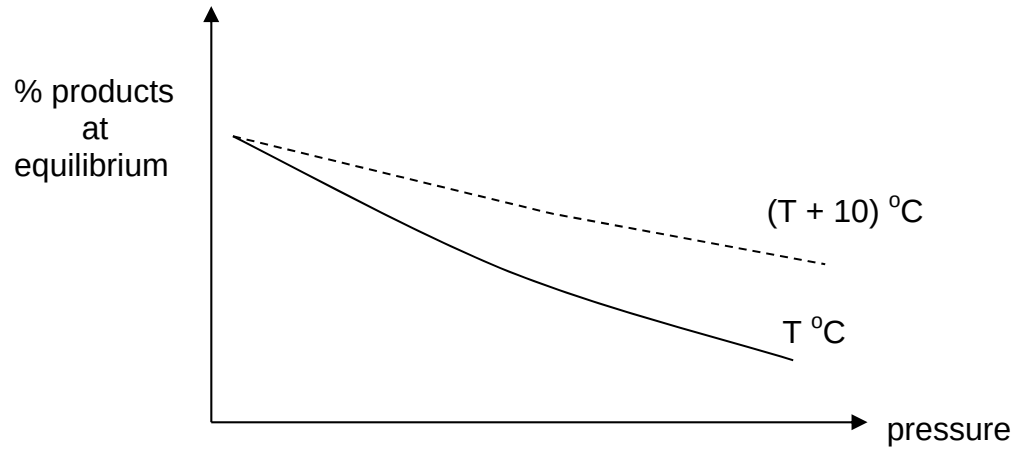
A The Mg^{2+}/ Mg half-cell is the positive electrode.

B Increasing the temperature has no effect on the e.m.f. of the cell.

C Addition of NaOH(aq) to the Mg^{2+}/ Mg half-cell decreases the e.m.f. of the cell.

D Addition of water to the Fe^{3+}/Fe^{2+} half-cell has no effect on the e.m.f. of the cell.

10 The graphs below show the variation of the percentage of gaseous products present at equlibrium, with temperature and pressure.



Which one of the following systems could the graphs represent?

A $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ $\Delta H = -92$ kJ mol^{-1}

B $3O_2(g) + 4NH_3(g) \rightleftharpoons 2N_2(g) + 6H_2O(g)$ $\Delta H = -1248$ kJ mol^{-1}

C $2N_2(g) + O_2(g) \rightleftharpoons 2N_2O\ (g)$ $\Delta H = +82$ kJ mol^{-1}

D $CO_2(g) + C(s) \rightleftharpoons 2CO\ (g)$ $\Delta H = +173$ kJ mol^{-1}

11 Which of the following statements about acids, bases and salts is correct?

A 10 cm^3 of 0.10 mol dm^{-3} of sodium hydroxide reacts with 5 cm^3 of 0.10 mol dm^{-3} ethanoic acid to produce an alkaline buffer.

B 10 cm^3 of 0.10 mol dm^{-3} of ammonia reacts with 5 cm^3 of 0.10 mol dm^{-3} hydrochloric acid to produce an alkaline buffer.

C 0.10 mol dm^{-3} of aqueous sodium ethanoate has lower pH than 0.10 mol dm^{-3} of aqueous ammonium chloride.

D 0.10 mol dm^{-3} of ethanoic acid has higher pH than 0.10 mol dm^{-3} of aqueous sodium ethanoate.

12 Which statement explains the observations that magnesium hydroxide dissolves in ammonium chloride, but not in aqueous sodium chloride?

A Ammonium hydroxide is first formed, and then acts through a common ion effect.

B The ammonium ion changes the solubility product of $Mg(OH)_2$.

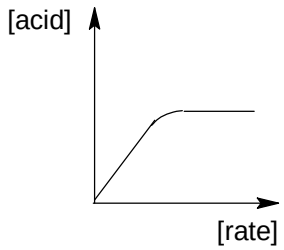
C NH_4Cl dissociates less fully than $NaCl$.

