TRIAL TEST 4:
ORGANIC CHEMISTRY
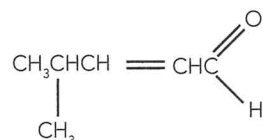
| Time allowed: 70 minutes | Section 1 – Multiple Choice | 20 marks |
| Total marks: 80 | Section 2 – Short & Extended Answer | 60 marks |

SECTION 1 – MULTIPLE CHOICE (20 MARKS)

1. Consider the compound whose structural formula is drawn below:

The IUPAC name for this molecule would need to indicate that the functional groups it contained included:
(a) a double bond and an aldehyde group.
(b) an alkyl group and an alcohol group.
(c) an alkyl group and a carboxyl group.
(d) a double bond and a carboxyl group.

2. From the list of 5 names below, pick the combination that are isomers of each other.

| I | butanoic acid | II | butan-2-ol | III | ethyl ethanoate |
| IV | butanal | V | butanone | | |

(a) I and II
(b) II and III
(c) III and IV
(d) IV and V

3. Three important types of chemical reaction are:

I Condensation polymerisation
II Addition polymerisation
III Esterification

The equation for the production of terylene is:
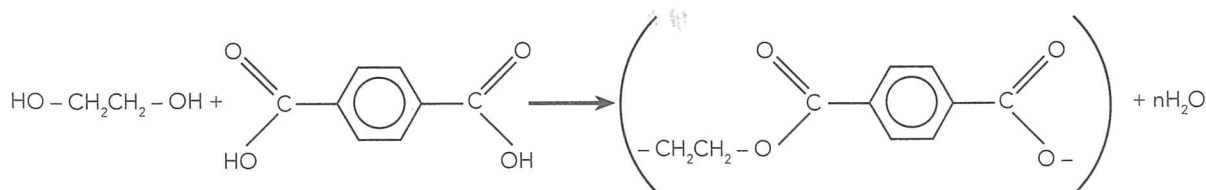
This reaction could be classified as a type:
(a) I reaction only.
(b) II reaction only.
(c) I and III reaction.
(d) II and III reaction.

4. Which of the following lists contains empirical formulae **only**.

   (a) C_2H_6 $CuSO_4$ Mn_2O_3

   (b) HO C_2H_3O $N_2H_8SO_4$

   (c) OF_2 CCl_4 C_6H_6

   (d) $Pt_2N_2H_6Cl_2$ AgN_2H_6 CaO_2H_2

Use the structural formulae drawn below to answer questions 5 to 7.
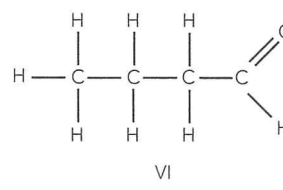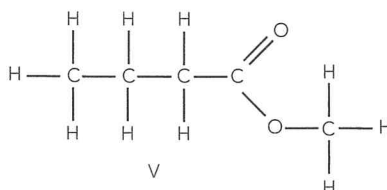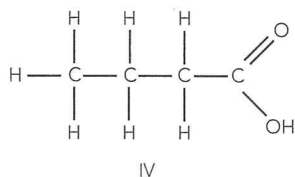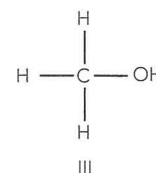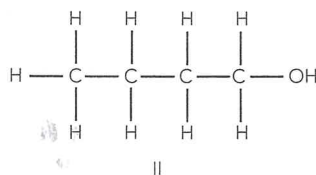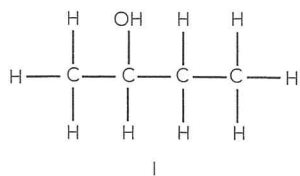
5. The substances which are polar but **do not** exhibit hydrogen bonding are:

   (a) IV & VI

   (b) I, IV, V & VI

   (c) IV & V

   (d) V & VI

6. The substance that would react with acidified $KMnO_4$ to form an isomer of VI is:

   (a) I

   (b) II

   (c) III

   (d) IV

7. The two substances that could be used to produce a third from the list are:

   (a) III & VI

   (b) II & IV

   (c) III & IV

   (d) V & VI

8. A compound containing only C, H and O was found to be composed of 77.38% oxygen and 19.36% carbon.

   (a) The compound would be carboxylic acid as it contains carbon, oxygen and a very small amount of hydrogen.

   (b) To determine the molecular formula of the compound, it would be necessary to vaporise a known mass of the compound to determine the percentage of hydrogen present.

