## N5 Calculations 1

1. Formula mass
   1. Calculate the formula mass of Mg(OH)2.
   2. How much would 2 moles of Mg(OH)2weigh?
   3. How many moles of Mg(OH)2 are in 2.925g?
2. Concentration
   1. What is the concentration of a solution of Mg(OH)2 containing 0.4moles in 500cm3?
   2. How many moles of Mg(OH)2 are in 300 cm3 of a 0.5 mol/l solution?
   3. What volume of a 4 mol/l solution contains 0.25 moles?
3. Titration calculations

2HCl+ Ca(OH)2 🡪 CaCl2 + 2 H2O

What concentration of 10cm3 HCl is needed to neutralise 20cm3 of

0.2 mol/l Ca(OH)2?

1. Calculation from a balanced equation

N2 + 3H2 🡪 2NH3

What mass of NH3 could be obtained from 210 grams of N2?

1. Rate calculations

A reaction had produced 42 cm3 of gas after 15 seconds and 72 cm3 of gas after 30 seconds. Calculate the average rates

* + 1. over the first 15 seconds,
    2. between 15 and 30 seconds.

6. Eh calculations

a) Calculate the heat needed to raise the temperature of 100cm3 of water by 20oC

b) Find the mass of water that would be heated by 10OC by 10450kJ

## N5 Calculations 2

1. Formula mass
   1. Calculate the formula mass of Ca(OH)2.
   2. How much would 3 moles of Ca(OH)2 weigh?
   3. How many moles of Ca(OH)2 are in 1.48g?
2. Concentration
   1. What is the concentration of a solution of Ca(OH)2 containing 0.2 moles in 250cm3?
   2. How many moles of Ca(OH)2 are in 200 cm3 of a 0.4 mol/l solution?
   3. What volume of a 2 mol/l solution contains 0.5 moles?
3. Titration calculations

H2SO4 + 2 NaOH 🡪 Na2SO4 + 2 H2O

What concentration of 20cm3 H2SO4 is needed to neutralise 10cm3 of

4 mol/l NaOH?

1. Calculation from a balanced equation

2SO2  + O2 🡪 2SO3

What mass of SO3 could be obtained from 8000kg of O2?

5. Rate calculations

A reaction had produced 32 cm3 of gas after 20 seconds and 42 cm3 of gas after 30 seconds. Calculate the average rates

* + 1. over the first 20 seconds,

ii. between 20 and 30 seconds.

6. Eh calculations

a) Calculate the heat energy needed to raise the temperature of 200cm3 of water by 30oC

b) Find the temperature rise that would happen if 2 litres of water was heated by 10.45kJ

## N5 Calculations 3

1. Formula mass
   1. Calculate the formula mass of Na2CO3.
   2. How much would 3 moles of Na2CO3 weigh?
   3. How many moles of Na2CO3 are in 37.1g?
2. Concentration
   1. What is the concentration of a solution of Na2CO3 containing 0.6 moles in 1200cm3?
   2. How many moles of Na2CO3 are in 500 cm3 of a 0.3 mol/l solution?
   3. What volume of a 2.5 mol/l solution contains 0.4 moles?
3. Titration or neutralisation calculations

2HNO3 + Ba(OH)2 🡪 Ba(NO3)2 + 2H2O

What concentration of 20cm3 HNO3 is needed to neutralise 40cm3 of

0.1 mol/l Ba(OH)2?

1. What % of Na2CO3 is oxygen?
2. Calculation from a balanced equation

2HNO3 + Ba(OH)2 🡪 Ba(NO3)2 + 2H2O

What mass of H2O could be obtained from 315g of HNO3?

6. Rate calculations

A reaction had produced 25 cm3 of gas after 10 seconds and 35 cm3 of gas after 22 seconds. Calculate the average rates

1. over the first 10 seconds,
2. between 10 and 22 seconds.

7. Eh calculations

a) Calculate the heat needed to raise the temperature of 500cm3 of water by 10oC

b) Find the final temperature if 0.5 litres of water at 10oC was heated by 52.5kJ

8. What mass of a 20g sample of Pb-210 would remain after 84 years given that its half-life is 21 years?

## N5 Calculations 4

1. Formula mass
   1. Calculate the formula mass of CuCl2
   2. How much would 4 moles of CuCl2 weigh?
   3. How many moles of CuCl2 are in 6.725g?
2. Concentration
   1. What is the concentration of a solution of CuCl2 containing 0.5 moles in 250cm3?
   2. How many moles of CuCl2 are in 200 cm3 of a 0.5 mol/l solution?
   3. What volume of a 4 mol/l solution contains 0.5 moles?
3. Titration or neutralisation calculations

2NaOH+ H2SO4 🡪 Na2SO4 + 2H2O

What concentration of 10cm3 NaOH is needed to neutralise 20cm3 of

0.2 mol/l H2SO4 ?

