Ratio Proportion Indices and Logarithm

Ratio & Proportion

For a :b we have , a → Antecedent b → Consequent

Operations on Ratio

1. Inverse ratio → $\dfrac{a}{b}$ → $\dfrac{b}{a}$

2. Duplicate ratio → $\dfrac{a}{b}$ → $\dfrac{a^2}{b^2}$

3. Triplicate ratio → $\dfrac{a}{b}$ → $\dfrac{a^3}{b^3}$

4. Sub-duplicate ratio → $\dfrac{a}{b}$ → $\dfrac{\sqrt{a}}{\sqrt{b}}$

5. Sub triplicate ratio → $\dfrac{a}{b}$ → $\dfrac{\sqrt[3]{a}}{\sqrt[3]{b}}$

6. Compound ratio → $\dfrac{a}{b} \times \dfrac{c}{d} \times \dfrac{e}{f}$

Proportion

1. Invertendo $\rightarrow \dfrac{a}{b} = \dfrac{c}{d} \rightarrow \dfrac{b}{a} = \dfrac{d}{c}$

2. Alternendo $\rightarrow \dfrac{a}{b} = \dfrac{c}{d} \rightarrow \dfrac{a}{c} = \dfrac{b}{d}$

3. Componendo $\rightarrow \dfrac{a}{b} = \dfrac{c}{d} \rightarrow \dfrac{a+b}{b} = \dfrac{c+b}{d}$

4. Dividendo $\rightarrow \dfrac{a}{b} = \dfrac{c}{d} \rightarrow \dfrac{a-b}{b} = \dfrac{c-b}{d}$

5. Componendo and Dividendo $\rightarrow \dfrac{a}{b} = \dfrac{c}{d} \rightarrow \dfrac{a+b}{a-b} = \dfrac{c+b}{c-d}$

6. Adendo $\rightarrow \dfrac{a}{b} = \dfrac{c}{d} = \dfrac{e}{f} \rightarrow \dfrac{a+c+e}{b+d+f}$

7. Subtrahendo $\rightarrow \dfrac{a}{b} = \dfrac{c}{d} = \dfrac{e}{f} \rightarrow \dfrac{a-c-e}{b-d-f}$

Indices

- $a^m \times a^n = a^{m+n}$

- $(a^m)^n = a^{mn}$

- $a^0 = 1$

- $a^{-m} = \dfrac{1}{a^m}$

- $a^m = \dfrac{1}{a^{-m}}$

- $a^{\frac{m}{n}} = \sqrt[n]{a^m}$

Logarithms

Property

1. $\log_a m = n \rightarrow a^n = m$

2. $\log_a m + \log_a n = \log_a mn$

3. $\log_a m - \log_a n = \log_a \frac{m}{n}$

4. $\log_a (m)^n = n . \log_a m$

5. $\log_a 1 = 0$

6. $\log_a a = 1$

7. $\log_a b = \frac{\log_x b}{\log_x a} \rightarrow$ change of base

* Base by default is taken as 10 which is also called as common logarithm

If a/3 = b/4= c/7, then a + b + c/c is

A 1

B 3

C 2

D None of these

Anand earns Rs 80 in 7 hours and Promode Rs 90 in 12 hours. The ratio of their earnings is

Q 16, Ex 1(A) (ICAI)

A 32 : 21

B 23 : 12

C 8 : 9

D None of these

P, Q and R are three cities. The ratio of average temperature between P and Q is 11 : 12 and that between P and R is 9 : 8. The ratio between the average temperature of Q and R is

A 22 : 27

B 27 : 22

C 32 : 33

D None of these

Two numbers are in the ratio 3 : 4, if 6 be added to each number of the ratio, then the new ratio will be 4 : 5, then the numbers are

Q 27, Exercise 1(B), (ICAI)

A 14, 20

B 17, 19

C 18 and 24

D None of these

$$\left[\left\{(2)^{1/2}\cdot(4)^{3/4}\cdot(8)^{5/6}\cdot(16)^{7/8}\cdot(32)^{9/10}\right\}^4\right]^{3/25} \text{ is}$$

Q 20, Exercise 1(C), (ICAI)

A A fraction

B an integer

C 1

D None of these

$[1 - \{1 - (1 - x^2)^{-1}\}^{-1}]^{-1/2}$ is equal to

A x

B 1/x

C 1

D None of these

If $x^{1/p} = y^{1/q} = z^{1/r}$ and $xyz = 1$, then the value of $p + q + r$ is

A 1

Q 13, Exercise 1(C), (ICAI)

B 0

C 1/2

D None of these

If $\log_3 4 \cdot \log_4 5 \cdot \log_5 6 \cdot \log_6 7 \cdot \log_7 8 \cdot \log_8 9 = x$, then find the value of x

A 4

B 2

C 3

D 1

Given that $\log_{10} 2 = x$, $\log_{10} 3 = y$, then $\log_{10} 1.2$ is expressed in terms of x and y as

A $x + 2y - 1$ **Q 18, Exercise 1(D), (ICAI)**

B $x + y - 1$

C $2x + y - 1$

D   None of these

If $a^x = b, b^y = c, c^z = a$, then xyz is

A 1

B 2

C 3

D None of these

If $\log_4(x^2 + x) - \log_4(x + 1) = 2$ then the value of x is

A 2

B 3

C 16

D 8

If $\dfrac{9^n \times 3^5 \times 27^5}{3 \times 81^4} = 27$, then the value of n is

A   2

B   0

C   3

D   4

The value of $[\log_{10}(5\log_{10}100)^2]$ is

June 2023

A 1

B 2

C 10

D 25

The ratio of the prices of two Fans was 16: 23. Two years later when the price of the first has increased by 10% and that of the second by ₹ 477, the ratio of the prices becomes 11: 20. Find the original prices of the two Fans.   **MTP Series 2 (JAN 2025)**

A ₹848, ₹ 1,219

B ₹ 838, ₹ 1,119

C ₹ 828, ₹ 1,219

D ₹ 848 ₹ 1,229

If a: b = 3: 4, the value of (2a+3b): (3a+4b) is

MTP Series 2 (JAN 2025)

A 54: 25

B 8: 25

C 17: 24

D 18: 25

The third proportional to 49 and 21

A 6

B 9

C 12

D 28

Given that $\log_{10} 2 = x$ and $\log_{10} 3 = y$, the value of $\log_{10} 60$ is expressed as

A $x - y + 1$

B $x + y + 1$

C $x - y - 1$

D   None of these

What should be added to $4x^2 + 4x$, so that it becomes perfect square?

$+1$

A 4

B 2

C 1

D 1/2

$$4x^2 + 4x + 1 = (2x+1)^2$$

$$(2x)^2 + 2(2x)1 + 1^2$$

$$a^2 + 2ab + b^2$$

The sum of two numbers is 62 and their product is 960. The sum of their reciprocals is

MTP Series 2 (JAN 2025)

$y + x = x + y = 62$

$xy = 960$

$\dfrac{1}{x} + \dfrac{1}{y} = \dfrac{y+x}{xy} = \dfrac{62}{960} = \dfrac{31}{480}$

$= \dfrac{31}{480}$

A 31/480

B 29/480

C 61/960

D 41/960

Three persons Mr. Roy, Mr. Paul and Mr. Singh together have ₹ 51. Mr. Paul has ₹ 4 less than Mr. Roy and Mr. Singh has got ₹ 5 less than Mr. Roy. They have the money as.

MTP Series 2 (JAN 2025)

A ₹ 20, ₹ 16, ₹ 15

B ₹ 15, ₹ 20, ₹ 16

C ₹ 25, ₹ 11, ₹ 15

D None of these

$$Roy = x \longrightarrow 20$$

$$Paul = x - 4 = 20 - 4 = 16$$

$$Sing = x - 5 = 20 - 5 = 15$$

$$x + x - 4 + x - 5 = 51$$

$$3x - 9 = 51$$

$$\Rightarrow 3x = 51 + 9$$

$$\Rightarrow x = \frac{60}{3} = 20.$$

Mathematics of Finance

- **Simple interest**: It is the interest computed on the principal for the entire period of borrowing.

I = Pit

$$SI = \frac{P \times r \times t}{100}$$

$$A = P + SI = P\left(1 + \frac{rt}{100}\right)$$

A = P + I

I = A – P

Here, A = Accumulated amount (final value of an investment)

P = Principal (initial value of an investment)

i = Annual interest rate in decimal.

I = Amount of Interest

t = Time in years

- **Compound interest:** as the interest that accrues when earnings for each specified period of time added to the principal thus increasing the principal base on which subsequent interest is computed.

