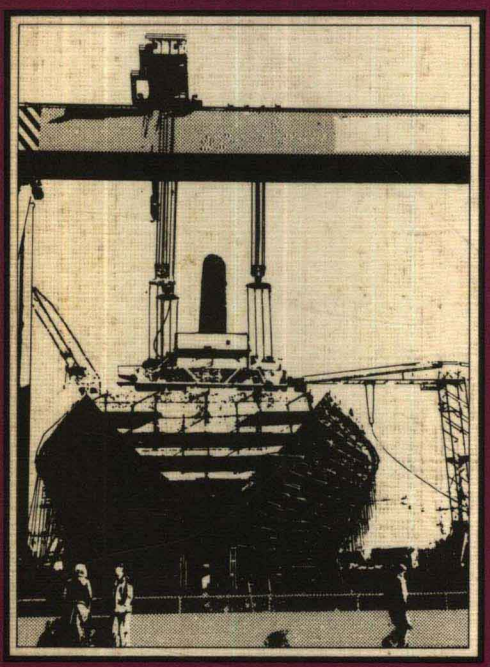
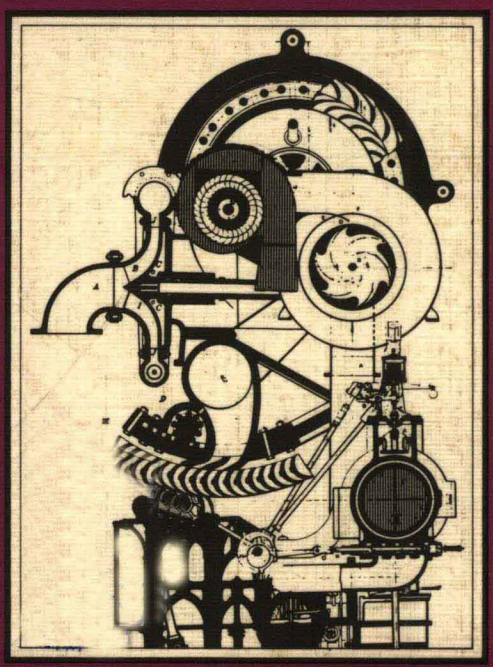
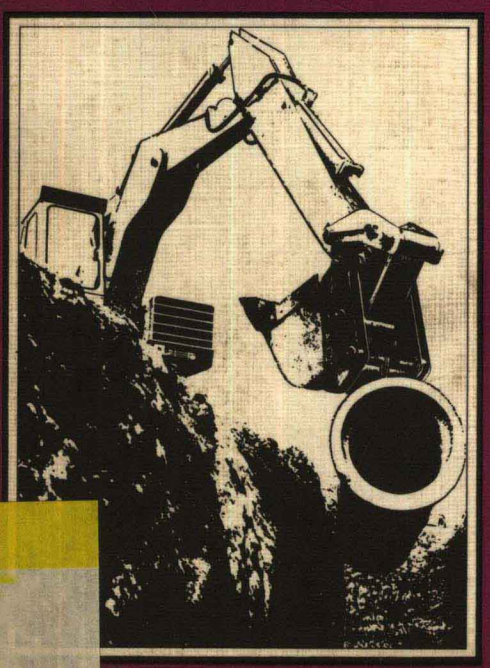
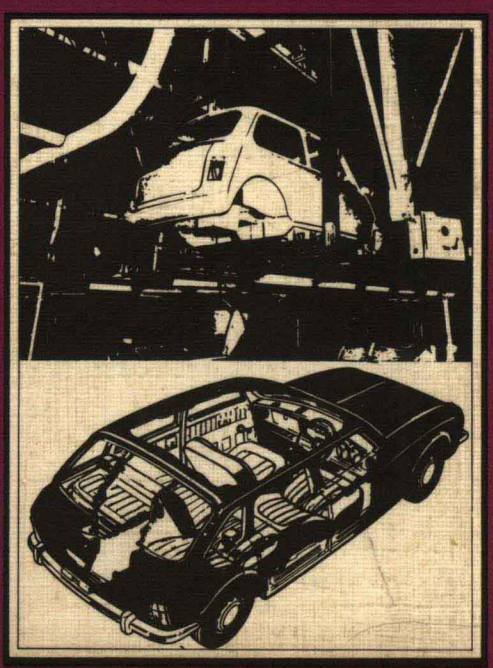
B W Smith

