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REAL NUMBERS

1. Real Numbers
1.1 Introduction
1.2 The Fundamental Theorem of Arithmetic
1.3 Revisiting Irrational Numbers
1.4 Summary

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Real Numbers

: The set of numbers containing all rationals and Irrationals is called Real Numbers.

- Denoted by R ($\mathbb{R}$)
- If a number is not rational, it must be irrational and vice versa.
- Any point on the Real Number line represents either a rational or irrational number.

Number Sets

N : Natural numbers $\{1, 2, 3, \ldots\}$

W : Whole numbers $\{0, 1, 2, 3, \ldots\}$

I or Z : $\{-\infty, \ldots -2, -1, 0, 1, 2, \ldots \infty\}$

in $\in$ $x \in N$

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POLYNOMIALS

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Topics

1.) Definition of Polynomial

2.) Degree of Polynomial

3) Types of Polynomials

4.) Value of a Polynomial

5.) Zero of a Polynomial

6.) Graphical meaning of zero of a polynomial

7.) Graphs of Quadratic & Cubic Polynomials

8.) Relation b/w Zeroes & Coefficients of a polynomial
- Linear
- Quadratic
- Cubic* (Not in Syllabus)

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PAIR OF LINEAR EQUATIONS IN TWO VARIABLES

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Linear Equation in One variable

- Equation has a single variable, whose highest power is 1.

- Eg $2x - 6 = 4 \Rightarrow 2x = 10 \Rightarrow x = 5$

  $x = 5$ is the unique solution to the linear Eq^{n} $2x - 6 = 4$

- Represented as a "point" on the number line



Linear Equation in two variables

- An equation in two variables with highest power = 1

  Eg: $x + y = 15$

- ✡ A Linear Eq^{n} in two variables has infinite solutions

- ✡ Graphically a L.E. in two variables is a straight line

x	y	Points
10	5	(10,5)
5	10	(5,10)
0	15	(0,15)
15	0	(15,0)
⋮	⋮	

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QUADRATIC EQUATIONS

1. . To check if given equation is a QE or not
   . Formulate a QE . from a word problem . ☆
2. Find roots of given QE using → factorization (split middle term)
   → The Quadratic formula ☆
3. Nature of roots

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Definition of a QE

- Any equation of the form $p(x) = 0$ where $p(x)$ is a polynomial of degree 2, is called a Quadratic Equation.
- **Standard form of QE:** $ax^2 + bx + c = 0 \; ; \; a \neq 0$

Practice problems

(1) Find roots of $x^2 - 5x + 6 = 0$

$x^2 - 3x - 2x + 6 = 0$

$x(x-3) - 2(x-3) = 0$

$(x-3)(x-2) = 0$

For $x - 3 = 0 \Rightarrow x = 3$

$x - 2 = 0 \Rightarrow x = 2$

Roots = $\{2, 3\}$

Sum $= -5x$

Prod $= +6x^2 <$ $-3x$, $-2x$

Zero product Law

If $a \cdot b = 0$

$\Rightarrow a = 0$ or $b = 0$

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ARITHMETIC PROGRESSION

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Arithmetic Progression (A.P.)

- An A.P. is a progression or series of terms in which each term is obtained by adding **a fixed number** to the preceding term except for the first term.
- The fixed number is called Common Difference denoted by 'd'

NOTE: d can be ← +ve, 0, -ve

Examples
1, 2, 3, 4, ... here d = 1
100, 90, 80, 70, ... here d = -10
7, 7, 7, 7, ... here d = 0

General form of an A.P.

a, a+d, a+2d, a+3d, ...

a → first term

d → Common difference

$$d = a_{k+1} - a_k$$

Finite AP → Has finite terms
Eg: 2, 4, 6, 8, ..., 38

Infinite A.P. → Has infinite terms
Eg: 1, 3, 5, 7, 9, ...