  Formula for compound interest:

  $A_n = P (1 + i)^n$

  $C.I. = A_n - P = P (1 + i)^n - P$

  where, P = Principal i = Annual rate of interest

  n = Number of total conversion period i.e. t x no. of conversions per year

$$A = P (1 + i)^n$$

$$i = \frac{r}{100 \cdot c} \qquad n = t \times c$$

$$CI = A - P = P ((1+i)^n - 1)$$

$$\text{Yrly} \rightarrow c = 1$$

$$\text{Half} \rightarrow c = 2$$

$$\text{Quarterly} \rightarrow c = 4$$

$$\text{Monthly} \rightarrow c = 12$$

- **Effective Rate of Interest:** The effective interest rate can be computed directly by following formula:

$$E = ((1 + i)^n - 1)*100$$

$$R = \frac{Int}{P} \times 100$$

- Future value of a single cash flow can be computed by above formula. Replace A by future value (F) and P by single cash flow (C.F.) therefore

$$F = C.F (1 + i)^n$$

$$PV = \frac{A_n}{(1+i)^n}$$

$$1 \text{yr} \, \frac{8}{12} \, \text{yr} = 1 + 0.667 = 1.667 \text{yr}$$

A sum of ₹46,875 was lent out at simple interest and at the end of 1 year 8 months the total amount was ₹50,000. Find the rate of interest percent per annum.

MTP Series 2 (JAN 2025)

$$A = P \left(1 + \frac{r \times t}{100} \right)$$

A 5%

B 6%

$$\Rightarrow 50,000 = 46,875 \left(1 + \frac{r \times 1.667}{100} \right)$$

C 4%

D 8%

$$\Rightarrow r = 4\%.$$

A = ₹ 5,200, R = 5% p.a., T = 6 years, P will be

SI

CI

A ₹2,000

B ₹ 3,880

C ₹ 3,000

D None of these

$$5200 = P\left(1 + \frac{5 \times 6}{100}\right)$$

$$P = \frac{5200}{1.3} = 4000$$

$$5200 = P\left(1 + \frac{5}{100}\right)^6$$

$$P = \frac{5200}{1.34} = 3880$$

QUESTION 24

The time by which a sum of money would treble itself at 8% p. a C. I is

→ triple

A   14.28 years

B   14 years

C   12 years

D   None of these

$$A = 3P$$

$$\Rightarrow P\left(1 + \frac{8}{100}\right)^t = 3P$$

$$\Rightarrow (1.08)^t = 3$$

$$\Rightarrow t = \frac{\log 3}{\log 1.08} = \frac{0.4771}{0.0334} = 14.28$$

The annual birth and death rates per 1,000 are 39.4 and 19.4 respectively. The number of years in which the population will be doubled assuming there is no immigration or emigration is

A. 35 years.

B. 30 years.

C. 25 years

D. none of these

$$extra = 20$$

$$yrly$$

$$\underset{P}{1000} \longrightarrow \underset{20}{I}$$

$$rate = \frac{I}{P} \times 100 = \frac{20}{1000} \times 100 = 2\%$$

$$P \xrightarrow[2\%, t]{} 2P$$

$$2P = P\left(1 + \frac{2}{100}\right)^t$$

$$\Rightarrow \quad 2 = (1.02)^t$$

$$t+1 = 36 \Rightarrow t = 35\,yr$$

$$t+1 = 36$$
$$1.02 \times == =$$
$$I$$
$$2 \approx 1.999$$

An amount is lent at R% simple interest for R years and the simple interest amount was one fourth of the principal amount. Then R is.......

[Dec. 2021]

A 5

B 6

C 5.5

D 61.5

$$SI = \frac{1}{4} P$$

$$\Rightarrow \frac{P \times R \times R}{100} = \frac{1}{4} P$$

$$\Rightarrow R^2 = \frac{100}{4} = 25$$

$$\Rightarrow R^2 = 25$$

$$\Rightarrow R = \sqrt{25} = 5$$

The present value of ₹ 10,000 due in 2 years at 5% p.a. compound interest when the interest is paid on half-yearly basis is

A ₹ 9,070

B ₹ 9,069

C ₹ 9,060

D None

$c = 2$

PV

$\xrightarrow[2yr]{c=2, \ 5\%} \ 1000$

$$PV = \frac{1000}{(1+i)^n}$$

$$= \frac{1000}{(1+0.025)^4} = 9059.5$$

$n = 2 \times 2 = 4$

$$i = \frac{5}{100 \times 2} = 0.025$$

The effective rate of interest corresponding to a nominal rate 3% p.a payable half yearly is

A 3.2% p.a

B 3.25% p.a

C 3.0225% p.a

D None of these

$$ERI = \left\{ \left(1 + \frac{r}{100 \times c}\right)^c - 1 \right\} \times 100$$

$$= \left[\left(1 + \frac{3}{100 \times 2}\right)^2 - 1 \right] \times 100$$

$$= 3.0225\%$$

The future value of an annuity of ₹1500 made annually for 5 years at an interest rate of 10% compounded annually is [Given that $(1.1)^5 = 1.61051$]

[**June 2024 MTP.1**]

A 9517.56

B 9157.65

C 9715.56

D 9175.65

$A = 1500, t = 5yr, r = 10\%.$

$$FV = A\left[\frac{(1+i)^n - 1}{i}\right]$$

$$= 1500\left[\frac{(1+0.1)^5 - 1}{0.1}\right]$$

$$= 1500\left[\frac{1.61051 - 1}{0.1}\right]$$

$$= 9157.65$$

$i = \dfrac{10}{100 \times 1} = 0.1$

$n = 5 \times 1 = 5$

The present value of annuity of ₹ 5,000 per annum for 12 years at 4% p.a C.I. annually is

A   ₹ 46,000

B   ₹ 46,850

C   ₹ 15,000

D   ₹ 46,925.40

Q 12, Exercise 4(C), (ICAI)

$$PV = A\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right]$$

$$= 5000\left[\frac{(1+0.04)^{12} - 1}{0.04(1.04)^{12}}\right]$$

$$= 46925.40$$

$$i = \frac{4}{100 \times 1} = 0.04$$

$$n = 12 \times 1 = 12$$
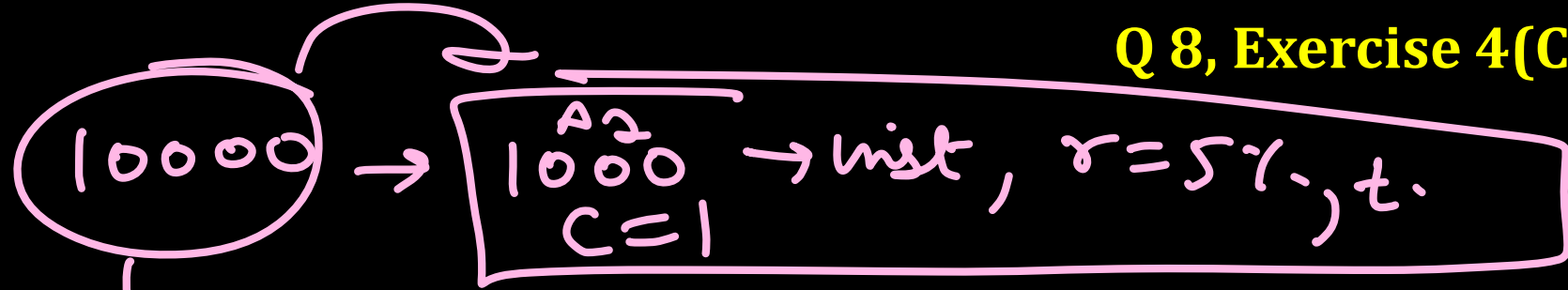
A company borrows ₹ 10,000 on condition to repay it with compound interest at 5% p.a by annual installments of ₹ 1000 each. The number of years by which the debt will be clear is

Q 8, Exercise 4(C), (ICAI)

A 14.2 years

B 10 years

C 12 years

D None of these

$10000 \rightarrow$ $\boxed{1000 \rightarrow \text{Inst}, \ r = 5\%, \ t.}$ A, C=1

$PV \ of \ AR = A\left[\dfrac{(1+i)^n - 1}{i(1+i)^n}\right]$

$i = \dfrac{5}{100 \times 1} = 0.05$

$n = t \times 1 = t$

$\Rightarrow 10000 = 1000\left[\dfrac{(1.05)^t - 1}{0.05(1.05)^t}\right]$

$\Rightarrow 0.5(1.05)^t = (1.05)^t - 1$

$\Rightarrow (1.05)^t = 2$

$$\Rightarrow \quad t = \frac{\log 2}{\log 1.05} = 14.2 \text{ yr}$$

$$PVA_{\infty} = \frac{A}{i} \quad \overset{Perp}{\longleftarrow}$$

$$PVA_{\infty} = \frac{A}{i-g}$$

Assuming that the discount rate is 10% per annum, how much would you pay to receive Rs. 800, growing at 8%, annually, forever?