D The NH_4^+ ion acts as an acid.

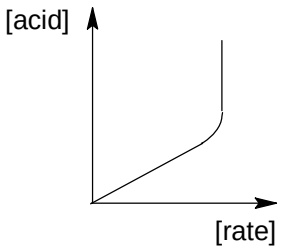
13 In the reaction between aqueous sodium thiosulfate and dilute acid, the reaction is found to be first order with respect to acid at low concentrations of acid, but zero order with respect to acid when the acid concentration is high.

Which graph represents the experimental results?

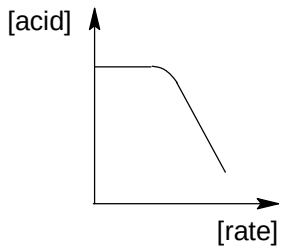
A



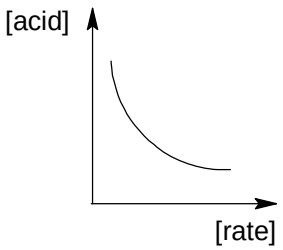
B



C



D



14 A chemical plant illegally dumped some radioactive waste in a landfill. This waste composed of two radioactive isotopes **M** and **N** in the proportion 4:1. The decay of radioactive isotopes follows first-order kinetics. The half-life of **M** is 2 days whereas that of **N** is 4 days. By the time the authorities found out about this illegal dumping and analysed a sample of the waste, they found equal amounts of **M** and **N**.

How long was the waste in the landfill before the authorities arrived?

A 2 days **B** 4 days **C** 8 days **D** 16 days

15 **P**, **Q** and **R** are elements of the third period of the Periodic Table. The oxide of **P** is amphoteric, the oxide of **Q** is basic and oxide of **R** is acidic.

What is the order of increasing atomic radius?

A **R** **P** **Q**

B **Q** **P** **R**

C **R** **Q** **P**

D **Q** **R** **P**

16 Magnesium oxide, a refractory material, is used in the lining of blast furnace. It is extracted from seawater as follows.

Aqueous calcium hydroxide is added to seawater.

$Ca(OH)_2(aq) + MgCl_2(aq) \rightarrow Mg(OH)_2(s) + CaCl_2(aq)$

The magnesium hydroxide is then filtered off and roasted.

Which of the following comparisons explains why solid magnesium hydroxide forms?

A Magnesium is lower than calcium in the reactivity series.

B The solubility product for $Mg(OH)_2$ is lower than that for $Ca(OH)_2$.

C The enthalpy change of hydration for Mg^{2+} is less exothermic than for Ca^{2+}.

D The magnitude of the lattice energy of $Mg(OH)_2$ is less than that of $Ca(OH)_2$.

17 Strontium lies between calcium and barium in Group II of the Periodic Table.

Which of the following properties could be predicted for strontium?

A It forms a water-soluble carbonate which does not decompose on heating.

B It burns in air to form an amphoteric oxide.

C It forms a nitrate which decomposes on heating to form strontium nitrite and oxygen.

D It is oxidised by cold water, liberating hydrogen.

18 An aqueous solution containing both potassium bromide and potassium iodide is treated with an excess of aqueous silver nitrate. The precipitate formed is filtered off and washed with distilled water. The precipitate is then shaken with concentrated aqueous ammonia and filtered off again.

Which ion is present in the final filtrate?

A bromide

B iodide

C potassium

D silver

19 An aqueous solution containing a mixture of Cu^{2+}, Fe^{2+} and Al^{3+} ions was treated with an excess of aqueous ammonia.

What precipitate was left by this reaction?

