1. C

[1]

2. (a) boiling points increase (from the first member to the fifth member);
increasing size of molecule/area of contact/number of electrons (from the first to the fifth member);
strength of intermolecular/van der Waals'/London/dispersion forces increase / more energy required to break the intermolecular bonds (from first member to fifth member); 3

(b) same general formula;
successive members differ by CH_2;
same functional group / similar/same chemical properties;
gradual change in physical properties; 2 max
Accept specific physical property such as melting point, boiling point only once.

[5]

3. add bromine water/bromine;
pentane no change/stays brown **and** pent-1-ene decolourizes bromine water/bromine;

OR

add acidified $KMnO_4$;
pentane no change/stays purple **and** pent-1-ene decolourizes acidified $KMnO_4$; 2 max
Accept any correct colour change.
Do not accept "clear" instead of "colourless".

[2]

³ã ³ã

4. **E**: primary **and F**: secondary;
G: primary;
G / **E**: only one alkyl group/2 H atoms attached to the carbon atom attached to the Cl / only one carbon atom attached to the carbon atom attached to the Cl;
F: two alkyl groups/1 H atom attached to the carbon atom attached to the Cl / two carbon atoms attached to the carbon atom attached to the Cl; 4

[4]

5. D

[1]

6. A

[1]

F: two alkyl groups/1 H atom attached to the carbon atom attached to the Cl / two carbon atoms attached to the carbon atom attached to the Cl; 4

[4]

7. B

[1]

8. D

[1]

9. C

[1]

10. A

[1]

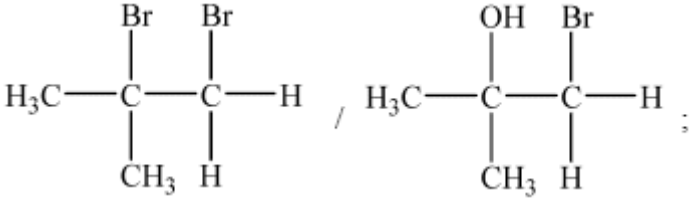
11. B

[1]

12. (a) methylpropene;
Accept 2-methylpropene. 1

(b) (i) brown/orange/yellow to colourless / bromine is decolorized; 1

(ii) 1,2-dibromo-2-methylpropane / 1,2-dibromomethylpropane / 1-bromo-2-methylpropan-2-ol / 1-bromomethylpropan-2-ol;
Do not penalize missing commas, hyphens or added spaces.



*Award **[1]** if structure and correct name are given for 2-bromo-2-methylpropan-1-ol.* 2

[4]

13. (i) CH_3OCH_2CH;
$CH_3CHOHCH$;
Allow more detailed structural formulas. 2

(ii) $CH_3CHOHCH_3$ has higher boiling point due to hydrogen bonding;
$CH_3OCH_2CH_3$ has lower boiling point due to Van der Waals'/London/ dispersion/dipole-dipole forces;
hydrogen bonds in $CH_3CHOHCH$ are stronger;
Allow ecf if wrong structures suggested. 2 max

[4]

14. B

[1]

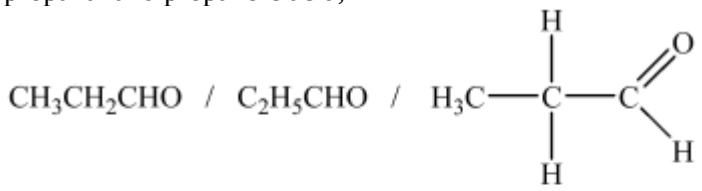
(ii) $CH_3CHOHCH_3$ has higher boiling point due to hydrogen bonding;
$CH_3OCH_2CH_3$ has lower boiling point due to Van der Waals'/London/ dispersion/dipole-dipole forces;
hydrogen bonds in $CH_3CHOHCH$ are stronger;
Allow ecf if wrong structures suggested. 2 max

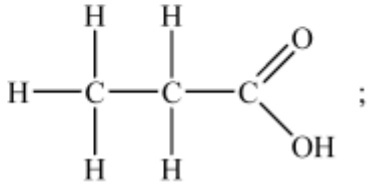
[4]

15. (i) butane < propanal < propan-1-ol;
butane has van der Waals'/London/dispersion forces;
propanal has dipole-dipole attractive forces;
propan-1-ol has hydrogen bonding;
imf marks are independent of the order.
Treat references to bond breaking as contradictions if the imfs are correct. 4

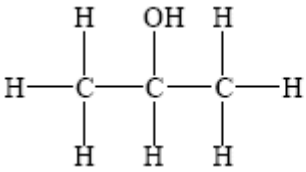
(ii) butane is least soluble;
it cannot form hydrogen bonds/attractive forces with water molecules; 2

(iii) propanal and propanoic acid;

CH_3CH_2CHO / C_2H_5CHO /  ;

CH_3CH_2COOH / C_2H_5COOH /  ;

3

(iv)  /$CH_3CH(OH)CH_3$;

1

(v) secondary (alcohol);
propanone / acetone; 2

[12]

16. C

[1]

17. C

[1]

18. (i) energy required to break (1 mol of) a bond in a gaseous molecule/state;
Accept energy released when (1 mol of) a bond is formed in a gaseous molecule/state / enthalpy change when (1 mol of) bonds are made or broken in the gaseous molecule/state.

average values obtained from a number of similar bonds/ compounds / *OWTTE*; 2

(ii) *Bonds broken*
(1)(C–C) + (1)(O–H) + (5)(C–H) + (1)(C–O) + (3)(O=O)
= (1)(347) + (1)(464) + (5)(413) + (1)(358) + (3)(498) = 4728(kJ);
Bonds formed
(2 × 2)(C=O) + (3 × 2)(O–H)
= (4)(746) + (6)(464) = 5768 (kJ);
ΔH = 4728 – 5768 = –1040 kJ mol^{-1} / –1040 kJ;
Units needed for last mark.
*Award **[3]** for final correct answer.*
*Award **[2]** for +1040 kJ.* 3

(iii) $M_r(C_2H_5OH)$ = 46.08 / 46.1 **and** $M_r(C_8H_{18})$ = 114.26/114.3;
1 g ethanol produces 22.57 kJ **and** 1 g octane produces 47.88 kJ;
Accept values ranges of 22.5–23 and 47.8–48 kJ respectively.
No penalty for use of M_r = 46 and M_r = 114. 2

(iv) **A**: CH_3CHO;
B: CH_3COOH/CH_3CO_2H;
Accept either full or condensed structural formulas but not the names or molecular formulas.

A: distillation;
B: reflux; 4

(v) ethanol/CH_3CH_2OH;
hydrogen bonding (in ethanol);
Award second point only if the first is obtained. 2

(vi) (concentrated) H_3PO_4 /(concentrated) phosphoric acid / H_2SO_4/sulfuric acid;
dyes / drugs / cosmetics / solvent / (used to make) esters / (used in) esterification/disinfectant; 2

[16]

19. C

[1]

20. (concentrated) H_2PO_4/(concentrated) phosphoric acid / H_2SO_4/sulfuric acid; dyes / drugs / cosmetics / solvent / (used to make) esters / (used in) esterification / disinfectant; 2

[2]

21. C

[1]