A   Rs. 40000

B   Rs. 40500

C   Rs. 39500

D   None of these

$$A = 800$$

$$i = \frac{10}{100 \times 1} = 0.1$$

$$g = \frac{8}{100 \times 1} = 0.08$$

$$PVA_\infty = \frac{A}{i-g}$$

$$= \frac{800}{0.1 - 0.08}$$

$$= \frac{800}{0.02}$$

$$= 40,000$$

A sinking fund is created redeeming debentures worth Rs. 5,00,000 at the end of 25 years. How much provision need to be made out of profits each year provided sinking fund investments can earn at 4% per annum **[June 2024 MTP 2]**
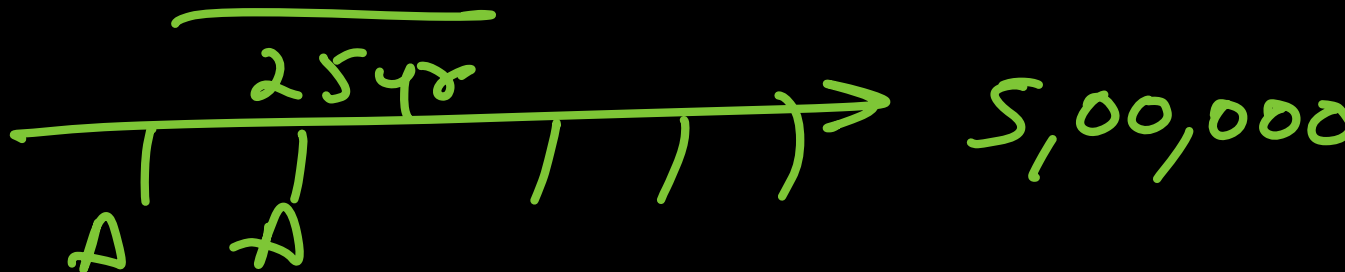
A 12,006

B 12,040

C 12039

D 12035

$$i = \frac{4}{100 \times 1} = 0.04$$

$$n = 25 \times 1 = 25$$

$$\xrightarrow{\text{25 yr}} \quad 5,00,000$$

$$\frac{A\left((1+0.04)^{25} - 1\right)}{0.04} = 5,00,000$$

$$\Rightarrow A \times 41.646 = 5,00,000$$

$$= \frac{1}{41.646} \times 5,00,000$$

$$A = 12,006$$

If the nominal rate of growth is 17% and inflation is 9% for the five years. Let P be the Gross domestic Product (GDP) amount at the present year then the projected real GDP after 6 years is

A 1.587 P

B 1.921 P

C 1.403 P

D 2.51 P

$$\text{real rate} = 17\% - 9\% = 8\%.$$

$$P \xrightarrow[6\, yr, CI]{8\%} A$$

$$A = P\left(1 + \frac{8}{100}\right)^6$$

$$= P(1.08)^6$$

$$A = 1.5868 P$$

A machine with useful life of 7 years costs ₹ 10,000 while another machine with useful life of 5 years costs ₹8000. The first machine saves labour expenses of ₹ 1900 annually and the second one saves labour expenses of ₹2200 annually. Determine the preferred course of action. Assume cost of borrowing as 10% → r compounded per annum.

[June 2023 MTP.1]

A 1st Machine should be purchased

B 2nd Machine should be purchased

C Information is not sufficient

D None of these

M_1 M_2

$$PV$$
$$10000$$
$$8,000$$

$7yr$ $A_1 = 1900$
$5yr$ $A_2 = 2200$

$$M_1 \rightarrow PV = 1900 \left(\frac{(1+0.1)^7 - 1}{0.1 \times (1.1)^7} \right)$$

$$= 9000$$

$r = 10\%$ $n = 7 \times 1 = 7$

$i = \dfrac{10}{100 \times 1} = 0.1$

$$u_2 \rightarrow 8000 \qquad PV = 2200 \left(\frac{(1+0.1)^5 - 1}{0.1 \times (1.1)^5} \right)$$

$$= \boxed{8339.}$$

QUESTION 36

Mr. X makes a deposit of ₹ 50,000 in the bank for a period of 2 and 1/2 years. If the rate of interest is 12% per annum compounded half yearly, then the maturity value of the money deposited by Mr. X is:

[Where $(1.06)^5 = 1.3382$]

[Dec. 2023]

A. ₹66,910

B. ₹66,123

C. ₹67,925

D. ₹65,550

$r = 12\%, c = 2$

$50000 \longrightarrow A$

$t = 2.5 \, yr$

$n = 2.5 \times 2 = 5$

$i\% = \dfrac{12}{2} = 6\%$

$A = 50000 + 6\% + 6\% + - - - = 66911$

$\underbrace{}_{5}$

QUESTION 37

A car is available for ₹4,98,200 cash payment or ₹60,000 cash down payment followed by three equal annual instalments. If the rate of interest charged is 14 % per annum compounded yearly, then total interest charged in the instalment plan is Given P(3, 0.14) = 2.32163

[June 2023]

A 146314

B 146137

C 128040

D 158040

$4,98,200$

$r = 14\%$

$\dfrac{C = 14}{100 \times 1} = 0.1$

$n = 3$

$60,000 \rightarrow$ Remaining Loan

$= 4,98,200 - 60,000$

$= 4,38,200$

$PV = 4,38,200$

$\dfrac{A\left((1+0.14)^3 - 1\right)}{0.14 \times (1.14)^3} = 4,38,200$

$$A = 1,88,746.5$$

Total Amount $3A + 6000 = 6,26,240$

$$- 4,98,200$$
$$\overline{1,28,040}$$

$n = 20 \times L = 20$

The present value of an annuity of ₹ 80 for 20 years at 5% p.a is

$i = \dfrac{5}{100 \times 1} = 0.05$

[Given $(1.05)^{20} = 2.6533$]

MTP Series 2 (JAN 2025)

A ₹ 997 (appx.)

B ₹ 900

C ₹ 1,000

D None of these

$PV = 80 \left[\dfrac{(1+0.05)^{20} - 1}{(0.05)(1.05)^{20}} \right]$

$= 997$

$$i = \frac{5}{100 \times 1} = 0.05, \quad n = 25 \times 1 = 25$$

A person bought a house paying ₹ 20,000 cash down and ₹ 4,000 at the end of each year for 25 yrs. at 5% p.a. C.I. The cash down price is [Given $(1.05)^{25} = 3.386355$]

MTP Series 2 (JAN 2025)

A ₹ 75,000

B ₹ 76,000

C ₹ 76,375.80

D None of these.

$$\text{Cash down} = 20000 + PV \text{ of } (4000 \rightarrow Am)$$

$$= 20000 + 4000 \left[\frac{(1+0.05)^{25} - 1}{0.05 (1.05)^{25}} \right]$$

$$= 76375.77$$

QUESTION 40

A man purchased a house valued at ₹3,00,000. He paid ₹2,00,000 at the time of purchase and agreed to pay the balance with interest at 12% per annum compounded half yearly in 20 equal half yearly instalments. If the first instalment is paid after six months from the date of purchase then the amount of each instalment is.

A ₹ 8,718.45

B ₹ 8,769.21

C ₹ 7,893.13

D None of these

$3,00,000$

$- 2,00,000$

$PV = 1,00,000$

$n = 20$

$r = 12\%$

$i = \dfrac{12}{100 \times 2} = 0.06$

$1,00,000 = A\left(\dfrac{(1+0.06)^{20}-1}{0.06 \times (1.06)^{20}}\right)$

$\Rightarrow A = 8718$

$$i = \frac{10}{100 \times 1} = 0.1$$

A person desires to create a fund to be invested at 10% CI per annum to provide for a prize of ₹ 300 every year. Using V = a/I find V and V will be   **MTP Series 2 (JAN 2025)**

$$V = \frac{A}{i} = \frac{300}{0.1} = 3000$$

(A) ₹ 2,000

(B) ₹ 2,500

(C) ₹ 3,000

(D) None of these.

A person invests ₹500 at the end of each year with a bank which pays interest at 10% p.a C.I. annually. The amount standing to his credit one year after he has made his yearly investment for the 12th time is.[Given $(1.1)^{12} = 3.1384$] **MTP Series 2 (JAN 2025)**

A ₹ 11,761.36

B ₹ 10,000

C ₹ 12,000

D None of these

AR

$A = 500$
$r = 10\% \rightarrow i = \dfrac{10}{100 \times 1} = 0.1$, $n = 12$

$FV \text{ of } AR \times (1+i) = 500 \left(\dfrac{(1+0.1)^{12} - 1}{0.1} \right) \times (1+0.1)$

$= 11761.36$

A machine depreciates at 10% of its value at the beginning of a year. The cost and scrap value realized at the time of sale being ₹ 23,240 and ₹ 9,000 respectively. For how many years the machine was put to use?