TEC Mathematics Exercises - Level 1









TEC

MATHEMATICS EXERCISES

Level I

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Section A

MANIPULATION OF NUMBERS AND CALCULATIONS

When you have completed this section you should be able to:

1. Apply the four basic arithmetic operations to expressions involving integers, fractions and decimals.
2. Solve problems relating to ratio, proportion and percentage.
3. Apply the precedence rules to multiple calculations involving fractions and decimals.
4. Use and convert denary numbers to and from standard form.
5. Use and convert binary numbers to and from denary.
6. Ensure that answers to numerical problems are reasonable.
7. Use 4 figure tables of square, square root and reciprocals.
8. Use 4 figure $\log_{10}$ tables.
9. Use a slide rule for simple calculations.
10. Perform basic arithmetic operations on a calculating machine.

1. Multiply the following using longhand:
   a) 5×374
   b) 5629×9
   c) $17\,135 \times 11$
   d) 13×2914
   e) 27×457
   f) 153×259

2. Divide the following using long division:
   a) $1554 \div 6$
   b) $3045 \div 7$
   c) $7059 \div 13$
   d) $3174 \div 23$
   e) $41\,496 \div 28$
   f) $23\,343 \div 31$

3. Find the L.C.M. of the following numbers:
   a) 2, 3, 4, 8
   b) 2, 4, 5, 6, 8, 10
   c) 3, 7, 9, 14, 21
   d) 1, 2, 3, 4, 5, 6, 7
   e) 9, 11, 18, 27, 44
   f) 13, 39, 65, 143

4. Find by the method of prime factors the H.C.F. of the following numbers:
   a) 84 and 96
   b) 190 and 798
   c) 24, 42 and 51
   d) 78, 182 and 195
   e) 84, 140 and 616
   f) 2117 and 4745

5. Reduce the following fractions to their lowest terms:
   a) $\frac{25}{100}$
   b) $\frac{6}{42}$
   c) $\frac{7}{56}$
   d) $\frac{12}{16}$
   e) $\frac{12}{32}$
   f) $\frac{14}{64}$
   g) $\frac{9}{15}$
   h) $\frac{11}{121}$
   i) $\frac{18}{27}$
   j) $\frac{48}{144}$
   k) $\frac{121}{22}$
   l) $\frac{221}{238}$

6. Multiply or divide the following fractions:
   a) $\frac{3}{5} \times \frac{2}{7}$
   b) $\frac{3}{4} \times \frac{6}{7}$
   c) $\frac{4}{9} \times \frac{9}{10}$
   d) $2\frac{1}{3} \times \frac{6}{7}$
   e) $3\frac{3}{4} \times 1\frac{1}{3}$
   f) $7\frac{4}{11} \times 3$
   g) $\frac{1}{2} \div 3$
   h) $\frac{7}{12} \div \frac{14}{15}$
   i) $4 \div 1\frac{3}{5}$
   j) $\frac{3}{14} \div \frac{3}{7}$
   k) $1\frac{2}{7} \div \frac{3}{5}$
   l) $\frac{11}{26} \div 1\frac{9}{13}$

7. Add or subtract the following fractions:
   a) $\frac{2}{3} + \frac{1}{2}$
   b) $\frac{4}{7} + \frac{7}{8}$
   c) $\frac{5}{11} + \frac{11}{12}$
   d) $\frac{6}{19} + \frac{20}{57}$
   e) $\frac{5}{6} + \frac{9}{14}$
   f) $\frac{13}{15} + \frac{15}{17}$
   g) $\frac{3}{4} - \frac{1}{2}$
   h) $\frac{7}{8} - \frac{5}{6}$
   i) $\frac{5}{12} - \frac{1}{6}$
   j) $\frac{9}{11} - \frac{3}{7}$
   k) $\frac{4}{5} - \frac{3}{15}$
   l) $4\frac{6}{7} - 1\frac{1}{6}$

1. Express as improper fractions:

a) $2\frac{1}{8}$	c) $3\frac{1}{16}$	e) $1\frac{5}{12}$	g) $3\frac{5}{64}$
b) $5\frac{3}{4}$	d) $2\frac{1}{5}$	f) $4\frac{5}{32}$	h) $3\frac{1}{7}$

