**Part 3**

**PROMPT Sheet**

**9/1 Standard Form**

Standard form is a way of expressing numbers that are too big or too small to be conveniently written in decimal form

A x 10n

‘A’ is between 1 & 10 and ‘n’ is an integer

Example: 93 000 000 can be written 9.3 x 107

 0.00000345 can be written 3.45 x 10-6

**9/2 Express error intervals when rounding**

Error interval – the range of values (between the upper and lower bounds) in which the precise value could be

* If 23cm is rounded to nearest whole cm
* **23** is between the whole numbers 22 & 24

 l l l

 22 **23** 24

 **22.5 23.5**

 lower upper

 bound bound

**Inequality notation to specify error interval:**

**22.5 < x ≤ 23.5**

**9/3 Solve simultaneous equations**

 **graphically**

* Draw the graphs of the equations
* Find where they cross



Solution is x = 2, y = 3

**9/3 Solve simultaneous equations by an**

 **algebraic method**

* Make the number of ys the same
* Add or subtract to eliminate the ys

 Same signs ~ subtract

 Different signs ~ add

* Find the value of x
* Substitute the value of x to find y

Example: 2x – 3y = 11 (x2)

 5x + 2y = 18 (x3)

 4x – 6y = 22

 15x + 6y = 54

Add the two equations to eliminate y

 19x = 76

 x = 4

Substitute x = 4 into one of the equations

 5x + 2y = 18

 5x4 + 2y = 18

 20 + 2y = 18

 2y = -2

 y = -1

**9/4 Factorise quadratic expressions**

* Form x2 + bx + c

x2 – 3x – 4 = (x – 4)(x + 1)

Difference of 2 squares

x2 – 25 = (x – 5)(x + 5)

 **Solve quadratic equations by factorising**

Example: To solve x2 = 6x - 5

* **Put equation in form x2 + bx + c = 0**

x2 – 6x + 5 = 0

* **Factorise the left hand side**

(x – 5)(x - 1) = 0

* **Equate each factor to zero**

x – 5 = 0 or x - 1 = 0

 **x = 5 or x = 1**

**9/5 Solve inequalities**

Inequalities can be treated like equations

The solution can be shown on a number line

e.g.1 2x – 4 < 2  *(+4 to each side)*

 2x < 6 *(÷2 each side)*

 x < 3

This would mean ≤

 l l l l l l

 **-1 0 1 2 3 4**

**9/6 Rearrange a formula**

Isolate the required new subject by balancing

Example: To make ‘y’ the subject of 3x + 2y = 7

3x + 2y = 7 (-3x both sides)

**To get rid of:**

+ -

x ÷

 √ ( )2

 2y = 7 – 3x (÷2 both sides)

 Y = 7 – 3x

 2

or y = 3.5 - $\frac{3}{2}$x

**9/7** **Solve equations with fractions**

Transform it into an equation **without** fractions

Use the balancing technique

Example: To solve $\frac{x}{3}$ + $\frac{x-2}{5}$ = 6

Multiply both sides by 15 (LCM of 3 & 5)

* 5x + 3(x – 2) = 90
* 5x + 3x – 6 = 90
* 8x – 6 = 90
* 8x = 96
* x = 12

**9/8 Use y=mx+c to identify parallel lines**

Parallel lines have the same gradient

Example: y = **3**x – 1

‘m’ represents the gradient

All parallel because they have the same gradient of 3

 Y = **3**x

 Y = 5 + **3**x

**9/9 Interpretation of gradient & intercept**

* Gradient (slope) is the rate of change
* Intercept is the constant (not always meaningful)

Constant

£3.00

Gradient≈17÷14≈£1.20 per mile

**This graph could be represented by: C=3+1.2d**

**This graph could be represented by: V=200-50t**

Gradient≈50÷1≈

50litres per hour

Constant

200litres

**9/10 Plot & use quadratic graphs**

The shape of a quadratic graph is a parabola

You will need to complete a table of values to work out the points to plot

Example: y = x2 – 2x – 3

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| x | -2 | -1 | 0 | 1 | 2 | 3 |
| Y | 5 | 0 | -3 | -4 | -3 | 0 |

* **To solve x2 – 2x – 3 = 0**

Note down the x-values where the graph cuts the x-axis (y=0) **i.e. x = -1 and 3**