   (c) The compound would be a carboxylic acid or an ester, more information would be needed to determine which.

   (d) The compound has an empirical formula O_3CH_2.

9. Consider the molecule shown.
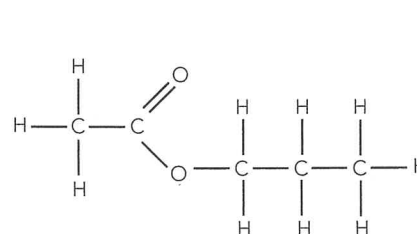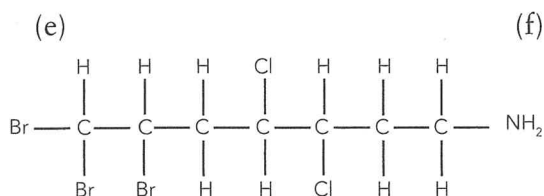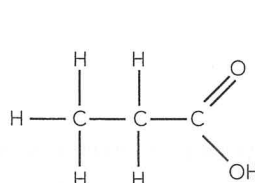
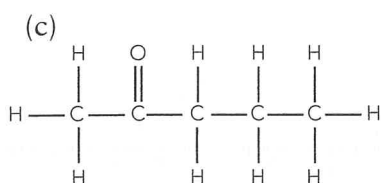   This molecule would be best identified as:

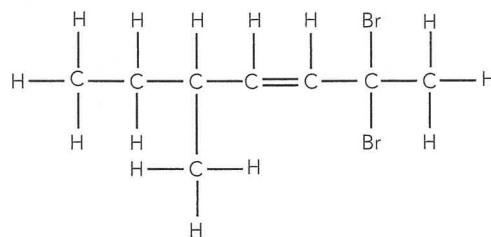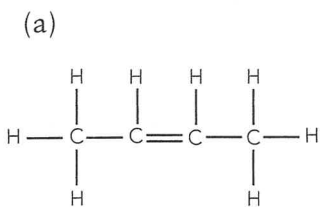   (a) a carboxylic acid

   (b) a primary amine

   (c) an α-amino acid

   (d) an amino aldehyde
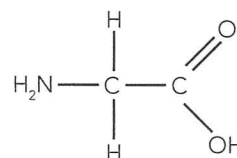
10. Which of the following compounds would you expect to be most soluble in water?
    (a)   propane
    (b)   propanal
    (c)   propanone
    (d)   propan-1-ol

SECTION 2 – SHORT AND EXTENDED ANSWER (60 MARKS)

11. Use IUPAC rules to name the following compounds.

(a)

(b)

(c)

(d)

(e)

(f)

[12 marks]

12. Draw the structural formula for each of the following compounds.

    (a)   1,2-dichloroethane

    (b)   *trans*-but-2-ene

    (c)   *cis*-2,3-diiodopent-2-ene

    (d)   pentan-1-amine (or pentanamine)

    (e)   3,4-dimethylheptanal

    (f)   propyl butanoate

[12 marks]

13. Write the balanced equation for each of the following reactions:

(a) propene + chlorine gas

_____

(b) butane + excess oxygen gas

_____

(c) ethane + bromine (in presence of suitable catalyst)

_____

[6 marks]

14. Use half equations to write balanced equations for the following reactions and name the organic product produced.

(a) Acidified potassium dichromate and propanal

OXIDATION: _____

REDUCTION: _____

REDOX: _____

NAME: _____

(b) Acidified potassium permanganate and butan-2-ol

OXIDATION: _____

REDUCTION: _____

REDOX: _____

NAME: _____

[8 marks]

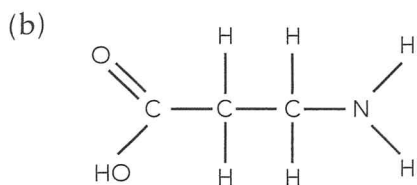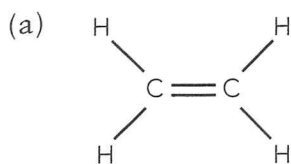15. Draw the structural formula and name the organic product of the following reactions:

(a) ethanol + propanoic acid
    _(with concentrated H_2SO_4 as catalyst)_

(b) heptan-1-ol + butanoic acid
   _(with concentrated H_2SO_4 as catalyst)_

[4 marks]

16. Draw a section of the polymer chain formed when the following monomers are polymerised. You need to draw at least 4 monomer units in your polymer.

