0620 MCQ Answers

1-A	11-C	21-C	31-B
2-D	12-B	22-D	32-B
3-D	13-D	23-B	33-C
4-B	14-C	24-B	34-B
5-C	15-C	25-B	35-B
6-B	16-D	26-D	
7-	17-C	27-D	
8-	18-C	28-D	
9-C	19-D	29-D	
10-D	20-B	30-D	

0620 Theory Answers

Question 1

(c) 0.104/0.026 [1]

n = 4

Question 2

(c) mass of hydrated magnesium sulfate = 1.476 g

mass of barium sulfate formed = 1.398 g

the mass of one mole of $BaSO_4$ = 233 g

the number of moles of $BaSO_4$ formed = 0.006 [1]

the number of moles of $MgSO_4.xH_2O$ used in experiment = 0.006 [1]

the mass of one mole of $MgSO_4.xH_2O$ = 1.476/0.006 = 246 g [1]

the mass of xH_2O in one mole of $MgSO_4.xH_2O$ = 246 – 120 = 126 g [1]

x = 126/18 = 7 [1]

if x given without method = max 1

note: apply ecf but x must be an integer and less than 10

Question 3

(c) calculation:

Mr for $NaHCO_3$ = 84 g; Mr for Na_2O = 62 g; Mr for NaOH = 40 g

Mr for Na_2CO_3 = 106 g

(i) number of moles of $NaHCO_3$ used = 3.36/84 = 0.04 [1]

(ii) if residue is Na_2O, number of moles of Na_2O = 2.12/62 =0.034 / 0.03

if residue is NaOH, number of moles of NaOH = 2.12/40 = 0.053 / 0.05

if reside is Na_2CO_3, number of moles of Na_2CO_3 = 2.12/106 =0.02 all three correct [2]

note: two correct = 1

(iii) equation 3 [1]

mole ratio 2:1 agrees with equation [1]

Question 4

(b) number of moles of HCl used = 0.04 × 2 = 0.08

number of moles $CoCl_2$ formed = 0.04

number of moles $CoCl_2.6H_2O$ formed = 0.04

mass of one mole of $CoCl_2.6H_2O$ = 238 g

maximum yield of $CoCl_2.6H_2O$ = 9.52g [4]

accept 9.5 g

mark ecf to moles of HCl

do not mark ecf to integers

to show that cobalt(II) carbonate is in excess

number of moles of HCl used = 0.08 must use value above ecf

mass of one mole of $CoCO_3$ = 119g

number of moles of $CoCO_3$ in 6.0g of cobalt(II) carbonate = 6.0/119 = 0.050 [1]

reason why cobalt(II) carbonate is in excess 0.05 > 0.08/2 [1]

Question 5

(d) (i) how many moles of H_2SO_4 were added = 0.02 × 0.3 = 0.006 [1]

(ii) how many moles of NaOH were used = 0.04 × 0.2 = 0.008 [1]

(iii) sulfuric acid [1]

only mark ecf if in accord with 1:2 ratio and with values from (i) and (ii).

reason 0.006 > 0.008/2 [1]

for ecf mark candidate must use 1:2 ratio in answer

(iv) less than 7 [1]

Question 6

(b) (i) 80 cm3 of oxygen therefore 40 cm3 of methane [1]

40/60 × 100 = 66.7 % [1]

accept 66 % and 67 %

no ecf

(ii) add sodium hydroxide(aq) / alkali [1]

carbon dioxide dissolves, leaving methane [1]

Question 7

(b) (i) add up to 5.8 g [1]

(ii) moles of C atoms = 2.4/12 = 0.2

moles of H atoms = 0.2/1 = 0.2

moles of O atoms = 3.2/16 = 0.2

all three correct = 2 [2]

two correct = 1

empirical formula CHO [1]

(iii) 116/29 = 4 [1]

$C_4H_4O_4$ [1]

correct formula with no working scores both marks.

(iv) HOOCCH=CHCOOH / $CH_2=C(COOH)_2$ [2]

Question 8

(c) number of moles of $FeSO_4$ used = 9.12/152 = 0.06 [1]

number of moles of Fe_2O_3 formed = 0.03* [1]

mass of one mole of Fe_2O_3 = 160 g [1]

mass of iron(III) oxide formed = 0.03 × 160 = 4.8 g [1]

number of moles of SO_3 formed = 0.03 [1]

volume of sulfur trioxide formed = 0.03 × 24 = 0.72 dm3 [1]

If mass of iron(III) oxide greater than 9.12 g, then only marks 1 and 2 available

Apply ecf to number of moles of Fe_2O_3* when calculating volume of sulfur trioxide.