* **To solve x2 – 2x – 3 = 4**

Note down the x-values where the graph cuts the line y = 4 **i.e. x ≈ -1.8 and 3.8**

**9/11 Recognise & sketch graphs**

* Learn the basic shapes of graphs

Linear graphs – **straight line** - equation in x

Quadratic graph – **parabola** – equation in x2

Cubic graph – **S**-**shape** – equation in x3

Reciprocal graph – **see sketch** e.g y = 3

 x

**9/12 Substitute into a formula/expression**

Remember ~ the rules for integers

 ~ BIDMAS for order of operations

Examples:

+ - = -

- - = +

3 + (-4) = 3 – 4 = -1

3 – (-4) = 3 + 4 = 7

(-6) x (-2) = +12

+ x - = -

- x - = +

(6) x (-2) = -12

Example: Evaluate P = x2 – 7x when x = -5

 P = (-5)2 – 7x

 P = (-5) x (-5) – 7 x (-5)

 P = +25 +35

 P = 60

**SUVAT formulae will be given**:

v = u+at

s=displacement; u=initial velocity

v=final velocity; a=acceleration; t=time

s = ut + ½ at2

v2 = u2 + 2as

Whenever you have a SUVAT question, identify the **three** things you know and the **one** thing you want to find out. Use the equation with these four things in.

* *If something is starting from rest then the initial velocity (u) is zero*
* *acceleration - gravity applies to all falling objects approximately 10m/s2*

**9/13 Simple interest**

Example:

£350 in a bank for 3 years at a rate of 8% per annum simple interest. Find the interest/balance.

After 1 year, interest = 0.08 x 350

After 3 years, interest = 0.08 x 350 x 3 = £84

Balance = £350 = £84 = £434

 **Compound interest**

Example:

£350 in a bank for 3 years at a rate of 8% per annum compound interest. Find balance.

Balance = 350 x 1.083 = £440.90

**9/14 Find original value after % change**

Remember:

To increase an amount by 15% you x 1.15

To decrease an amount by 15% you x 0.85

Example

**New value = Original x %increase/decrease**

e.g. New value = £12000 x 1.15 = £13800

**Original value = New value ÷ %increase/decrease**

Original value = 13800 ÷ 1.15 = £12000

**9/15 Compound Measure – Learn formulae**

* These triangles are useful
* Cover the quantity you are trying to find
* What is uncovered is the formula to use

D

M

V

D

T

S

M = D x V

D = M ÷ V

V = M ÷ D

 D = S x T

 S = D ÷ T

 T = D ÷ S

**9/16 Direct and inverse proportion**

* **Direct proportion**

~As one amount **increases**, another amount **increases** at the same rate.

~The graph is a straight line with a positive slope AND goes through the point (0, 0)

~The two variable divided give a constant

e.g. **As distance increases, cost increases**

Gradient = cost ÷ distance = constant = 3

i.e £3 per mile

* **Inverse Proportion**

~As one amount **increases**, another amount **decreases** at the same rate.

~Inverse proportion leads to curved graphs

~The two variable multiplied give a constant

e.g. **As speed goes up, travel time goes down**

Time x Speed = constant = 60

i.e. 60miles

**9/17 Missing lengths in similar shapes**

If one shape is an enlargement of the other, we say they are similar.

* Corresponding angles are equal
* Corresponding sides have proportional lengths

Example – these 2 triangles are similar

4.8m 6m

 x

8m

Scale factor = 6 ÷ 4.8 = 1.25

x = 8 ÷ 1.25 = 6.4cm

N.B.

Always draw the 2 triangles separately and the same way up – it is easier to spot the sides that correspond to each other

**9/18 Arc lengths & perimeters**



 **Semi-circle quarter circle**

Perimeter = ½πd + d Perimeter = ¼πd + 2r

***Sometimes answers can be in terms of π***

e.g. 3π; 3π + 6

**9/19 Sector areas**



 **Semi-circle quarter circle**

Area = ½πr2 Area = ¼πr2

**9/20 Surface area of cylinder – Learn**

Curved Surface Area of cylinder = 2πrh

 Πd or 2πr

 h h

**9/21 Congruence criteria**

* **Congruent shapes have the same size and shape, one will fit exactly over the other.**
* **2 triangles are congruent if any of these 4 conditions are satisfied on each triangle**

