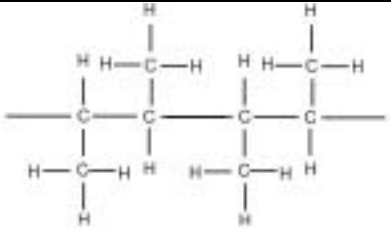
Question	Answer	Marks
1(a)	buta	**1**
(b)	compounds: E **and** F; general formula: C_nH_{2n+2}; **OR** compounds: A **and** B; general formula: C_nH_{2n};	**2** 1 1 1 1
(c)	compounds: E **and** F; explanation: same molecular formula / contain the same number of atoms each element; different structures / different structural formulae / different arrangement of atoms;	**3** 1 2
(d)	contains a double bond / not all bonds are single bonds; C and H only;	**2** 1 1
(e)	$C_2H_4 + H_2O \rightarrow C_2H_5OH$; any 2 from: high temperature / 220 °C–350 °C; high pressure / 60 atm–70 atm; phosphoric acid catalyst;	**3** 1 2
(f)	 **M1** correct carbon structure with only single bonds; **M2** continuation bonds;	**2**

2 **(a) (i)** C_4H_8 only
CH_2 (Allow C_1H_2) [2

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

(iii) M1 same molecular formula [1]

M2 different structural formulae or different structures
or different arrangement of atoms [1]

(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' [1]

(b) (i) M1 Action of heat or catalyst or thermal decomposition (on an alkane) [1]
Ignore steam. Ignore pressure.

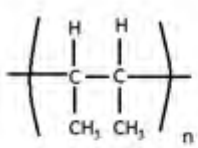
M2 Long-chained molecules or alkanes form smaller molecules (not smaller fraction) or forms smaller alkenes (or alkanes) [1]

(ii) $C_{10}H_{22}$ [1]

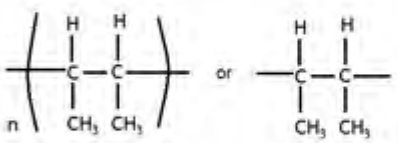
(c) (i) M1 Correct structure of one repeat unit [1]

M2 Continuation bonds **COND** on M1 [1]

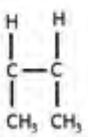
M3 use of brackets and subscript 'n' **COND** on M1 and M2 [1]



= 3 marks



= 2 marks



= 1 mark

(ii) dibromoethane or 1,2-dibromoethane [1]

3 **(a) (i)** butanoic / butyric acid (1)

$CH_3CH_2CH_2COOH$ / $C_2H_5CH_2COOH$ (1) [2]

(ii) any **three** from:

(same) general formula (1)

(consecutive members) differ by CH_2 (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) [3]

(b) (i) displayed formula of propan-1-ol, all bonds shown separately (1) [1]

(ii) acidified (1)

potassium manganate(VII) / potassium permanganate / $KMnO_4$ **or** potassium dichromate(VI) / $K_2Cr_2O_7$ / potassium dichromate (1) [2]

(c) (i) zinc + propanoic acid → zinc propanoate (+ hydrogen) (1) [1]

(ii) calcium oxide + propanoic acid → calcium propanoate + water (1) [1]

(iii) $LiOH + CH_3CH_2COOH \rightarrow CH_3CH_2COOLi + H_2O$ (1) [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) [2]

(ii) (higher temperature in B particles / molecules / atoms) move faster / have more energy / more have E_a **or** (particles / molecules / atoms) in A move slower / have less energy / less have E_a (1)

more collisions **or** less collisions in A (than in B) (1) [2]

(iii) It (D) has strong (acid) **and** A has weak acid / (D) stronger / (D) ionises more / (D) dissociates mo **or** A is weaker / A ionises less / A dissociates less (1)

It (D) has higher concentration of hydrogen ions **or** A has a lower concentration of hydrogen ions (1)

more collisions (in D) **or** fewer collisions in A (1) [3]

[Total: 18]

4 **(a) (i)** C and H only (1) [1]

(ii) only single bonds (1) [1]

(b) C_nH_{2n+2} (1) [1]

(ii) $C_{14}H_{30}$ (1)
$(14 \times 12) + 30 = 198$ (g) (1) [2]

(c) $C_9H_{20} + 14\ O_2 \rightarrow 9CO_2 + 10H_2O$ (2) [2]

(ii) Volume ratio

$C_xH_y(g)$ +	$O_2(g)$ →	$CO_2(g)$ +	$H_2O(l)$	
20	160	100		all in cm^3
1	8	5		mole ratio

$C_5H_{12} + 8O_2 \rightarrow 5C_2 + 6H_2O$
For evidence of method (1)
for equation as above (2) [3]

(d) alkanes in petrol / fuel / solvent (1)
alkenes to make alcohols / plastics / polymers / solvents (1)
hydrogen to make ammonia / fuel / fuel cells, etc. (1) [3]

(ii) a correct equation for example:
$C_{10}H_{22} \rightarrow C_8H_{16} + C_2H_4 + H_2$ (1) [1]

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

(ii) $CH_3–CHCl–CH_3$ (1) [1]

[Total: 16]