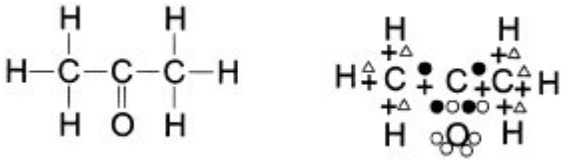
1. (a) Van der Waals/induced dipole-dipole 1

(b) (i) Hydrogen/dipole-dipole in **propan-1-ol**,(but no hydrogen/ dipole-dipole in butane) 1

(ii) Van der Waals forces in propan-1-ol are stronger
OR reverse argument **(1)**
because chain is not branched/so more surface contact between molecules)
OR reverse argument **(1)** 2

(c) (i) 2



(ii) 109(.5)° for HCH **(1)**
120 – 124° inclusive for CCO bonds **(1)** 2

(iii) (permanent) dipole-dipole 1

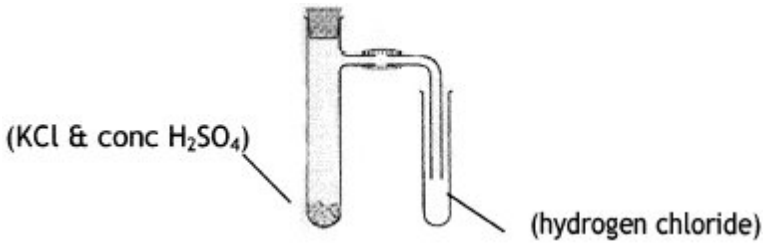
(iv) 25 (°C) < T < 75 (°C) 1

(d) Propanone can form hydrogen bonds **with water**, (but butane cannot) 1

[11]

2. (a) (i) $KCl + H_2SO_4 \rightarrow KHSO_4 + HCl$
OR
$2KCl + H_2SO_4 \rightarrow K_2SO_4 + 2HCl$ 1

(ii)



Preparation (1 mark)

Boiling/test tube but not on its side
Pear-shaped flask
Conical flask

Collection of gas (1 mark)

Downward delivery (mark lost if delivery tubing less than 1/3 down tube)

Gas syringe

Penalties
-1 for seated apparatus
-1 for poor diagram e.g. continuous pieces of apparatus, delivery tubing entering side of test tube 2

(b) (i) **White** smoke/solid/fumes *NOT* gas/vapour/cloud 1

(ii) $HCl(g) + NH_3(g) \rightarrow NH_4Cl(s)$ 1

(iii) Ammoni**um** chloride 1

(c) (i) Cl in HCl: –1 / 1 – Cl in Cl_2: 0 **(1)**

O in H_2O_2: –1 / 1– O in H_2O: –2 / 2– **(1)** 2

(ii) hydrochloric acid/hydrogen chloride/chloride ion/ HCl/Cl^-
NOT "chlorine" *UNLESS* "the chlorine in HCl" 1

(iii) *N.B. Read whole thing through.*
Look for good use of chemical language eg use of molecule / atom

O.N. of 2 Cls has increased by (1 × 2=) TWO
O.N. of 2 Os has decreased by (1 × 2=) TWO

OR

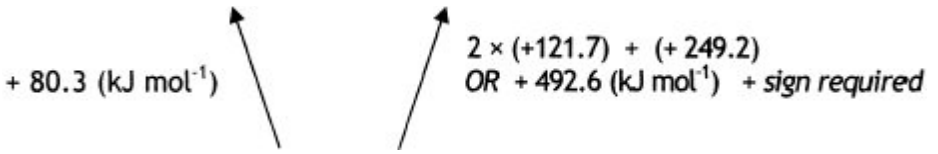
In terms of electron exchange from one **oxidation state** to another.

OR

Can consider total oxidation numbers remaining constant eg "sum of O and Cl
O.N. = –4 on left, sun of O and Cl O.N. = –4 on right too". 1

(d) (i) $C1_2(g)$ (+) ½ $O_2(g)$ 1

(ii)



ALLOW T. E from (i) 1

(iii) $DH^{\ominus}_{at}$ $[Cl_2O(g)]$ = –80.3 + 492.6 = + 412(.3) (kJ mol^{-1})
SIGN essential
PENALISE wrong units
*Correct answer with no working **(1)*** 1
ALLOW TE from(ii), provided Hess' Law applied correctly
*for **their** cycle*

(iv) E[Cl –O] (= ½ × (+ 412.3)) = (+)206(.2) (kJ $mo1^{-1}$)
ALLOW TE from (iii)
ALLOW (+)206.15
ALLOW missing sign 1

[14]

3. (a) (i) Ammonia/NH_3 **(1)**
Ethanolic/alcoholic conditions)
high temp/) *Any one* **(1)**
high pressure) 2

(ii) Substitution **(1)**
Nucleophilic **(1)** 2

(b) (i) $CH_3CH(OH)CH_2CH_3$ *OR* $CH_3CH(OH)C_2H_5$ 1

(ii) cream/off-white/ivory **(1)**
$Ag^+(aq) + Br^-(aq) \rightarrow AgBr(s)$ **(1)** 2

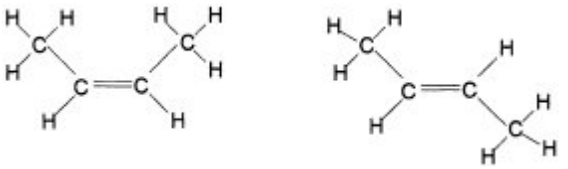
(iii) more slowly + *some attempt at explanation* **(1)**
C-Cl bond stronger than C-Br bond **(1)** - *must be a comparison of specific bonds*

