① Simple Maths

*** Pythagoras Theoram:**

$$H^2 = P^2 + B^2$$

*** Conversions:**

1cm = 10mm

1m = 100 cm

1Km = 1000 m

(Big —x→ Small) Quantity
(Big ←÷— Small)

*** % Increase:**

$$\frac{\text{Increase}}{\text{Actual value}} \times 100$$

*** % Discount:**

$$\frac{\text{Marked price} - \text{Selling price}}{\text{Marked price}} \times 100\%$$

*** Cuboid:**

Surface Area = 2lw + 2lh + 2hw

*** Circle:**

→ Area = πr^2

→ Circumference: $2\pi r$

*** Cylinder:**

→ Area: $2\pi r^2 + 2\pi rh$

→ Volume: $\pi r^2 h$

→ Height: $\frac{V}{\pi r^2}$

*** Interest:**

I = Interest

P = Principal amount

R = Interest rate/yr

T: Time/yr

n = No. of times compounded per yr.

A: Future amount a/ compounded.

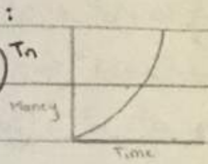
÷ R w/ 100 as its in %.

→ Simple interest:

$$I = PRT$$

→ Compound interest:

$$A = P\left(1 + \frac{R}{n}\right)^{Tn}$$



*** Significant figures:**

→ All non-0 no. are significant.

→ 0 b/w two no. is significant.

→ 0 at the end of decimal no. of a non-0 no. is significant. 1.10 (3s)

→ If a decimal no. starts w/ 0, all 0's b/ non-0 digit are not significant. 0.01 (1s)

→ 0's at the end of a whole no. may / may not be significant. 40005 (5s) 40000 (1s)

② Variations

*** Direct:** (Both ↑ or ↓ together)

$$y = kx$$

A ╲ ╱ C
×
B ╱ ╲ D

*** Inverse:** (If one ↑ then other ↓)

$$y = \frac{k}{x}$$

A — x — C

B — x — D

③ Solution To Quadratic Equations

* Identities:
  - → $(a+b)^2 = a^2 + 2ab + b^2$
  - → $(a-b)^2 = a^2 - 2ab + b^2$
  - → $a^2 - b^2 = (a+b)(a-b)$
* Completing Square:

$x^2 + bx = a \quad (a \neq 0)$

$x^2 + bx + (b/2)^2 = a + (b/2)^2$

$(x + b/2)^2 = a + (b/2)^2$

* $x^2 + bx$:

$x^2 + bx + (b/2)^2$

* Quadratic formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

④ Indices

* Properties:
  - → $a^m \times a^n = a^{m+n}$ → $x^0 = 1$
  - → $a^m \div a^n = a^{m-n}$ → $x^1 = x$
  - → $(a \times b)^n = a^n \times b^n$
  - → $\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$
  - → $(a^m)^n = a^{m \times n}$
  - → $a^{-n} = \frac{1}{a^n}$
* Standerd Form:

$x \cdot y \times 10^n$

left ↔ Right

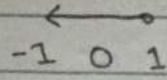
= positive . = negative

⑤ Polygons

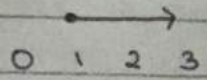
* Simple:
  - → Sum of interior (∧) = $(n-2) \times 180°$
  - → Sum of exterior (∧) = $360°$
* Regular:
  - → An interior (∧) = $\frac{(n-2) \times 180°}{n}$
  - → An exterior (∧) = $\frac{360°}{n}$
  - → Regular n sized polygon has rotational symmetry of order n.