2. Reduce to whole or mixed numbers:

a) $\frac{163}{4}$	c) $\frac{127}{2}$	e) $\frac{121}{64}$	g) $\frac{23}{7}$
b) $\frac{37}{16}$	d) $\frac{12}{4}$	f) $\frac{21}{8}$	h) $\frac{125}{25}$

3. Reduce to their lowest terms:

a) $\frac{12}{64}$	c) $\frac{144}{60}$	e) $\frac{8}{20}$	g) $\frac{24}{144}$
b) $\frac{10}{32}$	d) $\frac{12}{48}$	f) $\frac{40}{64}$	h) $\frac{64}{1000}$

4. Find the value of the following:

a) $\frac{1}{2} + \frac{1}{8} + \frac{5}{12}$	d) $2\frac{1}{4} + 5\frac{3}{8} + 1\frac{13}{16}$	g) $8\frac{1}{8} - 4\frac{3}{16}$	j) $\frac{65}{100} \times 5\frac{5}{8} \div 4\frac{1}{2}$
b) $1\frac{1}{3} + \frac{5}{16} + \frac{9}{48}$	e) $\frac{2}{3} - \frac{1}{8}$	h) $4\frac{17}{64} - 2\frac{11}{32}$	
c) $\frac{2}{3} + \frac{5}{9} + \frac{7}{18}$	f) $4\frac{1}{7} - 3\frac{4}{5}$	i) $\dfrac{4\frac{1}{2} \times 6\frac{3}{4}}{1\frac{4}{5}}$	

5. a) If the load a vehicle will carry has a mass of $2\frac{1}{2}$ tonne and this load is $\frac{5}{9}$ of the vehicle's mass, what is the total mass of the vehicle plus load?

   b) A tank containing 40 litres of oil leaks at the rate of $1\frac{1}{4}$ litres per hour.
   How many hours will be taken to empty the tank?

   c) A vehicle travels a distance of 64 km and uses $9\frac{1}{2}$ litres of petrol. Calculate the fuel consumption in km/litre.

   d) A machine component costs £1.25. If the material accounts for $\frac{7}{20}$ and labour $\frac{19}{40}$, the remainder being profit, what is the amount of profit?

   e) A housewife wishing to check her greengrocery bill needs to calculate $1\frac{1}{2}$ kg @ 12 p/kg, $\frac{3}{4}$ kg @ 16 p/kg, 2 packets weighing 3 kg @ 14 p/kg and $1\frac{1}{4}$ kg @ 24 p/kg. What is the total cost?

Express the following *ratios* as *fractions* in their lowest terms:

1. 4 m to $2\frac{1}{2}$ m
2. 6p to £1
3. $\frac{3}{20}$ to $\frac{1}{6}$ litre
4. 18:6
5. 1 cm to 1 m
6. $4\frac{1}{2}$ to 6
7. $1\frac{1}{4}$ kg to 5 kg
8. A craftsman is paid £1.95 per hour and his apprentice at £0.95 per hour.
   What is the ratio of the apprentice's wage to the craftsman's wage?
9. A map scale is 25 mm to 1500 m.
   What is the ratio between distances on the map to actual distances on the ground?
10. A railway line rises 1250 mm in a distance of 1 km.
    Give this slope as a ratio of rise to distance.
11. A tapered bar with a 100 mm long taper has a minor diameter of 3.68 mm and a major diameter of 9.16 mm.
    What is the taper per mm?
12. 8 cm^3 of mercury has a mass of 108.8 g.
    What is the relative density of mercury? (1 cm^3 of water has a mass of 1 g).
13. The ratio of the cost of labour to the cost of material in decorating a room is 4:3.
    What is the cost of materials if the total cost is £56?
14. A tinsmith reckons that the ratio of the area of sheet metal used in a job to the area of waste is 13:2.
    What area is wasted from 10 sheets of metal each $4\frac{1}{2}$ m^2 in area?
15. A machine costing £5000 when new is valued now at £4750.
    Determine the fractional depreciation.
16. A plank of wood 6 m long costs £1.35.
    Find the cost of two planks, each 5 m long, at the same rate.
17. A car consumes 4.5 litres of petrol during a run of 48 km.
    How much will it consume on a run of 200 km under similar conditions?
18. A photograph is to be enlarged from 74 x 52 mm to an enlargement making the longer side 297 mm.
    What will be the length of the other side?