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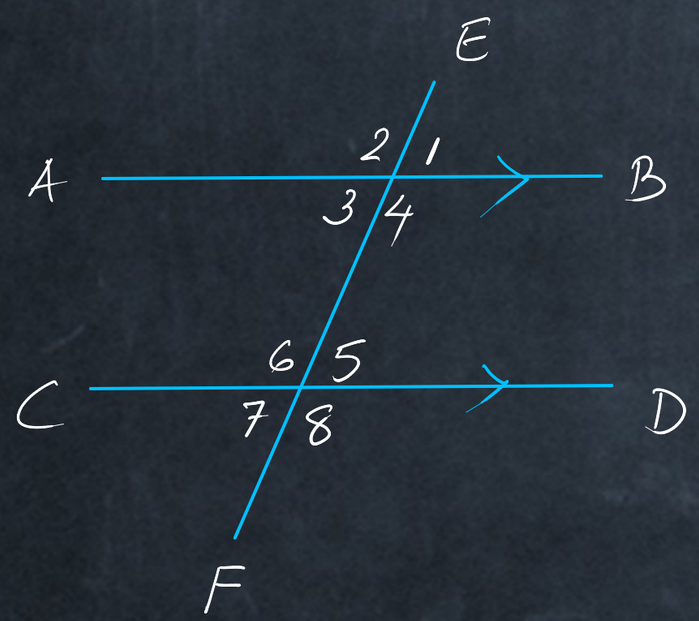
TRIANGLES

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Prerequisites

① Parallel lines & Transversal



Z S N M

(i) Alternate Interior Angles (3,5) , (4,6)

$\angle 3 = \angle 5 \quad \angle 4 = \angle 6$

(ii) Co-Interior Angles (3,6) (4,5)

$\angle 3 + \angle 6 = 180^\circ$

$\angle 4 + \angle 5 = 180^\circ$

(iii) Corresponding Angles (1,5), (4,8), (2,6), (3,7)

$\angle 1 = \angle 5$, $\angle 4 = \angle 8$

$\angle 2 = \angle 6$, $\angle 3 = \angle 7$

(iv) Vertically Opposite $\angle$s (1,3) (2,4) (6,8) (5,7)

$\angle 1 = \angle 3$, $\angle 2 = \angle 4$

$\angle 6 = \angle 8$, $\angle 5 = \angle 7$

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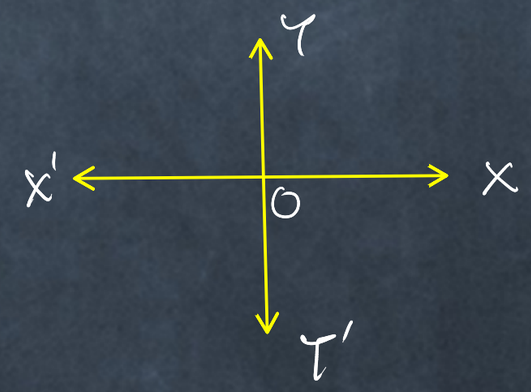
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COORDINATE GEOMETRY

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Coordinate or Cartesian Plane



- The 2D plane defined by the intersection of X & Y axes is known as the Coordinate or Cartesian Plane
- Horizontal Axis → X
  Vertical Axis → Y
- Intersection point of X & Y axes is the Origin O
- Perpendicular distance from a point P(x, y) to
  (i) The Y-axis is its x-Coordinate known as **abscissa**
  (ii) The X-axis is its y-Coordinate known as **Ordinate**
- Coordinates of any point
  (i) on the X-axis is (a, 0) ← Y-Coordinate is Zero
  (ii) on the Y-axis is (0, a) ← X-Coordinate is zero



