

Introduction to algebra - Worksheet 1

If the value of $a = 2$, $b = 3$ and $c = 4$, evaluate the following:

- | | |
|--|--|
| 1. $a^2 = 4$ | 2. $ab^3 = 54$ |
| 3. $2a^2c = 32$ | 4. $5a^2 + 6b^2 = 74$ |
| 5. $a^2 + c^2 = 20$ | 6. $\frac{3a^4}{c^2} = 3$ |
| 7. $\frac{c^5}{ab^3} = \frac{512}{27}$ | 8. $\frac{6a^3 + 4b^2}{2c^2} = \frac{21}{8}$ |

Introduction to algebra - Worksheet 2

Simplify the following where appropriate:

- | | |
|--|-----------------------------------|
| 1. $3x + 4x^2 - 2x + x^3 = x^3 + 4x^2 + x$ | 2. $5a^3 - 2a^3 + 6a = 3a^3 + 6a$ |
| 3. $3a + 4b - 3c = 3a + 4b - 3c$ | 4. $4a + 3a^2 - 2a^2 = a^2 + 4a$ |
| 5. $2b^3 - 4b^3 + 2b^3 = 0$ | 6. $4ab + 2ba - 5ba = ab$ |
| 7. $3xy + 5yx - 2xy^3 = -2xy^3 + 8yx$ | 8. $7abc - 3bca + 5bac = 9abc$ |
| 9. $4ab - 2a^2b + 2ab^2 = 4ab - 2a^2b + 2ab^2$ | |

Law of indices - Worksheet 1

Simplify the following:

- | | |
|---|---|
| 1. $x^2 \times x^4 = x^6$ | 2. $a^3 \times x^5 = a^3 x^5$ |
| 3. $p^{-3} \times p^2 = p^{-1}$ | 4. $y^{-3} \times y^4 = y^{-7}$ |
| 5. $a^5 \times a^4 \times a^{-3} = a^6$ | 6. $p^{-3} \times p^{-2} \times p^4 = p^{-1}$ |
| 7. $x^2 \times x^{-3} \times x^4 \times x^{-2} = x$ | 8. $a^{-2} \times a^{-4} \times a^{-2} \times a^5 = a^{-3}$ |

Law of indices - Worksheet 2

Simplify the following:

- | | |
|---|--|
| 1. $9x^5 \div 3x^2 = 3x^3$ | 2. $8x^3 \div 2x^{-5} = 4x^8$ |
| 3. $y^{-3} \times y^{-2} \div y^3 = y^{-8}$ | 4. $x^{-4} \times x^{-3} \div x^{-5} = x^{-2}$ |
| 5. $(x^3)^2 = x^6$ | 6. $(y^5)^3 = y^{15}$ |
| 7. $(2a^3)^4 = 16a^{12}$ | 8. $(3y^{-2})^{-2} = 0.111y^4$ |

Multiplication of algebraic terms - Worksheet 1

Simplify the following:

1. $4(3x^3 + x^2 + 4x) = 12x^3 + 4x^2 + 16x$ 2. $5(a^3 - a^2 + 3a) = 5a^3 - 5a^2 + 15a$
 3. $7(x^2 - 3x + 4) = 7x^2 - 21x + 28$ 4. $-6(4x^3 - x^2 - 3x) = -24x^3 + 6x^2 + 18x$
 5. $a(a^2 - 3a + 4) = a^3 - 3a^2 + 4a$ 6. $c(4c^2 + 3c) = 4c^3 + 3c^2$

Multiplication of algebraic terms - Worksheet 2

Simplify the following:

1. $a^2b(3a^2 - 4b^2 + 3x^2) = 3a^4b - 4a^2b^3 + 3a^2bx^2$ 2. $-x^2b(a^2 - b^2 - x^2) = -a^2bx^2 + b^3x^2 + bx^4$
 3. $a^2x^3(a^3x^2 - 4ax^2 + 5a^2y^2) = a^5x^5 - 4a^3x^5 + 5a^4x^3y^2$
 4. $7x^2y^2(3a^2b + ab + 4cd - 2xy) = 21a^2bx^2y^2 + 7abx^2y^2 + 28cdx^2y^2 - 14x^3y^3$
 5. $(p^2 + 7)(p - 4) = p^3 - 4p^2 + 7p - 28$ 6. $(x^2 - 3x)(2x^2 + x) = 2x^4 - 5x^3 - 3x^2$
 7. $4(p - q)(4p + 3q) = 16p^2 - 4pq - 12q^2$ 8. $7(x + 3y)(5x - 2y) = 35x^2 + 91xy - 42y^2$

