Marking Scheme: Organic (IGCSE 0620)

Question 1

(i) butanoic acid/butyric acid

(displayed formula below)

\[ \text{H} \quad \text{H} \quad \text{H} \quad \text{H} \quad \text{O} \quad \text{C} \quad \text{H} \quad \text{O} \quad \text{H} \]

(ii) any three from:

- same or similar chemical properties
- same general (molecular) formula
- (consecutive members) differ by CH₂
- same functional group
- common methods of preparation
- physical properties vary in predictable manner/show trends/gradually change
- or example of a physical property variation i.e. melting point/boiling point/volatility

(iii) dissociates/ionises/splits up (into ions)

- partially/incompletely/slightly/not fully
- (donates) protons/forms H⁺/HO⁻ (as the only positive ion)

(b) (i) methyl propanoate

\[ \text{CH}_3\text{CH}_2\text{COOCH}_2\text{CH}_3 \]

(ii) methyl ethanoate

\[ \text{CH}_3\text{CH}_2\text{COOCH}_3 \]

(c) (i) \(3\text{C}_8\text{H}_{10} + \frac{5}{2}\text{O}_2 \rightarrow 4\text{C}_2\text{H}_4\text{COOH} + 3\text{H}_2\text{O}\)

(ii) propanol or propan-1-ol or propanal

[Total: 14]

Question 2

(a) (i) M1 contain carbon, hydrogen and oxygen (only)

M2 hydrogen and oxygen is in a 2:1 ratio (or in the same ratio as water)

(ii) M1 -O- linkage

M2 3 monomer units with 3 blocks and 3 oxygen atoms

[Total: 3]

Question 3

(a) (i) \(\text{C}_4\text{H}_{10}\) only

\(\text{CH}_3\text{CH}_2\text{CH}(_2)\text{CH}_3\) (allow \(\text{C}_6\text{H}_{12}\))

(ii) Any unambiguous structural formula of methyl cyclopropane or but-1-ene or but-2-ene or methyl propene

(iii) M1 same molecular formula

M2 different structural formulae or different structures or different arrangement of atoms

(iv) If ‘No’,

- one an alkane, the other an alkene
- or
- one is saturated / has single bonds, the other is unsaturated / has a double bond

Ignore: references to the ‘functional group’

If ‘yes’ both alkanes or both saturated

Ignore: references to the ‘functional group’

[Total: 14]
Question 4

(b) (i) M1 Action of heat or catalyst or thermal decomposition (on an alkane)
   Ignore steam. Ignore pressure.

M2 Long-chained molecules or alkanes form smaller molecules (not smaller fraction) or
   forms smaller alkenes (or alkanes)

(ii) C_{12}H_{22}

(c) (i) M1 Correct structure of one repeat unit
   
M2 Continuation bonds COND on M1
   
M3 use of brackets and subscript 'n' COND on M1 and M2

(ii) dibromoethane or 1,2-dibromoethane

Question 6

5 (a) protective / layer and of oxide

(b) correct repeat unit
   continuation shown

(c) (i) catalyst
   biological / protein

   (ii) hydrochloric acid / any strong acid / any strong alkali

   (iii) amino acids

   (iv) chromatography

   (v) nylon / kevlar

(d) (i) non-biodegradable

   (ii) CH_2=CH(C_2H_5)

[Total: 11]
Question 7

(a) (i) contains only carbon, hydrogen and oxygen hydrogen (atom) to oxygen (atom) ratio is 2:1 ALLOW: C:H:O as 1:2:1 or C₂(H₂O)₅

(ii) condensation
polymisation

(b) (i) cells / micro-organisms / plants / animals / metabolic reactions obtaining energy from food / glucose / nutrients

(ii) 2C₂H₅OH + 2CO₂
    allow: C₂H₅O for C₂H₂OH
    not balanced = (T) only

(iii) to prevent aerobic respiration / to get anaerobic respiration / to prevent ethanoic acid / lactic acid / carboxylic acids being formed / to prevent oxidation of ethanol

(c) displayed formula of methyl butanoate
    NOTE: all bonds must be shown
    NOTE: award (1) if error in alkyl groups but correct displayed structure of –COO–

(d) (i) alcohol, e.g. glycerol, circled
    ALLOW: if only part of glycerol molecule is circled as long as it involves an OH group

(ii) saturated
    correct reason based on group C₃H₆O₂ / all C–C bonds / no C = C bonds

(iii) salt / carboxylic acid / alkanoate
    (making) soap
    ACCEPT: detergent / washing

(e) at least one correct amide linkage –CONH–
    continuation shown at both ends of chain
    diagram showing three (different) amino acid residues

[Total: 18]

Question 8

(a) (i) hydrogen (atoms) replaced by (atoms) of a different element e.g. chlorine NOT: substitute

(ii) light required

(b) exothermic reaction gives out energy
    endothermic reaction absorbs
    takes in energy

[Total: 18]

Question 9

5 (a) (i) have same molecular formula / both are C₅H₁₂ they have different structural formulae / different structures

(b) (i) CH₂–(Br)₂–CH₂Br
    NOT: C₃H₆Br₂
dibromoethane
    NOTE: numbers not required but if given must be 1, 2

(ii) CH₃–CH₂–CH₃
    NOT: C₃H₈
    propane

(iii) CH₃–CH₂–CH₂–OH / CH₃–CH₂–CH(OH)–CH₃
    butanol
    numbers not required but if given must be correct and match formula

(c) (i) CH₃–CH–CH₂–CH₃
    CH₃–CH=CH–CH₃

(ii) pink / purple
    colourless
    NOT: clear

(d) –CH₂–CH(CN)–CH₂–CH(CN)–
correct repeat unit CH₂–CH(CN)
    COND: at least 2 units in diagram
    continuation

[Total: 16]
Question 10

(c) (i) amide / peptide;  
(ii) named strong acid / alkali;  
allow: HCl / enzymes  
(iii) amino acid;  
allow: peptides

Question 11

5 (a) (i) add bromine water / bromine / aqueous bromine;  
colourless;  
or add potassium manganate(VII) / permanganate; (ignore acid or alkali)  
colourless;  
(ii) add metal / carbonate / insoluble base / strong alkali allow: ammonia with an  
indicator / use pH meter;  
COND: on reagent  
metal - hydrogen given off / metal dissolves / effervescence / gas given off /  
burning splint pops;  
carbonate - carbon dioxide given off / effervescence / gas given off / limewater  
milky;  
insoluble base - solution formed / dissolves;  
alkali - use of indicator to show neutralisation / temperature increase;  
pH meter - gives pH less than 7

(b) ethyl propionate;  
correct SF all bonds shown;  
allow: [1] for correct displayed ester linkage

Question 12

7 (a) (i) C\textsubscript{2}H\textsubscript{3}OH  
(ii) 116-17 = 99, 2n+1 = 99, n = 7  
for any evidence of working out  
C\textsubscript{2}H\textsubscript{5}OH  
(iii) 4bps around C\textsubscript{2}  
1 bp on each hydrogen;  
2bps and 2bps on oxygen;