1. A brass casting consists of 2 parts copper and 1 part zinc by mass. Calculate the mass of copper and zinc in a casting weighing 240 kg.

2. A solution for pickling castings is made of sulphuric acid and water in the ratio of 4.5 water to 1 acid.
How much water is needed if $2\frac{1}{2}$ litres of acid is used?

3. The ratio of the length of the con-rod to crank in an engine is $4\frac{1}{2}/1$. Find the length of the con-rod if the crank is 100 mm.

4. How much copper is required to be melted with 60 kg of zinc so as to make an alloy consisting of copper and zinc in the ratio of 7/3?

5. The mass of a casting is reduced by machining in the ratio of $\frac{1}{8}/1$. If after machining it has a mass of 80 kg, calculate the mass of the casting.

6. A motor car has a mass of 900 kg and carries 5 persons who have a total mass of 330 kg.
What fraction is the load of the total mass?

7. $\frac{3}{5}$ of the 300 employees at a factory are skilled men, $\frac{1}{4}$ are unskilled and the remainder semi-skilled.
How many semi-skilled employees are there?

8. Glass contains by mass, $\frac{3}{10}$ silica, $\frac{1}{20}$ potash and the remainder being lime.
How many kg of each are there in 160 kg of glass?

9. Three men are awarded £270 to be shared out in the ratio 2 : 3 : 4. Find out how much each man will receive.

10. A factory working full time, 5 days per week, 8 hours per day is reduced to a $3\frac{1}{2}$ day week. If fuel bills are normally £872 per week calculate how much should be saved.

11. A model $\frac{2}{7}$ full size is 360 mm long by 270 mm wide, what are the proportions of the full size article?

12. A length of wire 18 m long has a resistance of 270 ohms.
Find the resistance of a length of wire 1.25 km long.

1. Find the value of the following:

a) $3 + 5 - 4$
b) $7 - 5 + 3$
c) $2 - 4 + 7$
d) $3 \times 2 + 4$
e) $5 - 2 \times 2$
f) $2 + 7 \times 3$
g) $6 - 4 \div 2$
h) $8 \div 2 + 2$
i) $5 \times 3 + 2 \times 4$
j) $3 \times (2 + 3) \times 2$
k) $11 - 3 \times (2 + 6)$
l) $5 - 3 \times 2 + 4 \div 2$

2. Evaluate the following:

a) $3 \times \frac{3}{8} - \frac{1}{8}$
b) $2\frac{1}{2} - \frac{2}{3} \times 1\frac{1}{2}$
c) $\frac{1}{2}$ of $\frac{3}{5} + \frac{1}{10}$
d) $(\frac{3}{8} - \frac{1}{4}) \times \frac{2}{3}$
e) $5\frac{1}{4} - 3\frac{1}{3} \times \frac{2}{5}$
f) $1\frac{1}{8} \times 4 + 2\frac{5}{6} \times 3$
g) $9 \div 3 + \frac{1}{2} \div 3$
h) $2\frac{1}{4} \times (3 + 1\frac{1}{3}) \div 2$
i) $(2 - \frac{3}{5}) \div (3 - \frac{1}{5})$
j) $8 + \frac{1}{2} \times 2 \div 16$

3. Find the value of the following:

a) $\dfrac{3 \times 5}{6}$
b) $\dfrac{5 - 2}{10}$
c) $\dfrac{3 - 2 \times 6}{9}$
d) $\dfrac{6 \times (2 + 5)}{4}$
e) $\dfrac{2 + 5(6 - 3)}{3 + 7}$
f) $\dfrac{\frac{1}{2} + \frac{1}{3}}{6}$
g) $\dfrac{4 \times \frac{3}{4} + \frac{1}{4}}{\frac{1}{3}}$
h) $\dfrac{\frac{1}{2}}{1\frac{1}{2} + \frac{2}{3}}$
i) $\dfrac{4\frac{1}{3} - \frac{1}{2} \times \frac{2}{3}}{\frac{9}{10}}$
j) $\dfrac{2 - \frac{3}{5}}{1\frac{5}{7} \times \frac{1}{6}}$