1. What % of CuCl2 is copper?
2. Calculation from a balanced equation

2HCl+ Cu(OH)2 🡪 CuCl2 + 2H2O

What mass of CuCl2 could be obtained from 146g of HCl?

6. Rate calculations

A reaction had produced 50 cm3 of gas after 20 seconds and 80 cm3 of gas after 40 seconds. Calculate the average rates

* + 1. over the first 20 seconds,

ii. between 20 and 40 seconds.

7. Eh calculations

a) Calculate the heat needed to raise the temperature of 250cm3 of water by 15oC

b) Find the final temperature if 2 litres of water at 20oC was heated by 83.6kJ

8. What mass of a Bi-214 was present at the start if 10g remained after 100 minutes, given that its half-life is 20 minutes?

## N5 Calculations 5

1. Formula mass
   1. Calculate the formula mass of CO2
   2. How much would 5 moles of CO2 weigh?
   3. How many moles of CO2 are in 8.8g?
2. Concentration
   1. What is the concentration of a solution of NaClcontaining 0.2 moles in 500cm3?
   2. How many moles of NaClare in 400 cm3 of a 0.4 mol/l solution?
   3. What volume of a 2 mol/l solution contains 0.8 moles?
3. Titration or neutralisation calculations

3LiOH+ H3PO4 🡪 Li3PO4 + 3H2O

What concentration of 20cm3 LiOH is needed to neutralise 10cm3 of

0.2 mol/l H3PO4 ?

1. What % of CO2 is carbon?
2. Calculation from a balanced equation

2HF+ Ca(OH)2 🡪 CaF2 + 2H2O

What mass of CaF2 could be obtained from 100g of HF?

6. Rate calculations

A reaction had produced 40 cm3 of gas after 10 seconds and 80 cm3 of gas after 50 seconds. Calculate the average rates

* + 1. over the first 10 seconds,

ii. between 10 and 50 seconds.

7. Eh calculations

a) Calculate the heat needed to raise the temperature of 50cm3 of water by 10oC

b) What mass of water will have its temperature increased by 8oC using 167.2kJ of heat energy?

8. What mass of a Tl-208 was present at the start if 40g remained after 12.4 minutes, given that its half-life is 3.1 minutes?

## N5 Calculations 1 Answers

1. Formula mass
   1. Calculate the formula mass of Mg(OH)2.

24.5 + (2 x 16) + (2 x 1) = 58.5

* 1. How much would 2 moles of Mg(OH)2weigh?

mass

n gfm

1 mole = 58.5g

2 moles = 2 x 58.5g

= 117g

* 1. How many moles of Mg(OH)2 are in 2.925g?

58.5g = 1 mole

2.925g = 2.925 / 58.5 moles

= 0.05 moles

1. Concentration

n

c v

* 1. What is the concentration of a solution of Mg(OH)2containing 0.4moles in 500cm3?

n = cv

c = n/v

c = 0.4/0.5 mol/l

c = 0.8 mol/l

* 1. How many moles of Mg(OH)2 are in 300 cm3 of a 0.5 mol/l solution?

n = cv

n = 0.5 x 0.3 moles

n = 0.15 moles

* 1. What volume of a 4 mol/l solution contains 0.25 moles?

n = cv

v = n/c

v = 0.25/4 litres

v = 0.0625 litres (or 62.5 cm3)

1. Titration calculations

2HCl+ Ca(OH)2 🡪 CaCl2 + 2 H2O

What concentration of 10cm3 HCl is needed to neutralise 20cm3 of

0.2 mol/l Ca(OH)2?

C1 x 10/2 = 0.2 x 20 / 1

5 C1 = 4

C1 = 4/5

= 0.8 mol/l

1. Calculation from a balanced equation

What mass of NH3 could be obtained from 210g of N2?

n of N2 = m/GFM

= 210 / 28

= 7.5 moles

N2 + 3H2 🡪 2NH3

1 mole of N2 🡪 2 moles of NH3

7.5 moles 🡪 15 moles

1 mole NH3 = 17g

15 moles NH3 = 15 x 17g

= 255g

1. Rate Calculations

(i) average rate = 42 cm3 / 15 s

= 2.8 cm3 s-1

(ii) average rate = (72 – 42) cm3 / (30 – 15) s

= 30 cm3 / 15 s

= 2 cm3 s-1

6. Eh calculations

a) Calculate the heat needed to raise the temperature of 100cm3 of water by 20oC

Eh = cmΔT

= 4.18 x 0.1 x 20 kJ

= 8.36kJ

b) Find the mass of water that would be heated by 10OC by 10450kJ

IF Eh = cmΔT

THEN m = Eh / cΔT

= 10450 / (4.18 x 10)

= 250 kg

## N5 Calculations 2 Answers

1. Formula mass
   1. Calculate the formula mass of Ca(OH)2.

40 + (2 x 16) + (2 x 1) = 74

* 1. How much would 3 moles of Ca(OH)2 weigh?