(b) (i) increases yield; moves equilibrium to RHS; favours forward reaction;  
high pressure favours side with smaller number of (gas) molecules;  
(ii) any two from:  
higher temperature; catalyst causes faster reaction;  
comment about compromise conditions to give best rate and yield;  
at 250°C (lower temp) higher yield / forward reaction favoured;  
at 350°C (higher temp) lower yield / back reaction favoured;

(c) (i) methanoic acid;  
correct SF showing all bonds;  
accept: -OH  
(ii) methyl methancate;

[Total: 14]

Question 13

3 (a) (i) correct structure of an isomer e.g. 2-chloropropane;  
(ii) chlorine;  
light / heat / lead tetraethyl;
Question 14

(iii) could produce 2-chloropropane;
    could produce HCl;
    or
    could produce dichloropropanes = [2]

(b) (i) add silver nitrate / lead nitrate;
    yellow precipitate;
    note: do not insist on presence of dilute nitric acid

(ii) propanol / propan-1-ol;

(c) (i) for A;
    reaction slower;
    decreased collision rate;
    less bromobutane present / concentration of bromobutane less / less reacting
    particles;
    any two
    accept: reverse arguments for B

(ii) halogens Cl > Br > I reactivity / reactivity decreases down group;
    organic halides I > Br > Cl / reactivity increases down group;
    opposite without explanation = [1]

(iii) any three from:
    less energy;
    particles move slower;
    less collisions / fewer particles have energy to react / fewer successful collisions;
    slower rate;
    [Total: 3]

[Total: 15]

Question 15

4 (a) it is an alkane or hydrocarbon
    it is saturated or only C—C single bonds
    accept: no double bonds

(b) molecular formula C₂H₂
    empirical formula CH₂

(c) correct structural formula of cyclobutane

6 (a) (i) amino acid / peptides;
    salt / carboxylate or soap / fatty acid or glycere / alcohol;
    sugars or glucose;
    accept: named sugar

(ii) polyester;
    allow: named polyester
    polyamide;
    allow: nylon

(b) one correct amide linkage;
    second amide linkage correctly orientated
    — NHCO — followed by — NHCO —;
    note: monomers are amino acids not diamines or dicarboxylic acid

(c) bromine / bromine water / aqueous bromine;
    unsaturated — brown / orange to colourless not: clear
    saturated — stays brown / orange
    or: alkaline potassium manganate(VII);
    from purple/pink to green / brown;
    stays purple;
    or: acidic potassium manganate(VII)
    from purple/pink to colourless; not: clear
    stays purple;
    [Total: 10]
Question 16

1. (a) (i) contains carbon and hydrogen
   cond: only / just [1]
   (ii) (different) boiling points
   cond: separate [1]

2. (b) bitumen-making roads / roofs / water-proofing, etc.
   lubricating fraction – waxes, vaseline, grease, etc., or machinery example, e.g. oil a bike, hinges, reducing friction [1]
   paraffin fraction – jet fuel, cooking or tractors or cooking or lighting [1]
   gasoline fraction – petrol or fuel for cars / vans / trucks [1]

[Total: 8]

Question 17

8. (a) proton donor; [1]

(b) equal concentrations of both (solutions);
   add Universal indicator / determine pH / pH paper;
   ethylamine has lower pH / ORA;
   or
   measure conductivity of aqueous ethylamine and sodium hydroxide;
   ethylamine will have lower conductivity / sodium hydroxide will have higher conductivity; [1]

(c) add strong(er) base / NaOH / KOH;
   warm / heat; [1]

(d) (ethylamine forms) hydroxide ions / OH⁻ (in water);
   hydroxide ions / OH⁻ reacts with iron(III) ions / Fe³⁺;
   or
   iron(III) hydroxide / Fe(OH)₃ (forms as a brown precipitate);
   note: balanced or unbalanced ionic equation i.e. Fe³⁺ + 3OH⁻ → Fe(OH)₃ scores both marks [1]

[Total: 11]
**Question 18**

(a) (i) CH₂H₂C
(ii) same ratio of C:H (atoms) / all cancel to CH₂ / because general formula is C₆H₁₂O₆ / same ratio of atoms or elements (in the compound) / C:H ratio is 1:2;

(b) (i) propanic / propionic (acid);
ethanoic / acetic (acid);

(ii) Formula of ethene / but-2-ene / any symmetrical alkene;

(c) (i) CH₂CH(Br)CH₂Br

(ii) CH₂CH(OH)CH₂ / CH₂CH₂CH₂OH / C₂H₅OH

(d) [Diagram of a polymer with structural formula: \(-\text{CH}_2-\text{CH}_2-\_n\)]

Correct unit: accept: more than one repeat unit
continuation bonds at both ends;

(e) If C₆H₁₀ is given award 3 marks:
If C₁₂H₂₄O₆ is given award 2 marks:
If 1:7:6:8 / 2:16:10 is given award 2 marks:
in all other cases a mark can be awarded for moles of O₂ (= 2.4/32 = 0.075 AND moles of CO₂ (= 2.2/44 = 0.05):

2C₆H₁₀ + 15O₂ → 12CO₂ + 10H₂O
accept: multiples including fractions
allow: eqf for correct equation from any incorrect alkene

**Question 19**

(a) (i) correct -O- linkage;
correct unit and continuation -O- [minimum];

(ii) any name or correct formula of a (strong) acid / H⁺;

(iii) contain carbon hydrogen and oxygen / C, H and O;

(b) (i) glucose → ethanol + carbon dioxide

(ii) yeast is catalyst / provides enzymes / speeds up reaction / too slow without yeast;
yeast cells grow / multiply / reproduce / undergo budding / breed;

(iii) heat or high temperature would kill yeast (cells) / heat or high temperature denatures enzymes;
not / enzyme killed / denatures yeast
reduces rate of reaction / slows reaction / (yeast or enzyme) no longer catalyses / no catalyst / stops reaction / no more product;

(c) (i) would produce carbon dioxide or carboxylic or organic acids (if oxygen is present) / to prevent aerobic respiration / so products are not oxidised / anaerobic bacteria can't live with oxygen;

(ii) fossil fuels have a reduced need / conserved / no need to import / will last longer / cracking hydrocarbons to make methane no longer required:
(methane is renewable / carbon neutral, reduce pollution of water or sea / prevents visual pollution / prevents need for waste disposal or accumulation (accept: any methods of waste disposal) / so that waste is recycled; any two

2C₆H₁₀ + 15O₂ → 12CO₂ + 10H₂O
Question 20

7 (a) burning
produces toxic gases / harmful to health
increases greenhouse gases / global warming
reduces visual pollution / litter
reduces risks to wildlife
shortage of landfill sites / reduces space needed in landfill sites / saves space
non-biodegradable / long time to rot / decompose / accumulates waste
burning source of energy / used to generate electricity