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1. Express the following vulgar fractions in decimal form:
   a) $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{40}$, $\frac{1}{800}$, $\frac{1}{2000}$, $\frac{1}{10\,000}$
   b) $\frac{3}{80}$, $\frac{7}{16}$, $\frac{15}{32}$, $\frac{3}{64}$, $\frac{9}{64}$, $\frac{15}{64}$
   c) $\frac{4}{25}$, $\frac{8}{125}$, $\frac{39}{500}$, $\frac{9}{4}$, $\frac{13}{8}$, $\frac{33}{16}$

2. Find in their lowest terms the vulgar fractions equivalent to the following decimals:
   a) 0.1, 0.01, 0.001, 0.5, 0.05, 0.005
   b) 0.25, 0.025, 0.75, 0.075, 0.125, 0.375
   c) 0.625, 0.875, 0.9375, 0.0625, 0.1875, 0.4375

3. Express $\frac{1}{7}$ to 6 decimal places
   Express $\frac{1}{7}$ to 5 decimal places
   Express $\frac{1}{7}$ to 3 decimal places
   Express $\frac{1}{7}$ to 2 decimal places

4. Express the following to the number of decimal places stated:
   a) 10.5743 (2)
   b) 2.0275 (2)
   c) 0.037 45 (3)
   d) 2.750 85 (4)
   e) 2.899 (1)
   f) 3.04 (1)

5. Express the following decimals to the number of significant figures stated:
   a) 0.002 741 (3)
   b) 11.056 (2)
   c) 51.73 (3)
   d) 11.056 (4)
   e) 25.2 (4)
   f) 61.85 (3)
   g) 11.056 (3)
   h) 61.204 (4)
   i) 67.75 (3)

6. What is the value of:
   a) 23.061 − 21.062
   b) 23.97 − 11.4 + 6.03 − 7.8
   c) 5.42 + 0.7 − 4.08
   d) 5.63 − 2.12 + 7.96

7. Evaluate the following stating your answer to the significant figures stated:
   a) 0.5 × 2.5 (2)
   b) 0.75 × 0.5 (1)
   c) 2.05 × 1.75 (4)
   d) 0.0500 × 0.2 (2)
   e) 2.64 × 3.01 (3)
   f) 2.35 × 0.04 (1)
   g) 3.75 ÷ 27 (2)
   h) 26.4 ÷ 10 (2)
   i) 3.8 ÷ 1000 (1)
   j) 2.56 ÷ 1600 (2)
   k) 0.0084 ÷ 17 (3)
   l) 4.516 ÷ 2.51 (3)
   m) $\dfrac{0.75 + 0.125 - 0.1875}{0.03}$ (4)
   n) $\dfrac{2.5 \times 0.04}{1.8}$ (3)

1. Reduce to decimal form (3 sig. fig.):
   a) $\frac{14}{19}$ b) $\frac{11}{230}$ c) $\frac{16}{3100}$

2. Express as a single decimal:
$$\tfrac{1}{2} + \tfrac{1}{4} + \tfrac{1}{8} - \tfrac{1}{16} - \tfrac{1}{32} - \tfrac{1}{64}$$

3. Find the following quotients correct to 3 significant figures:
   a) $0.034\,75 \div 150$ b) $0.4785 \div 83.1$ c) $287.3 \div 0.0045$

4. Simplify the following:
$$\frac{\frac{3}{8} + 0.5 - 0.875 + 2}{1 - (\frac{1}{2} + \frac{3}{4} \text{ of } \frac{1}{4})}$$

5. $$\frac{2.875 - 0.234 + 0.025}{1 - (\frac{5}{16} - \frac{3}{8} \times \frac{3}{4})}$$

6. $$\frac{0.3 + 0.68 \times 0.103}{0.912 \times 6 - 3 \times 3.175}$$

7. The boiling point of water rises 0.37 C degrees for an increase of 1 cm in the height of the barometer. Water boils at 100 °C when the barometric pressure is 76 cm.
   Find the boiling point when the barometric pressure is 78.35 cm. (Give the answer to 2 decimal places.)