2nd mark dependent on 1st 2

(c) (i) Potassium/sodium hydroxide **(1)**
ALLOW formulae

Ethanolic **and** heat/reflux **(1)** - *ethanol can* be *given as a reagent* 2

(ii)



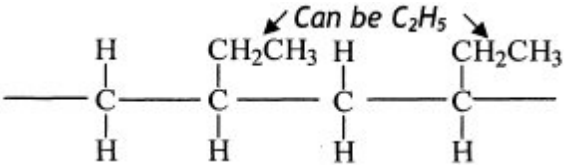
1

(iii) *N. B. Read whole answer to see if it makes sense*

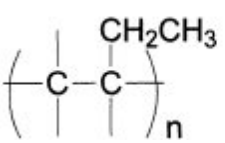
Two hydrogen atoms (two identical atoms) are linked to one of the carbon atoms holding the double bond (so two distinct geometric isomers not possible) 1

[13]

4. (a)



Missing end links (max 1)
C_2H_5 could be on C1 and C4 or C2 and C3. 2



(1 out of 2)

(b) activation energy for catalysed process clearly marked **(1)**
appropriate curve drawn starting at "reactants" , finishing at "products" **(1)**
with the maximum **above** the one for the catalysed reaction **(1)** 3

(c) (i) (catalyst) provides route/pathway with lower activation energy
NOT reach activation energy earlier/faster 1

(ii) to provide the activation energy necessary/energy to break some bonds 1

[7]

5. (a) (Sweat is a dilute aqueous) solution of sodium chloride and urea, (and also other metabolic waste products, such as the lactates produced in muscles)
OR
Is a mixture of water, sodium chloride, urea 1

(b) (Sweat is produced by the eccrine glands) via emotional, thermal and sensory stimuli 1

(c) $CH_3CH_2CH_2CH(CH_3)CH_2COOH$
correct answer **(2)**
correct structure, except CH_3 branch in wrong place **(1)**
structure for a methylheptanoic acid **(1)** 2

(d) Antiperspirants were too acidic and irritated the skin/rotted clothes 1

(e) $Al_2(OH)_2Cl_4$ 1

(f) e.g. more wasted using aerosol
application more precise with roll-on/ consequences for atmospheric pollution using aerosols/any other feasible alternative
ACCEPT environmental pollution + *qualification* 1

(g) Examiners will need to consider each answer for (i) key points and (ii) Quality of communication.

[7]

Word total/penalty

Candidates should have recorded their word total at the end of their answer, and this should be checked.

up to 105 words: no penalty
106 – 115 words: –1
116 – 125 words: –2
126 – 135 words: –3

and at a rate of –1 penalty for every 5 words excess thereafter, up to a maximum penalty equal to the number of key points included by the answer.

Note that words appearing in the title to the summary do not count in the word total. Normally hyphenated words (such as odour-causing, roll-ons, mid-1970s, zinc-based), numbers and chemical formulae count as one word. The question does not ask for equations in the summary, but if included they should be counted in the word total.

99 % = 2 words
RCOOH = 2 words
BO = 2 words
$Al_2(OH)_mCl_n$ = 2 words
ACH = 2 words
1947 = 2 words
$C_4 – C_{10}$ = 3 words
m+n = 6 = 3 words

Marking for key points (6 marks)

One mark should be awarded for every key point clearly identified in an answer, up to a maximum of 6 marks.

A tick should be made in the script. Examiners should show the key point being awarded,
i.e.✓[3] shows key point 3 given.

List of key points: these may be in a different order, and need not be expressed in the wording below provided that the sense of each point is conveyed.

Key pt

Distinction

✓[1] Deodorants act (solely) to reduce BO by **killing** / **eradicating** / **destroying** the (odour-causing) bacteria. **(1)**

✓[2] Antiperspirants reduce both odour **and** wetness
OR
In addition antiperspirants reduce wetness - *dependent on* key *pt 1* **(1)**

✓[3] Ethanol is the **principal** antibacterial agent **(1)**

✓[4] with **further activity** [OWTTE] derived from some of the added perfume oils.**(1)**

✓[5] Aluminium **salts** are (commonly) used in antiperspirants (nowadays).....
NOT aluminium chlorohydrates **(1)**

✓[6] ..... and these **physically** block the eccrine/sweat glands - *must follow on from "aluminium"* **(1)** 4

Formulation

✓[7] Deodorants and antiperspirants can be sold as a solution, a suspension or emulsion **(1)**

Application

✓[8] and can be applied in)
pump sprays)
roll-ons) *Any two* **(1)**
sticks)
aerosols)
gels)

2

Quality of Written Communication (2 marks)

These should *be impression* marked on a scale 2-1-0, and the mark out of 2 should be recorded in the body of the script at the end of the answer. This mark can not be lost as a result of a word penalty.

Candidates are expected to:

- show clarity of expression;
- construct and present coherent argument;
- demonstrate effective use of grammar punctuation and spelling.

The aspects to be considered are:

- use of technical terms; the answer should convey a correct understanding by the writer of the technical terms used in the passage which are involved in the key points.
- articulate expression; the answer should be well-organised in clear, concise English, without ambiguity. It should read fluently, with the links between key points in the original maintained.
- legible handwriting; the reader should be able to read the answer without difficulty at normal reading pace, with only the occasional difficulty with a word.
- points must be in a logical order.

Good style and use of English, with only infrequent minor faults, no use of formulae **(2)**

Frequent minor or a few major faults in style and use of English **(1)**

Very poor style and use of English **(0)**

[15]