Factorisation - Worksheet 1

Take out the common factors from each of the following:

1. $qt + rt = t(q + r)$ 2. $rt - 5rs = r(t - 5s)$ 3. $3xy + 4xz = x(3y + 4z)$

Using difference of two squares factorise the following:

4. $p^2 - q^2 = (p + q)(p - q)$ 5. $t^2 - 1 = (t + 1)(t - 1)$ 6. $4 - n^2 = (2 + n)(2 - n)$

Factorise the following:

7. $x^2 + 3x + 2 = (x + 2)(x + 1)$ 8. $x^2 + 4x + 4 = (x + 2)(x + 2)$ 9. $x^2 - 11x + 24 = (x - 3)(x - 8)$

Factorisation - Worksheet 2

Take out the common factors from each of the following:

1. $4a + 6ab - 8ab^2 = 2a(2 + 3b - 4b^2)$ 2. $5h^2 + 10gh - 20g^2h = 5h(h + 2g - 4g^2)$
 3. $2c^2d - 4cd^2 = 2cd(c - 2d)$

Using difference of two squares factorise the following:

4. $7 - 7x^2 = 7(1 + x)(1 - x)$ 5. $2y^2 - 8x^2 = 2(y + 2x)(y - 2x)$ 6. $108 - 3x^2 = 3(6 + x)(6 - x)$

Factorise the following:

7. $5x^2 + 9x + 4 = (5x + 4)(x + 1)$ 8. $6x^2 + 35x - 6 = (6x - 1)(x + 6)$ 9. $8x^2 - 19x + 6 = (8x - 3)(x - 2)$

Simple Linear Equations - Worksheet 1

Find the numerical value of the letter in each of the following equations

1. $3m - 4 + 5m = 2m + 20$ [$m = 4$]
2. $3x - 2 - 5x = 2x - 4$ [$x = 0.5$]
3. $20x - 3 + 3x = 11x + 5 - 8$ [$x = 0$]
4. $4a + 3a - 6 = 2a + 3a + 4$ [$a = 5$]
5. $16 = 4(x + 2)$ [$x = 2$]
6. $6(x + 3) = 24$ [$x = 1$]
7. $3(4y + 1) = 27$ [$y = 2$]
8. $-3(4a - 2) = -6$ [$a = 1$]

Simple Linear Equations - Worksheet 2

Find the numerical value of the letter in each of the following equations

1. $3(2 - 3y) + 12y = 24$ [$y = 6$]
2. $\frac{1}{4}x + 8 = 16$ [$x = 32$]
3. $\frac{3}{4}x - 2 = 7$ [$x = 12$]
4. $\frac{1}{2}x + 2x = \frac{1}{4}x + 9$ [$x = 4$]
5. $3(x + 1) + 2(x - 4) = 5$ [$x = 2$]
6. $5(x - 2) - 3(2x + 5) + 15 = 0$ [$x = -10$]
7. $5(x + 6) - 3x = 45$ [$x = 7.5$]
8. $2(x - 1) + 3(2x + 3) = 31$ [$x = 3$]

Simple Graphical Techniques Worksheet 1**Simple Linear Graphs**

The exchange rate on a certain day was £1 = \$2.4. Draw a graph showing the currency conversion for up to £5000. From the graph determine how many \$ would be exchanged for £900, and how much in £ would you receive in exchange for \$8500. [**£900 = \$2160 , \$8500 = £3540**].

Simple Graphical Techniques Worksheet 2**Simple Linear Graphs**

For small businesses, gas can be charged on tariff A or tariff B.

Tariff A - Standing charge of £14.50	Price per kilowatt hour - 2.4p
Tariff B - No standing charge	Price per kilowatt hour - 3.6p

Draw a graph to show the cost for up to 5000 kilowatt hours for both tariffs. Use the graph to determine the break even point. If a business consumes, on average, 3850 kilowatt hours per quarter, which tariff should they opt for?

[**Break even = 1210 kWh , Tariff A**].

Introduction to Geometry Worksheet 1

Each of the following gives two angles of a triangle. Determine the third.