⑥ Inequalities

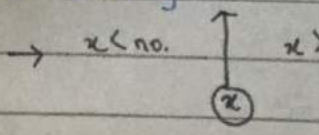
* Linear Inequality:
  - → 1) $a - x < bx < x$ 2)
  - → $x < 1$

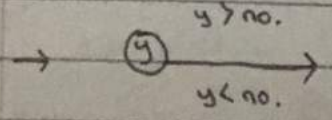


  - → $x \geq 1$



* Shading:





→ $y > mx + c$ / $y < mx + c$

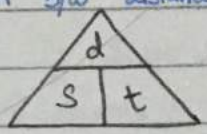
⑦ Bearings

* A from B

→ North line. Clockwise till A.

⑧ Graphs

* Relation b/w distance, speed, time:



* Acceleration:

$\frac{\text{Speed}}{\text{Time Taken}}$ Or $\frac{\text{Change in Speed}}{\text{Time Taken}}$

* Properties:

→ Gradient of speed-time graph = Acceleration

→ Gradient of distance-time graph = Speed

→ Area under speed-time graph = Distance travelled

* Graphical Curves:

→ $y = x$

→ $y = x^2$

→ $y = x^3$

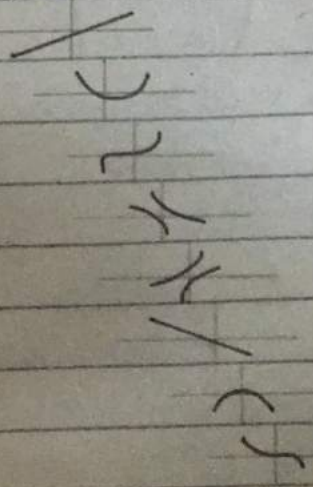
→ $y = \frac{1}{x}$

→ $y = -\frac{1}{x}$

→ $y = -x$

→ $y = -x^2$

→ $y = -x^3$



⑨ Coordinate Geometry

* Distance b/w coordinates:

$$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

* Gradient of line w/ 2 coordinates:

$$\frac{y_2 - y_1}{x_2 - x_1}$$

* Equation of Straight line:

$y = \underset{\text{gradient}}{m}\, x + \underset{\text{y-intercept}}{c}$

* Mid-Point:

$$\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}$$

* Area of non-90° triangle:

$\frac{1}{2}\, ab \sin C$

* Area of coordinates:

$(a,b)\ (c,d)\ (e,f)$

$$\frac{1}{2} \begin{vmatrix} a & c & e & a \\ b & d & f & b \end{vmatrix}$$

$$\frac{1}{2} \left| (ad + cf + eb) - (bc + de + fa) \right|$$

To cut (-ive) from value

⑩ Similar Triangles

* Area:

$$\frac{A_1}{A_2} = \left(\frac{L_1}{L_2}\right)^2$$

* Volume :

$$\frac{V_1}{V_2} = \left(\frac{l_1}{l_2}\right)^3$$

* $\Delta ABC = \Delta XYZ$:

$$\frac{AB}{XY} = \frac{BC}{YZ} = \frac{CA}{ZX}$$

* Properties :

→ AAA: All (∧) are equal.

→ SSS : Ratios of corresponding (∧) are same.

→ SAS: Ratios of two sides & included (∧) is same.

⑪ Congruent Triangles

* Properties :

→ SSS : All sides are equal.

→ SAS : Two sides & included (∧) is same.

→ AAS : Two (∧) & corresponding sides are same.

→ RHS : Hypotenous & a side is same.

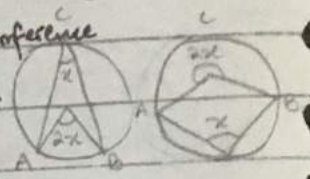
⑫ Circle Properties

→ If a line from center bisects chord, it's perpendicular to chord.

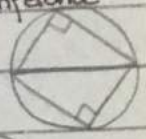
→ If two chords are equal, They are equidistant from center.

AB = CD
$d_1 = d_2$

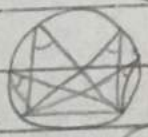
→ (∧) at center by arc = 2x of (∧) at circumference by same arc.