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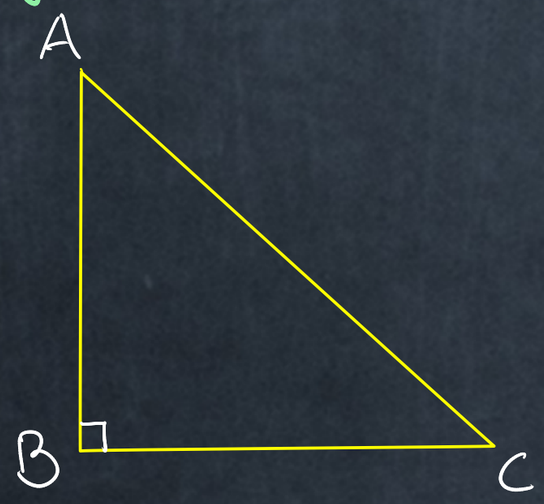
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INTRODUCTION TO TRIGONOMETRY

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Trigonometric Ratios



Hypotenuse → Always opp. to 90° angle.

Opposite → From ∠A, BC is opposite.
From ∠C, AB is opposite.

Adjacent → For ∠C, BC is adjacent.
For ∠A, AB is adjacent.

The 6 trig. ratios

1. Sine → Sin
2. Cosine → Cos
3. tangent → tan

} Main Ratios

4. Cosecant → Cosec
5. Secant → sec
6. Cotangent → Cot

} Reciprocals of Main Ratios

★

$$\tan\theta = \frac{\sin\theta}{\cos\theta}, \quad \operatorname{Cosec}\theta = \frac{1}{\sin\theta} \quad \sec\theta = \frac{1}{\cos\theta} \quad \cot\theta = \frac{1}{\tan\theta}$$

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APPLICATIONS OF TRIGONOMETRY

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POINTS TO REMEMBER

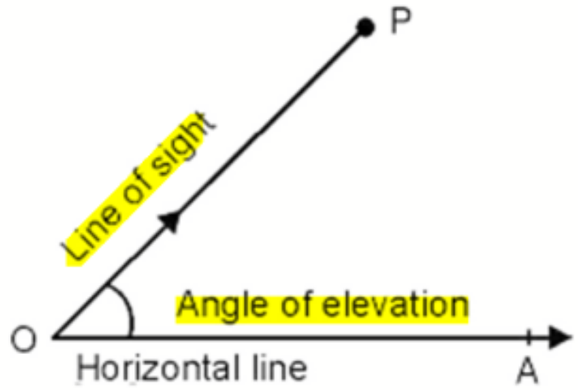
1. **Line of Sight.** When the eye of a person at a point O looks at an object P, then the line OP is called the line of sight.

2. **Angle of Elevation.** Suppose a man from a point O, looks up at an object P, placed above the level of his eye. Then, the angle which the line of sight makes with the horizontal through O, is called the angle of elevation of P as seen from O.

   Let OA be a horizontal line. Let a man at O on the level ground be looking up towards an object P, say an aeroplane or the top of a tower or the flag at the top of a building.

   Then, $\angle AOP$ is the angle of elevation of P as seen from O.

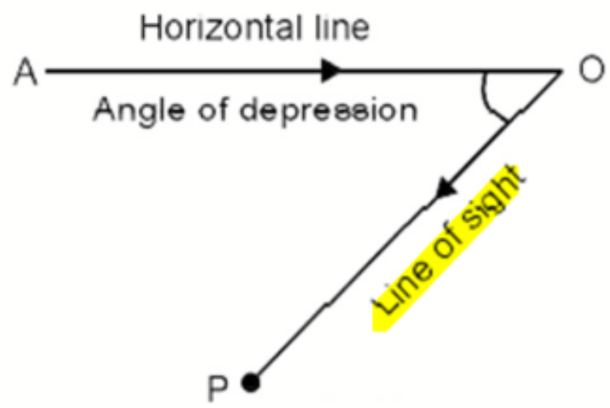
   (see fig.)