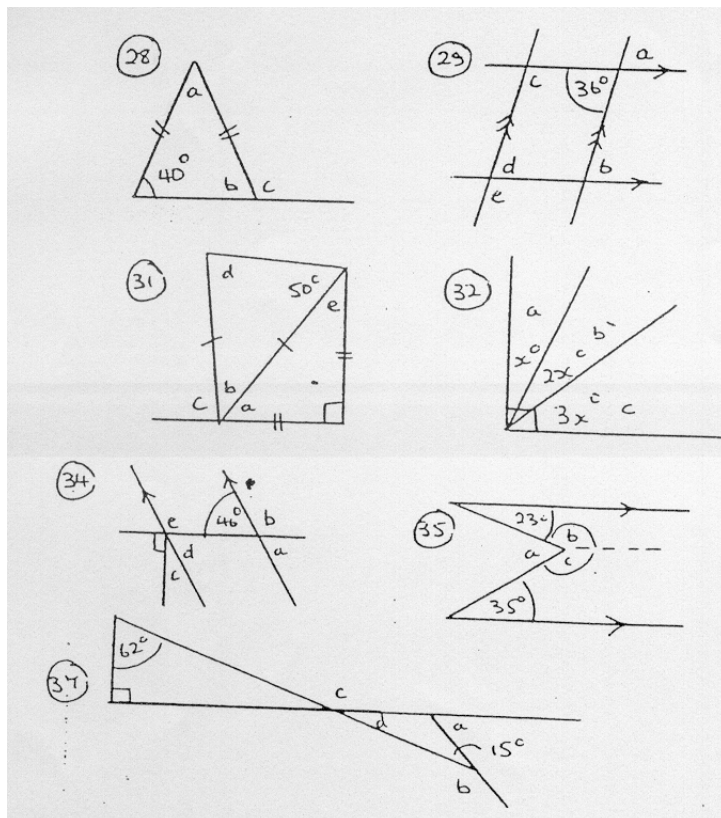
- | | |
|---|---|
| 1. $26^\circ, 48^\circ, \mathbf{106^\circ}$ | 2. $81^\circ, 17^\circ, \mathbf{82^\circ}$ |
| 3. $64^\circ, 71^\circ, \mathbf{45^\circ}$ | 4. $28^\circ 12', 62^\circ 21', \mathbf{45^\circ 50'}$ |
| 5. $108^\circ 42', 12^\circ 36', \mathbf{68^\circ 39'}$ | 6. $100^\circ 14', 68^\circ 49', \mathbf{10^\circ 57'}$ |

Which of the following triangles are right-angled?

7. Triangle with sides of 7cm, 11.3cm, 18cm **[N]**
8. Triangle with sides of 26cm, 24cm, 10cm **[Y]**
9. Triangle with sides of 19.36cm, 16.8cm, 9.2cm **[N]**
10. Triangle with sides of 35.4cm, 47.2cm, 59cm **[Y]**