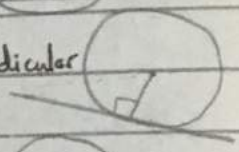
→ (∧) made at circumference by diameter is a 90° (∧).



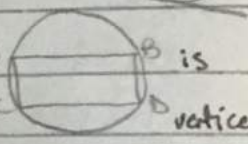
→ (∧) of same segment are equal.



→ Radius is perpendicular to tangent.



→ Cyclic quadliateral is formed if all of its vertices fall on circumference. Opposite (∧) sum upto 180°.



⑬ Matrices

* Formation :

$$\begin{pmatrix} a & x \\ b & y \\ c & z \end{pmatrix} \quad \rightarrow 3 \downarrow 2$$

* Multiplication :

→ x ↓

* Inverse :

$$A^{-1} = \frac{\text{Adjoint}}{\text{Determinant}}$$

→ $A = \begin{pmatrix} a & x \\ b & y \end{pmatrix}$

$A^{-1} = \begin{pmatrix} y & -x \\ -b & a \end{pmatrix}$

→ $(a \times y) - (b \times x)$

(14) Functions

★ Inverse:

$f^{-1}(x) = abc$

Make "y" subject, rest equation same

Make "x" subject now.

Substitute f^{-1} in place of "x" & write x in place of "y".

(15) Mensuration

★ Area of ring:

$\pi(R^2 - r^2)$

★ Area of sector:

$\frac{\theta}{360} \times \pi r^2$

★ Perimeter of sector:

Arc length + 2r

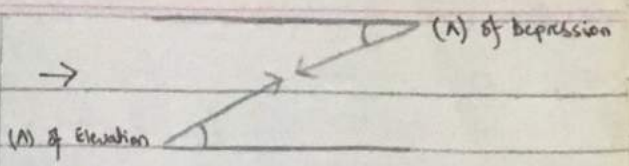
★ Arc length:

$\frac{\theta}{360} \times 2\pi r$

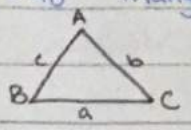
(16) Trignometry

★ 90° Triangles

→ $S\theta = P/H$	→ $\theta = (P/H)\,S^{-1}$
→ $C\theta = B/H$	→ $\theta = (B/H)\,C^{-1}$
→ $T\theta = P/B$	→ $\theta = (P/B)\,T^{-1}$



★ Non-90° Triangle:



→ Sine Rule:

$$\frac{a}{\sin\hat{A}} = \frac{b}{\sin\hat{B}} = \frac{c}{\sin\hat{C}}$$

→ Cosine Rule: (If 3 length or 2 length & included (Δ) given.)

(i) • $a^2 = b^2 + c^2 - 2bc\cos\hat{A}$

• $\cos\hat{A} = \frac{b^2 + c^2 - a^2}{2bc}$

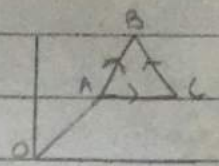
(ii) • $b^2 = a^2 + c^2 - 2ac\cos\hat{B}$

• $\cos\hat{B} = \frac{a^2 + c^2 - b^2}{2ac}$

(iii) • $c^2 = a^2 + b^2 - 2ab\cos\hat{C}$

• $\cos\hat{C} = \frac{a^2 + b^2 - c^2}{2ab}$

(17) Vectors



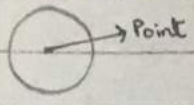
→ $\vec{AB} = \vec{AC} + \vec{CB}$

→ $\vec{AB} = \vec{OB} - \vec{OA}$

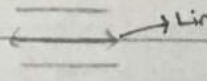
→ $\begin{bmatrix} x \\ y \end{bmatrix} = \sqrt{x^2 + y^2}$

(18) Loci

★ Loci from a Point:



★ Loci from a Line:



(19) Sets

★ Symbols:

→ ξ = Universal set (Limit)
→ $\cup$ = Union
→ $\cap$ = Intersection (Common)
→ $n(x)$ = No. of elements
→ $\emptyset$ = Empty set
→ x' = Compliment (Excluding)
→ $\in$ = An element of...
→ $\notin$ = Not an element of...
→ $\subset$ = Is proper (same) set of...
→ $\not\subset$ = Is not a proper set of...
→ $\subseteq$ = Is a subset of...
→ $\not\subseteq$ = Is not a subset of... (Part of)

(20) Probability

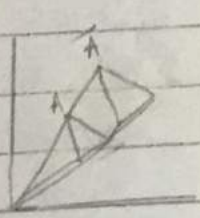
$P(\text{Event}) = \frac{n(E)}{n(S)}$ → No. of results favourable to event.

$n(S)$ → Total no. of possible results of experiment.

(21) Transformation

★ Enlargement:

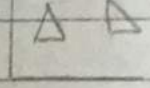
Match points ABC w/ center coordinates. Measure distance & multiply w/ factor. Answer gives length of A'B'C' from center. If factor is -ive then image opposite to object else on object's side.



★ Shear: ×

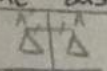
→ Shear factor = $\frac{\text{Distance from A to A'}}{\text{Distance from invariant line}}$

→ Any 2/3 given. Complete for ABC & you get A'B'C' hence match points. Distance from A to A' is on same line. (+ive: →, -ive: ←)



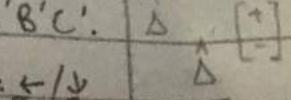
★ Reflection:

Measure distance from invariant line, x-axis or y-axis (whatever asked). Measure distance for ABC & draw A'B'C' w/ same distance on opposite side.



★ Translation:

→ x & y axis given as $\begin{bmatrix} x \\ y \end{bmatrix}$. Move points ABC as directed in [ ]. Answer is A'B'C'.



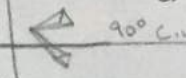
+ive: →/↑, -ive: ←/↓

→ $\begin{bmatrix} + \\ + \end{bmatrix}$: →↑ $\quad \begin{bmatrix} - \\ + \end{bmatrix}$: ←↑

$\begin{bmatrix} + \\ - \end{bmatrix}$: →↓ $\quad \begin{bmatrix} - \\ - \end{bmatrix}$: ←↓

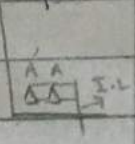
★ Rotation:

Draw a line b/w objects points ABC w/ coordinates (x,y) which is given. Put a protractor on the lines ABC one by one. Move clockwise or anti-clockwise about the angle given. Draw image with same length from coordinates as of object.



★ Stretch:

Draw the invariant line. y-axis: horizontal line, x-axis: vertical line. Measure length from points ABC to invariant line. Multiply with factor & answer gives lengths of A'B'C' from invariant line. If factor -ive then image opposite to object else on object's side.



(22) Statistics

★ Table:

x	a	b	c	= Σfx (ax+by+cz)
f	x	y	z	= Σf (x+y+z)

★ Mean:

$$\frac{\Sigma fx}{\Sigma f}$$

★ Range:

c − a

★ Median:

- Even Σf = $\frac{\Sigma f}{2}$ th value
- Odd Σf = $\frac{\Sigma f+1}{2}$ th value

★ Quartile:

Find median of data, mark as Q_2. Find median on left side of Q_2, mark it Q_1 & median on right side as Q_3.

★ Interquartile Range:

Q_3(75%.) − Q_1(25%.)

(23) Histogram

★ x-axis

→ for class widths without gaps, simply draw it on x-axis

→ For class widths with gaps, first find class boundaries by adding & subtracting upper & lower limits from class width to remove the gaps and then draw class boundaries on x-axis.

★ y-axis:

→ If class intervals on x-axis are of equal lengths, we draw the frequency given, on y-axis.