1 mole = 74

2 moles = 3 x 74g

= 222g

* 1. How many moles of Ca(OH)2 are in 1.48g?

74g = 1 mole

1.48g = 1.48 / 74moles

= 0.02 moles

1. Concentration

(a)What is the concentration of a solution of Ca(OH)2 containing 0.2 moles in 250cm3?

n = cv

c = n/v

c = 0.2/0.25 mol/l

c = 0.8 mol/l

(b) How many moles of Ca(OH)2 are in 200 cm3 of a 0.4 mol/l solution?

n = cv

n = 0.4 x 0.2 moles

n = 0.08 moles

(c)What volume of a 2 mol/l solution contains 0.5 moles?

n = cv

v = n/c

v = 0.5/2 litres

v = 0.25 litres (or 250 cm3)

1. Titration calculations

H2SO4 + 2 NaOH 🡪 Na2SO4 + 2 H2O

What concentration of 20cm3 H2SO4 is needed to neutralise 10cm3 of

4 mol/l NaOH?

C1 x 20/1 = 4 x 10/ 2

20 C1 = 20

C1 = 1 mol/l

1. Calculation from a balanced equation

What mass of SO3 could be obtained from 8000kg of O2?

n of O2 = m/GFM

= 8000000 / 32

= 250000 moles

2SO2  + O2 🡪 2SO3

1 mole of O2 🡪 2 moles of SO3

250000 mole of O2 🡪 500000 moles of SO3

1 mole SO3 = 80g

500000 moles SO3 = 5000000 x 80g

= 40000000g

= 40000kg

5. Rate calculations

* 1. A reaction had produced 32 cm3 of gas after 20 seconds and 42 cm3 of gas after 30 seconds. Calculate the average rates
     1. over the first 20 seconds,

ii. between 20 and 30 seconds.

(i) average rate = 32 cm3 / 20 s

average rate = 1.6 cm3 s-1

(ii) average rate = (42 - 32) cm3 / (30 - 20) s

average rate = 10 cm3 / 10 s

average rate = 1 cm3 s-1

6. Eh calculations

a) Calculate the heat energy needed to raise the temperature of200cm3 of water by 30oC

Eh = cmΔT

= 4.18 x 0.2 x 30 kJ

= 25.08kJ

b) Find the temperature rise that would happen if 2 litres of water washeated by 10.45kJ

IF Eh = cmΔT

THEN ΔT = Eh / cm

= 10.45 / (4.18 x 2)

= 1.25 oC

## N5 Calculations 3 Answers

1. Formula mass
   1. Calculate the formula mass of Na2CO3.

(2 x 23) + 12 + (3 x 16) = 106

* 1. How much would 3 moles of Na2CO3 weigh?

1 mole = 106g

m = n x GFM

= 3 x 106g

= 318g

* 1. How many moles of Na2CO3 are in 37.1g?

n = m / GFM

37.1g= 37.1/106 moles

= 0.35 moles

1. Concentration
   1. What is the concentration of a solution of Na2 CO3 containing 0.6 moles in 1200cm3?

n = cv

c = n/v

c = 0.6/1.2 mol/l

c = 0.5 mol/l

* 1. How many moles of Na2 CO3 are in 500 cm3 of a 0.3 mol/l solution?

n = cv

n = 0.3 x 0.5 moles

n = 0.15 moles

* 1. What volume of a 2.5 mol/l solution contains 0.4 moles?

n = cv

v = n/c

v = 0.4/2.5 litres

v = 0.16 litres (or 160cm3)

1. Titration calculations

2HNO3 + Ba(OH)2 🡪 Ba(NO3)2 + 2H2O

What concentration of 20cm3 HNO3 is needed to neutralise 40cm3 of

0.1 mol/l Ba(OH)2?