Introduction to Geometry Worksheet 2

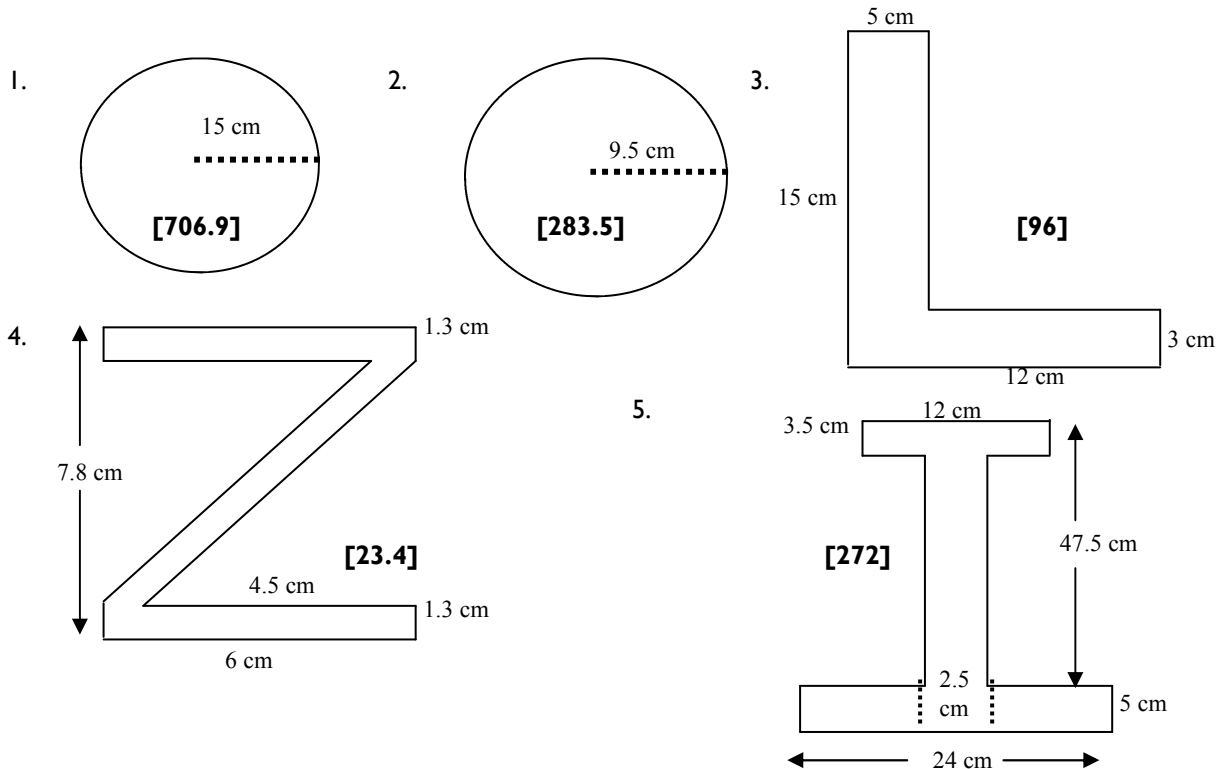
Determine the size of all the lettered angles in each of the following diagrams.



- | | |
|--|---------------------------------------|
| 28. $a = 100, b = 40, c = 140$ | 29. $a = 36, b = 36, c = 144, d = 36$ |
| 31. $a = 45, b = 80, c = 55, d = 50, e = 45$ | 32. $a = 15, b = 30, c = 45$ |
| 34. $a = 46, b = 134, c = 44, d = 46, e = 134$ | 35. $a = 58, b = 157, c = 145$ |
| 37. $a = 43, b = 165, c = 152, d = 28$ | |

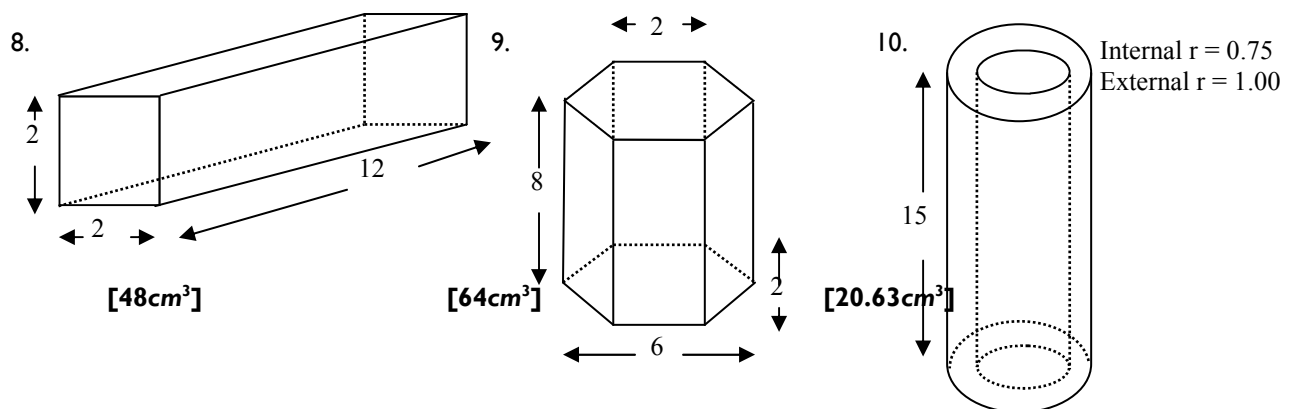
Perimeter, Area and Volume of Regular Shapes Worksheet I

