2.8 test ms

1. 1(-)bromobutane 1

correct structure for 1-bromo-2-methylpropane 1
(C– C bonds must be clear where drawn)

[2]

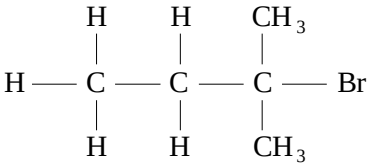
2. (i) 2-bromo-3-methylbutane

correct spelling each of bromo, methyl and butane **(1)**
for numbers – 2 & 3 either order **(1)** 2

(ii) compounds with the same molecular formula / compounds or molecules with the same number and type of atoms
not atoms or elements instead of compounds **(1)**

different structural formulae / different arrangement of atoms / different structures / different graphical (displayed) formulae / functional groups in different places **(1)** 2

(iii)



accept CH3–CH_2–.... **(1)** 1

[5]

3. (a) (i) (Free) radical substitution 1
(Both words needed)

(ii) M1 initiation ONLY 1
M2 ultra-violet light OR sunlight OR 1000°C ≥ T ≥ 450°C 1
(Ignore reference to temperature if included with uv light)
(Penalise "high temperature" for M2)

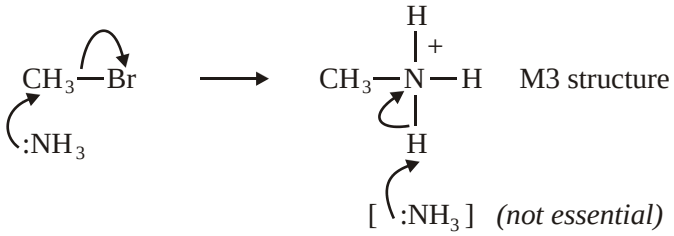
(iii) $2\dot{C}H_3 \rightarrow C_2H_6$ 1
(OR CH_3CH_3 as alternative to C_2H_6)

(iv) $CH_3Br + Br_2 \rightarrow CH_2Br_2 + HBr$ 1

(b) (i) Electron pair donor 1
OR species with an electron pair able to form a covalent bond.

(ii) Methylamine 1
(Credit " aminomethane")

(iii) 1



M3 structure

(not essential)

M1 arrow to show breakage of C – Br bond 1

M2 arrow from lone pair on N of NH_3 to form bond with C 1

M4 arrow from bond of N – H to N atom of $CH_3\overset{+}{N}H_3$ 1

(Ignore partial charges on haloalkane but penalise if incorrect)

(Accept $CH_3\overset{+}{N}H_3$ for M3)

(Full credit for carbocation mechanism; M1 for C – Br bond breakage and M2 for lone pair attack on carbocation)

(Second mole of ammonia not essential to mechanism for full credit)

[11]

4. (a) C 22.24/12 = 1.85 H 3.71/1 = 3.71 Br 74.05/79.9 = 0.927 **(1)**
ratio C:H:Br = 2:4:1 ∴ C_2H_4Br **(1)**
empirical mass = 107.9 ∴ mol formula = 215.8/107.9 × C_2H_4Br = $C_4H_8Br_2$ **(1)**

must use % to justify answer

or
C (22.24/100) × 215.8 = 47.99 i.e. 48/12 = 4 carbon atoms **(1)**
H (3.71/100) × 215.8 = 8.01 i.e. 8/1 = 8 hydrogen atoms **(1)**
Br (74.05/100) × 215.8 = 159.8 i.e. 159.8/79.9 = 2 bromine atoms **(1)**

or
C (48/215.8) × 100 = 22.24% **(1)**
H (8/215.8) × 100 = 3.71 % **(1)**
Br (159.8/215.8) × 100 = 74.05% **(1)** 3

(b) **any two pairs of marks**

1,1-dibromo-(2-)methylpropane **(1)**
graphical formula to suit $(CH_3)_2CHCHBr_2$ **(1)**
1,2-dibromo-(2-)methylpropane **(1)**
graphical formula to suit $(CH_3)_2C(Br)CH_2Br$ **(1)**
1,3-dibromo-(2)-methylpropane **(1)**
graphical formula to suit $BrCH_2CH(CH_3)CH_2Br$ **(1)**
allow unambiguous names

mark name and structure independently
accept order of bromo / methyl reversed

penalise once for each of
numbering from wrong end and di in dibromo omitted max 4

(c) (i) alcoholic/ethanolic solution (not just alcohol must be solvent) **(1)**
structure to suit $CH_3CH=CH_2$ **(1)** 2

(ii) aqueous solution (not water alone, unless solvent penalised in (i)) **(1)**
structure to suit $CH_3CH(OH)CH_3$ **(1)** 2

(d) (i) cyanide ion / CN^- / NC^- **not** nitrile ion **(1)** 1

(ii) nucleophilic substitution / S_NI / S_N2 **(1)** 1

(iii) $CH_3CH(Br)CH_3 + KCN \rightarrow CH_3CH(CN)CH_3 + KBr$ / ionic version **(1)**
(condone missing brackets) 1

(iv) structure to suit $CH_3CH(CN)CH_3$ (with CN bond shown as a triple bond) **(1)**
1

[15]

5. Ml curly arrow <u>from lone pair</u> on oxygen of hydroxide ion to H atom on C-H adjacent to C-Br 1

M2 curly arrow <u>from single bond</u> of adjacent C-H <u>to adjacent single bond</u> C-C 1

(only credit M2 if Ml is being attempted to correct H atom)

M3 curly arrow <u>from C-Br bond</u> to side of Br atom 1

6. (a) dichlorodifluoromethane / accept halogens reversed **(1)** 1

ignore number ' l' in name; penalise other numbers
ignore hyphens and gaps

(b) appropriate tetrahedral shape **(1)**

explains that tetrahedral shape due to repulsion between (four bonding) pairs of electrons **not** pairs of atoms repelling **(1)**

repulsion unequal due to bonds to different atoms / covalent radii / bond lengths / different electronegativity / dipoles **(1)** 3

(c) C– Cl bond weaker / longer than C-F bond / C– F bond is stronger **(1)** 1

[5]

7. (a) $(CH_3)_2$ CH CH_2CH_2Br **(1)**

1-bromo-3-methylbutane **(1)**

CH_3 CH_2CH (CH_3) CH_2Br **(1)**

1-bromo-2-methylbutane **(1)**

$(CH_3)_2CH$ CHBr CH_3 **(1)**

2 bromo-3-methylbutane **(1)**

6

(b) two bromine isotopes **(1)**

$C_5H^{11}\ ^{79}Br = 150$ and $C_5H_{11}\ ^{81}Br = 152$ **(1)**

relative abundances approximately equal **(1)**

[9]