Recycling
conserves petroleum / natural resources
difficult to recycle / expensive / takes much energy
problems over sorting
reduces need for landfill
quality of plastic is reduced each time it is recycled
four DIFFERENT valid points which are advantages or disadvantages of burning and/or recycling
(b) (i) addition (polymerisation);
(polymer) only product / no by-products;
condensation (polymerisation);
(polymer and) simple molecule / water / hydrogen chloride / one other product forms;
(ii) a correct linkage for a polyamide / polyester;
two different monomers;

Question 21

6 (a) 10 cm$^3$; 65 cm$^3$;

(b) (i) chlorination / substitution / photochemical / exothermic / halogenation / free radical;
(ii) (compounds) same molecular formula; different structural formulae;
(iii) CH$_3$-CH$_2$-CH$_2$-CH$_2$-Cl
CH$_3$-CH$_2$-CH(Cl)-CH$_3$;

(c) (i) potassium manganate(VII) / potassium dichromate(VI) / copper(II) oxide;
(note: do not insist on oxidation numbers but if given must be correct)
(ii) butanoic acid;
(iii) butyl ethanoate;
correct formula all bonds shown = 2
if alkyl groups incorrect then correct ester linkage showing bonds = 1

Total: 10

Question 22

(b) (i) correct structural or displayed formula of another chlorobutane / dichlorobutane / polychlorobutane
(ii) light / 200 °C / lead tetraethyl
(iii) cracking is the decomposition/breaking down of an alkane/hydrocarbon/petroleum
heat/high temperature / Temperature between 450 °C to 800 °C
OR catalyst / named catalyst
to give a simpler alkane and alkene
word equation or equation as example
to make polymers / to increase petrol fraction / organic chemicals/petrochemicals / hydrogen
any four
Question 23

(b) (i) ester

(ii) soap/sodium stearate or any acceptable salt/glycerol

(iii) burning both fuels forms carbon
growing plants to make biodiesel removes carbon dioxide from atmosphere

(c) (i) correct SF of an octane

(ii) add bromine (water)bromine in an organic solvent
result octane remains brown/orange/yellow/red
result octane goes colourless/decolours
not clear/discolours
colour of reagent must be shown somewhere for [3] otherwise max [2]
accept equivalent test using KMnO₄ in acid or alkali

Question 24

8 (a) addition – polymer only product / only one product
accept monomer has C=C
accept monomer and polymer have same empirical formula
accept no loss of material in polymerisation
not only one monomer
condensation – polymer and water / small molecule formed

(b) -CH₂ – CC₆₂-
repeat unit correct
COND continuation

(c) CH₃=CHOOCCH₃

(d) -OC(CH₃)₂CONH(CH₃)₂NH-
COND amide correct linkage
correct repeat units
continuation
not NH₂ or COOH endings

Question 25

6 (a) (i) cracking / heat with catalyst
to make butane
butane reacts with steam/water / hydrated
accept heat and catalyst for cracking but if specified: 450 to 880°C zeolites / aluminiumsilicates / silica / aluminium oxide/alumina / china / broken pot / porcelain / chromium oxide

(ii) glucose / sugar changed to alcohol / ethanol
accept an unbalanced equation
(catalysed by) enzymes / yeast

(b) butyric acid
CH₃CH₂CH₂COOH
hydrogen atoms omitted from ends of bonds, penalise once

(c) (i) ester

(ii) C₆H₁₂O₆
ignore CH₃COOC₂H₅

(iii) correct structural formula of butyl ethanoate showing all bonds
Question 26

4 (a) (i) same molecular formula / same number of C and H atoms
different structural formula or structure
same compound = [1]

(ii) correct formula of but-2-ene / methy propane / methyl cyclopropane [1]

(iii) bromine / bromine water / aqueous bromine
brown to colourless not clear
stays brown
bromide loses the first mark only

OR alkaline potassium manganate(VII)
from purple/pink to green/brown
stays purple

OR acidic potassium manganate(VII)
from purple/pink to colourless not clear
stays purple [1]

(b) heat / high temperature (temperature need not be stated, but if it is stated it must be 500°C or above)
catalyst (need not be named, but if they are named accept any metal oxide or zeolite / aluminosilicates / silicon dioxide)
not nickel/platinum [1]

(c) (1,2) dibromobutane
if numbers given must be correct
butane not but-1-ol / but-1-ene / butanol [1]

Question 27

2 (a) (i) enzymes are proteins / come from living organisms / biological (catalysts)
not enzymes are living or natural [1]

(ii) carbohydrates have 2H:1O ratio
contain elements of water
contain water = [1]
unless they state that carbohydrates contain water, this response scores 2 or 0

(b) correct -O- linkage
cond same correct manner (this mark is lost if 2 different boxes are shown)
cond continuation (i.e. builds at both ends) [1]

(c) (i) (concentration or amount or mass etc.) of starch decreases (with time)
(concentration etc.) of starch becomes zero / all starch gone
colour (intensity) indicates how much starch is present (can be inferred)

(ii) enzyme denatured / destroyed
not enzymes killed / don’t work / saliva denatured [1]
Question 28

8 (a) biodegradable or breaks down naturally
made from a renewable source or does not use up petroleum
reduce visual pollution or reduces need for landfill sites or less danger to wildlife
any TWO
ignore mention of toxic gases

(b) (i) ester
accept polyester or fat or lipid or vegetable oil or carboxylic acid

(ii) acid or carboxylic acid or alkanolic acid
alcohol or hydroxyl or alkanol
NOT formiate NOT hydroxide

(iii) condensation
COND because water is formed in reaction
or monomer does not have C=C bond

(c) (i) lactic acid → acrylic acid + water

(ii) add bromine (water) or bromine in an organic solvent
remains brown/orange/yellow
goes colourless NOT clear
If mark 1 near miss e.g. bromide allow marks 2 and 3
Colour of reagent must be shown somewhere for [3] otherwise max [2]
OR acidified potassium manganate(VII)
purple/pink to colourless
OR alkaline potassium manganate(VII)
purple/pink to green
or purple/pink to brown precipitate

Question 29

(b) (i) fats or lipids

(ii) -O- linkage, no other atoms in linkage
COND same monomer
COND continuation bonds at each end -A-

(iii) same linkage or amide linkage or peptide or -CONH-
collections
synthetic polyamide usually two monomers
protein many monomers
protein monomers are amino acids or proteins hydrolyse to amino acids or a protein
monomer has one -NH₂ and one -COOH group
synthetic polyamide each monomer has 2 -NH₂ or 2COOH groups or monomers are
dioic acid and diamine
accept diagrams or comments that are equivalent to the above
ANY TWO

Question 30

(c) (i) biological catalyst
accept protein catalyst

(ii) production of energy (from food)
by living "things" or by cells, etc.