Calculate the area of the following shapes



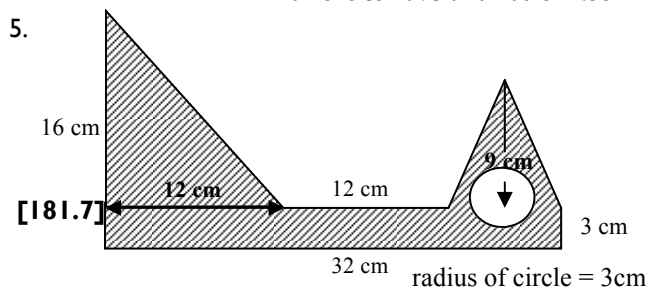
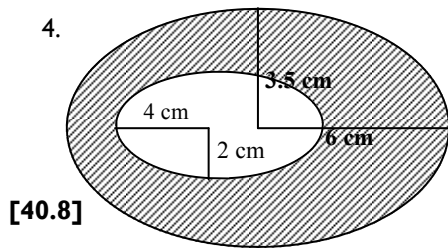
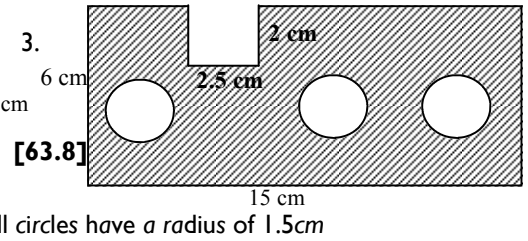
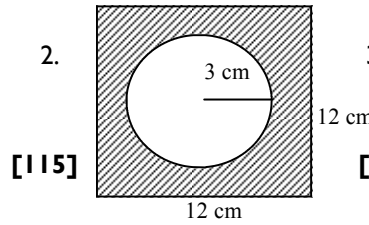
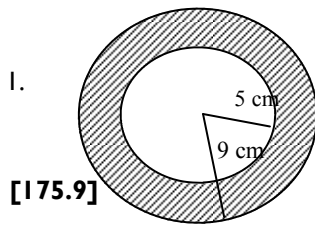
6. A water tank is a cuboid with a base of 1.2m by 0.8m. How deep is the water when the tank contains 0.384m^3 of water? **[0.4m]**
7. A classroom is 5m x 6m x 3m. Health regulations require that each student must have a minimum of 5m^3 of air. How many students can occupy the room? **[18]**

Calculate the volume of the following shapes. All dimensions in cm.



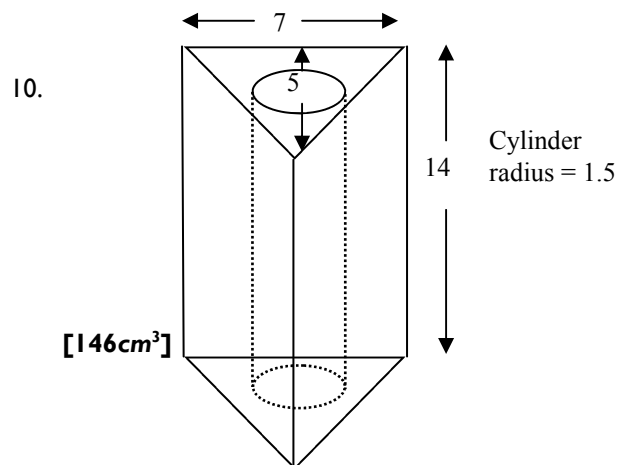
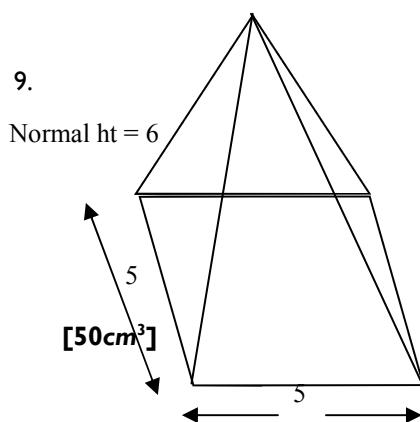
Perimeter, Area and Volume of Regular Shapes Worksheet 2