8. The mass of a steel bar of length 222.25 mm is 3.29 kg.
   Find the mass of a 25 mm length of bar.

9. The electrical resistance of a certain type of wire is 1.24 ohm per cm
   Calculate to 2 decimal places the resistance of a piece of wire 18.02 cm long.

10. A certain engine normally develops 32 kW; by increasing the compression ratio the power is raised to 36 kW.
    Express this increase in power as a decimal.

11. An assembly is held together using 17 nuts, bolts and washers. If the nuts cost 50 p per dozen, the bolts cost 7 p each, the washers cost £1.65 per hundred, the other components a total of £6.27 and the labour involved costs £1.15, find the total cost of the assembly.

1. Express as percentages:

   a) $\frac{3}{5}$ b) 0.55 c) $\frac{0.45}{0.75}$ d) $\frac{\frac{1}{10}}{8}$

2. Evaluate:

   a) 0.15% of 1 kg
   b) 2½% of £100
   c) 85% of 4500 W
   d) 4% of 254

3. A machine costing £6000 when new, is valued now at £3500. Determine the % depreciation.

4. Box A contains 240 screws, and box B contains 25% more than A.
   What percentage is the contents of box A compared to the number in Box B?

5. A bar of 'Babbit' metal consists of 2 parts antimony, 3 parts copper and 20 parts tin. Express these as percentages and find the mass of each in 225 kg of the metal.

6. If 32 men from a shift of 576 were absent, calculate:
   a) the percentage absent b) the percentage present.

7. A shaft weighing 22.5 N has been turned from a bar weighing 25 N.
   What percentage of the original weight was lost in turning?

8. 840 kg of latex lost 2½% of its mass on being cleaned.
   What was the mass of clean latex obtained?

9. A rod 1.5 m long is drawn out to $3\frac{1}{2}$ times its length.
   What is the percentage increase in length?

10. During a tensile test a steel wire increases in length from 290 mm to 295 mm.
    Determine the percentage elongation.

11. A 10 mm diameter steel bar is reduced to 8.5 mm diameter during a tensile test.
    Determine the percentage reduction in area.

12. The workers in a factory consist of 235 men, 171 women and 29 teenagers.
    What is the percentage of teenagers?

13. A company employing 753 people needs to reduce its staff by 15%.
    How many people will lose their jobs?

Express the following numbers in standard form:

1. a) 3107 f) 0.0107 k) 3763 p) 40 000

b) 20 g) 0.01 l) 0.672 q) $\frac{1}{40\,000}$

c) 56 712 h) 0.001 m) 0.801 r) $\frac{7}{1\,000\,000}$

d) 96.3 i) 1001 n) 0.073 s) $\frac{654}{1275}$

e) 54.23 j) 302 o) 9499 t) $\frac{0.007\,61}{0.000\,45}$

2. Express in standard form the number of kilometres travelled by a light wave in one year. (Speed of light = 300 000 km/s approx.)

3. Convert the following into normal decimal form.

a) 7.1×10^{-4} d) 1.933×10^{-1} g) 94×10^{6}

b) 8.34×10^{2} e) 2.347×10^{3} h) 1.0×10^{-5}

c) 1.67×10^{3} f) 17.26×10^{-3}

4. Evaluate the following, expressing your answer in standard form.

a) $(4 \times 10^{3}) + (3 \times 10^{5})$ h) $(9.23 \times 10^{6}) \times (1.91 \times 10^{5})$

b) $(5 \times 10^{2}) + (6 \times 10^{2})$ i) $\frac{7.88 \times 10^{4}}{3.94 \times 10^{2}}$

c) $(5 \times 10^{-2}) + (6 \times 10^{-2})$ j) $\frac{2.62 \times 10^{6}}{1.31 \times 10^{7}}$

d) $(30 \times 10^{3}) + (2 \times 10^{2})$ k) $3.96 \times 10^{6} \times 1.32 \times 10^{-2}$

e) $5 \times 10^{2} \times 3 \times 10^{4}$ l) $\frac{3.6 \times 10^{2} \times 8.4 \times 10^{3}}{1.8 \times 10^{3} \times 1.2 \times 10^{4}}$

f) $(6.7 \times 10^{2}) \times (7.3 \times 10)$ m) $\frac{4.8 \times 10^{-2} \times 6 \times 10^{4}}{2.4 \times 10^{-3} \times 1.5 \times 10^{3}}$

g) $(7.92 \times 10^{4}) \times (6.31 \times 10^{4})$ n) $\frac{3.9 \times 10^{-2} \times 1.6 \times 10^{4} \times 7.5 \times 10^{6}}{1.3 \times 10^{3} \times 3.2 \times 10^{5} \times 1.875 \times 10^{4}}$