MTP Series 2 (JAN 2025)

A 7 years

B 8 years

C 9 years

D 10 years

WPV

$$CI, -10\%$$

$$23,240 \longrightarrow 9,000$$

$$9000 = 23,240 \left(1 + \frac{(-10)}{100}\right)^t$$

$$\Rightarrow 0.3873 = (0.9)^t$$

$$t+1 \approx 10 \rightarrow t = 10-1 = 9$$

$$0.9 \, x = = = = \text{--} \text{--} \longrightarrow 0.3873$$

The compound interest on half-yearly rests on ₹ 10,000 the rate for the first and second years being 6% and for the third year 9% p.a. is

A. ₹2,200

B. ₹ 2,287

C. ₹ 2,285

D. ₹2290.84

half yrly   3rd

$A = 10000 + 3\% + 3\% + 3\% + 3\% + 4.5\% + 4.5\%$

$= 12290.83$

$CI = A - P = 12290.83 - 10000$

$= ₹ 2290.83$

Number Series , Coding Decoding and Odd Man Out

4,9,25,49,?,169,289,361

$2^2, 3^2, 5^2, 7^2, 11^2, 13^2, 17^2, 19^2$

Q17, Exercise 9(A), (ICAI)

A 120

B 121

C 122

D 164

1,1,4,8,9,?,16,64

A 27

B 28

C 32

D 40
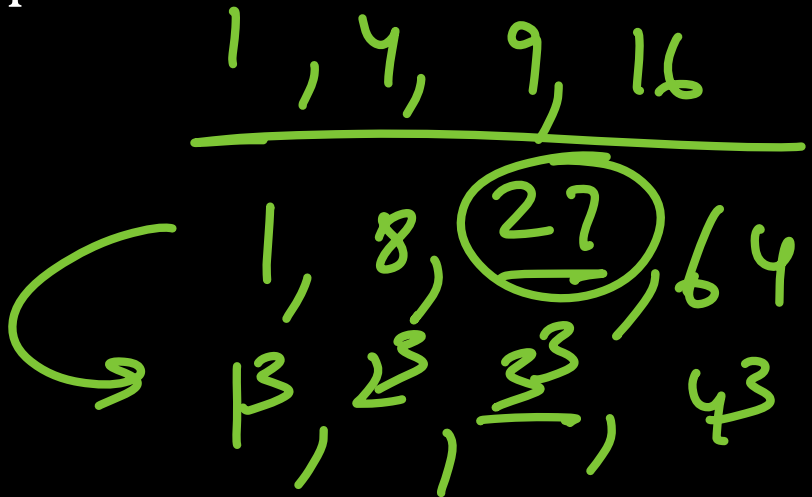
$$1, 4, 9, 16$$

$$1, 8, \boxed{27}, 64$$

$$1^3, 2^3, 3^3, 4^3$$

48 ⊃ ×4

48,24,96,? 192

×½ ×4 ½×

A 48

B 47

C 44

D 54

5760,960,192,?16,8

48

6 5 4 3 2
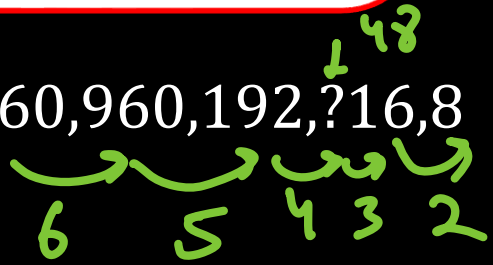
Q20, Exercise 9(A), (ICAI)

A 47

B 48

C 52

D 50

Find missing term 7, 26, 63, 124, 215, 342? 511

$\rightarrow$ 8-1, 27-1, 64-1, 125-1, 216-1, 343-1, 512-1

$\Rightarrow 2^3$-1, 3^3-1, 4^3-1, 5^3-1, 6^3-1, 7^3-1, 8^3-1

A 391

B 421

C 481

D 511

8,28,116,584,?

A 1752

B 3502

C 3504

D 3508

$8 \times 3 + 4 = 28$

$28 \times 4 + 4 = 116$

$116 \times 5 + 4 = 584$
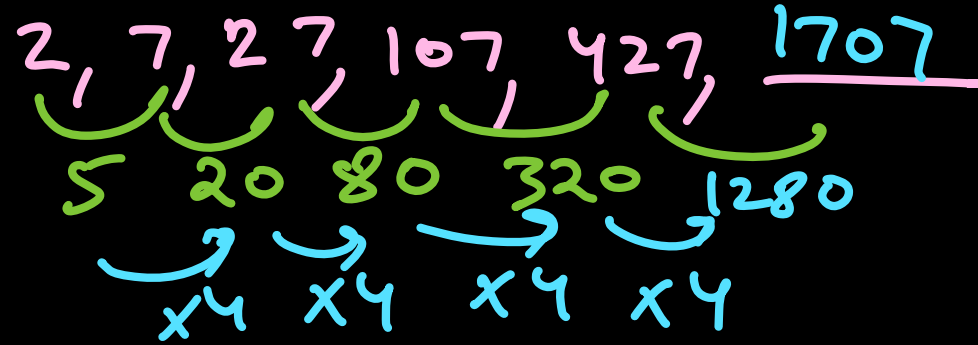
$584 \times 6 + 4 = \underline{3508}$

2,7,27,107,427, ?

A 1707

B 4027

C 4207

D 1207

2, 7, 27, 107, 427, 1707

5   20   80   320   1280

×4   ×4   ×4   ×4

If GARDEN is coded as 325764 and WATER as 92165, how can we code the word WARDEN in the same way?

A 925764

B 295764

C 952764

D 957264

GARDEN
325764

WATER
92165

WARDEN
925764

If F = 6 , MAT = 34 , then how much is CAR?

A. 21

B. 22

C. 25

D. 28

F – 6

$$\begin{vmatrix} MAT \\ 13 + 1 + 20 = 34 \end{vmatrix}$$

CAR
↓ ↓ ↓
3 + 1 + 18 = 22

DML | PT | X
4 8 12 | 16 20 | 24

Find the odd man out of the following data?

190,145,136,352,460,324,631,244

$1+9+0$ $1+4+5$ $1+3+6$ $3+5+2$ $4+6+0$

A   460

$3+2+4 \rightarrow 9$

$6+3+1 \rightarrow 10$
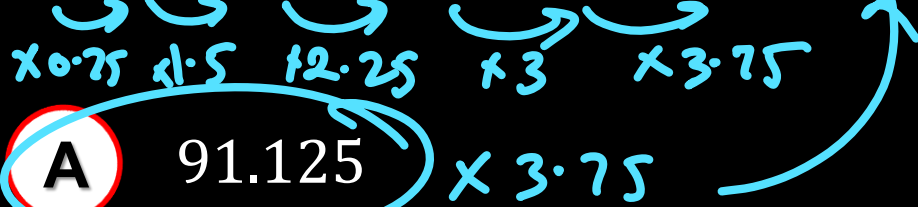
$2+4+4 \rightarrow 10$

B   244

C   136

D   324

What is the missing number in the sequence given below?

12, 9,13.50, 30.375, ?, 341.71875

x0.75 ÷1.5 12.25 +3 x3.75

[June 2022]

A 91.125   x 3.75

B 89.145

C 90.475

D 92.485

Find the wrong term of the series 121, 143, 165, 186, 209   **MTP Series 2 (JAN 2025)**

187

+22 +22 +22 +22

A 143

B 165

C 186

D 209

Find odd man out of the series 145, 197, 257, 325, 399

$$144+1, 196+1, 256+1, 324+1, 400+1$$

$$12^2+1, 14^2+1, 16^2+1, 18^2+1, 20^2+1$$

401

A. 145

B. 399
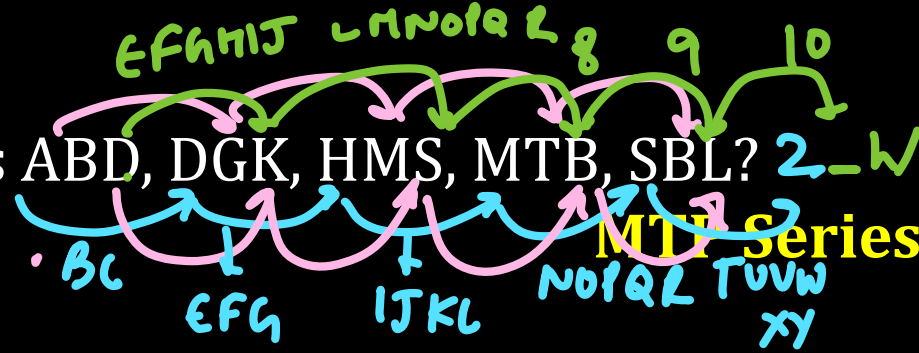
C. 257

D. 325
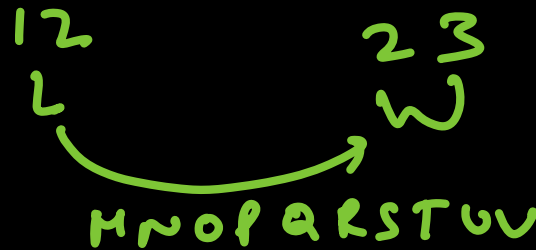
Find missing term of the alphabet series ABD, DGK, HMS, MTB, SBL?

MTP Series 2 (JAN 2025)

A XKW

B ZAB

C ZKU

D ZKW

DHLPTX
4 8 12 16 20 24

In a certain language, FLOWER is coded UOLDVI, then how is TERMINAL coded in that language?