→ If the class intervals on x-axis are of unequal lengths, we find the frequency density & the draw the f.d on y-axis.

$$\text{Frequency} = \text{density} \times \text{class width}$$

* Probability (A or B) = P(A) + P(B).
* $\sqrt{x} = x^{\frac{1}{2}}$
* Trapizium = $\frac{1}{2}(a+b)h$
* Completing pie chart = $\frac{\text{Frequency}}{\text{Total frequency}} \times 360$ = Any quantity

(24) Number sequence

* For common difference of terms:

Eg: 1, 3, 5, 7 ...
(2, 2, 2)

$$T_n = a + (n-1)d$$

n^{th} term; 1^{st} term : 1; Common difference : 2

* for common difference's difference of terms:

Eg: 3, 12, 27, 48 ...
(9, 15, 21)
(6, 6)

$$T_n = a + (n-1)d + \frac{(n-1)(n-2)c}{2}$$

n^{th} term; 1^{st} term : 3; Common difference's 1^{st} term : 9; Common's common difference : 6

Extras

* $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$
* Acute (∠) : 0°-90°, Obtuse (∠) : 90°-180°, Reflex (∠) : 180°-360°.

① Numbers

* HCF:
→ Common multiple
* Perfect Square/Cube:
→ A square/cube which has square/cube on all values.
* Smallest possible value of n:
→ x^n is a multiple of y^n
→ x^n = Multiple of x.
→ x^n = Multiple of y.
→ n = Prime factors of $\frac{y^x}{x}$ / Prime factors of x
* Trigonometric Ratios:
→ $\cos(180-\theta) = -\cos\theta$
→ $\sin(180-\theta) = \sin\theta$
→ $\tan(180-\theta) = -\tan\theta$

② Coordinate Geometry

* Gradient:
$\frac{y}{x}$ (rise/vertical) / (run/horizontal)
* Equation of two lines:
Equation which is satisfied by point(s) of intersection is formed by equating the equations of graph for which point of intersection was found.
* Perpendicular lines:
Line$_1$ & Line$_2$ are perpendicular when gradient$_1$ × gradient$_2$ = −1.

⑨ Similarity & Congruency

* Triangles sharing common side:
→ $\frac{A_1}{A_2} = \frac{\frac{1}{2} \times b \times h}{\frac{1}{2} \times b \times h}$

⑪ Symmetry

* Rotational Symmetry:
→ Rotate the figure 360°, see how many times it retains its original sequence

⑬ Angle & Circle Properties

* Relation between interior & exterior angle of triangle:
One interior angle + One exterior angle = 180°

⑰ Transformation

* Finding the transformation;
- Isometric:
Objects & images are congruent. Areas lengths & angles are same.
→ Translation: Follow the path $\begin{bmatrix} a \\ b \end{bmatrix}$ from object to image. Occurs when object & image are 100% identical, just apart from each other.
→ Reflection: Occurs when both the object & image are 100% identical but laterally inverted. Middle of object & image is the reflection line.
→ Rotation: Occurs

when object & image is 100% identical but rotated. Join two vertices (same) & draw perpendicular bisector of both. The point where both perpendicular sector meet is the centre of rotation. Now join both vertices with centre & find angle. Also write clockwise or anticlockwise.

- Non-isometric:

Objects & image are similar.

→ Enlargement; For the scale factor simply count the blocks of image & divide them by number of blocks of object. It should be same for all vertices.

(i) Image on same side of object: Join vertices & extend the line. The point where all lines meet is the centre of enlargement.

(iii) Image on opposite side of object: Join vertices, point of intersection is centre of enlargement.

(18) Vectors

* Parallel vector:

→ Parallel vectors are equal in ratio.

(19) Statistics

* Types of data representation graphs:

→ Bar chart.

→ Pie chart.

→ Histogram.

→ Frequency polygon.