(iii) "kill" yeast or denature enzymes (due to increase in temperature)

(iv) all glucose used up
yeast "killed" or denatured or damaged by ethanol/alcohol

(v) filter or centrifuge
fractional distillation
Question 31

7 (a) butanol
no number needed but if one is given it has to be 1
structural formula (all bonds shown)
accept –OH NOT –HO
ethanoic acid
structural formula (all bonds shown)
accept –OH NOT –HO
no conseq marking
if all bonds are not shown (CH₂–CH₂), penalise once
(b) (i) must have correct ester linkage
COND continuation and a group on either side of the ester group
Accept –COO–
(ii) accept any sensible suggestion
ropes, clothing, bottles, packaging, bags
(c) (i) 8
(ii) double bond becomes single and 4 bonds per carbon atom
COND a bromine atom on each carbon
C₃H₅Br₂ ONLY [1]
accept a structural formula with hydrogen atoms
(iii) corn oil
(d) 100g of fat react with 86.2g of iodine
884g of fat react with 762 g of iodine
limit 762 x 2
one mole of fat reacts with 762/254 moles of iodine molecules
one mole of fat reacts with 3 moles of iodine molecules
number of double bonds in one molecule of fat is 3
limit 6
consequential marking allowed provided the number of double bonds is an integer.

[Total: 14]

Question 32

1 (a) (i) coal or coke or peat
NOT wood or charcoal
(ii) natural gas or methane or propane or butane or petroleum gases or calor gas or refinery gas
(b) (i) petrol or gasoline
paraffin or kerosene
diesel
aviation fuel or jet fuel
fuel oil
heavy fuel oil
heating oil
Any TWO
NOT a named alkane e.g. octane
(ii) waxes or greases or lubricants or polishes or bitumen (tar, asphalt) or naphtha
Any TWO from the primary or secondary distillation of petroleum
(iii) (liquid) air, ethanol and water or alkenes (made by cracking) or Noble Gases [1]
Question 33

7 (a) (i) any correct equation  [1]
    structural formulae from but-1-ene, but-2-ene, methylpropene or cyclobutane  [2]
    Any TWO

(b) (i) light or 200°C or lead tetraethyl  [1]
    (ii) substitution or photochemical or chlorination or free radical or halogenation  [1]
    (iii) 1-chlorobutane, 2-chlorobutane, dichlorobutane etc.  [2]
    Any TWO

(c) (i) CH₃CH₂CH₂CH₃OH or CH₃CH(OH)CH₃  [1]
    (ii) CH₃CH(Br)CH₂Br
    NOT 1,3-dibromopropane  [1]

(d) moles of CH₃-CH = CH₂ reacted = 1.4/42 = 0.033  [1]
    maximum moles of CH₃-CH(II)-CH₃ that could be formed = 0.033  [1]
    maximum mass of 2-iodopropane that could be formed = 5.61 g
    accept 170 x 0.033 = 5.61 and 170 x 0.033333 = 5.67
    conseq unless greater than 100%  [1]
    percentage yield 4.6/5.67 x 100 = 70.5%

Do not mark consequent to a series of small integers. There has to be a serious attempt to answer the question, then consequential marking is appropriate.

(TOTAL = 13)

Question 34

(iv) amide linkage  [1]
    COND different monomers
    Accept hydrocarbon part of chain as boxes
    If nylon 6 then only one monomer  [1]
    NOT different monomers
3 (a) (i) CH₂-CH=CH₂
(ii) correct repeat unit
COND evidence of continuation
(iii) monomer
COND because it has a double bond or unsaturated or alkene
NOT addition
(b) (i) to remove filter or remove solid
NOT precipitate, NOT impurities, NOT to obtain a filtrate
(ii) because silver atoms have lost electrons
OR oxidation number increased
(iii) silver chloride
(c) (i) name of an ester
formula of an ester
if they do not correspond MAX 1
Accept name - terephtalene
for formula ester linkage and continuation
If a 'fat' complete structure must be correct e.g. C₇H₈O₂ etc.
Mark for formula only - 1
(ii) alcohol or alkanol
NOT a named alcohol
(d) (i) acid loses a proton
base accepts a proton
OR same explanation but acid loses a hydrogen ion (1)
and base gains hydrogen ion (1)
(ii) only partially ionised or poor hydrogen ion donor or poor proton donor
NOT does not form many hydrogen ions in water or low concentration of hydrogen ions
NOT pH  

6. (a) (i) correct repeat unit
COND evidence of polymer chain
(ii) glucose or maltose
(iii) addition (polymerisation) or no other product except polymer
condensation (polymerisation) or polymer
and water
(b) (i) sodium hydroxide
COND ammonia or alkaline gas or litmus red to blue
if aluminium added we = 0
(ii) measure pH
more than 1 and less than 7 or
correct colour eg orange or yellow NOT red
NOT green
OR add magnesium or calcium carbonate
weak acid reacts slowly
(c) (i) ethyl acrylate
ester or alkene
(ii) brown to colourless (NOT clear)
correct formula for acid NOT ester
Question 37

3 (a) (i) Correct equation
   For giving correct formula of alkane and alkene [1] only
   Accept alkene and hydrogen
   Chlorine
   \( \text{COND light or } 200^\circ \text{C or heat or lead tetraethyl} \)
   or high temperature MAX 1800^\circ \text{C}
   Ignore comment 'catalyst'

   (b) (i) same molecular formula
   Different structures or structural formulae
   But-2-ene or cyclobutene
   Corresponding structural formula
   NOT 2-butene

   (c) butanol
   Ignore numbers
   Butane
   Ignore numbers
   Dibromobutane
   Ignore numbers

(d) (i) propene
   \( \text{CH}_3-\text{CH}==\text{CH}_2 \)

   (ii) Correct structure of repeat unit
   Ignore point of attachment of ester group
   \( \text{COND upon repeat unit} \)
   Shows continuation
   If chain through ester group [1] out of [2]
   Do not decay or non-biodegradable
   Shortage of sites or amount of waste per year
   Visual pollution
   Forms methane
   Any TWD

   (iv) form poisonous or toxic gases or named gas CO, HCl, HCN
   NOT carbon dioxide, harmful, sulphur dioxide

Question 38

6 (a) (i) heat (energy)
   Exothermic

   (ii) \( \text{C}_3\text{H}_7\text{OH} + 3\text{O}_2 = 2\text{CO}_2 + 3\text{H}_2\text{O} \)
   FOR \( \text{CO}_2 + \text{H}_2\text{O} \) ONLY [1]

   (iv) Plotting points correctly
   Straight line
   Between --2640 and --2700kJ/mol
   NOTE minus sign needed

   (v) General (molecular) formula
   Same functional group
   Consecutive members differ by \( \text{CH}_2 \)
   Similar chemical properties or react same way
   NOT a comment about physical properties
   ANY TWO

(b) \( \text{CH}_3-\text{CH}(_2\text{OH})-\text{CH}_3 \)
   Not \( \text{C}_2\text{H}_5\text{OH} \)
   Propan-2-ol '2' is needed
   NOTE the name and the formula must correspond for both marks
   Accept full structural formula — all bonds shown correctly
   Accept formulæ of the ether
   Not \( \text{CH}_3-\text{CH}(_2\text{NO})\text{-CH}_3 \)
(c) (i) cracking
heat (alkane) or (alkane) and catalyst
NOTE thermal cracking or catalytic cracking [2]
alkane = alkene + hydrogen
ANY TWO
OR steam reforming
CH4 + H2O = CO + 3H2 [2]
or water/steam catalyst or heat [1]
(ii) combustion or burning
incomplete or insufficient oxygen/air [1]
OR ACCEPT steam reforming as above [2]
(iii) high pressure
COND forward reaction volume decrease
or volume of reactants greater than that of products
or fewer moles of gas on the right
or fewer gas molecules on right
NOTE accept correct arguments about either reactants or products
(d) (i) methyl ethanoate [1]
(ii) propanoic acid or propanal [1]
(iii) ethene [1]
[Total: 20