MTP Series 2 (JAN 2025)
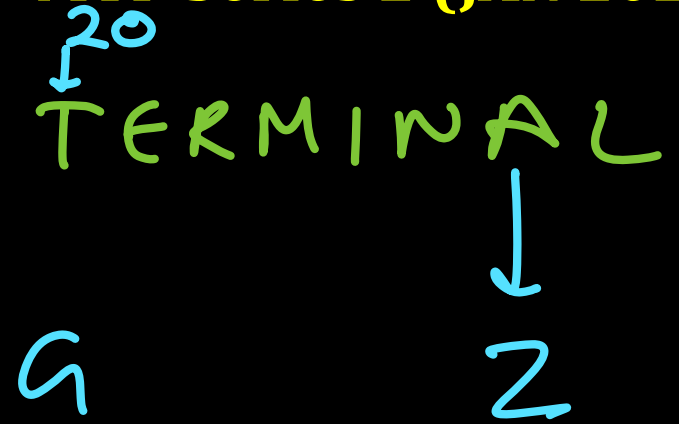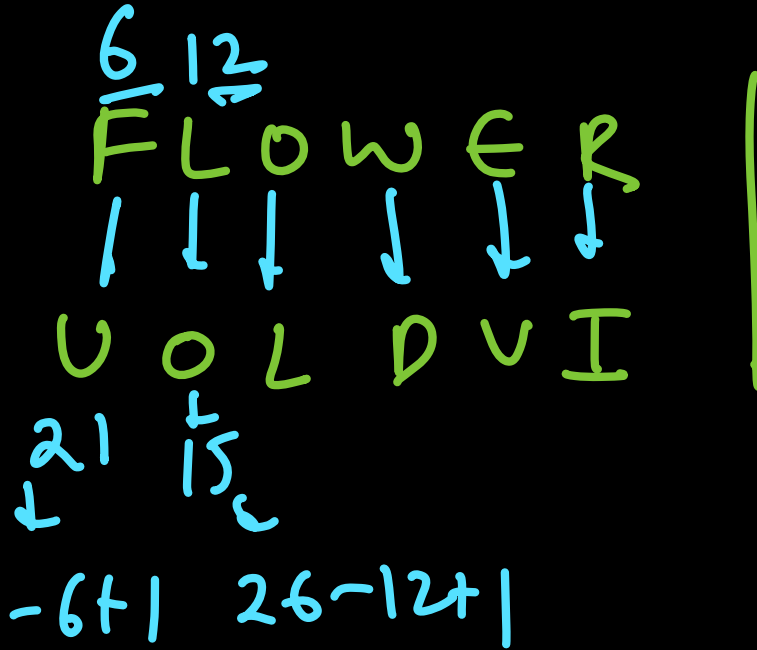
6 12
FLOWER
↓↓↓↓↓↓
UOLDVI

20
TERMINAL
↓
G   Z

21 15
↓   ↓
26-6+1 26-12+1

A) FLKPMROZ

B) GVINRMZO

C) RVNIGLKA

D) MNIVGYEO

In a certain code, TELEPHONE is written as ENOHPELET. How is ALIGATOR written

ROTAGILA

A ROTAGILA

B ROTAGAIL

C ROTAGILE

D ROTEGILA

Direction Test

One evening, Raja started to walk toward the Sun. After walking a while, he turned to his right and again to his right. After walking a while, he again turned right. In which direction is he facing?

Q16, Exercise 10(A), (ICAI)

A South

B East

C West

D North
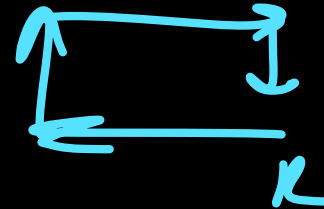
If X stands on his head with his face towards south, to which direction will his left hand point ?

Q22, Exercise 10(A), (ICAI)

A East

B West

C North

D South

Seetha

$L \leftarrow \uparrow \rightarrow R$

So

on head

$R \leftarrow \odot \rightarrow L$
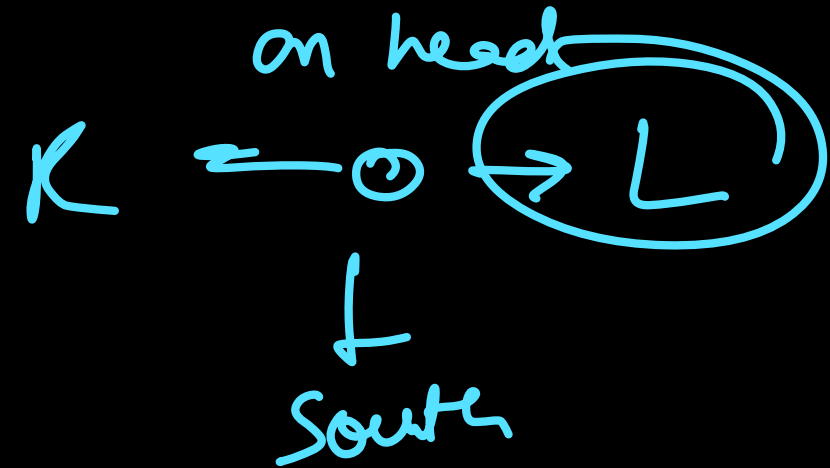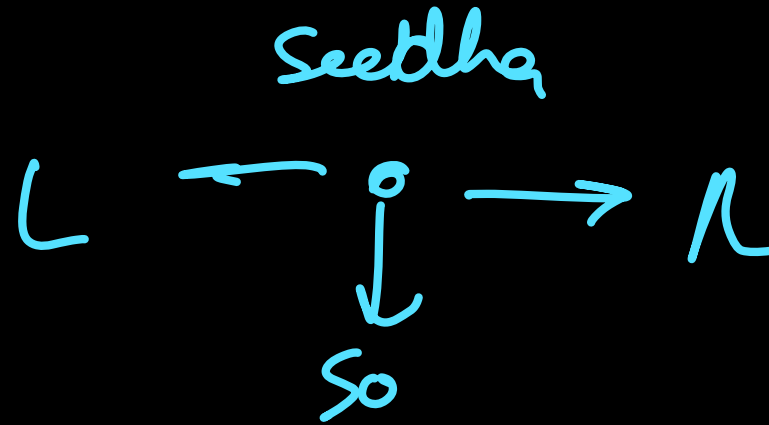
South

QUESTION 63

If Mohan sees the rising sun behind the temple and the setting sun behind the railway station from his house, what is the direction of the temple from the railway station?

A South

B North

C East

D West
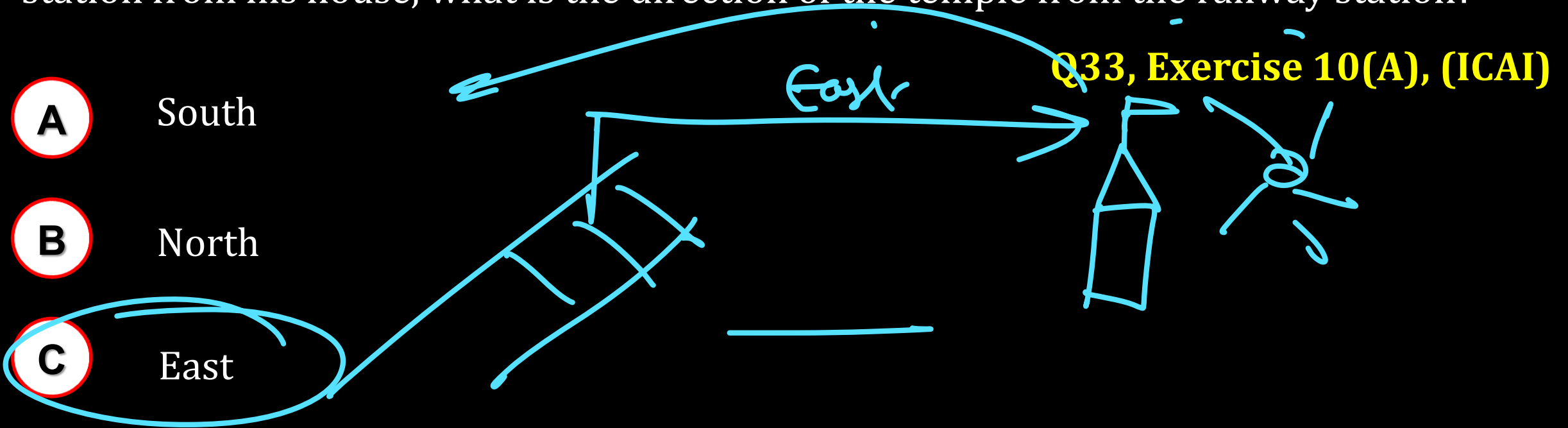
It is 3'o clock in a watch. If the minute hand points towards the North-East then the hour hand will point towards the

A South

B South - West

C North- West

D South - East

12

3

12 (NE)

E

3 (SE)

S
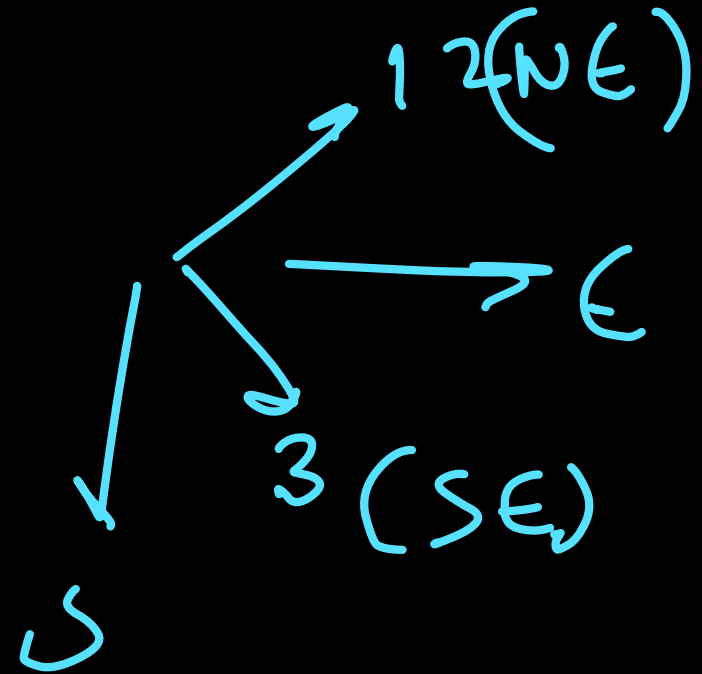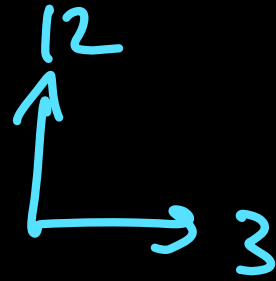
Raju facing North and moves 20 kms, then he turned to his right and moves 20 kms and then he moves 10 kms in North-East, then he turned to his right and moves 20 kms and then he turned to his right and moves 20 kms and again he turned to his left and moves 20 kms. Now in which direction Raju is facing?