C1 x V1 / n1 = C2 X V2/ n2

C1 x 20 / 2 = 0.1 x 40 / 1

10 C1 = 4

C1 = 4/10 mol/l

= 0.4 mol/l

4. What % of Na2CO3 is oxygen?

GFM = (2 x 23) + 12 + (3 x 16) = 106g

m of O = 48g

% of O = (48 x 100)/ 106

= 45.3 %

5. Calculation from a balanced equation

2HNO3 + Ba(OH)2 🡪 Ba(NO3)2 + 2H2O

What mass of H2O could be obtained from 315g of HNO3?

n of HNO3 = m/GFM

= 315 / 63

= 5 moles

2HNO3 + Ba(OH)2 🡪 Ba(NO3)2 + 2H2O

2 moles of HNO3 🡪 2 moles of H2O

5 moles of HNO3 🡪 5 moles of H2O

1 mole H2O = 18g

5 moles of H2O = 5 x 18g

= 90g of H2O

6. Rate calculations

A reaction had produced 25 cm3 of gas after 10 seconds and 35 cm3 of gas after 22 seconds. Calculate the average rates

(i) over the first 10 seconds,

(ii) between 10 and 22 seconds.

(i) average rate = 25 cm3 / 10 s

average rate = 2.5 cm3 s-1

(ii) average rate = (35 - 25) cm3 / (22 - 10) s

average rate = 10 cm3 / 12 s

average rate = 0.83 cm3 s-1

7. Eh calculations

a) Calculate the heat needed to raise the temperature of 500cm3 of water by 10oC

Eh = cmΔT

= 4.18 x 0.5 x 10 kJ

= 20.9 kJ

b) Find the final temperature if 0.5 litres of water at 10oC was heated by 52.5kJ

IF Eh = cmΔT

THEN ΔT = Eh / cm

= 52.5 / (4.18 x 0.5)

= 25.1 oC

FINAL T =10 + 25.1 = 35.1oC

8. What mass of a 20g sample of Pb-210 would remain after 84 years given

that its half-life is 21 years?

|  |  |  |
| --- | --- | --- |
| Quantity | No. of half-lives | Time |
| 20g | 0 | 0 years |
| 10g | 1 | 21 years |
| 5g | 2 | 42 years |
| 2.5g | 3 | 63 years |
| 1.25g | 4 | 84 years |

1.25g of Pb-210 remain

## N5 Calculations 4 Answers

1. Formula mass
   1. Calculate the formula mass of CuCl2

63.5 + (2 x 35.5) = 134.5

* 1. How much would 4 moles of CuCl2 weigh?

1 mole = 134.5g

m = n x GFM

m = 4 x 134.5g

= 538g

* 1. How many moles of CuCl2 are in 6.725g?

n = m / GFM

n = 6.725 /134.5 moles

= 0.05 moles

1. Concentration
   1. What is the concentration of a solution of CuCl2 containing 0.5 moles in 250cm3?

n = cv

c = n/v

c = 0.5/0.250 mol/l

c = 2 mol/l

* 1. How many moles of CuCl2 are in 200 cm3 of a 0.5 mol/l solution?

n = cv

n = 0.5 x 0.200 moles

n = 0.1 moles

* 1. What volume of a 4 mol/l solution contains 0.5 moles?

n = cv

v = n/c

v = 0.5/4

v = 0.125 litres (or 125cm3)

1. Titration calculations

2NaOH+ H2SO4 🡪 Na2SO4 + 2H2O

What concentration of 10cm3 NaOH is needed to neutralise 20cm3 of

0.2 mol/l H2SO4 ?

C1 x V1 / n1 = C2 x V2 / n2

C1 x 10 / 2 = 0.2 x 20 / 1

5 C1 = 4

C1 = 4/5 mol/l

= 0.8 mol/l

1. What % of CuCl2 is copper?

GFM = 63.5 + (2 x 35.5) = 134.5g

m of Cu = 63.5g

% of Cu = (63.5 x 100)/ 134.5

= 47.2 %

5. Calculation from a balanced equation

2HCl+ Cu(OH)2 🡪 CuCl2 + 2H2O

What mass of CuCl2 could be obtained from 146g of HCl?

n of HCl = m/GFM

= 146 / 36.5

= 4 moles

2HCl+ Cu(OH)2 🡪 CuCl2 + 2H2O

2 moles of HCl🡪 1 moles of CuCl2

4 moles of HCl🡪 2 moles of CuCl2

1 mole CuCl2 = 134.5g

2 moles of CuCl2= 2 x 134.5g

= 269g

6. Rate calculations

A reaction had produced 50 cm3 of gas after 20 seconds and 80 cm3 of gas after 40 seconds. Calculate the average rates

* + 1. over the first 20 seconds,

ii. between 20 and 40 seconds.