Do not apply ecf to integers

Question 9
7 (a) (i) 35 cm3 [1]
40 cm3 [1]

Question 10
(b) (i) 7.7% [1]
(ii) for any number: equal number ratio [2]
for example 1:1 or 6:6
(iii) empirical formula is CH [1]
molecular formula is C6H6 [1]
no e.c.f., award of marks not dependent on (ii)

Question 11
(c) (i) 196 [1]
(ii) 112/196 × 100 [1]
= 57(.1)% ACCEPT 57 to nearest whole number [1]
mark e.c.f. to (c)(i) provided percentage not greater than 100%
ONLY ACCEPT 112/answer (c)(i) × 100
otherwise [0]

Question 12
(ii) mass of one mole of CaCO3 = 100
number of moles of CaCO3 = 0.3/100 = 0.003 [1]
moles of HCl = 5/1000 x 1 = 0.005 [1]
reagent in excess is CaCO3 [1]
ecf from above
would need 0.006 moles of HCl
or hydrochloric acid only reacts with 0.0025 moles of CaCO3 [1]
NOTE this mark needs to show recognition of the 1:2 ratio
(iii) mark ecf to (ii), that is from moles of limiting reagent in (ii)
moles of CO2 = 0.005 x 0.5 x 24 = 0.06 dm3 [1]
NOT cm3 unless numerically correct. 60 cm3
Ignore other units
NOTE If both number of moles integers then no ecf for (ii) and (iii)

Question 13
(a)
copper iron sulphur
composition by
mass/g
(4.80) (4.20) 4.8 [1]
number of moles
of atoms
0.075 0.075 0.15 [1]
simplest mole ratio
of atoms
1 1 2 [1]
[3]
The empirical formula is CuFeS2 [1]

Question 14
(b) (i) 100 [1]
56 ignore units in both cases [1]
(ii) 7.00kg is 1/8 of 56 [1]
1/8 of 100kg is 12.5kg [1]
Give both marks for correct answer without explanation.
Ignore missing units
but penalise wrong units

Question 15
Question 6
(a)(i) moles of NiCO3 reacted = 0.08 [1]
mass of nickel carbonate reacted = 9.52 g [1]
mass of nickel carbonate unreacted = 2.48 g [1]
(ii) maximum number of moles of hydrated salt = 0.08 [1]
maximum mass of salt = 0.08 x 281 = 22.48 g [1]
percentage yield 10.4/22.48 x 100 = 46.3% [1]

Question 16
Mark consequentially to any error but not involving simple integers
There has to be some evidence that the candidate has attempted to work
through the calculation and not merely inserted whole numbers.
For example 2, 1, 160 or 1, 0.5, 80
number of moles of Fe2(SO4)3 = 1/40 or 0.025
number of moles of Fe2 O3 formed = 1/40 or 0.025
mass of iron(III) oxide formed = 0.025 x 160 = 4g
number of moles of SO3 produced = 3/40 or 0.075
volume of sulphur trioxide at r.t.p. = 0.075 x 25
= 1.8dm3 [5]

Question 17
(d) the number of moles of S02 in the mixture= 0.125
the number of moles of Cb in the mixture = 0. 2
cond reagent was not in excess? S02
cond moles of S02Cb formed = 0.125
cond the mass of sulphuryl chloride formed = l 6.9g
[5]

Question 18
(f) (i) 11.5/23 = 0.5 [I]
(ii) 0.25 [1]
conseq to (i)
...
(iii) 0.25 x 32 = 8 g [I]
conseq
(iv) 2.0 g [1]
only conseq to (iii) if answer to (iii) is less than 10
NB If (ii) is 0.3(125), no excess is possible, (iv) ZERO

Question 19
(c) (i) copper sulphate or anhydrous copper sulphate [l]
accept "unhydrated"
NOT formula
(ii) goes blue or becomes hot or steam [l]

(iii) copper oxide [1]
(iv) 5/250 = 0.02 moles
Mr=80
80 x 0.02 = 1.6 g
NB (iv) to be marked conseq to (iii)
Correct answer no working ONLY [1]

Question 20
(e) (i) percentage of oxygen = 31.6 % [1]
(ii) calculate the number of moles of atoms for each element
number of moles of Ti = 31.6/48 = 0.66
number of moles of O = 31.6/16 = 1.98 accept 2 [1]
both correct for one mark
(iii) the simplest whole number ratio for moles of atoms:
Fe : Ti : O
1 1 3 [1]
(iv) formula is $FeTiO_3$ accept $TiFeO_3$ [1]
must be whole numbers from (iii) or cancelled numbers from (iii)
mark ecf throughout