Q11, Exercise 10(A), (ICAI)

A South-East

B North-East

C South-West

D North-West
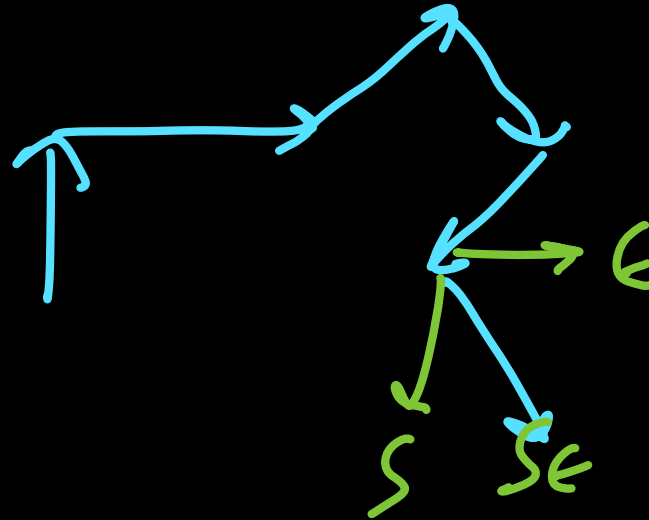
One evening before sunset Rekha and Hema were talking to each other face to face. If Hema's shadow was exactly to the right of Hema, which direction was Rekha facing?

A North

B South

C West

D East
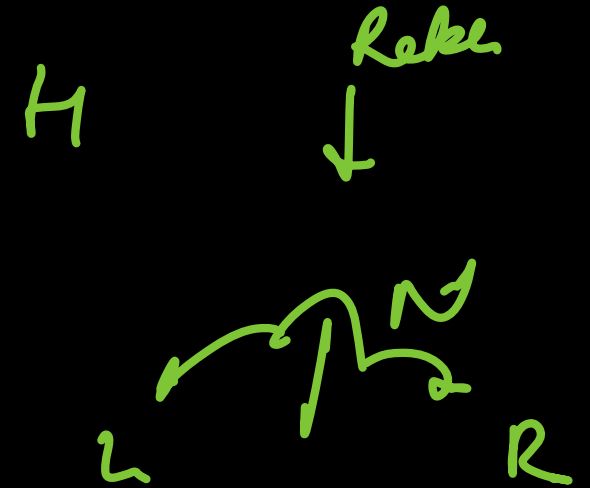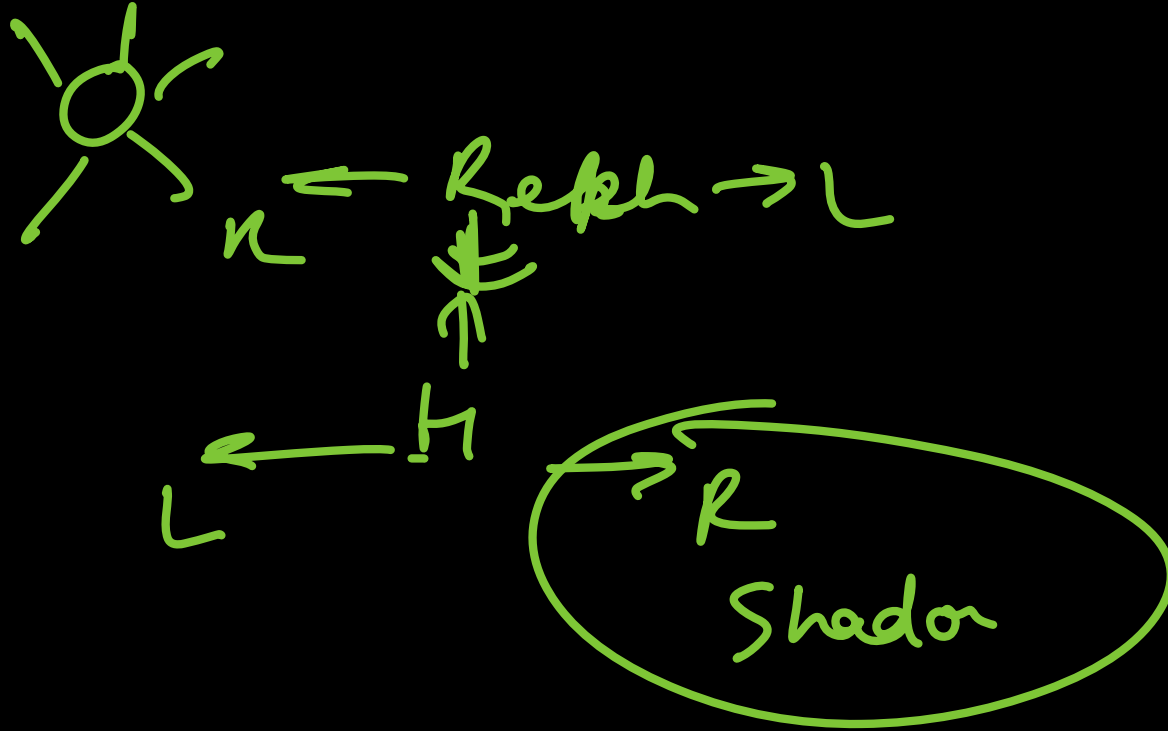
Puru was driving his car and at a circle there was direction pole, which was showing all the four correct directions. But due to the wind, it turns in such a manner that now North pointer is showing West. Puru went in the wrong direction thinking that he was travelling East. In what direction he was actually travelling?

[June 2022]

A West

B East

C North

D South
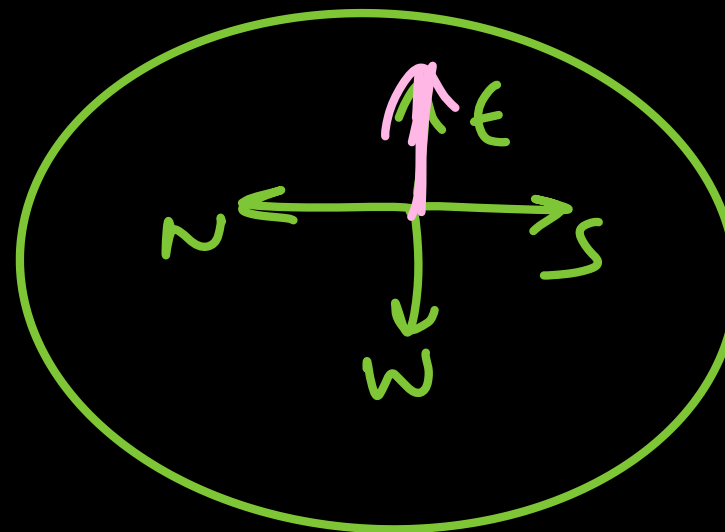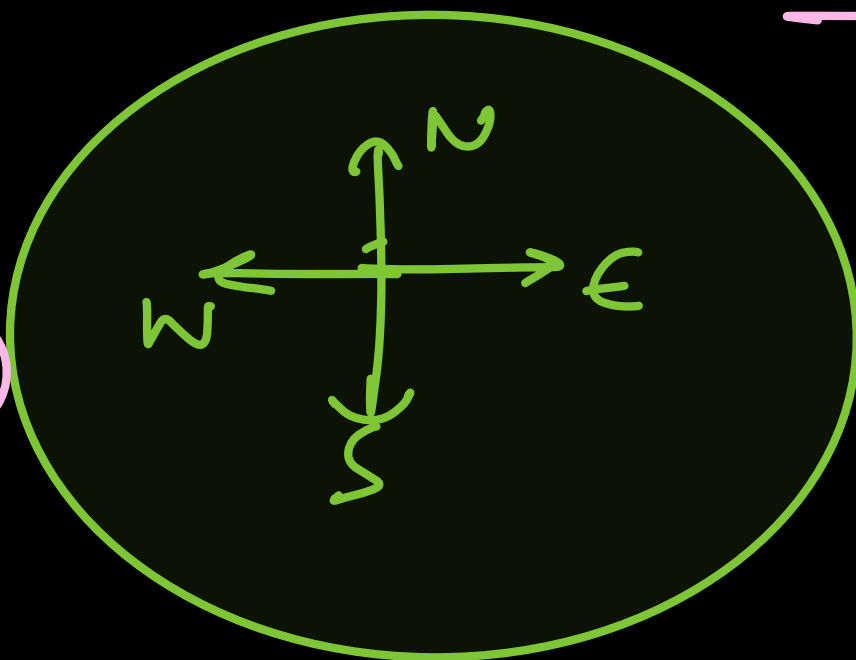
A man is facing towards East and turns through 45° clockwise again 180° clock wise and then turns through 270° anti-clock wise. In which direction is he facing now?