5. Express the answers to the following questions in standard form.

a) Reduce to metres: 16.43 kilometres, 50 450 cm, 75 mm

b) Reduce to centimetres: 90 m, 0.434 km, 15 mm

c) Reduce to km: 7500 m, 36 000 cm

d) Express in grammes: 19.5 kg, 1750 mg

e) Express in kg: 650 g, 254 300 mg

f) Reduce 1.63 litres to cm^3, and 22 400 cm^3 to litres

6. Evaluate the following, expressing your answer in standard form:

a) $\frac{7.2 \times 10^{6} - 60 \times 10^{4}}{0.12 \times 10^{3}}$ b) $\frac{0.36 \times 10^{2} + 4.8 \times 10^{3}}{42 \times 10^{2} - 1.2 \times 10^{2}}$

1. Convert to binary from denary notation:

a) 7	d) 45	g) 85
b) 11	e) 78	h) 103
c) 32	f) 61	i) 121

2. Convert to denary from binary notation:

a) 1011	d) 1011010	g) 10010010
b) 110011	e) 101011	h) 10101010
c) 10101	f) 1110111	i) 11011011

3. Add or subtract the following binary numbers:

a) 11 + 101	f) 110 − 100
b) 101 + 1101	g) 1101 − 1001
c) 11011 + 11011	h) 110011 − 101101
d) 10100 + 10011	i) 100010 − 10001
e) 111001 + 1011101	j) 1000000 − 101011

4. Convert the answers to question **3** into denary form.

a) Using four figure tables find the answer to the following:

1. 8^2
2. 9^2
3. 1.5^2
4. 1.6^2
5. 2.5^2
6. 25^2
7. 7.31^2
8. 9.613^2
9. 10.13^2
10. 7.634^2
11. 9.98^2
12. 3.01^2
13. 5.13^2
14. 6.072^2
15. 7.003^2
16. 101^2
17. 12.72^2
18. 169^2
19. 2051^2
20. $(1.762 \times 10^2)^2$
21. $\sqrt{121}$
22. $\sqrt{64}$
23. $\sqrt{49}$
24. $\sqrt{6.25}$
25. $\sqrt{2.96}$
26. $\sqrt{3.96}$
27. $\sqrt{39.6}$
28. $\sqrt{396}$
29. $\sqrt{3960}$
30. $\sqrt{10}$
31. $\sqrt{100}$
32. $\sqrt{1000}$
33. $\sqrt{10\,000}$
34. $\sqrt{59}$
35. $\sqrt{601}$
36. $\sqrt{8420}$
37. $\sqrt{8.3}$
38. $\sqrt{0.534}$
39. $\sqrt{0.064}$
40. $\sqrt{0.0036}$
41. $\frac{1}{0.5}$
42. $\frac{1}{0.25}$
43. $\frac{1}{5.61}$
44. $\frac{1}{7.81}$
45. $\frac{1}{96.1}$
46. 3.921^{-1}
47. 25.4^{-1}
48. 1.332^{-1}
49. 0.792^{-1}
50. 0.6341^{-1}
51. $0.098\,75^{-1}$
52. $\frac{1}{(3.25)^2}$
53. $\frac{1}{\sqrt{0.44}}$
54. $3.29^{-0.5}$
55. 5.71^{-2}

b) Evaluate using square, square root and reciprocal tables only:

1. $3.4^2 + 2.35^2$
2. $\sqrt{(2.71)^2 + (31.4)^2}$
3. $\frac{1}{\sqrt{(3.15)^2 - (2.92)^2}}$
4. $\frac{3}{\sqrt{57.2} + (0.015)^2}$
5. $\frac{0.02}{\sqrt{0.015} + \sqrt{0.0015}}$

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