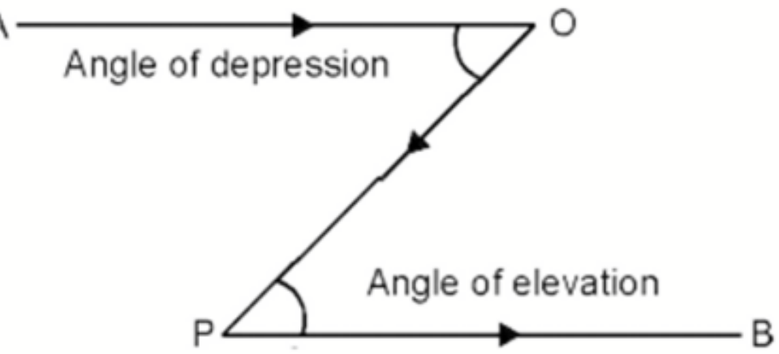


3. **Angle of Depression.** Suppose a man from a point O, looks down at an object P, placed below the level of his eye. Then, the angle which the line of sight makes with the horizontal through O, is called the angle of depression of P as seen from O.

   Let AO be a horizontal line. Let a man at O, on the top of a tower be looking down towards an object P, say a ship in the sea.

   Then, $\angle AOP$ is the angle of depression of P as seen from O.





An Important Remark :

Angle of depression of P as seen from O

= Angle of elevation of O as seen from P.

$\therefore \angle AOP = \angle BPO$ (Alternate angles, as AO $\parallel$ PB)

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CIRCLES

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Terms related to Circles

1. Chord
2. Diameter / Radius
3. Circumference
4. Arc
5. Semi-circle
6. Segment
7. Sector
8. Semi circular region
9. Tangent

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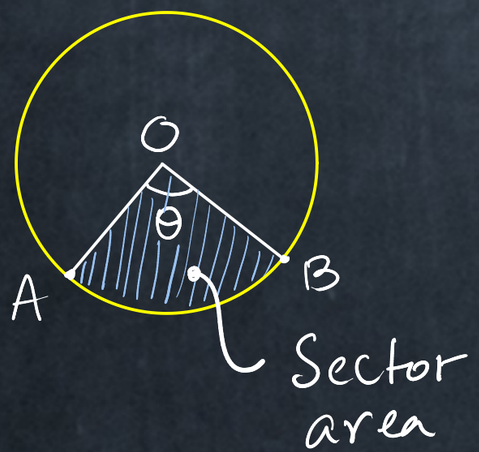
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AREAS RELATED TO CIRCLES

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Area of a Sector

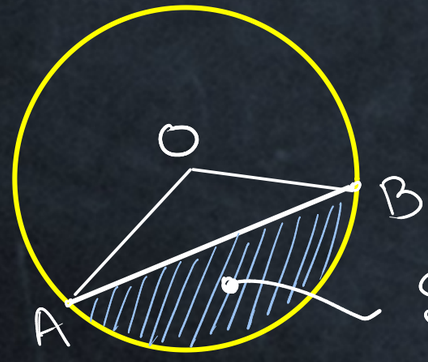


$$\text{Area of sector (minor)} = \frac{\pi r^2 \theta}{360^\circ}$$

$$\text{Area of major sector} = \pi r^2 - \frac{\pi r^2 \theta}{360}$$

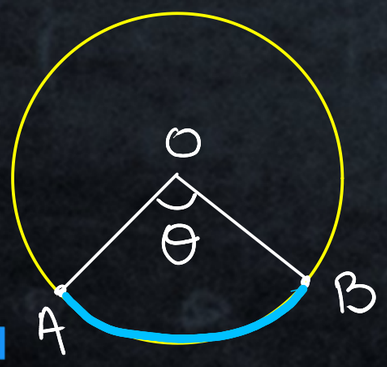
Angle	Area
360°	πr^2
θ	$\frac{\pi r^2}{360}\theta$