Question 39

8 (a) (i) biological catalyst [1]
(ii) linkage —O—
same unit as in glucose as on question paper that is rectangles [1]
(iii) chromatography [1]
(b) (i) —NHCO—Linkage
different units
-NH and -CO on same monomer unit
All three [2] two points [1]
(ii) amino acids [1]
(c) (i) propanol + ethanoic acid = propyl ethanoate + water
reactants [1] products [1]
(ii) ester linkage correct
rest of molecule correct [1]
(iii) browning on water
fat 1 orange or yellow or brown to colourless
fat 2 remains orange or yellow or brown
Accept Potassium Manganate(VII) with corresponding colour changes
(iv) soap or sodium salts (of carboxylic acids)/sodium stearate
alcohol/glycerol [1]
[Total = 15]
Question 40

(a)(i) general molecular formula
same functional group
physical properties show trend — bp increase with n
same chemical properties
common methods of preparation
any TWO [2]

(ii) C₆H₁₂OH Mass of one mole = 130 (g)
if formula correct but mass wrong [1]

(b) propan-1-ol or propan-2-ol
corresponding structural formula
name and formula must correspond for [2] if not ONLY [1]

(c)(i) structural formula of isomer

(ii) carbon dioxide and water
pentene
pentanoic acid

TOTAL = 10

Question 41

(b)(i) calcium ethanoate + hydrogen [1]

(ii) zinc oxide or hydroxide [1]

(c) CH₃COOH + NaOH \rightarrow CH₃COONa + H₂O
reactants [1] products [1]

Question 42

8 (a)(i) C₆H₁₂ between 60 to 65°C [1]

(ii) C₁₂H₂₄
COND giving some indication of the method [1]

(b) add bromine water or potassium manganate[VII]
butene it goes from brown/orange/yellow to colourless
or manganate (VII) from pink to colourless:
NOT clear
Cyclobutane it remains brown/orange/yellow or manganate (VII) stays pink
or no colour change
Accept does not react
Provided colour of reagent somewhere in the answer [3] is possible

(c)(i) alcohol [1]

(ii) CH₂-CH₂-CH₂-CH₂- [1]

(iii) -CH(CH₃)-CH(CH₃)-
or any equivalent diagram
[1] for repeat unit and [1] for continuation
Question 43

6. (a) (i) correct structure
   \[ \text{CH}_2=\text{C} \equiv \text{CH} \]
   (ii) because it has a lower \( M \) or density or its molecules move faster
        it is lighter ONLY [1]
        only comment - smaller molecules [0]
        answer implies or states sieves idea then [0]

(b) (i) ester linkage
      COND polymer chain showing different monomers and
      continuation
      \(-\text{OOC-CH}_2\text{CHCH}_2\text{CH}_2\text{-}\)

(ii) fats or lipids

(iii) does not decompose easily when heated
      accept similar statements

(c) (i) does not decompose or non-biodegradable shortage of landfill sites or of
      space visual pollution
      poisonous/toxic/harmful gases when burnt
      NOT carbon monoxide, sulphur dioxide. If gas named has
      to be a correct one e.g. HCl, HCN
      dangerous to animals
      Any TWO [2]

(ii) conserve petroleum or save energy
     NOT cheaper
     TOTAL = 10

Question 44

(b) (i) \( \text{CO}_2 \) and \( \text{H}_2\text{O} \)
     balanced
     \[ 2\text{CH}_3\text{OH} + 3\text{O}_2 = 2\text{CO}_2 + 4\text{H}_2\text{O} \]

(ii) methyl ethanoate
     water
     [1]

(iii) Methanoic acid accept formic acid
     [1]
Question 46

(i) steam or water or hydration
heat or catalyst

OR bubble into (concentrated) sulphuric acid
add water

oxidised
by air or dichromate or manganate(VII)

(iv) ethanoic acid and butanol

[1]

Question 47

5 (a) molecular formula
Must be able to give isomers, need not be alkenes
two corresponding isomers
If do not correspond then MAX [2] out of [3]

(b) (i) ethanol
structure

(ii) ethane
structure

(c) (i) many simple molecules or monomers
form one large one or macromolecule or chain

TOTAL = 17
(ii) Addition polymer only one product - the polymer condensation - polymer and water etc

(iii) Correct unit
COND evidence of polymer in structure eg shows continuation such as terminal bonds

(d) (i) Water proof or impervious or flexible or good adhesion or non-biodegradable or unreactive

(ii) Steel in contact with water or air

(iii) Zinc more reactive
 Oxygen /water reacts with zinc not iron sacrificial protection
 Zinc anodic
 Steel receives electrons from zinc
 Zinc forms cations
 Cell
 TWO valid points

TOTAL = 17

8 (a) Same general formula
Same chemical properties
Same functional group
Physical properties vary in predictable way
Common methods of preparation
Consecutive members differ by CH₂
Any two
Mark first two
Ignore others unless it contradicts a point which has been awarded a mark

(b) (i) 2H₄COOH + CaCO₃ → Ca(H₂COO)₂ + CO₂ + H₂O
Not balanced = [1]

(ii) Zinc + Methanoic acid → zinc methanoate + hydrogen
[1] for each product

(iii) Protected by oxide layer
[1]

(c) Butanoic acid
CH₃CO₂CH₂COOH / C₄H₈O₂ / C₄H₇COOH / C₄H₇OOH
C₄H₈O₂
Mark each to molecular formula
Question 49

(a) ethanol
CH₃CH₂OH
propanic acid
CH₃CH=CH₂COOH
independent marking, no acf
accept CH₄
not – HO

(i) type of compound – salt / sodium carboxylate / alkane / not soap / sodium stearate etc
use – soap / cleaning / detergent

(ii) terylene / PET / Dacron / diolen / mylar / crimplene

(b) polyamide / amide / peptide / polypeptide

(i) correct amide linkage NHCO then CONH
cond to mark 1, 2 monomers (different shading in box)
cond continuation (to ONE correct linkage)

OR nylon 6
only one linkage – NHCO
cond only one monomer
cond continuation (to correct linkage)

(iii) use locating agent
measure distance travelled by sample / travelled by solvent front
cond this is Rₓ = 0.5
for mark 3, either mark 1 or mark 2 must be awarded
accept run a chromatogram of glycine [1]
compare with sample

Question 50

(iii) chlorine
not chlorine / water
cond light / UV / heat / high temperature if numerical value given about 200°C / lead tetraethyl
not warm

Question 51

(a) C and H only [1]

(i) only single bonds [1]

(b) C₆H₁₂O₂ [1]