A West

B North- East

C South

D South-West
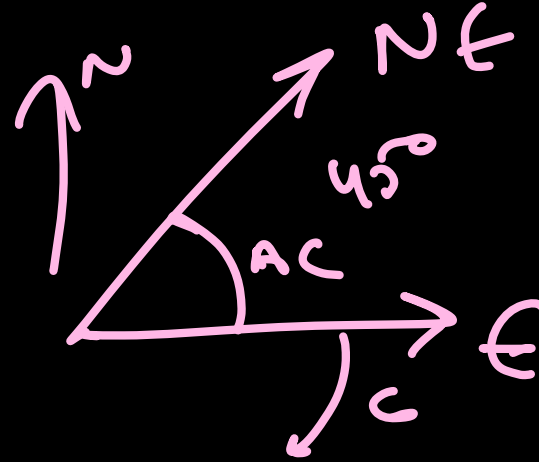
$$C = 45° + 180° = 225°$$

$$AC = 270°$$

$$AC = 270 - 225 = 45°$$

Facing towards North, Ravi walks 35 m. He then turns left and walks 55 m. He again turns left and walks 35 m. How far is from original position and towards which direction.

MTP Series 2 (JAN 2025)

A   30 m, North

B   20 m, East

C   55 m, West

D   20 m, South
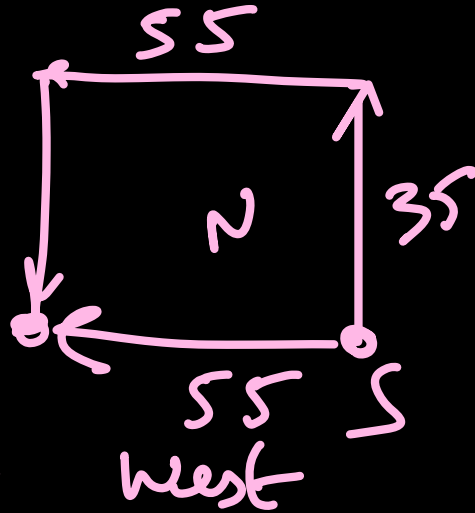
Ram start moving from a point, facing in East direction. After walking 15 m, he turned to his left and walked 25m, before turning to his right. Then, he walked a distance of 35 m, then turned to his right and stop after walking further a distance of 25 m. Find how far Ram is from his starting point.

MTP Series 2 (JAN 2025)

A 20 m

B 50 m

C 15 m

D 25 m

35

25   25

S   15 + 35 = 50 m
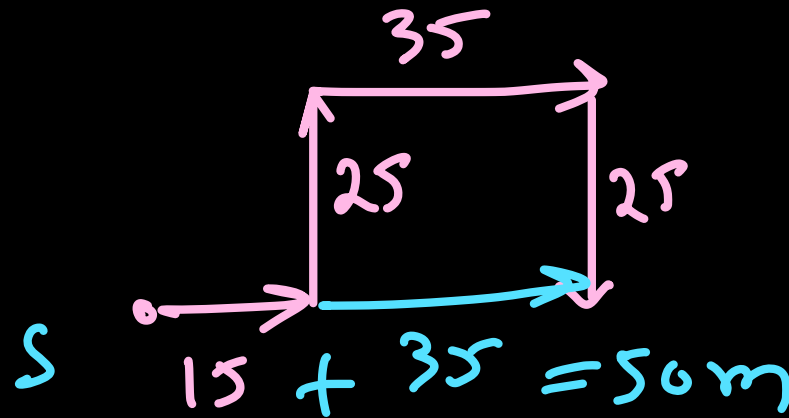
Seating Arrangement

Five Friends are sitting on a bench. A is to the left of B but on the right of C, D is to the right of B but on the left of E. Who are at the extremes?

A A, B

B A, D

C C, E

D B, D
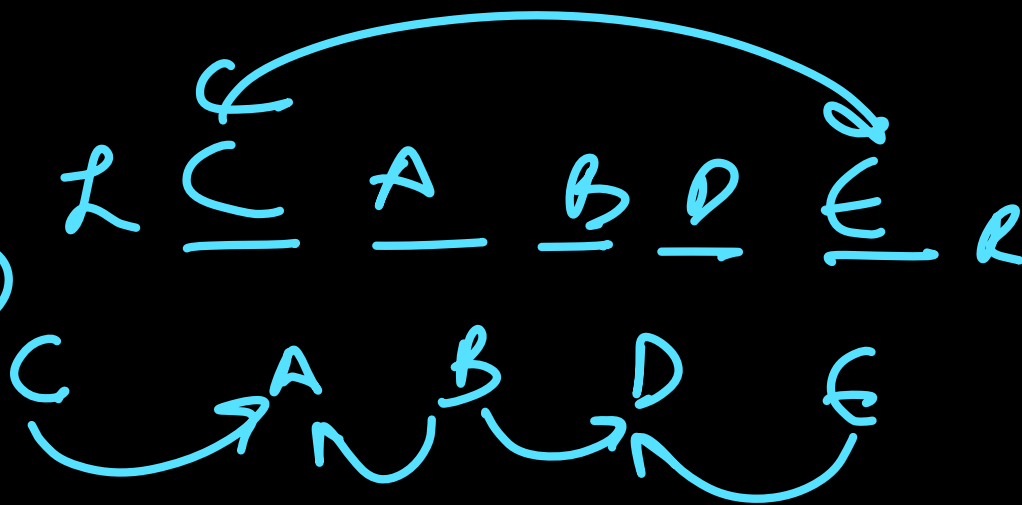
Five boys are standing in a row facing East . Pavan is to the left of Tavan , Vipin and Chavan. Tavan , Vipin and Chavan are to the left of Nakul. Chavan is between Tavan and Vipin. If Vipin is fourth from the left , then how far is Tavan from the right ?

A First

B Second

C Third

D Fourth
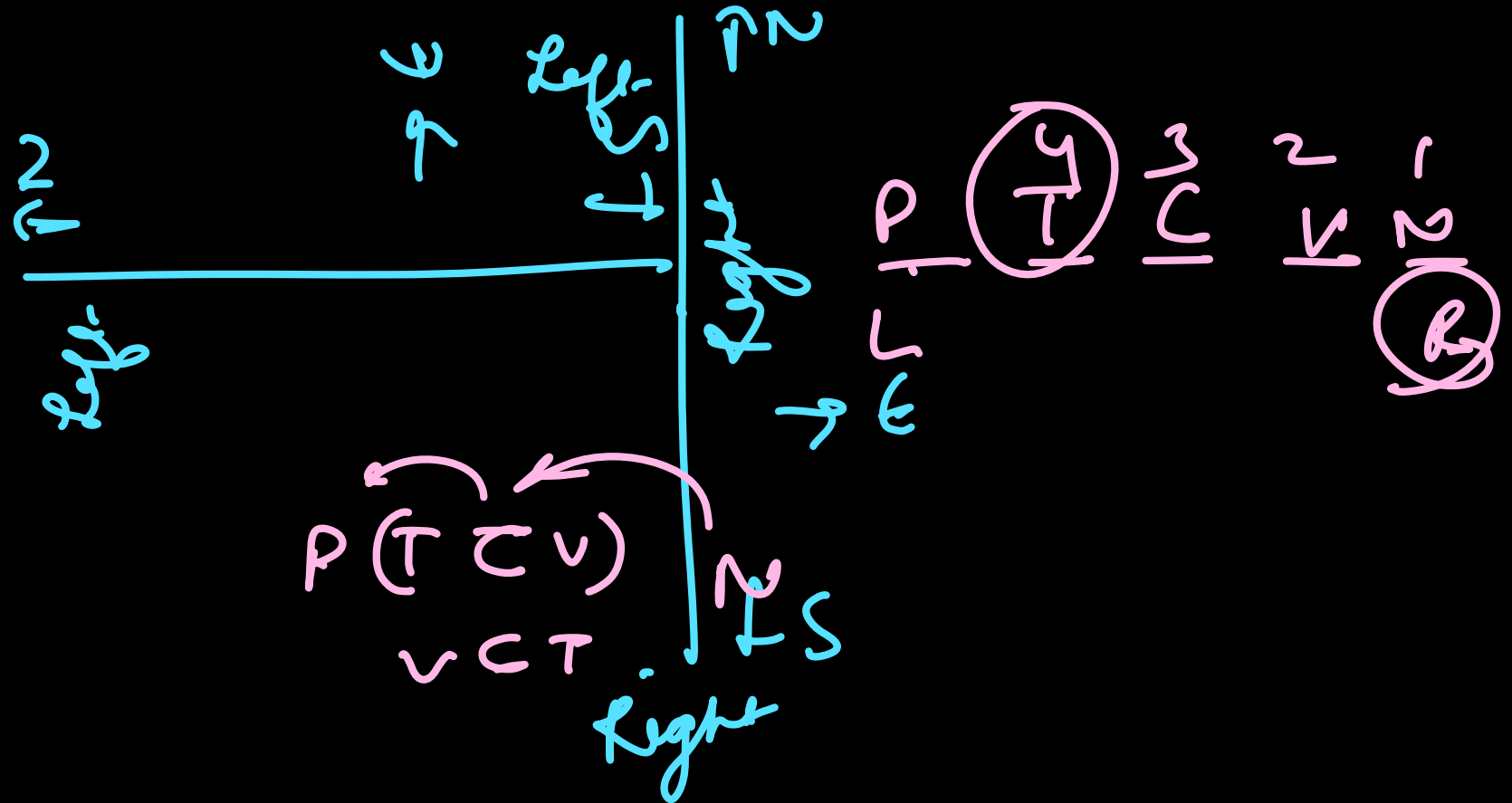
Four girls A, B, C, D are sitting around a circle facing the centre. B and C infront of each other, which of the following is definitely true ? (MAT 2009) **Q28, Exercise 11(A), (ICAI)**