→ Scattered diagram.

→ Cumulative frequency curve.

(20) Sets & Venn diagram

* Relation between two sets;

- Equal:

When two sets have exact same elements, order doesn't matter. Eg A = B.

A = {1,2,3}, B = {2,1,3}

- Disjoint:

when two sets have nothing in common. Eg A ∩ B.

A = {1,2,3}, B = {7,8,9}

- Subset:

When elements of a set are possessed by other set too. Eg A ⊆ B. A = {1}, B = {1,2}

- Overlapping:

When two sets have elements in common. Eg A ∩ B. A = {1,2,3}, B = {3,4,5}

(21) Matrices

- Finding inverse:

Determinant of matrix must not be "0" to find its inverse.

- Position vectors:

Matrix of transformation

×

Matrix of position vector of object

=

Matrix of position vector of image

* Histogram:

When comparing histograms, check for the spread and average on the x-axis. Spread also refers to the range.

* Prism:

Vol = Area of cross-section x height

* Similar figures:

- Vol factor = L^3
- Length factor = $\sqrt[3]{V}$ or $\sqrt{A}$
- Area factor = L^2

* Number sequence;

- Linear sequence:

Multiply with common difference & then check its relation with 1st term.

Q: 4, 7, 10, 13 ...

(3, 3, 3)

A: $3n+1$

- Quadration sequence:

$an^2 + bn + c$

→ $2a$ = 2nd difference (constant)

→ $3a+b$ = 2nd term - 1st term

→ $a+b+c$ = 1st term

Q: 3, 10, 21, 36, 55 ...

(7, 11, 15, 19)

(4, 4, 4)

A: $2a = 4$

$\boxed{a = 2}$

$3(2) + b = 7$

$b = 7 - 6$

$\boxed{b = 1}$

$2 + 1 + c = 3$

$3 + c = 3$

$\boxed{c = 0}$

$\therefore 2n^2 + n$

- Cubic sequence:

$an^3 + bn^2 + cn + d$

→ $6a$ = 3rd difference (constant)

→ $12a + 2b$ = First of 2nd difference

→ $7a + 3b + c$ = 2nd term - 1st term

→ $a+b+c+d$ = 1st term

Q: 4, 14, 40, 80, 164 ...

(10, 26, 48, 76)

(16, 22, 28)

(6, 6)

A: $6a = 6$

$\boxed{a = 1}$

$12(1) + 2b = 16$

$b = 16 - 12/2$

$\boxed{b = 2}$

$7(1) + 3(2) + c = 14 - 4$

$c = 10 - (7+6)$

$\boxed{c = -3}$

$1 + 2 + (-3) + d = 4$

$\boxed{d = 4}$

$\therefore n^3 + 2n^2 - 3n + 4$

* Matrix of transformation;

* Standard matrix: $\begin{matrix} x \\ y \end{matrix}\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

- Enlargement:

Centre origin with scale factor k.

$$\begin{bmatrix} k & 0 \\ 0 & k \end{bmatrix}$$

- Rotation:

→ 90° clockwise, centre origin.

$$\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$$

→ 90° anti-clockwise, centre origin.

$$\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$$

- Reflection:

→ x-axis

$(x,y) \Rightarrow (x,-y)$ $\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$

→ y-axis

$(x,y) \Rightarrow (-x,y)$ $\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$

→ $y = x$

$(x,y) \Rightarrow (y,x)$ $\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$

→ $y = -x$

$(x,y) \Rightarrow (-x,-y)$ $\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix}$

* Coordinate representation in matrix form:

a: (a,b) b: (c,d) c: (e,f)

→ M: $\begin{pmatrix} a & c & e \\ b & d & f \end{pmatrix}$

* Gain & loss in price:

When there is a gain, increase 100% 's value & when there's a loss, decrease it.

* LCM of two numbers:

To find lcm, take lcm of two numbers separately & write highest recurring value.