Question 21
(ii) Volume ratio
$C_xH_y(g) + O_2(g) \rightarrow CO_2(g) + H_2O(l)$
20 160 100 all in cm3
1 8 5 mole ratio
$C_5H_{12} + 8O_2 \rightarrow 5CO_2 + 6H_2O$
For evidence of method (1)
for equation as above (2) [3]

Question 22
(c) (i) (to prove) all water driven off or evaporated or boiled / no water remains / to
make salt anhydrous (1)
(ii) m1– m2 = mass of water (1)
(calculate) moles of water AND moles of hydrated or anhydrous salt (1)
1:1 ratio / should be equal (1) [3]

Question 23
(d) number of moles of O_2 formed = 0.096 / 24 = 0.004 (1)
number of moles of H_2O_2 in 40 cm3 of solution = 0.004 × 2 = 0.008 (1)
concentration of the hydrogen peroxide in mol / dm3 = 0.008 / 0.04 = 0.2 (1) [3]

Question 24
8 (a) (i) (the number of particles which is equal to the number of atoms in) 12 g of carbon 12
or
the mass in grams which contains the Avogadro's constant number of particles
or
Avogadro's constant or 6 to 6.023×10^{23} of atoms / ions / molecules / electrons / particles
or
(the amount of substance which has a mass equal to) its relative formula mass / relative
atomic mass / relative molecular mass in grams
or
(the amount of substance which has a volume equal to) 24 dm3 of a gas at RTP
[1]
(ii) (Avogadro's constant is the) number of particles / atoms / ions / molecules in one mole of
a substance
or
the number of carbon atoms in 12 g of C(12).
or
the number of particles / molecules in 24 dm3of a gas 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
(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 × 40 = 0.8 (g) [1]

Question 25
(d) volume of oxygen used = 150 cm3
volume of carbon dioxide formed = 100 cm3 [1]
any equation of the combustion of an alkene
e.g. $2C_5H_{10} + 15O_2$ ⍰ $10CO_2 + 10H_2O$
formulae [1]
COND balancing

Question 26
(b) number of moles of HCl = 0.020 x 2.20 = 0.044 [1]
number of moles of LiOH = 0.044
concentration of LiOH = 0.044/0.025 = 1.769 (mol / dm3) [1]

accept 1.75 to 1.77 need 2 dp
correct answer scores = 2
(c) (for $LiCl.2H_2O$)
mass of one mole = 78.5 [1]
percentage water = 36 / 78.5 x 100 [1]
45.9 so is $LiCl.2H_2O$ [1]
only award the marks if you can follow the reasoning and it gives 45.9% of water
note: if correct option given mark this and ignore the rest of the response
allow: max 2 for applying a correct method to another hydrate, [1] for the method and [1] for the correct value, working essential

Question 27
(e) if C_5H_{10} is given award 3 marks;;; [3]
if $C_{10}H_{20}$ is given award 2 marks;;
if 1:7.5:5 / 2:15:10 is given award 2 marks;;
in all other cases a mark can be awarded for moles of O_2 (= 2.4/32 =) 0.075 AND moles of CO_2 (= 2.2/44 =) 0.05;
$2C_5H_{10} + 15O_2 \rightarrow 10CO_2 + 10H_2O$ [1]
accept: multiples including fractions
allow: ecf for correct equation from any incorrect alkene

Question 28
(b) moles of Fe = 51.85/56 = 0.926 (0.93); [1]
moles of O = 22.22/16 = 1.389 (1.39); [1]
moles of H_2O = 16.67/18 = 0.926 (0.93); [1]
if given as 0.9 1.4 0.9
three of the above correct = [2]
two of the above correct = [1]
simplest whole number mole ratio Fe : O : H_2O is 2: 3: 2 / $Fe_2O_3.2H_2O$; [1]
allow: ecf for a formula based on an incorrect whole number ratio

Question 29
8 (a) (i) (to avoid) carbon monoxide formation/so complete combustion occurs/avoid incomplete combustion So that CO_2 is produced [1]
CO does not dissolve/react with alkali [1]
(ii) CO_2 is acidic [1]
(iii) volume of gaseous hydrocarbon 20 cm3
volume of oxygen used = 90 cm3 [1]
volume of carbon dioxide formed = 60 cm3 [1]
no mark for 20 cm3 of hydrocarbon.
(iv) $2C_3H_6(g)/2C_xH_y(g) + 9O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$ [1]
OR … $C_3H_6(g) + 9/2O_2(g) \rightarrow 3CO_2(g) + 3H_2O(l)$
C_3H_6 [1]
C_3H_6 can be given in the equation for the second mark