A $Cu(OH)_2$ and $Fe(OH)_2$

B $Fe(OH)_2$ and $Al(OH)_3$

C $Cu(OH)_2$ and $Al(OH)_3$

D $Fe(OH)_2$ only

20 When aqueous potassium fluoride is added to an aqueous solution of iron(III) chloride, the yellow solution decolourises. No colour change is observed when aqueous ammonium thiocyanate is added to the resulting solution. However, when aqueous sodium cyanide is added, the colourless solution turns red.

complex	$[Fe(H_2O)_6]^{3+}$	$[Fe(H_2O)F_5]^{2-}$	$[Fe(H_2O)_5SCN]^{2+}$	$[Fe(CN)_6]^{3-}$
colour	yellow	colourless	blood red	red

In which sequence are the ligands listed in order of increasing ligand strength?

A $F^- < SCN^- < CN^-$

B $SCN^- < F^- < CN^-$

C $F^- < CN^- < SCN^-$

D $CN^- < F^- < SCN^-$

21 How many isomers (including both structural isomers and stereoisomers) with molecular formula $C_4H_{10}O$ liberates hydrogen on reaction with sodium?

A 2 **B** 3 **C** 4 **D** 5

22 Ethane reacts with chlorine in the presence of ultraviolet light to form a mixture of products.

Which of the following about the reaction mechanism is **incorrect**?

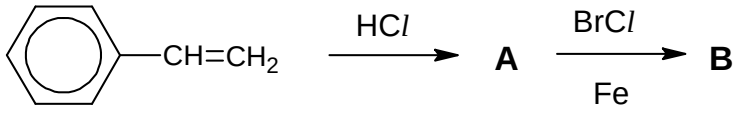
A Both initiation and propagation steps involve homolytic fission.

B Both initiation and propagation steps produce chlorine atoms.

C Both propagation and termination steps produce hydrogen chloride molecules.

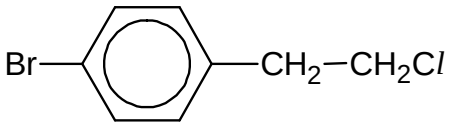
D Both propagation and termination steps involve C-C*l* bond formation.

23 Phenylethene undergoes the following reaction to form compound **B**.

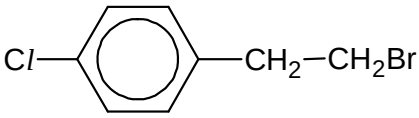


What is the structural formula of compound **B**?

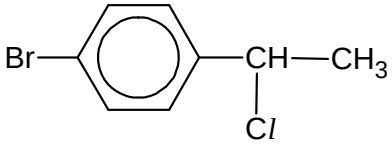
A



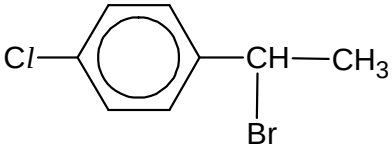
B



C



D



24 When sodium iodide in propanone is added to an optically active sample of 2-bromobutane, a sodium bromide precipitate is formed after 13 minutes upon heating.

$$NaI + CH_3CHBrCH_2CH_3 \longrightarrow CH_3CHICH_2CH_3 + NaBr(s)$$

The experiment was repeated several times and the rate equation was found to be

$$\text{Rate} = k[CH_3CHBrCH_2CH_3][NaI]$$

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

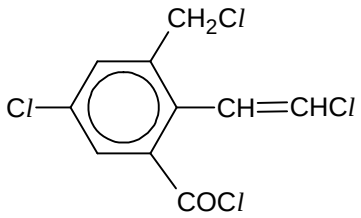
A The mechanism involves a reactive intermediate.

B The organic product obtained rotates the plane of polarised light.

C A similar experiment, using 1-bromobutane, will produce a precipitate in less than 13 minutes.

D A similar experiment, using 2-chlorobutane, will take more than 13 minutes to produce a precipitate.

25 The structural formula of compound **Y** is shown below.



Compound **Y**

1 mole of compound **Y** is heated with an excess of aqueous sodium hydroxide. The reaction mixture is cooled and acidified with dilute nitric acid.

How many moles of silver chloride will be precipitated out when an excess of silver nitrate is added to the resulting mixture?

A 0 **B** 1 **C** 2 **D** 3

26 Lithium tetrahydridoaluminate, $LiAlH_4$, is a strong reducing agent.

Which of the following reduction could **not** be achieved using $LiAlH_4$?