Area of Segment



$$\text{Segment area} = \text{Sector area} - \text{area of Included triangle}$$

Arc Length



$$\text{Arc length} = \left(\frac{2\pi r}{360^\circ}\right)\theta$$

Angle	Arc length
360°	$2\pi r$
θ	$\left(\frac{2\pi r}{360^\circ}\right)\theta$

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SURFACE AREAS AND VOLUMES

Ex 12.1 & 12.2

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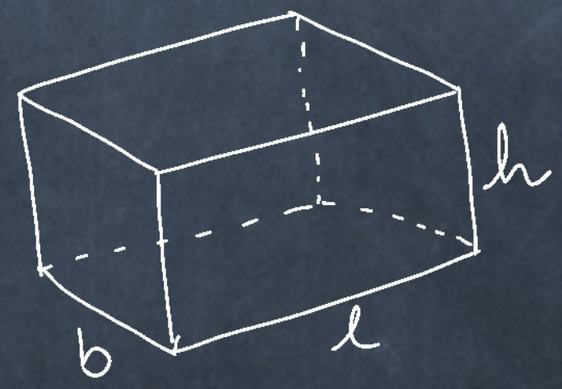
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Cuboid

Lateral Surface Area (LSA) = $2(lh+bh)$

Total Surface Area (TSA) = $2(lb+lh+bh)$

Volume = lbh

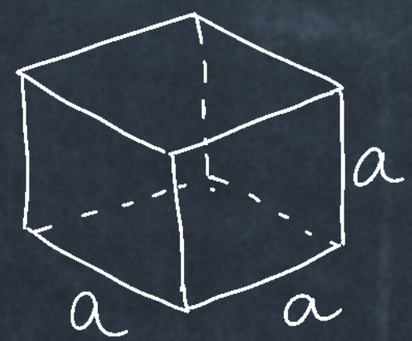


Cube

$LSA = 4a^2$

$TSA = 6a^2$

$Volume = a^3$



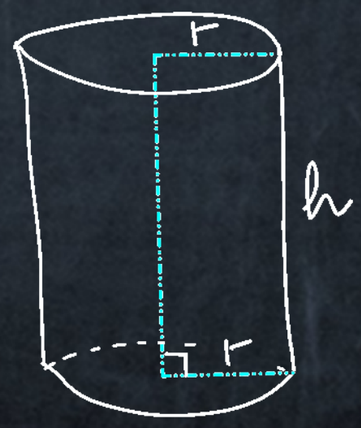
Right Circular Cylinder

Curved Surface Area (CSA) = $2\pi rh$

Total Surface area (TSA) = $\boxed{2\pi rh + 2\pi r^2}$

$= \boxed{2\pi r(h+r)}$

Volume = $\pi r^2 h$



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C.I.	f_i	x_i	$d_i = x_i - a$	$u_i = \frac{d_i}{h}$	$f_i u_i$
15-25	6	20	-30	-3	-18
25-35	11	30	-20	-2	-22
35-45	7	40	-10	-1	-7
45-55	4	50	0	0	0
55-65	4	60	10	1	4
65-75	2	70	20	2	4
75-85	1	80	30	3	3

$\Sigma f_i = 35$ $\quad \Sigma f_i u_i = -36$

c) Step Deviation Method

$$\bar{x} = a + h\left(\frac{\Sigma f_i u_i}{\Sigma f_i}\right)$$

$$\bar{x} = 50 + 10\left(\frac{-36}{35}\right)$$

$$\bar{x} = 39.71$$

Mean % female teachers = 39.71

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Example 3 : The distribution below shows the number of wickets taken by bowlers in one-day cricket matches. Find the mean number of wickets by choosing a suitable method. What does the mean signify?