Calculate the shaded area of the following shapes



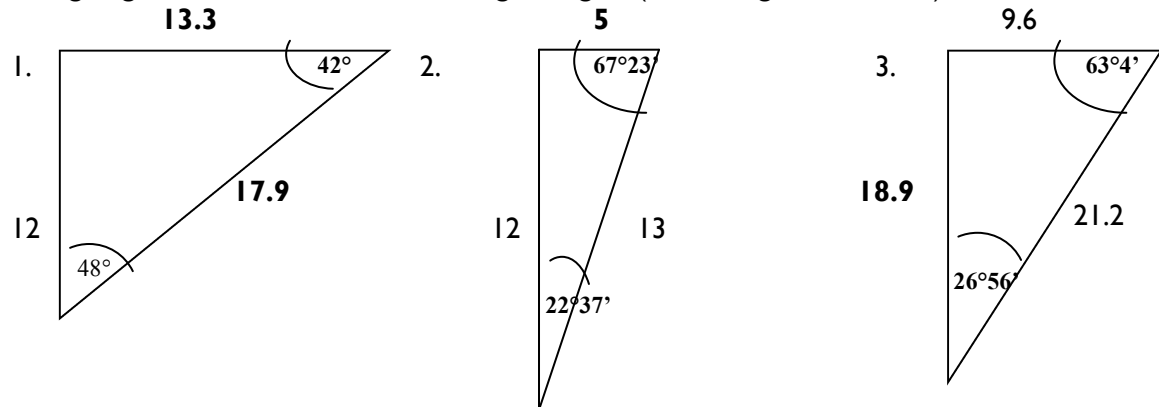
6. An ingot $80 \times 10 \times 300\text{mm}$ is cast into a cylinder 120mm diameter. Calculate its length. **[21.22mm]**
7. A rivet has a hemispherical head 6mm radius and a stem of 6mm diameter and 15mm length. Calculate the volume of 100 of the rivets. **[87660mm³] = [87.66cm³]**
8. What would be the volume of (a) air (b) plastic in a ball with 25cm diameter made from plastic 2mm thick? **[(a) 7794.78mm³ (b) 386.45mm³]**

Calculate the volume of the following shapes. All dimensions in cm.



Introduction to Trigonometry Worksheet 1

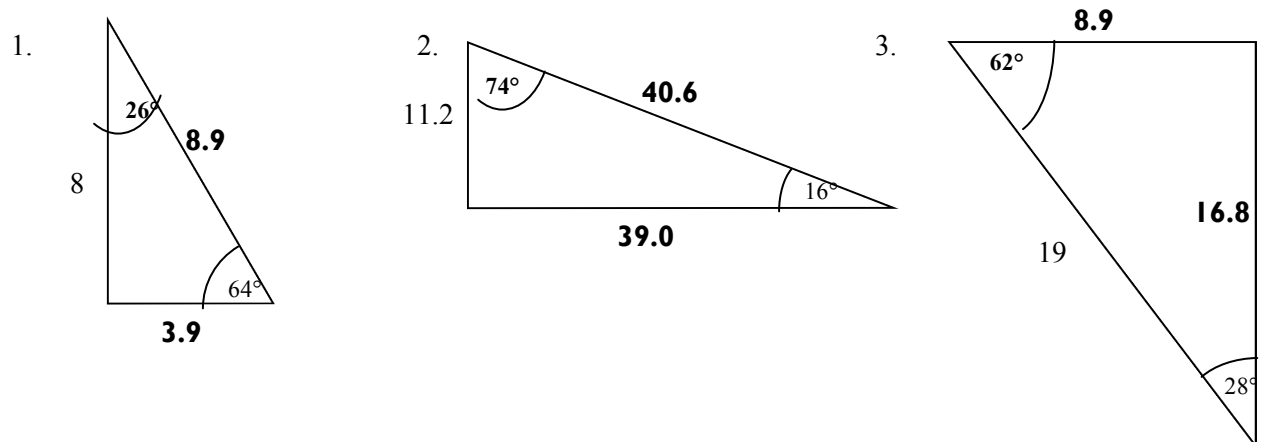
Using trig methods solve the following triangles (i.e. all angles and sides)



4. The angle of elevation of the top of a tower is 36° . If the tower is 25m away from the observer, calculate its height. **[18.2m]**
5. A man 1.8m tall is standing 12m away from a tree. If the angle of elevation of the top of the tree is $24^\circ 14'$, calculate the height of the tree. **[7.2m]**
6. A point K is 12km due west of a second point L and 25km due south of a third point M. Calculate the bearing of L from M. **[154° 22']**

Introduction to Trigonometry Worksheet 2

Using trig methods solve the following triangles (i.e. all angles and sides)



