Question	Answer	Marks	Guidance
1(a)	($_3$ →) CuO + CO_2; ($Cu(OH)_2$ →) CuO + H_2O; ($2Cu(NO_3)_2$ →) 2CuO + ($4NO_2$) + O_2 species; balancing;	4	**A** multiples **I** state symbols
(b)(i)	(black to) pink / brown / orange;	**1**	red
(b)(ii)	(hot) copper reacts / is oxidised; with oxygen / air;	**2**	**A** forms copper oxide for 2 marks
(iii	monoxide / ammonia / methane;	**1**	
(b)(iv)	/ graphite or any metal more reactive than copper;	**1**	
1(c)(i	79.28 79.6205853; 84.7161572;	**2**	Minimum 3 sig figs **A** rounding or truncating *All three correct = 2 marks,* *Two correct = 1 mark*
(c)(ii)	the last one **OR** Cu and O_2 **OR** the one from copper; not all the copper oxidised **OR** the outside of the pieces of copper oxidised but the inside did not **OR** (still) contains copper (metal);	**2**	ecf of biggest for M1

2 **(a) (i)** 82.76/12 and 17.2(4)(/1)
or evaluation: 6.89 / 6.9(0) and 17.2(4) [1]

C_2H_5 [1]

OR
82.76 / 100 × 58 = 48 and 17.24 / 100 × 58 = 10
or evaluation i.e. 48 and 10 [1]

C_2H_5 [1]

(ii) (C_2H_5 =) 29 [1]

(58 / 29 =2) C_4H_{10} [1]

OR:
82.76 / 100 × 58 = 48 and 17.24 / 100 × 58 = 10
or evaluation i.e. 48 and 10 [1]

48 / 12 = 4 10 / 1 = 10 (therefore) C_4H_{10} [1]

(b) (i) C_nH_{2n} [1]

(ii) CH_2 [1]

(c) (contains) double bond / triple bond / multiple bond(s) / not all bonds are single [1]

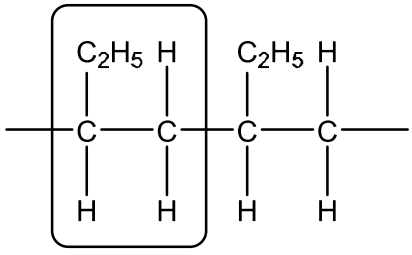
(contains) carbon and hydrogen **only** [1]

(d) bromine / bromine water [1]

no change / stays brown / orange / yellow / red-brown or only changes in UV [1]

(brown / orange / yellow) to colourless / decolourised

(e) (i) circle / brackets around any 2 consecutive carbon atoms in the main chain and all attached atoms [1]
e.



(ii) $CH_3CH_2CH=CH_2$ / $C_2H_5CH=CH_2$ (double bond must be shown) [1]

butene / but-1-ene

(iii) $(CH_3)_2C=CH_2$ / $CH_3CH=CHCH_3$ / $(CH_2)_2CHCH_3$ / $(CH_2)_4$ [1]

[Total:15]

3 **(a)** Any **two** from:
yeast / 20–40 °C / anaerobic or without oxygen or without air / (aqueous) solution or water or aqueous [2]

(b) (i) Mr = 180 (1) (30/180) = 0.167 (1) [2]

(ii) 2×0.167 or 2×46 or 0.333 or 92 [1]

$(2 \times 0.167 \times 46) = 15.3(33)$ (g) [1]

(iii) $(2 \times 0.167 \times 24) = 8$ (dm^3) [1

(c) (i) Crude oil / petroleum

(ii) $C_2H_4 + H_2O \rightarrow C_2H_5OH$ / CH_3CH_2OH [

[Total:9]

4 **(a (i)** (the number of particles which is equal to the number of atoms in) 12 g of carbon 12
or
the mass <u>in grams</u> which contains the Avogadro's constant number of particles
or
Avogadro's constant **or** 6 to 6.023×10^{23} <u>of atoms / ions / molecules / electrons / particles</u>
or
(the amount of substance which has a mass equal to) its relative formula mass / relative atomic mass / relative molecular mass <u>in grams</u>
or
(the amount of substance which has a volume equal to) 24 dm^3 of a <u>gas</u> at RTP
[1]

(ii) (Avogadro's constant is the) number of particles / atoms / ions / molecules in one mole of a substance
or
the <u>number</u> of carbon atoms in 12 g of C(12).
or
the number of particles / molecules in 24 dm^3 of a <u>gas</u> at RTP
or
6 to 6.023×10^{23} (particles / atoms / ions / molecules / electrons) [1]

(b) CH_4 **and** SO_2 [1]

2/16 = 1/8 or 0.125 moles of CH_4 **AND** 8/64 = 1/8 or 0.125 moles of SO_2 [1]

(c) (i) 4.8/40 = 0.12 moles of Ca
3.6/18 = 0.2 moles of H_2O **both** correct [1]

(ii) Ca is in excess (**no mark**) (because 0.12 moles of Ca need) 0.24 moles / 4.32 g of H_2O to react [1]
there is not enough / there are 0.2 moles / 3.6 g of H_2O [1]
or
Ca is in excess **(no mark)** (because 0.2 moles / 3.6 g of water will react with) 0.1moles/4.0 g of Ca [1]
there is more than that / there are 0.12 moles / 4.8 g of Ca [1]
or
Ca is in excess **(no mark)** because the mole ratio Ca:H_2O is 3:5 / mass ratio 4:3 [1]
which is bigger than the required mole ratio of 1:2 / mass ratio 10:9 [1]
or
Ca is in excess **(no mark)** because the mole ratio H_2O:Ca is 5:3 / mass ratio 3:4 [1]
which is smaller than the required mole ratio of 2:1 / mass ratio 9:10 [1]

(iii) $0.02 \times 40 = 0.8$ (g) [1]

5 **(a** 72/24 = 3 and 28/14 = 2 [1]
Mg_3N_2 [1]
accept just formula for [2] even with incorrect or no working
NOT ecf

(b) $Al_4C_3 + 12H_2O = 4Al(OH)_3 + 3CH_4$ [2]
For Al_4C_3 ONLY [1]

(c) silicon is limiting reagent [1]
0.07 moles of Si and 25/160 = 0.156 moles of Br_2 [1]
because 0.14 (2 × 0.07) < 0.156 [1]
If 80 used to find moles of Br_2 the mark 1 and 3 still available
arguments based on masses can be used

(ii) 0.07 [1]
NOT ecf

[Total: 8]

6 **(a)(i)** lattice **[1]**

(ii) high melting point **or** high fixed points
poor conductor as solid
good conductor as liquid, accept either aqueous or molten
hard
soluble in water
Any **TWO** **[2]**

(b)(i) Mg^{2+} **[1]**

(ii) N^{3} **[1]**

(iii) Mg_3N_2 **[1]**

(iv) opposite charges **[1]**
Do NOT accept "attract" it is in the question
accept electrostatic attraction as a phrase

TOTAL = 7