(a)

$$H-C=C-H$$

(with H atoms on each carbon: H, H on left C and H, H on right C forming $CH_2=CH_2$)

(b)

A molecule: $O=C(HO)-CH_2-CH_2-NH_2$

[4 marks]

17. The general formula of an a-amino acid can be written as:

$$H_2N-\overset{\displaystyle H}{\underset{\displaystyle R}{C}}-C\overset{\displaystyle O}{\underset{\displaystyle OH}{}}$$
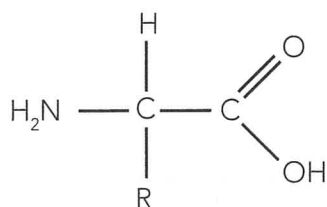
Write the formula to show the ions formed when:

(a) It is dissolved in an acidic solution

_____

(b) It is dissolved in a basic solution

_____

[4 marks]

18. A 0.467 g sample of nicotine was burnt in excess oxygen to produce 1.266 g of carbon dioxide and 0.3589 g of water vapour.

A second sample of the nicotine, weighing 0.362 g was analysed and found to contain 0.06263 g of nitrogen.

A third sample of the nicotine, weighing 0.964 g was vaporised in a 0.0500 L container and found to exert a pressure of 544 kPa at a temperature of 277°C.

Determine the empirical and molecular formulae of the nicotine.

_____

_____

_____

_____

173

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

[10 marks]

END OF TEST – TOTAL 80 MARKS

iron with zinc. The more reactive zinc will corrode in preference to the iron.

- Using cathodic prevention by applying a low voltage to, say, a steel jetty. The power source provides a source of electrons in preference to the iron.

[14]

TRIAL TEST 4:
Organic Chemistry

Section 1

1. a
2. d
3. c
4. b
5. d

6. a
7. c
8. d
9. c
10. d

[20]

Section 2

11.
(a) cis-but-2-ene
(b) cis-2,2-dibromo-5-methylhept-3-ene
(c) pentan-2-one
(d) propanoic acid
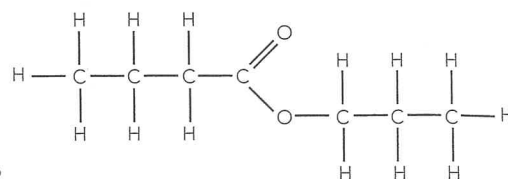(e) 6,7,7-tribromo-3,4-dichloroheptan-1-amine
(f) propylethanoate

12.
(a)

(b)

(c)

(d)

(e)

(f)
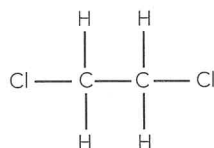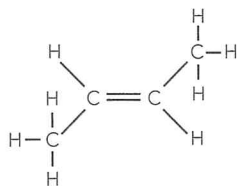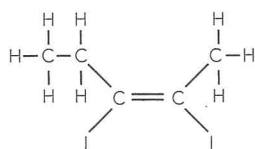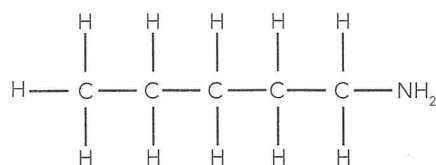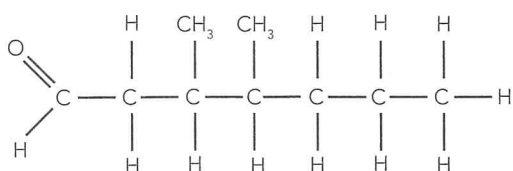
13.
(a)
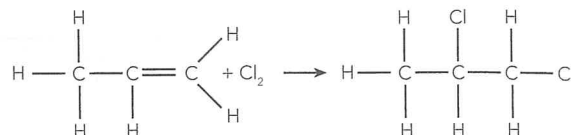
(b) $2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$

(c)
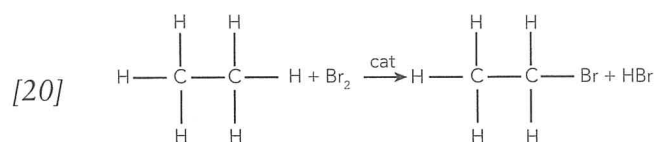
14.
(a) Oxidation: $CH_3CH_2CHO + H_2O \rightarrow CH_3CH_2COOH + 2H^+ + 2e^-$
Reduction: $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$
Redox: $3CH_3CH_2HO + Cr_2O_7^{2-}(aq) + 8H^+(aq) \rightarrow 3CH_3CH_2COOH(aq) + 2Cr^{3+}(aq) + 4H_2O(l)$
Name: propanoic acid