4. Point Y is 1km due north of point X. The bearings of point Z from X and Y are $26^{\circ}30'$ and $42^{\circ}40'$ respectively. Calculate the distance from point Y to point Z. **[1.61km]**
5. A ship steams 4km due north of a point then 3km on a bearing of 040° . Calculate the direct distance between the starting and finishing points. **[6.59km]**
6. The angles of elevation of the top of a tower from A and B, two points in line with its foot are 27° and 32° respectively. If the distance between A and B is 21m, calculate the height of the tower. **[57.9m or 5.89m]**

Simultaneous linear equations - Worksheet 1

Solve the following pairs of simultaneous equations for both unknowns:

1. $x + y = 8$, $x - y = 4$ **[x=6,y=2]** 2. $2x + y = 7$, $2x - y = 3$
[x=2.5,y=2]
3. $2x + 3y = 5$, $3x + 4y = 7$ **[x=1,y=1]** 4. $5x + 4y = 22$, $3x + 5y = 21$
[x=2,y=3]

Simultaneous linear equations - Worksheet 2

Solve the following pairs of simultaneous equations for both unknowns:

1. $3(x + 1) = 2(y + 2)$, $3(x + 3) = 4(y + 2)$ **[x=1,y=1]**
2. $4(x + y + 1) = 7(x + 2y)$, $4(2x + y) = 10(x + y + 1)$ **[x=19,y=62]**
3. $3(x + 1) = 2(2y + 1)$, $2(y + 3) = 4(x + 1)$ **[x=1,y=1]**
4. $3(x + y + 2) = 7x$, $2x = 3y$ **[x=3,y=2]**

Introduction to Statistics - Worksheet 1

1. Determine the median value for the following sets of data
- (a) £24, £36, £19, £43, £28, £29, £31 **[£29]**
- (b) 84, 76, 39, 47, 81, 56, 73, 62 **[67.5]**
- (c) 61.8, 63.2, 64.5, 61.2, 64.1, 85.9, 65.9, 62.3, 63.6 **[63.6]**
2. Calculate the mean, median and modal wage for the following casual workers:
8 workers earn £76.50 per week, 7 earn £82.40 per week and 5 earn £83.60 per week. **[£80.34, £82.40, £76.50]**

Introduction to Statistics - Worksheet 2

3. The following table shows the number of rejects produced by a factory, for 15 consecutive weeks

week no	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
rejects	7	55	96	38	17	55	5	49	28	83	72	66	23	41	14

Calculate the mean weekly rejects. If the acceptable mean rejects is 45, how many more rejects could have been made over the 15 weeks and the target still met?

[43.3, 26]

4. Calculate the mean, median and modal values for each of the following sets of data

(a) diameter	14.96	14.97	14.98	14.99	15.00	15.01	15.02
number	3	5	13	21	26	24	8

[15.00, 15.00, 15.00]

(b) length	29.5	29.6	29.7	29.8	29.9	30.0	30.1	30.2
number	3	7	22	28	18	12	7	3

[29.84, 29.8, 29.8]

Introduction to Differentiation Worksheet 1

Differentiate the following:

1. $x^2 + 1$ **[2x]** 2. $x^3 - 3$ **[3x²]** 3. $x^4 + 2$ **[4x³]** 4. $x^5 - 4$ **[5x⁴]**

5. $2x^2 - 3$ **[4x]** 6. $3x^2 + x$ **[6x+1]** 7. $2x^2 - 3x$ **[4x-3]** 8. $3x^2 + 2x$ **[6x+2]**

Determine the gradient of the following expressions where $x = 2$

9. $y = 3x + 2$ **[y'=3]**

10. $y = x^2 - x$ **[y'=2x-1=3]**

Introduction to Differentiation Worksheet 2

Differentiate the following:

1. $2x^4 + 5x + 1$
 $[8x^3 + 5]$

2. $5x^4 - 6x^3 + 7x - 5$
 $[20x^3 - 18x^2 + 7]$

3. $x^3 - x^2 + x + 1$
 $[3x^2 - 2x + 1]$

4. $\frac{1}{2}x^2 - 3x + 4$
 $[x - 3]$

5. $\frac{x^3}{3} + \frac{1}{4}x^2$
 $[\frac{x^2 - x}{2}]$

6. $\frac{2x^3}{3} - \frac{4x^5}{5}$
 $[2x^2 - 4x^4]$

Determine the gradient of the following expressions where $x = 3$

7. $y = 2x^3 - 4x$ $[y' = 6x^2 - 4 = 50]$ 8. $y = x^4 - 3x^3$ $[y' = 4x^3 - 9x^2 = 27]$