(i) C₆H₁₃O (1)
14 x 12 + 30 = 198 (g) [1]

(ii) Volume ratio
C₆H₁₃O (g) + O₂ (g) → CO₂ (g) + H₂O(l)
all in cm³
mole ratio
20 180 100 5
C₆H₁₃O + 8O₂ → 5CO₂ + 6H₂O
For evidence of method (1)
for equation as above (2)

(d) alkenes in petrol / fuel / solvent [1]
alkenes to make alcohols / plastics / polymers / solvents [1]
hydrogen to make ammonia / fuel / fuel cells, etc [1]

(i) a correct equation for example:
C₁₅H₃₂ → C₆H₁₃O + C₂H₄ + H₂ (1)

(e) (i) light or lead tetraethyl / catalyst / high temperature [1]

(ii) CH₃-CH₂Cl-CH₃ (1)

[Total: 16]

Question 52

(b) correct linkage [1]
rest of molecule correct and continuation shown [1]
(other product is) water [1] [3]
Question 53

4 (a) (i) butanoic/butyric acid (1)
CH₃CH₂CH₂COOH/CH₃CH₂COOH (1)
(ii) any three from:
(same) general formula (1)
(consecutive members) differ by CH₂ (1)
same functional group (1)
common methods of preparation (1)
physical properties vary in predictable manner/show trends/gradually change or example of a physical property variation i.e. melting point/boiling point/volatility (1)
(b) (i) displayed formula of propan-1-ol, all bonds shown separately (1)
(ii) acidified (1)
potassium manganate(VII)/potassium permanganate/KMnO₄ or potassium dichromate(II)/K₂Cr₂O₇/potassium dichromate (1)
(c) (i) zinc + propanoic acid → zinc propanoate (+ hydrogen) (1)
(ii) calcium oxide + propanoic acid → calcium propanoate + water (1)
(iii) LiOH + CH₃CH₂COOH → CH₃CH₂COOLi + H₂O (1)
(d) (i) concentration (of acid in C) is less/halved or concentration of A is more/doubled. (1)
less collisions or more collisions in A (than in C) (1)
(ii) (higher temperature in B particles/molecules/atoms) move faster/have more energy/more have Eₚ or (particles/molecules/atoms) in A move slower/less energy/less have Eₚ (1)
more collisions or less collisions in A (than in B) (1)

Total: 18

Question 54

2 (a) (i) substance/material/compound/element/mixture (burnt) to produce/release energy or heat (1)

(ii) Any two from:
coal
coke
petroleum/crude oil
refinery/gas/LPG
gasoline/petrol
naphtha
kerosene/paraffin
crude (oil)/gas oil
fuel oil
propane
butane

(iii) wood/charcoal/animal dung/biomass/Uranium/U/plutonium/Pu (1)

(b) (i) any two from:
water/steam/water vapour/H₂O (1)
carbon dioxide/CO₂ (1)
carbon monoxide/CO (1)

(ii) any two from:
limited or finite resource/non-renewable/will run out/depleted (1)
greenhouse effect/gas(es)/climate change/(cause) global warming (1)
acid rain (1)
production of poisonous/toxic gases (1)

Total: 8
Question 55

(a) (i) CH₂=CH=CH₂

(ii) one correct amide linkage between two rectangles: 1 mark

Correct sequencing of a second amide link and monomers: 1 mark

Two correct amide links and rest of structure correct (including additional monomers if seen) and correct continuation bonds: 1 mark

(iii) protein or polypeptide or named protein: 1 mark

(iv) addition: only the polymer or one product is formed: 1 mark

Condensation: the polymer and a small molecule/water/HCl is formed: 1 mark

(b) (i) does not break down or not or decompose: 1 mark

by microbes or fungi or bacteria or by living organisms: 1 mark

(ii) Any three from:
- visual pollution: 1 mark
- shortage of landfill sites: 1 mark
- danger to wildlife/animals (including at sea): 1 mark
- toxic gases when burnt or greenhouse gases produced when burned: 1 mark

(c) Any two from:
- resistant to corrosion/unreactive to water/more durable: 1 mark
- lighter/less dense: 1 mark
- easier to manufacture/can be moulded: 1 mark
- good insulator/keeps the water cold: 1 mark

[Total: 14]

Question 56

7 (a) (i) CH₃COOCH₂CH₃ / CH₂CO₂CH₂CH₃ / CH₂CO₂H₂ / CH₃CO₂C₂H₅ / C₆H₅CO₂CH₃ / CH₃CH(OH)CH₃

Note: formulae can be displayed or semi-displayed
Note: penalise sticks (i.e. any missing atoms)

(ii) butyl methanoate

(b) (i) fats / vegetable oils / triglycerides / lipids

(ii) two correct ester linkages, e.g. -OOC- -O-C and -COO- -CO-

Contents of the boxes being C₆H₁₂ and C₆H₁₄ or CH₃CH₂

continuation bonds at both ends

Question 57

5 (a) (i) does not decay or non-biodegradable or flexible or bendable or easily moulded or low density / light / lightweight or waterproof / insoluble in water or does not corrode or durable

(ii) any two from:
- chlorine
- hydrogen chloride
- carbon monoxide

(b) (i) CH₃=CH = CH₂

Note: can be fully or semi-displayed, C = C must be shown

(ii) correct repeat unit
- CH(CH₃)CH₂-

Continuation shown

(c) glucose two products (polymer and water) / condensation (polymerisation) / (small) molecules removed

phenylethenone product (polymer) / addition (polymerisation)
Question 58

(b) (i) \( \text{C}_6\text{H}_{16} \rightarrow 2\text{C}_2\text{H}_4 + \text{H}_2 \)  
(ii) \( 2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2 \)  
\[\text{or } 2\text{H}_2\text{O}^+ + 2\text{e}^- \rightarrow \text{H}_2 + 2\text{H}_2\text{O} \]  
\text{accept: } -2\text{e}^+ \text{ on right hand side} \text{ accept: } e^- \text{ note: } \text{net balanced} = 1 \]

Question 60

(a) (i) measure melting point 
\text{pure sample would melt at } 135^\circ\text{C} 
\text{OR impure would melt lower than } 135^\circ\text{C} 
\[\text{NOT just heating} \]  
(ii) \( \text{C}_3\text{H}_4\text{O}_4 \)  
(iii) \( \text{C}_2\text{H}_5\text{O}_2 \text{ OR } \text{CH}_3\text{COOH} \) 
\text{ethanoic OR acetic acid} 
\text{both marks are independent of each other}  
\[\text{NOT organic covalent} \]  
(iv) \( \text{ester} \)  

(b) (i) \text{malonic is a weaker acidless dissociated} 
\text{OR sulfurous acid is a strongest acid more dissociated} 
\text{NOT sulfurous acid is a strong acid}  

(i) add piece of suitable metal, e.g. \( \text{Mg} \) \( \text{ALLOW Ai, Ca NOT K, Na, Cu} \) 
\text{sulfurous acid reacts faster OR malonic reacts slower}  
\text{OR as above add a piece of } \text{CaCO}_3 \text{ if soluble carbonate then } [1] \text{ only} 
\text{OR measure electrical conductivity} 
\text{sulfurous acid is the better conductor OR malonic acid poorer conductor}  
\text{NOT sulfurous acid is a good conductor}  