(b) Oxidation: $CH_3CHOHCH_2CH_3 \rightarrow CH_3COCH_2CH_3 + 2H^+ + 2e$
Reduction: $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$
Redox: $5CH_3CHOHCH_2CH_3 + 2MnO_4^-(aq) + 6H^+(aq) \rightarrow 5CH_3COCH_2CH_3 + 2Mn^{2+}(aq) + 8H_2O(l)$
Name: butanone

15.
(a)
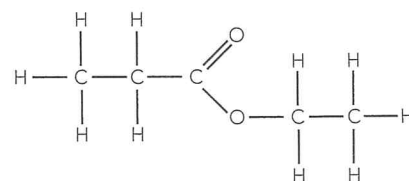
ethyl propanoate

(b)
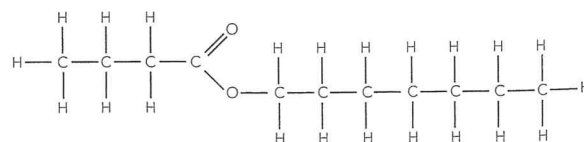
heptyl butanoate

16.
(a)

(b)

17.
(a)
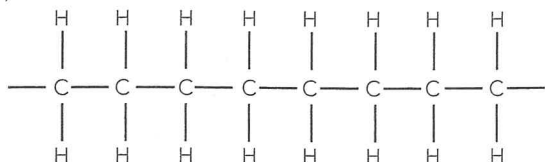
(b)
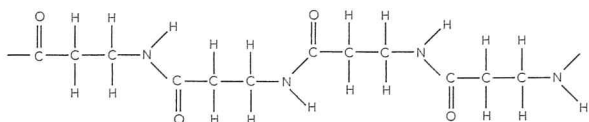
Nicotine contains C, H + N only

C	H	N
0.02877	0.03984	0.005767
0.005767	0.005767	0.005767
4.98	6.91	1

EF of Nicotine = C_5H_7N

Sample 3
$m = 0.964$ g

$$n = \frac{PV}{RT} = \frac{544 \times 0.0500}{8.315 \times 550} = 5.948 \times 10^{-3} \, mol$$

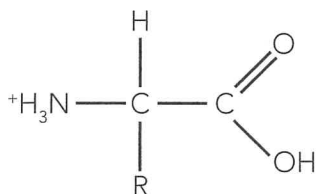$$M = \frac{m}{n} = \frac{0.964}{5.948 \times 10^{-3}} = 162.08 \, g \, mol^{-1}$$

mass of EF = 81.116

mass of molecular formula = 2 × mass of EF
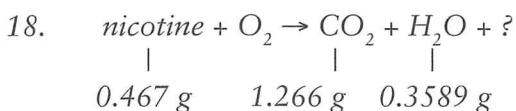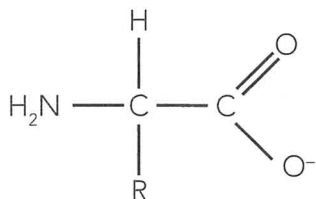∴ *molecular formula = 2 × EF*
= $C_{10}H_{14}N_2$

18. nicotine + $O_2 \rightarrow CO_2 + H_2O + ?$
| | | |
0.467 g   1.266 g   0.3589 g

$$n(C) = n(CO_2) = \frac{1.266}{44.01} = 0.02877 \, mol$$

$$m(C) = 0.02877 \times 12.01 = 0.34548 \, g$$

$$n(H) = 2n(H_2O) = \frac{2 \times 0.3589}{18.016} = 0.03984 \, mol$$

$$m(H) = 0.03984 \times 1.008 = 0.04016 \, g$$

2nd sample is different size to first sample but must contain the same proportion of N. i.e. proportion N in first sample

$$= 0.467 \times \frac{0.06263}{0.362}$$

$$= 0.0808 \, g$$

$$n(N) \text{ in first sample} = \frac{0.0808}{14.01} = 5.767 \times 10^{-3} \, mol$$

$$m(O) \text{ in nicotine} = 0.467 - (0.3455 + 0.04016 + 0.0808) = 0.0 \, g$$