~ **SSS** ~ corresponding sides are equal

~ **SAS** ~2 sides & the included angle are equal

~ **ASA** ~2 angles & angle between are equal

~ **RHS** ~ Both triangles are right-angled, hypotenuses are equal and another pair of sides are equal

**~AAS ~** 2 adjacent angles are equal & an angle excluding the included angle(similar to ASA because 3rd angle could be found)

**9/22 Pythagoras Theorem - Learn**

 For this right angled triangle:

 hypotenuse

 a

 c

 b

**a2 = b2 + c2**

To find the hypotenuse

* ADD the squares of the other 2 sides
* Then square root the answer

To find one of the shorter sides

* SUBTRACT the squares of the other 2 sides
* Then square root the answer

**9/23 Trigonometry - Learn**

SOH CAH TOA

 O A O

 S H C H T A

EXAMPLES

sin x = 4 cos28o = x tan 28 = 5

 5 5 x

sin x = 0.8 x = 5xcos28o x = 5

 x = sin-1(0.8) x = 4.4 tan 28

 x = 53.1o x = 9.4

**9/24 Trigonometry-know exact values**

450

450

$$\sqrt{2}$$

1

1

600

600

300

300

$$\sqrt{3}$$

1

1

2

2

|  |  |  |  |
| --- | --- | --- | --- |
| **Angle**  | **sin θ0** | **cos θ0** | **tan θ0** |
| **0** | 0 | 1 | 0 |
| **30** |  |  |  or  |
| **45** |  or  |  or  | 1 |
| **60** |  |  |  |
| **90** | 1 | 0 |  |

**9/25 Constructions of bisectors**

* Perpendicular bisector of a line

Draw a straight line through where

the arcs cross above and below.

* Bisector of an angle

Draw a line from where the arcs

cross to the vertex of the angle

**9/26 Construction of perpendiculars**

* Perpendicular **from** a point to a line

Draw arcs on the line from the point P

**P**

* Perpendicular **to** a point on a line

Draw arcs on the line from the point P

**P**

**9/27 Venn Diagrams & Probability**

Universal set $ε$= {1,2,3,4,5,6,7,8}

$$ε$$

A

**B**

2

5

4

3

6

7

1

8

A

B

A

B

A

B

A

B

A = {1, 2, 4, 5}

2$ϵ$A (2 is a member of Set A)

B = {2, 3, 5, 6, 7}

A$∪$B = {1, 2, 3, 4, 5, 5, 6, 7}

(union)

A$∩$B = {2, 5)

(intersection)

**9/28 Tree Diagrams**

* When going along the branches.

 MULTIPLY the probabilities

* If more than one route is wanted,

 ADD the probabilities

Example: The probability that Jane is late = 0.2

**Day 1 Day 2**

 late – 0.2 x 0.2 = 0.04

 0.2

 late

 0.8

 0.2 not – 0.2 x 0.8 = **0.16**

 late

 0.8 late– 0.8 x 0.2 = **0.16**

 0.2

 not

 late 0.8

 not– 0.8x 0.8 = 0.64

 late

**To find the probability of late on only one day:**

day1 & day2 OR day1 & day 2

late not late not late late

**= 0.16 + 0.16**

= **0.32**

**9/29 Sampling**

**A sample** is a subset containing the characteristics of a larger population & should be unbiased.

***The larger the sample size the lower the risk of a non-representative sample***

**Sampling** is a process of selection from a population of interest so that by studying the sample, the results can be extended to the population of interest.

* **Random sample** - each member has an equal chance of being chosen.

e.g. 30 chosen from a hat from a year group.

* **Systematic sample** – each member is selected according to a random starting point and a fixed, periodic interval.

e.g. Year group numbered 1-150. Start at 3 and choose every 10th from there.

* **Stratified sample** – ensure sub-groups are equally represented and not biased.

e.g. for a sample of **30** from 90 boys and 60 girls in a year group, choose $\frac{90}{150}×30=18boys$ randomly.

**9/30 Time Series**

Data collected over a period of **time** is called **time series data** and is used to form a **time series graph.**

Time series graphs make trends easy to spot and can be used to project into the future.

* **Trend** is when, on average, measurements tend to increase (upward trend) or decrease (downward trend) over a period of time.
* **Seasonality** is indicated by a regular repeating pattern of highs and lows e.g. monthly, quarterly etc
* **Cyclic** is indicated by highs and lows but not over fixed periods of time