(c) (i) \text{sodium malonate and water} 
\[\text{NOT } \text{H}_2\text{CO}_3 \]  
(ii) \( \text{CuSO}_4 \) 
\( \text{H}_2\text{O} \)  
(iii) \( \text{CH}_3\text{(COO)}_2\text{Mg} \) 
\( \text{H}_2 \)  
(iv) \( \text{K}_2\text{SO}_4 \) 
\( \text{CO}_2 \text{ and } \text{H}_2\text{O} \) 

\[\text{[Total: 16]} \]
Question 61

7 (a) correct method shown
i.e. 126/14 (= 9) or 14x = 126 or x = 9 or (12 x 9) + 18 = 126
C₂H₈
Note: correct formula only = 1

(b) (i) all hydrogen atoms 1bp
C—C bond atoms 1bp
C=C 2 bp

(ii) correct repeat unit
continuation

(iii) bonds broken
H-H +436 (kJ/mol)  C=C +610 = +1046 (kJ/mol)
bonds formed
2C-H = 346 x 2 kJ/mol  C—C = -1176 (kJ/mol)
-130 kJ/mol / more energy released than absorbed
or:
bonds broken
3882 (kJ/mol)
bonds formed
4012 (kJ/mol)
-130 kJ/mol / more energy released than absorbed
Allow: est for final mark as long as the answer is not positive
Note: units not necessary

(c) (i) butan-1-ol or butan-2-ol or butanol

(ii) CH₃CH₂CH(Br)CH₂Br
C₄H₈Br₂ = 1
Note: any other dibromobutane = 0

(iii) HI

Question 62

2 (a) (i) molecule / unit / simple compound / building block and used to make a polymer / big molecule / long chain / macromolecule

Note: formation of a polymer / big molecule / long chain / macromolecule or joining of monomers and elimination / removal / formation of a small molecule / H₂O / HCl

(ii) -O- linkage
three correct monomer units
continuation

(iii) catalyst and from living organism
accept: biological catalyst / protein catalyst

(ii) enzyme denatured / destroyed

(iii) chromatography
locating agent / description of locating agent
measure Rf / compare with standards
Question 63

7   (a) fraction is the distillate collected between 40°-100°C / in the stated range [1]

(b) (i) $\text{C}_6\text{H}_{12} + 25\text{O}_2 \rightarrow 8\text{CO}_2 + 9\text{H}_2\text{O}$
accept: double the above / 12.5 in front of oxygen [2]

(ii) poisonous / toxic / damages health / brain / kidneys
note: must relate to people
not: just harmful [1]

(iii) dibromo 2 bromine atoms (per molecule)
not: Br$_2$
accept: 2 bromine groups
eth 2 carbon atoms (per molecule)
ane a C-C single bond / a C=C / group C$_2$H$_{4n-1}$/ saturated
ignore: any reference to alkanes
all three correct [2] two correct only [1]

(iv) position of bromine atom(s) [1]

(c) 0.104/0.026
n = 4 [1]

(d) (oxides of nitrogen) change carbon monoxide into carbon dioxide
oxides of nitrogen then become nitrogen
(oxides of nitrogen) change hydrocarbons into carbon dioxide and water
accept: balanced equations for first two marks
$2\text{NO} + 2\text{CO} \rightarrow \text{N}_2 + 2\text{CO}_2$ and $2\text{NO} \rightarrow \text{N}_2 + \text{O}_2$ [2]
oxxygen changes hydrocarbons into carbon dioxide and water [1]

Question 64

5   (a) $\text{CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-OH}$
88
156 to 159°C [1]

(b) any two from:
(same) general (molecular) formula
same functional group
consecutive members differ by –CH$_2$
common methods of preparation [1]

(c) correct structure and 4bp around carbon
2bp and 2nbp around oxygen
1bp on hydrogens [1]

(d) (i) correct structural formula for propanoic acid
allow: OH but all other bonds to be shown [1]

(ii) air / oxygen
bacteria / microbes / micro-organisms
accept: mother of vinegar
not: yeast [1]

(e) propyl thionate
allow: $\text{CH}_3\text{COOC}_3\text{H}_7$ not: $\text{C}_2\text{H}_5\text{O}_2$ [1]
Question 65

(a) (i) correct structural formula of ethanoic acid
   allow: -OH not: -COOH

(ii) correct structural formula of ethanol
   allow: -OH

(b) (i) ethyl ethanoate
    -OC₂H₄COOC₂H₅
    (ii) correct ester linkage
    correct repeat units
    continuation
    accept: boxes if it is clear what the box represents

(iii) any two from:
    long time to decay
    landfill sites
    visual pollution / litter
    danger to animals
    poisonous gases when burnt
    accept: any correct suggestion

(c) synthetic – only two monomers
    protein – many different monomers
    or:
    protein has 1 C=O and 1N–H
    nylon has 2 C=O / 2N–H
    or:
    synthetic – one monomer is a dicarboxylic acid and the other is a diamine
    protein all monomers are amino acids

[Total: 6]

Question 66

5 (a) (i) many (simple) molecules form one (large) molecule / monomer molecules form one polymer molecule

(ii) addition – polymer is the only product
    accept: nX → Xn
    condensation polymer and simpler molecules formed
    accept: nX → Xn + nHCl / H₂O

(b) (i) C₃H₆ → C₂H₆ + 2C₂H₄
    / any other correct version

(ii) ethane and ethene give range of products
    / ethene more readily available than ethane
    / waste half chlorine as hydrogen chloride
    / ethene more reactive than ethane

(iii) electrolysis
    aqueous sodium chloride

(iv) must have three correct units
    cond continuation
    accept: –CH₂–CH(CH₃)–n

[Total: 9]
### Question 67

(a) same general formula
- consecutive members differ by CH₂
- same chemical properties
- same functional group
- physical properties vary in predictable way / give trend — mp increases with n etc.
- common methods of preparation

(b) (i) they have the same molecular formula
- not general formula
- different structures / structural formulae

(ii) CH₃CH₂CH₂CH₂OH / CH₃CH₂OH
- not ether-type structures
- NOTE butan-2-ol and 2-methylpropan-2-ol acceptable

(c) (i) air/oxygen / (acidified) potassium chromate(VI) / (acidified) potassium manganate(VII)
- must have oxidation states

(ii) carboxylic acid / alkanonic acid
- CH₃CH₂CH₂COOH / CH₃CH₂COOH / C₂H₅O₂
- accept C₆H₄OH

(d) (i) measure volume of carbon dioxide
- time
- accept day / hour for time mark

(ii) increase in temperature / more yeast present / yeast multiplies

(iii) glucose used up
- accept sugar / not reagent / reactant
- concentration of ethanol high enough to kill / poison yeast / denature enzymes
- not kill enzymes