A $CH_2=CH_2$ to CH_3CH_3

B CH_3CHO to CH_3CH_2OH

C CH_3CONH_2 to $CH_3CH_2NH_2$

D CH_3OCOCH_3 to CH_3CH_2OH and CH_3OH

27 In the presence of dilute alkali, some aldehydes and ketones undergo nucleophilic addition to form a hydroxycarbonyl compound. For example, ethanal forms 3-hydroxybutanal.

$$2CH_3CHO \xrightarrow{OH^-} CH_3CH(OH)CH_2CHO$$

Which of the following gives the structure of the product formed when propanone undergoes the same reaction?

A $CH_3CH_2CH(OH)CH(CH_3)CHO$

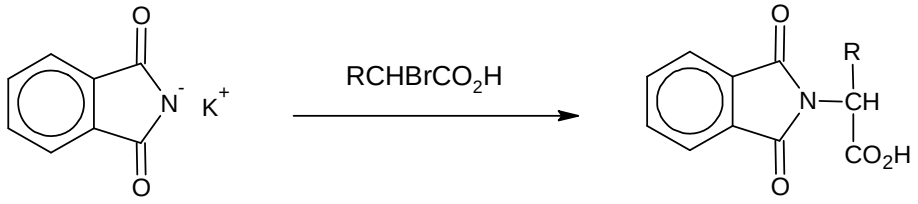
B $CH_3C(OH)(CH_3)CH(CH_3)CHO$

C $CH_3CH_2CH(OH)CH_2COCH_3$

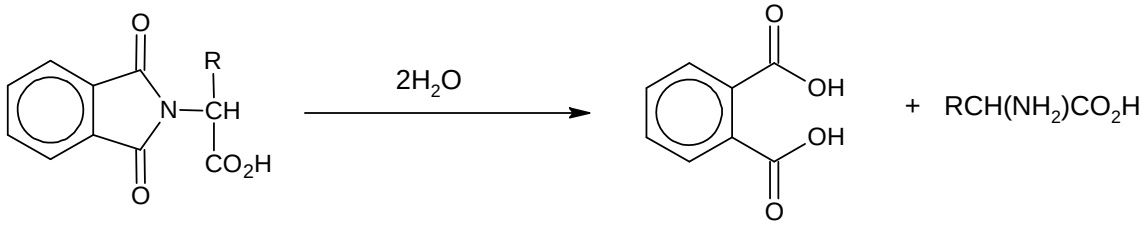
D $CH_3C(OH)(CH_3)CH_2COCH_3$

28 The Gabriel synthesis shown below is used to synthesise amino acids.

Step 1:



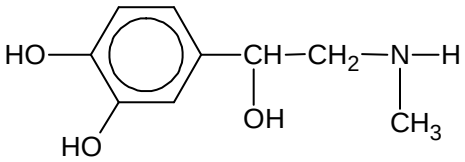
Step 2:



Which of the following gives the types of reaction taking place in step **1** and **2**?

	Step 1	**Step 2**
A	electrophilic substitution	hydrolysis
B	nucleophilic substitution	hydrolysis
C	electrophilic substitution	oxidation
D	nucleophilic substitution	oxidation

29 Adrenalin is a hormone which, when secreted directly into the bloodstream, acts a stimulant. It has the structure:



Which of the following statements about adrenalin is correct?

A 1 mole of adrenalin reacts with excess PCl_5 to form 3 moles of HCl.

B The number of sp^3 hybridised carbon atoms increases by one when adrenalin is heated with acidified potassium dichromate(VI).

C It dissolves in aqueous sodium hydroxide but not in aqueous sodium carbonate.

D A secondary amide is obtained when adrenalin reacts with ethanoyl chloride.

30 A small peptide **Z** is hydrolysed according to the following reaction.

$$\mathbf{Z} \xrightarrow{\text{hydrolysis}} 2NH_2CH_2CO_2H + 2NH_2CH(CH_3)CO_2H + 2NH_2CH(CH_2OH)CO_2H$$

(M_r = 75) (M_r = 89) (M_r = 105)

What is the M_r of **Z**?

