1 **(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) $LiOH + CH_3CH_2 COOH \rightarrow CH_3CH_2COOLi + H_2O$ (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]

2 **(a** any **three** from:
particles have more energy (1)
move faster (1)
collide more frequently (1)
more particles have energy greater than E_a [3]
guidance: more colliding molecules have enough energy to react is worth (2)

(b) particles move in all directions / randomly <u>in both</u> liquids and gases (1)

no bonds / very weak forces between particles in gases (1)
molecules can move apart / separate (to fill entire volume) (1)
OR
bonds / forces / IMF between particles in liquids (1)
molecules cannot move apart / separate (so fixed volume in liquids) (1) [3]

[Total: 6]

3 **(a** same general formula
consecutive members differ by CH_2
same chemical properties
same functional group
physical properties vary in predictable way / give trend – mp increases with n etc.
common methods of preparation
any **THREE** [3]

(b) they have the same molecular formula [1]
not general formula
different structures / structural formulae [1]

(ii) CH_3-CH_2-CH(OH)-CH_3 / $(CH_3)_3$C-OH [1]
not ether-type structures
NOTE butan-2-ol and 2-methylpropan-2-ol acceptable

(c) air/oxygen / (acidified) potassium chromate(VI) /
(acidified) potassium manganate(VII) [1]
must have oxidation states

(ii) carboxylic acid / alkanoic acid [1]
CH_3-CH_2-CH_2-COOH / C_3H_7COOH / $C_4H_8O_2$ [1]
accept C_4H_7OOH

(d) measure <u>volume</u> of carbon dioxide [1]
time [1]
accept day / hour for time mark

(ii) increase in temperature / more yeast present / yeast multiplies [1]

(iii) glucose used up [1]
accept sugar **not** reagent / reactant

concentration of ethanol high enough to kill/poison yeast / denature enzymes [1]
not kill enzymes

(iv) to prevent aerobic respiration [1]
/ ethanol would be oxidised / ethanoic acid/ acid formed / lactic acid formed / carbon dioxide and water formed

[Total: 15]

4 **(a** 23p 23e 28n [1]
23p 20e 28n [1]
23p 23e 27n [1]

(b) (contains) iron [1]
cond with other element(s) / compounds / suitable named element [1]
if iron is absent = 0

(ii) mild steel [1]
cars / fridges / white goods / construction etc. [1]
credit any sensible suggestion e.g. roofing, nails, screws, radiators
or
stainless steel [1]
cutlery / chemical plant / jewellery / (kitchen) utensils / named kitchen utensil / in cars / surgical equipment / car exhausts etc. [1]
not vanadium steel (this is in the question)

(c) V_2O_3 [1]
VO_2 [1]

(ii) add sodium hydroxide(aq) or other named alkali [1]
not ammonia
cond vanadium(IV) oxide dissolves / reacts [1]
filter (to remove vanadium(III) oxide) [1]

[Total: 12]