(iv) to prevent aerobic respiration
- / ethanol would be oxidised / ethanoic acid / acid formed / lactic acid formed / carbon dioxide and water formed

### Question 68

(a) (i) contains carbon, hydrogen and oxygen
- accept example
- rate 2H₂ : 1O₂
- not contains water
- ignore comments about carbon

(ii) living organism / plants and animals / cells
- obtain energy from food
- not burn negates energy mark

(iii) carbohydrates contain oxygen

(iv) as a fertiliser / manure

(b) (i) 80cm³ of oxygen therefore 40cm³ of methane
- 40/80 × 100 = 66.7%
- accept 66% and 67% no ecf

(ii) add sodium hydroxide(aq) / alkali
- carbon dioxide dissolves, leaving methane

[Total: 15]
### Question 69

1. (a) **lighter / light / lightweight / lower density**
   - does not corrode / rust / oxidised
   - cheaper / easier to mould
   - **ignore**

2. (i) credit any two sensible suggestions e.g. rope / clothing / netting / string / carpets / fishing line / fishing nets / parachutes / tents / bottles / thread / umbrellas / curtains / toothbrushes / cassettes / video tapes
   - **ignore**

3. (ii) non-biodegradable / do not rot / do not decompose / persist for years / accumulate landfill sites / limited / getting filled up
   - visual pollution
   - danger to fish / animals
   - (burn to form) toxic gases / harmful gases / pollutant gases / acidic gases / CO / HCl / HF / HCN
   - not oxides of nitrogen / sulfur
   - **any three**

4. (b) (i) propene / propylene
   - **accept** prop-1-ene
   - not prop-2-ene
   - **CH\_2=CH\_2**
   - double bond must be shown

   (ii) **correct** repeat unit (one or more whole repeat units must be given)
   - *cond continuation*

5. (c) (i) amide / peptide / polypeptide
   - *protein / polypeptide*
   - (iii) H\(_2\)N(CH\(_2\))\(_2\)NH\(_2\) HOOC(CH\(_2\))\(_3\)COOH

### Question 70

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>5 (a) (i)</strong></td>
<td>Mg + 2CH(_3)COOH → (CH(_3)COO(_2))(_2)Mg + H(_2)</td>
</tr>
<tr>
<td></td>
<td>correct formula of magnesium ethanoate</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>(b) (i)</strong></td>
<td>add up to 5.8 g</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>(ii)</strong></td>
<td>moles of C atoms = 2.4/12 = 0.2</td>
</tr>
<tr>
<td></td>
<td>moles of H atoms = 0.2/1 = 0.2</td>
</tr>
<tr>
<td></td>
<td>moles of O atoms = 3.2/16 = 0.2</td>
</tr>
<tr>
<td></td>
<td>all three correct = 2</td>
</tr>
<tr>
<td></td>
<td><em>empirical formula CHO</em></td>
</tr>
<tr>
<td><strong>(iii)</strong></td>
<td>118/28 = 4</td>
</tr>
<tr>
<td></td>
<td><strong>C(_4)H(_8)O(_4)</strong></td>
</tr>
<tr>
<td></td>
<td>correct formula with no working scores both marks.</td>
</tr>
<tr>
<td><strong>(iv)</strong></td>
<td>HOOCCH=CHCOOH / CH(_2)=C(COOH)(_2)</td>
</tr>
</tbody>
</table>

[Total: 13]
Question 71

(a) (i) heat catalyst
(ii) an equation that gives:
alkene + alkane
or alkene + alkene + hydrogen
a correct and balanced equation for the cracking of decane, C\textsubscript{10}H\textsubscript{22} but not but-1-ene
(iii) water or steam

(b) (i) C\textsubscript{2}H\textsubscript{5}OH + 3O\textsubscript{2} -> 2CO\textsubscript{2} + 3H\textsubscript{2}O
if only error is balancing the oxygen atoms
(ii) butanol + methanoic acid -> butyl methanesulfonic acid + water
correct products or reactants ONLY

(c) (i) correct structural formulae (1) each
accept either propanol and −OH in alcohol and acid
penalise once for CH\textsubscript{3} type diagrams
For either C\textsubscript{3}H\textsubscript{7}O or C\textsubscript{3}H\textsubscript{7}O [0]
(ii) to conserve petroleum or reduce greenhouse effect

(d) have same boiling point

[Total: 13]

Question 72

(i) structural formula of Ge\textsubscript{2}H\textsubscript{12} all bonds shown

(ii) germanium(IV) oxide

water

[Total: 12]

Question 73

(a) (i) 36 cm\textsuperscript{3}
40 cm\textsuperscript{3}

(ii) forms carbon monoxide
poisonous or toxic or lethal or prevents blood carrying oxygen
or effect on haemoglobin
NOT just harmful

(b) (i) chlorobutane or butyl chloride
number not required but if given must be 1, it must be in correct position
(ii) light or UV or 200°C or lead tetraethyl
(iii) any correct equation for example 2-chlorobutane
or dichlorobutane

(c) (i) correct repeat unit
COND continuation
\(-\text{CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-}\)
(ii) butan-1-ol or butan-2-ol or butanol
if number given then formula must correspond for second mark and number must be in correct position
structural formula of above
CH\textsubscript{3}CH\textsubscript{2}CH\textsubscript{2}CH\textsubscript{2}OH or CH\textsubscript{3}CH(OH)CH\textsubscript{2}CH\textsubscript{3}
NOT C\textsubscript{3}H\textsubscript{7}OH
if first mark not awarded then either formula will gain mark [1]
ACCEPT either formula for "butanol"

(iii) CH\textsubscript{3}CH\textsubscript{2}CH\textsubscript{2}Cl or CH\textsubscript{3}CH\textsubscript{2}CH\textsubscript{2}Cl
NOT C\textsubscript{3}H\textsubscript{7}Cl
response must not include HCl
if equation given look at RHS only

[Total: 1]
Question 74

(b) (i) sterilise/disinfect water or kill microbe/germs bacteria, etc.

NOT just to make it safe to drink or purify it or clean it

 treat above as neutral they do not negate a correct response

(ii) ammonia or methanol or hydrogen chloride or margarine

NOT nylon

(iii) fat or lipid or triester or named fat or glyceryl stearate

or vegetable oil

heat

[1]

[Total: 12]

Question 75

4 (a) (i) C₂H₅COOH or C₆H₅CO₂H

NOT C₂H₆O₂ or C₆H₅COO

(ii) sodium hydroxide + benzoic acid = sodium benzoate + water

correct spelling needed NOT benzeneate

ACCEPT correct symbol equation

(iii) sodium carbonate or oxide or hydrogen carbonate

any TWO

NOT Na

[1]

[2]

(b) (i) 7.7%

(ii) for any number: equal number ratio

for example 1:1 or 6:6

[1]

(iii) empirical formula is CH

molecular formula is C₆H₆

no e.c.f., award of marks not dependant on (ii)

[1]

(c) (i) C₂H₅O₂

(ii) carbon – carbon double bond or alkene

alcohol or hydroxyl or hydroxy

NOT hydroxide

hydroxide and alcohol = 0

[1]