A 430 **B** 448

C 520 **D** 538

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 (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 The use of *Data Booklet* is relevant to this question.

Calcium burns in oxygen with a red flame.

Which statements about the electronic arrangements in the atoms and ions of calcium and oxygen are correct?

1 Ca^{2+} and O^{2-} ions have similar outer electronic configurations.

2 A Ca atom has two more occupied electron shells than an O^{2-} ion.

3 A Ca^{2+} ion has one more occupied electron shell than an O atom.

32 Which of the following statements about an ideal gas are correct?

1 One mole of any ideal gas occupies the same volume under the same conditions of temperature and pressure.

2 The density of an ideal gas at constant pressure is directly proportional to the temperature.

3 The volume of a given mass of an ideal gas is doubled when its temperature is raised from 25 °C to 50 °C.

33 An aqueous copper(II) salt is electrolysed between copper electrodes, using a constant current.

Which of the factors below would affect the mass of the copper deposited on the electrode?

1 the time taken

2 the concentration of the solution

3 the size of the electrode used

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.

34 In the gas phase, aluminium chloride dimerises to form Al_2Cl_6 molecules.

Which of the following are structural features of the Al_2Cl_6 molecules?

1 Each aluminium atom is surrounded by four chlorine atoms.

2 There are sixteen non-bonded electron pairs in the molecule.

3 Each aluminium atom contributes electrons to four covalent bonds.

35 Which of the following account for the decrease in oxidising power of the halogens down the group, from Cl_2 to I_2?

1 a less endothermic enthalpy change of atomisation

2 a less exothermic electron affinity

3 a less exothermic enthalpy change of hydration

36 In which of the following chemical reactions does the transition metal compounds function as catalysts?

1 The chlorination of benzene, using chlorine and iron(III) chloride.

2 The formation of oxygen from hydrogen peroxide, using iron(III) hydroxide.

3 The formation of ethanal from ethanol, using acidified potassium dichromate(VI).

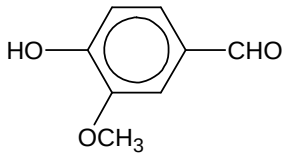
15

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 Vanillin is the active ingredient of vanilla.



vanillin

Which of the following will be observed with vanillin?

1 Hot alkaline potassium manganate(VII) turns green and eventually forms a brown precipitate.

2 A brick-red precipitate is formed on warming with Fehling's solution.

3 A yellow precipitate is formed on warming with aqueous, alkaline iodine.

38 Propanal and propanone are both colourless liquids which react with 2,4-DNPH to form precipitates known as 2,4-dinitrophenylhydrazones.

Which of the following statements about the reaction are correct?

1 The type of reaction involved is condensation.

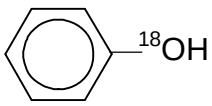
2 The 2,4-dinitrophenylhydrazone obtained from propanal shows geometric isomerism but not the one obtained from propanone.

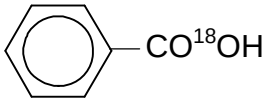
3 The identities of the carbonyl compounds can be determined by measuring the melting points of the 2,4-dinitrophenylhydrazones.

39 Phenyl ethanoate undergoes acid hydrolysis in the presence of water labelled with the ^{18}O isotope.

Which of the following products are formed?

1 $CH_3CO^{18}OH$

2 

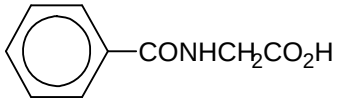
3 

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 Benzoylglycine (hippuric acid) was first isolated from stallions' urine.



benzoylglycine

Which properties does this compound possess?

1 It can be hydrolysed to produce an amino acid.

2 It can be neutralised by cold aqueous sodium hydroxide.

3 It can be made by reacting benzoic acid with aminoethanoic acid.

END OF PAPER

Answers

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