Number of wickets	20 - 60	60 - 100	100 - 150	150 - 250	250 - 350	350 - 450
Number of bowlers	7	5	16	12	2	3

$h = 20$

$a = 200$

CI.	f_i	x_i	$d_i = x_i - a$	$u_i = \frac{d_i}{h}$	$f_i u_i$
20-60	7	40	-160	-8	-56
60-100	5	80	-120	-6	-30
100-150	16	125	-75	-3.75	-60
150-250	12	200	0	0	0
250-350	2	300	100	5	10
350-450	3	400	200	10	30

$\Sigma f_i = 45$ $\quad$ $\Sigma f_i u_i = -106$

$$\bar{x} = a + h\left(\frac{\Sigma f_i u_i}{\Sigma f_i}\right)$$

$$= 200 + 20\left(\frac{-106}{45}\right)$$

$$\bar{x} = 152.89$$

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13. A die is thrown once. Find the probability of getting

(i) a prime number; (ii) a number lying between 2 and 6; (iii) an odd number.

$S = \{1, 2, 3, 4, 5, 6\}$

(i) $P(\text{prime No.}) = \frac{3}{6} = \frac{1}{2}$

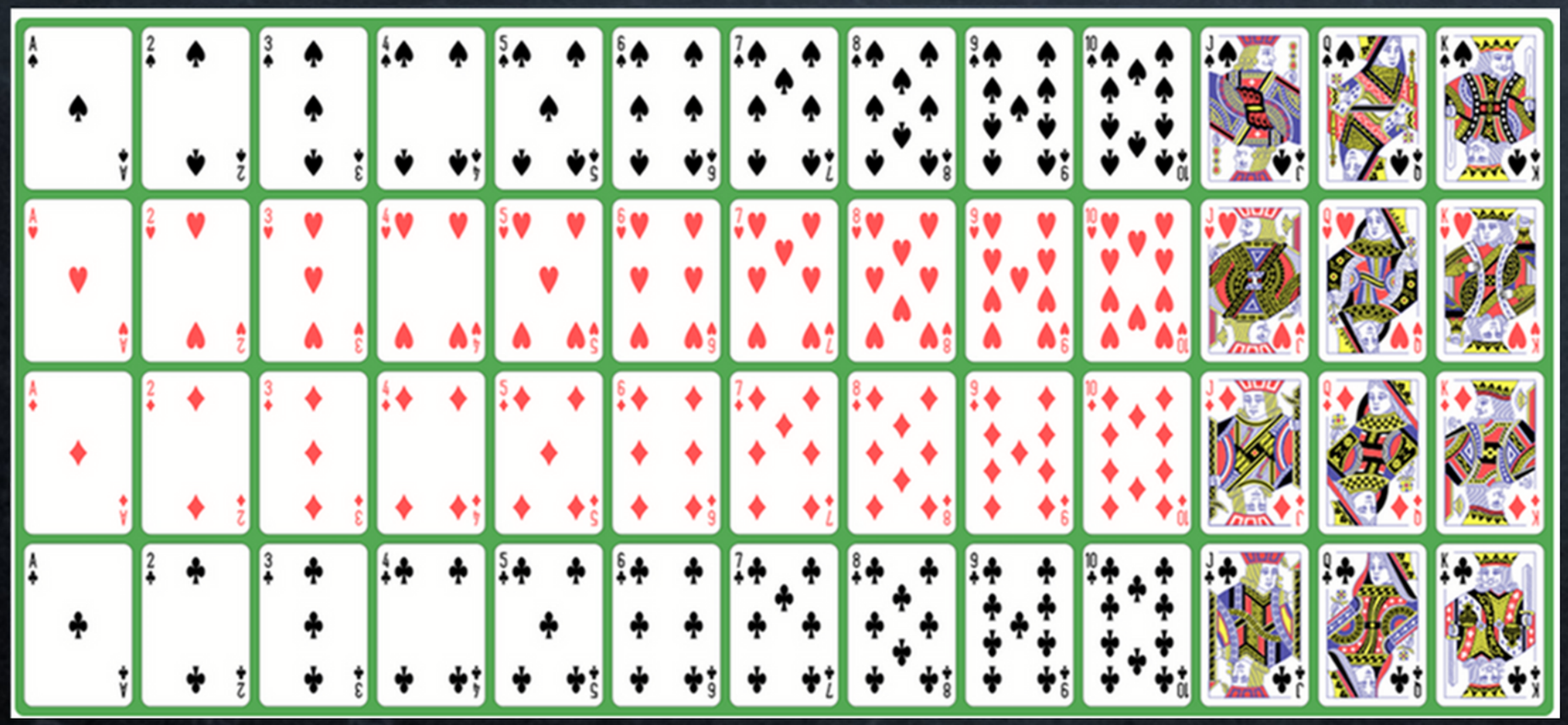
(ii) $P(2\text{-}6) = \frac{3}{6} = \frac{1}{2}$

