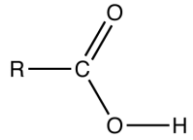
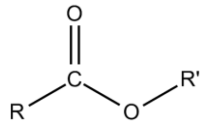
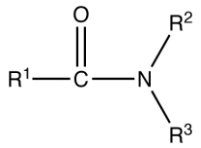
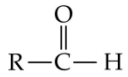
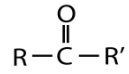
SCH 4U

FUNCTIONAL GROUPS with C=0 BONDS [carbonyl groups]

FUNCTIONAL GROUP	NAME
	Carboxylic acids
	Esters
	Amides
	Aldehydes
	Ketones

① ALDEHYDES

- R – CHO
- Carbonyl group at the end of molecule

NAMING

1. main group with carbonyl group
   - since carbonyl always position #1 – do not indicate position number
2. replace **-e** ending of alkane with **-al**
3. side chains

② KETONES

- $R_1 – COR_2$
- Carbonyl group is flanked by 2 alkyl groups

NAMING

1. main group with carbonyl group
2. replace **-e** with -one, -dione, -trione
3. if more than 4 carbons, indicate position # (carbonyl group in lowest)
4. side chains

PROPERTIES:

1. $C = O$ is a polar bond [ΔEN = 3.44-2.55 = 0.89]

2. No H – bonds between themselves.

3. H – bonds with water.

4. Low C's in molecule – water soluble; as # C's increase (non-polar), solubility decreases.

5. Can dissolve in both polar and non-polar substances.
   Eg. Acetone/ Propanone/ Butone

6. MP/ BP -- alkane < aldehyde/ketone < alcohol

7. Other properties:

ALDEHYDES

- Pungent odour
- More C's, then pleasant odour -- eg. Cinnamon

KETONES

- Sweet odour
- Molecules found in roses, perfume.

③ CARBOXYLIC ACIDS

- R – COOH
- Carbonyl group at one end of molecule
- Carbonyl groups at both ends of molecule – called a dicarboxylic acid (or diacid)

NAMING

1. parent alkane

2. replace -e with -oic acid

3. # carbonyl group as carbon #1 – do not indicate position #

4. side chains

PROPERTIES:

1. polar O – H and $C = O$ bonds.

2. H-bonding stronger in self and with water.

3. soluble in water; decreases as # C's increases.

4. very high MP/BP due to H-bonding.

5. unpleasant odour -- Eg. Butanoic acid smells like stale sweat.

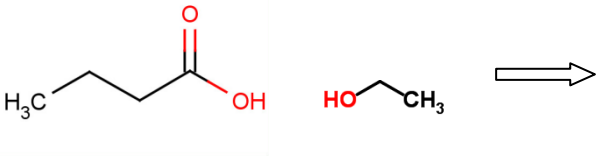
④ DERIVATIVES OF CARBOXYLIC ACIDS

- Replace – OH with different group

4A: ESTERS

- R_1 - COO - R_2
- Formed by combining a carboxylic acid and an alcohol.

Eg. Butanoic acid + ethanol --- condensation or synthesis reaction



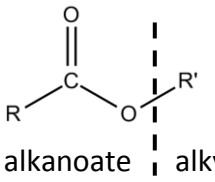
NAMING

1. parent chain with $C = O$ group.

2. replace -oic acid with -oate

3. name other part (that is attached to – O –) as an alkyl group.

4. use 2 words --



alkanoate | alkyl ⟶ name as "alkyl alkanoate"

PROPERTIES:

1. polar molecules

2. no H-bonding with themselves, but there is H-bonding with water.

3. If there are less than 4 carbons, soluble in water

4. low MP/BP – since there are no H bonds.

5. pleasant odours and taste – found in fruits.

4B: AMIDES

- $R_1 – CO – NR_2R_3$
- the R groups may be H's or C's.
- Combined carboxylic acids with amines.

NAMING

1. parent carbonyl chain (always position #1)

2. replace ***-oic acid*** with ***-amide***

3. for alkyl groups attached to N -- ie. secondary and tertiary N's
   - use prefix N – instead of numbering system
   - if N has 2 substituents, then use N, N –

4. side chains

PROPERTIES:

- very similar to Esters, with the following exceptions
  -- less polar due to containing the N-atom, not the O-atom
  -- no sweet odours -- more pungent odours like amines.