Question 30
7 (a) metal A is magnesium [1]
cond most reactive or fastest reaction [1]
metal B is aluminium [1]
cond faster reaction after removal of oxide layer / it would give more hydrogen / aluminium
more reactive than zinc [1]
metal C is zinc [1]
zinc least reactive [1]
NOTE MAX [5]
If you encounter different reasoning which is correct, please award the appropriate marks.
(b) for magnesium and zinc same volume of hydrogen [1]
because both have valency of 2 / 1 mole of metal gives 1 mole of hydrogen / 1 mole of metal
reacts with 2 moles of acid [1]
bigger volume for aluminium because its valency is 3 / 1 mole of metal gives 1.5 moles of
hydrogen / 1 mole of metal reacts with 3 moles of acid [1]
If you encounter different reasoning which is correct, please award the appropriate marks.
accept balanced equations
accept ionic charges as alternative to valency

Question 31
(d) (i) the reaction is exothermic / reaction produces heat/energy [1]
all the sodium hydroxide used up/neutralised / reaction has stopped [1]
(ii) adding colder acid / no more heat produced [1]
if not given in (d)(i) any comments such as “reaction has stopped” can gain mark
(iii) 1.33 / 1.3 / 1.3333 (mol/dm3) scores both marks [2]
not 1.34
for a correct method – M1 V1 / moles of NaOH = 0.02
with an incorrect answer only [1]

Question 32
(c) if the final answer is between 86–89% award all 4
if the final answer is between 66–67% award 3 marks (Mr of 32 must have been used)
for all other answers marks can be awarded using the mark scheme as below and applying
ecf if necessary
number of moles of O_2 formed = 0.16/24 = 0.0067/0.00667 or 1/150
number of moles of $Pb(NO_3)_2$ in the sample = 0.0133/0.013 or 1/75
mass of one mole of $Pb(NO_3)_2$ = 331 g
mass of lead(II) nitrate in the sample = 4.4(1) g
percentage of lead(II) nitrate in sample = 88.3% (allow 88–89) [4]
mark ecf in this question but not to simple integers
if mass of lead(II) nitrate > 5.00 only marks 1 and 2 available
If divides by 32 (not 24) only last 3 marks can score consequentially

Question 33
(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) (i) 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

Question 34
(b) number of moles of NaOH used = 0.025 x 2.24 = 0.056 [1]
maximum number of moles of $Na_2SO_4.10H_2O$ that could be formed = 0.028 [1]
mass of one mole of $Na_2SO_4.10H_2O$ = 322g
maximum yield of sodium sulphate – 10 - water = 9.02g [1]
percentage yield = 42.8% [1]
mark ecf but NOT to simple integers
if ecf marking, mark to at least one place of decimals
if percentage > 100% then 3/4 maximum

Question 35
(d) 100g of fat react with 86.2g of iodine
884g of fat react with 762 g of iodine [1]
limit 762 x 2
one mole of fat reacts with 762/254 moles of iodine molecules
one mole of fat reacts with 3 moles of iodine molecules [1]
number of double bonds in one molecule of fat is 3 [1]
limit 6
consequential marking allowed provided the number of double bonds is an integer.

Question 36
(d) moles of CH_3-CH = CH_2 reacted = 1.4/42 = 0.033 [1]
conseq
maximum moles of CH_3-CH(I)-CH_3 that could be formed = 0.033 [1]
conseq
maximum mass of 2-iodopropane that could be formed = 5.61 g [1]
accept 170 x 0.033 = 5.61 and 170 x 0.033333 = 5.67
conseq unless greater than 100%
percentage yield 4.0/5.67 x 100 = 70.5% [1]
Do not mark consequently to a series of small integers. There has to be
a serious attempt to answer the question, then consequential marking is
appropriate.

Question 37
(d) mass of one mole of $CaSO_4$ = 136
moles of $CaSO_4$ in 79.1g = 0.58 accept 0.6 [1]
moles of H_2O in 20.9 g = 1.16 accept 1.2 [1]
conseq x = 2 x given as an integer [1]

Question 38
(c) $I_2 + 3Cl_2 = 2ICl_3$ [2]
For having either reactants or products correct ONLY [1]