(iii) $P(\text{odd}) = \frac{3}{6} = \frac{1}{2}$

14. One card is drawn from a well-shuffled deck of 52 cards. Find the probability of getting

(i) a king of red colour (ii) a face card (iii) a red face card

(iv) the jack of hearts (v) a spade (vi) the queen of diamonds



(i) $P(\text{Red k}) = \frac{2}{52} = \frac{1}{26}$

(ii) $P(\text{face}) = \frac{12}{52} = \frac{3}{13}$

(iii) $P(\text{Red face}) = \frac{6}{52} = \frac{3}{26}$

(iv) $P(\text{Jack heart}) = \frac{1}{52}$

(v) $P(\text{spade}) = \frac{13}{52} = \frac{1}{4}$

(vi) $P(\text{Q D}) = \frac{1}{52}$

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15. Five cards—the ten, jack, queen, king and ace of diamonds, are well-shuffled with their face downwards. One card is then picked up at random.

(i) What is the probability that the card is the queen?

(ii) If the queen is drawn and put aside, what is the probability that the second card picked up is (a) an ace? (b) a queen?

$S = \{10, J, Q, K, A\diamondsuit\}$

(i) $P(Q) = \frac{1}{5}$ (ii) a) $P(ace) = \frac{1}{4}$ b) $P(Q) = 0$

16. 12 defective pens are accidentally mixed with 132 good ones. It is not possible to just look at a pen and tell whether or not it is defective. One pen is taken out at random from this lot. Determine the probability that the pen taken out is a good one.

$n(\text{defective}) = 12$

$n(\text{good}) = 132$

$\text{Total} = 144$

$P(\text{good}) = \frac{132}{144} \quad \frac{11}{12} = \boxed{\frac{11}{12}}$

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17. (i) A lot of 20 bulbs contain 4 defective ones. One bulb is drawn at random from the lot. What is the probability that this bulb is defective?

(ii) Suppose the bulb drawn in (i) is not defective and is not replaced. Now one bulb is drawn at random from the rest. What is the probability that this bulb is not defective ?

(i) $n(\text{bulbs}) = 20$

$n(\text{defective}) = 4$ $\qquad$ $n(\text{good}) = 16$

$P(\text{defective}) = \frac{4}{20} = \frac{1}{5}$

(ii) $P(\text{good}) = \frac{15}{19}$

18. A box contains 90 discs which are numbered from 1 to 90. If one disc is drawn at random from the box, find the probability that it bears (i) a two-digit number (ii) a perfect square number (iii) a number divisible by 5.

$S = \{1, 2, 3, \ldots, 90\}$

(i) $P(\text{two digit No}) = \frac{81}{90}\,\frac{9}{10} = \boxed{\frac{9}{10}}$

(ii) $P(\text{Perfect square}) = \frac{9}{90} = \boxed{\frac{1}{10}}$

(iii) $P(\text{divisible by } 5) = \frac{18}{90} = \frac{2}{10} = \boxed{\frac{1}{5}}$

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