Matrix Algebra Worksheet 1

Express each of the following as a single matrix

1. $\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} + \begin{pmatrix} 2 & 4 \\ 3 & 1 \end{pmatrix} = \begin{pmatrix} 3 & 6 \\ 6 & 5 \end{pmatrix}$

2. $\begin{pmatrix} 6 & 11 \\ 7 & 4 \end{pmatrix} + \begin{pmatrix} 9 & 13 \\ 14 & 2 \end{pmatrix} = \begin{pmatrix} 15 & 24 \\ 21 & 6 \end{pmatrix}$

3. $\begin{pmatrix} 9 & 0 \\ 0 & 8 \end{pmatrix} + \begin{pmatrix} 0 & 7 \\ 5 & 0 \end{pmatrix} = \begin{pmatrix} 9 & 7 \\ 5 & 8 \end{pmatrix}$

4. $\begin{pmatrix} 11 & -1 \\ -7 & 4 \end{pmatrix} + \begin{pmatrix} -3 & 15 \\ 12 & -6 \end{pmatrix} = \begin{pmatrix} 8 & 14 \\ 5 & -2 \end{pmatrix}$

5. $2 \begin{pmatrix} 2 & 1 \\ 3 & 4 \end{pmatrix} + 3 \begin{pmatrix} 1 & 2 \\ 4 & 3 \end{pmatrix} = \begin{pmatrix} 7 & 9 \\ 18 & 17 \end{pmatrix}$

6. $3 \begin{pmatrix} 6 & 1 \\ -2 & 3 \end{pmatrix} + 5 \begin{pmatrix} -4 & 7 \\ 0 & 9 \end{pmatrix} = \begin{pmatrix} -2 & 38 \\ -6 & 54 \end{pmatrix}$

7. $\begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \begin{pmatrix} 2 \\ 1 \end{pmatrix} = \begin{pmatrix} 4 \\ 10 \end{pmatrix}$

8. $\begin{pmatrix} 3 & 4 \\ -2 & 1 \end{pmatrix} \begin{pmatrix} 1 \\ 5 \end{pmatrix} = \begin{pmatrix} 23 \\ 3 \end{pmatrix}$

Matrix Algebra Worksheet 2

Express each of the following as a single matrix

$$1. \begin{pmatrix} 3a & 2a \\ 5a & 6a \end{pmatrix} + \begin{pmatrix} 0 & 9a \\ 4a & 11a \end{pmatrix} = \begin{pmatrix} 3a & 11a \\ 9a & 17a \end{pmatrix}$$

$$2. \begin{pmatrix} -2b & 3b \\ 4b & -7b \end{pmatrix} + \begin{pmatrix} 8b & 2b \\ -6b & -9b \end{pmatrix} = \begin{pmatrix} 6b & 5b \\ -2b & -16b \end{pmatrix}$$

$$3. 2 \begin{pmatrix} a & b \\ c & d \end{pmatrix} + 3 \begin{pmatrix} a & -b \\ -c & d \end{pmatrix} = \begin{pmatrix} 5a & -b \\ -c & 5d \end{pmatrix}$$

$$4. p \begin{pmatrix} a & 0 \\ 0 & a \end{pmatrix} + q \begin{pmatrix} 0 & -a \\ a & 0 \end{pmatrix} + r \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}$$

$$5. \begin{pmatrix} a & b \\ b & a \end{pmatrix} \begin{pmatrix} 1 \\ 0 \end{pmatrix} = \begin{pmatrix} a \\ b \end{pmatrix}$$

$$6. \begin{pmatrix} a & 2a \\ -a & 2a \end{pmatrix} \begin{pmatrix} 1 \\ -1 \end{pmatrix} = \begin{pmatrix} -a \\ -3a \end{pmatrix}$$

$$7. \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} = \begin{pmatrix} 7 & 10 \\ 15 & 22 \end{pmatrix}$$

$$8. \begin{pmatrix} 2 & -1 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} 2 & -1 \\ 1 & 3 \end{pmatrix} = \begin{pmatrix} 3 & -5 \\ 5 & 8 \end{pmatrix}$$