Question 39
skip

Question 40
(c) (i) number of moles CO_2 = 0.24/24 = 0.01
conseq number of moles of $CaCO_3$ and $MgCO_3$ = 0.01
conseq number of moles of $CaCO_3$ = 0.005 [3]
(ii) Calculate the volume of hydrochloric acid, 1.0 mole/dm^3, needed to react with
one tablet.
number of moles of $CaCO_3$ and $MgCO_3$ in one tablet = 0.01
Expect same as answer to (c)(i). NO marks to be awarded. Just mark
consequentially to this response
conseq number of moles of HCl needed
to react with one tablet = 0.02
conseq volume of hydrochloric acid, 1.0 mole/dm^3, needed to react with one
tablet = 0.02 dm^3 or 20 cm^3
[1]
[1]

Question 41
(c) number of moles of HCl in 50 cm^3 of acid, concentration 2.2 mol/dm^3 = 0.11 [1]
maximum number of moles of $CoCl_2.6H_2O$ which could be formed = 0.055 [1]
mass of 1 mole of $CoCl_2.6H_2O$ = 238 g
maximum yield of $CoCl_2.6H_2O$ = 13.09 g [1]
percentage yield = 48.2% or ecf mass of $CoCl_2.6H_2O$ above/13.09 × 100% to 1
dp [1]

Question 42
(b) (i) 14.3 [1]
(ii) 85.7 ÷ 12 and 14.3 ÷ 1 or 7.14 and 14.3 [1]
ratio 1:2 [1]
CH_2 [1]
note: Award all 3 marks for correct answer
allow: alternative working e.g.
85.7 × 84 ÷ 100 and 14.3 × 84 ÷ 100 or 71.988/72 and 12/12.012 [1]
6:12 or ratio 1:2 [1]
CH_2 [1]
(iii) C_6H_{12} [1]

Question 43
(iii) M1 = 2.07 Allow 2.1 or 2.0666…7
M2 = 62.8.g
M3 =(M2/152 =) 0.41(3)
M4 (=M1/M3) rounded to the nearest whole number × = 5 [4]

Question 44

(ii) number of moles of ethanoic acid = 0.1 [1]
number of moles of ethanol = 0.12(0) [1]
the limiting reagent is ethanoic acid [1]
number of moles of ethyl ethanoate formed = 0.1 [1]
maximum yield of ethyl ethanoate is 8.8 g [1]

Question 45
(ii) mass of $AgNO_3$ needed is 170 × 0.2 × 0.1 = 3.4g [2]
NOTE: if answer given is 34 they have omitted 0.1
ALLOW: (1) ecf
(iii) number of moles of $AgNO_3$ used = 0.02 × 0.2 = 0.004 [1]
number of moles of Ag_2CrO_4 formed = 0.002 [1]
mass of one mole of Ag_2CrO_4 = 332g
mass of Ag_2CrO_4 formed = 0.664g [1]
NOTE: use ecf when appropriate

Question 46
(c) number of moles of CO_2 formed = 2.112 / 44 = 0.048 [1]
number of moles of H_2O formed = 0.432 / 18 = 0.024 [1]
x = 2 and y = 1 NOT: ecf from this line
formula is $2PbCO_3.Pb(OH)_2$ / $Pb(OH)_2. 2PbCO_3$ [1]

Question 47
(d) number of moles of HCl in 40 cm^3 of hydrochloric acid,
concentration 2.0 mol / dm^3 = 0.04 × 2.0 = 0.08 [1]
maximum number of moles of CO_2 formed = 0.04 [1]
mass of one mole of CO_2 = 44 g [1]
maximum mass of CO_2 lost = 0.04 × 44 = 1.76 g [1]

Question 48
(b) (i) (97.4 / 75 =) 1.3 and (2.6 / 1 =) 2.6; [1]
empirical formula AsH_2; [1]
note: correct formula with no working = [1]
(ii) As_2H_4; [1]
(iii) $H_2As–AsH_2$ / $AsH_2–AsH_2$; [1]

Question 49
(d) number of moles of Na_2SO_3 = 3.15/126 = 0.025 [1]
number of moles of SO_2 formed = 0.025 [1]
volume of SO_2 = 0.025 x 24 = 0.6 dm^3/litres or 600 cm^3 [1]
allow: ecf
for 1.6 g of SO_2 [1] only
If used 22.4 max [2]
note: need correct units for last mark

Question 50
(c) number of moles of HCl used = 0.05 × 2 = 0.1 [1]
number of moles of $SrCl_2.6 H_2O$ which could be formed. = 0.05 [1]
mass of one mole of $SrCl_2.6H_2O$ is 267 g
theoretical yield of $SrCl_2.6H_2O$ = 0.05 × 267 = 13.35 g [1]
percentage yield = 6.4 / 13.35 × 100 = 47.9% [1]
accept: 48%
allow: ecf

Question 51
(c) BrF_3 / F_3Br; [1]
BrF_5 / F_5Br; [1]