(i) average rate = 50 cm3 / 20 s

average rate = 2.5 cm3 s-1

(ii) average rate = (80 - 50) cm3 / (40 - 20) s

average rate = 30 cm3 / 20 s

average rate = 1.5 cm3 s-1

7. Eh calculations

a) Calculate the heat needed to raise the temperature of 250cm3 of water by 15oC

Eh = cmΔT

= 4.18 x 0.250 x 15 kJ

= 15.675 kJ

b) Find the final temperature if 2 litres of water at 20oC was heated by 83.6kJ

IF Eh = cmΔT

THEN T = Eh / cm

= 83.6 / (4.18 x 2)

= 10 oC

FINAL T =20 + 10 = 30oC

8. What mass of a Bi-214 was present at the start if 10g remained after 100 minutes, given that its half-life is 20 minutes?

|  |  |  |
| --- | --- | --- |
| Quantity | No. of half-lives | Time |
| 320g | 0 | 0 |
| 160g | 1 | 20 |
| 80g | 2 | 40 |
| 40g | 3 | 60 |
| 20g | 4 | 80 |
| 10g | 5 | 100 |

320g of Bi-214

## N5 Calculations 5 Answers

1. Formula mass
   1. Calculate the formula mass of CO2

12 + (2 x 16) = 44

* 1. How much would 5 moles of CO2 weigh?

1 mole = 44g

m = n x GFM

m = 5 x 44

= 220g

* 1. How many moles of Co2 are in 8.8g?

n = m / GFM

n = 8.8 /44 moles

= 0.2 moles

1. Concentration
   1. What is the concentration of a solution of NaClcontaining 0.2 moles in 500cm3?

n = cv

c = n/v

c = 0.2/0.500 mol/l

c = 0.4 mol/l

* 1. How many moles of NaClare in 400 cm3 of a 0.4 mol/l solution?

n = cv

n = 0.4 x 0.400 moles

n = 0.16 moles

* 1. What volume of a 2 mol/l solution contains 0.8 moles?

n = cv

v = n/c

v = 0.8/2

v = 0.4 litres (or 400cm3)

1. Titration calculations

3LiOH+ H3PO4 🡪 Li3PO4 + 3H2O

What concentration of 20cm3 LiOH is needed to neutralise 10cm3 of

0.2 mol/l H3PO4 ?

C1 x V1 / n1 = C2 x V2 / n2

C1 x 20 / 3 = 0.2 x 10 / 1

6.7 C1 = 2

C1 = 2/6.7 mol/l

= 0.299 mol/l (0.3 mol/l)

1. What % of CO2 is carbon?

GFM = 12 + (2 x 16) = 44g

m of C = 12

% of C = (12 x 100)/ 44

= 27.3 %

5. Calculation from a balanced equation

2HF+ Ca(OH)2 🡪 CaF2 + 2H2O

What mass of CaF2 could be obtained from 100g of HF?

n of HF = m/GFM

= 100 / 20

= 5moles

2HF+ Ca(OH)2 🡪 CaF2 + 2H2O

2 moles of HF🡪 1 moles of CaF2

5 moles of HF🡪 2.5 moles of CaF2

1 mole CaF2 = 40 + (2 x19) = 78g

2.5 moles of CaF2= 2.5 x 78

= 195g

6. Rate calculations

A reaction had produced 40 cm3 of gas after 10 seconds and 80 cm3 of gas after 50 seconds. Calculate the average rates

* + 1. over the first 10 seconds,

ii. between 10 and 50 seconds.

(i) average rate = 40 cm3 / 10 s

average rate = 4 cm3 s-1

(ii) average rate = (80 - 40) cm3 / (50 - 10) s

average rate = 40 cm3 / 40 s

average rate = 1 cm3 s-1

7. Eh calculations

a) Calculate the heat needed to raise the temperature of 50cm3 of water by 10oC

Eh = cmΔT

= 4.18 x 0.050 x 105 kJ

= 2.09 kJ

b) What mass of water will have its temperature increased by 8oC using 167.2kJ of heat energy?

IF Eh = cmΔT

THEN m= Eh / cΔT

= 167.2 / (4.18 x 8)

= 5kg

8. What mass of a Tl-208 was present at the start if 40g remained after 12.4 minutes, given that its half-life is 3.1 minutes?

No. of half-lives = 12.4 / 3.1 = 4

Therefore the mass has halved 4 times

|  |  |  |
| --- | --- | --- |
| Quantity | No. of half-lives | Time (min) |
| 640g | 0 | 0 |
| 320g | 1 | 3.1 |
| 160g | 2 | 6.2 |
| 80g | 3 | 9.3 |
| 40g | 4 | 12.4 |

640g of Tl-208