Transition skills - basic mathematical competencies answer sheet

Rearranging equations

1.

a. $c = \frac{1000n}{v}$

b. $v = \frac{1000n}{c}$

2.

a. $m = d \times v$

b. $d = \frac{m \, x \, 10^{-3}}{v \, x \, 10^{-6}} = \frac{m}{v \, x \, 10^{-3}}$

1 mark for both parts of the fraction correct, 1 mark for cancelling down the × 10^{-6} to × 10^{-3}.

3.

a. $p = \frac{h}{\lambda}$

b. $v = \frac{h}{\lambda m}$

1 mark for substitution of p = mv into the first equation and 1 mark for successful rearrangement.

4.

$v = \sqrt{\frac{KE}{0.5m}}$ or $v = \sqrt{\frac{2KE}{m}}$

1 mark for first rearrangement moving 0.5 m underneath the KE, 1 mark for dealing with the v^2 by addition of the square root.

BODMAS

1. a. 28

   b. 40

   c. 8

   d. 45

   e. 6

   f. 40

2. a. 180

   b. 5352

   c. 180

Evaluation: Pressing equals after each operation leads to BODMAS errors.

Quantity calculus

1. g cm–3
2. 2.mol dm–3
3. 3.g cm–3
4. 4.mol dm–3 s–1
5. 5.N m–2
6.
   a) mol2 dm–6
   b) mol–1 dm3 s–1
   c) kPa–0.5
   d) mol2 dm–6
   e) mol dm–3

Expressing large and small numbers

1. a. 1.06×10^{6}

b. 1.06×10^{-3}

c. 2.222×10^{2}

2. 1 mark for sensible choice of $\times 10^{x}$ power, in this case $\times 10^{-2}$ or $\times 10^{-3}$ is most sensible. 0.5 marks for each number correctly converted.

3. a. 10^{4}

b. 10^{14}

c. 0.5×10^{-11} or 5×10^{-12}

d. 2.4×10^{2}

Significant figures, decimal places and rounding

		Significant figures	Decimal places
1	3.131 88	6	5
2	1000	1	0
3	0.000 65	2	5
4	1006	4	0
5	560.0	4	1
6	0.000 480	3	6

(0.5 mark for each correct answer)

7. a. i. 0.0758
ii. 0.08
b. i. 231
ii. 231.46

Unit conversions 1 – Length, mass and time

1. 12 mm

2. 72.00 m

3. 270 s

4. 154 s

5. 2 h 25 min

6. 15.5 t

7. 26.5 g

8. 75 mg/tablet = 0.075 g/tablet
1 g ÷ 0.075 g/tablet = 13.3 tablets
Minimum number of tablets needed = 14

9. 30 g/min

NOTE In this example, as you are converting 1/the unit, you need to do the inverse of what is described in the diagram eg instead of ÷ 60, × 60.

10. 10.44 kg/h = 10 440 g/h = 174 g/min = 2.9 g/s

Unit conversions 2 – Volume

1. drinks bottle, 1 dm^3; sugar cube, 1 cm^3; washing machine, 1 m^3

2. To convert a volume in **cm^3** into a volume in **dm^3**, divide by 1000.

To convert a volume in **cm^3** into a volume in **m^3**, divide by 1 000 000.

3. a. 1.6 dm^3
b. 5.5×10^{-4} m^3
c. 1350 cm^3
d. 375 000 000 cm^3
e. 0.006 54 m^3

	£ per m^3		p per cm^3		p per dm^3
Cylinder 'a'	7.27	or	7.27×10^{-4}	or	0.727
Cylinder 'b'	7.87		7.87×10^{-4}		0.787
Cylinder 'c'	4.11		4.11×10^{-4}		0.411

Therefore 'c' is the best value for money.

Moles and mass

1. a. $32.0\ g \div 16.0\ g\ mol^{-1} = 2\ mol$
b. $175\ g \div 100.1\ g\ mol^{-1} = 1.75\ mol$
c. $0.2\ g \div 180.0\ g\ mol^{-1} = 0.0011\ mol$

2. a $20\ mol \times 180\ g\ mol^{-1} = 3\ 600\ g$
b $5.00 \times 10^{-3}\ mol \times 63.5\ g\ mol^{-1} = 0.318\ g$
c $42.0\ mol \times 249.6\ g\ mol^{-1} = 10\ 500\ g$

3. a. i. $3.09\ g \div 0.0250\ mol = 123.6\ g\ mol^{-1}$
ii. $CuCO_3$
b. molar mass of chromium carbonate = $4.26\ g \div 0.015\ mol = 284\ g\ mol^{-1}$
$Cr_2(CO_3)$

BONUS QUESTION

6.02×10^{23} p ÷ 7 500 000 000 people = 8.03×10^{13} p per person or 803 000 million pounds per person!

Moles and concentration

1. a. $1.5\ mol \div 0.25\ dm^3 = 6.0\ mol\ dm^{-3}$
b. $0.25\ dm^3 \times 0.0150\ mol\ dm^{-3} = 3.75 \times 10^{-3}\ mol$
c. $0.125\ mol \div 0.85\ mol\ dm^{-3} = 0.15\ dm^3$

2. a. $5.0\ g \div 84.0\ g\ mol^{-1} =$ <u>0.0595 mol</u>
$0.0595\ mol \div 0.100\ dm^3 =$ <u>$0.60\ mol\ dm^{-3}$</u>
b. $0.025\ dm^3 \times 3.8\ mol\ dm^{-3} =$ <u>0.095 mol</u>
$0.095\ mol \times 40.0\ g\ mol^{-1} =$ <u>3.8 g</u>
c. $2.5\ g \div 129.9\ g\ mol^{-1} =$ <u>0.0192 mol</u>
$0.0192\ mol \div 1.3\ mol\ dm^{-3} =$ <u>$0.015\ dm^3$</u>
$0148\ dm^3 =$ <u>$15\ cm^3$</u> (to 2 sig. fig.)