A   A and D infront of each other

B   A is not between B and C

C   D is left of C

D   A is left of C
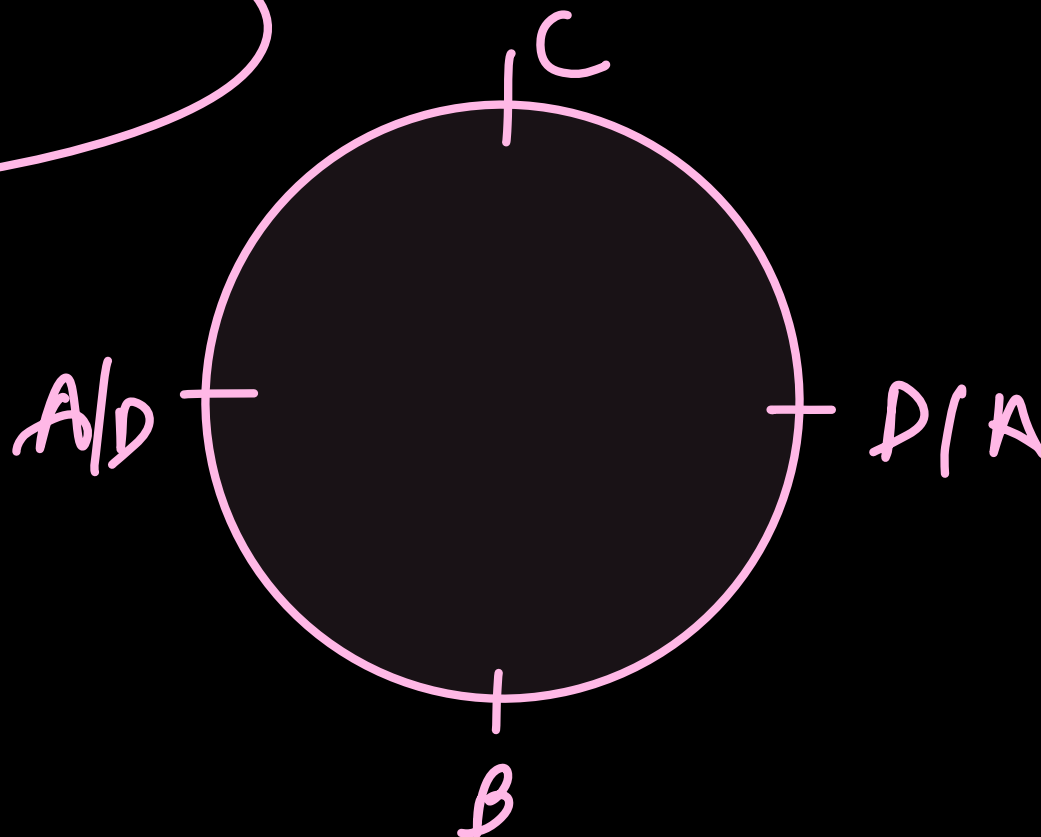
Five People A, B, C, D and E are seated around a round table. Every chair is spaced equidistant from adjacent chairs. (UPSC (CSAT) 2013)

I. C is seated next to A.

II. A is seated two seats from D.

III. B is not seated next to A.

Which of the following must be true?

I. D is seated next to B.

II. E is seated next to A.

Select the correct from the options given below:

Example 11, Pg. 11.7 (ICAI)

A   Only I

B   Only II

C   Both I and II

D   Neither I nor II
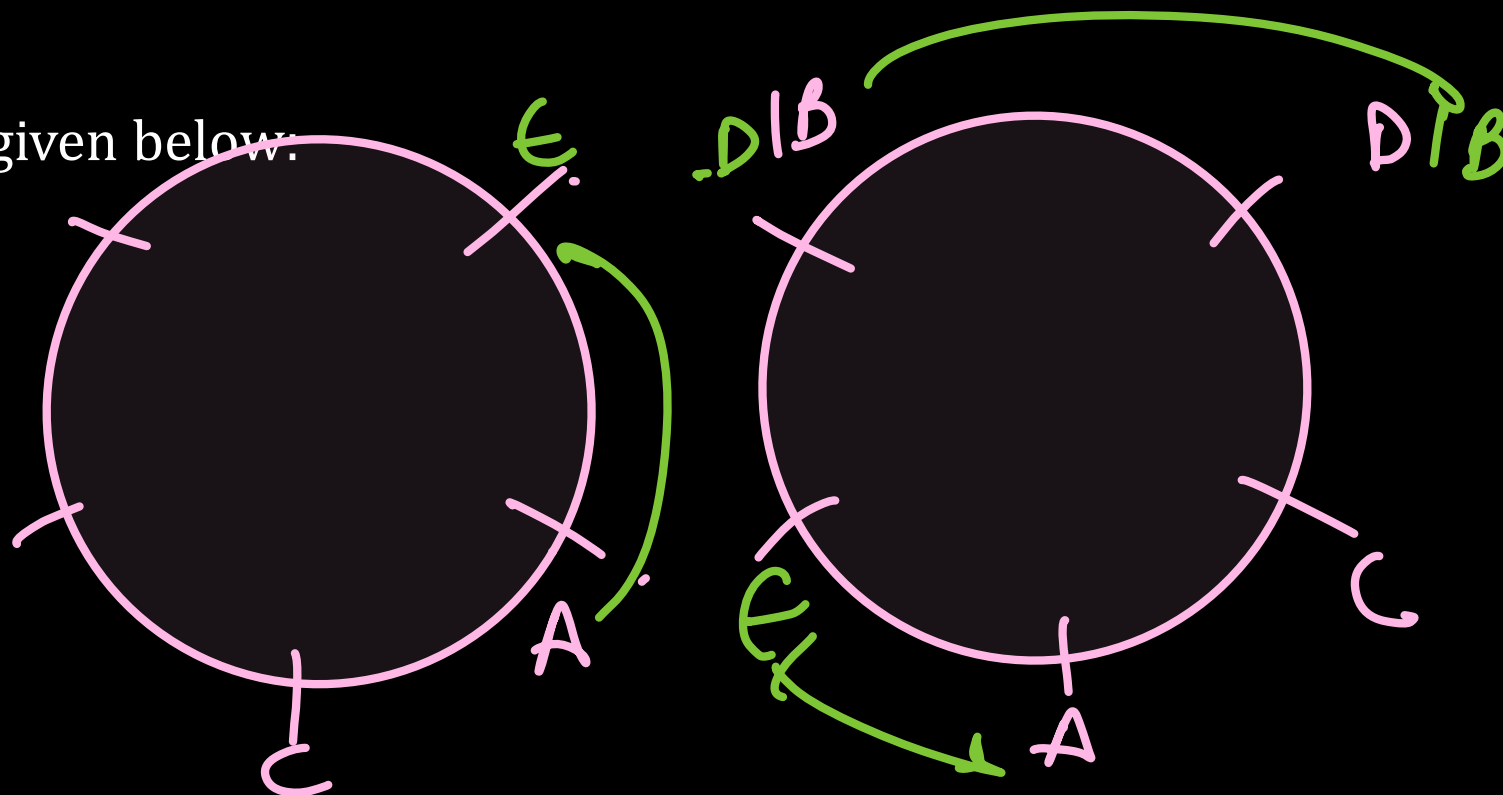
Directions (For next 3 Questions): Study the following information carefully to answer the given questions.

Eight persons P to W are sitting in front of one another in two rows. Each row has four persons. P is between U and V and facing North. Q, who is to the immediate left of M is facing W. R is between T and M and W is to the immediate right of V.

(UCO Bank 2011)
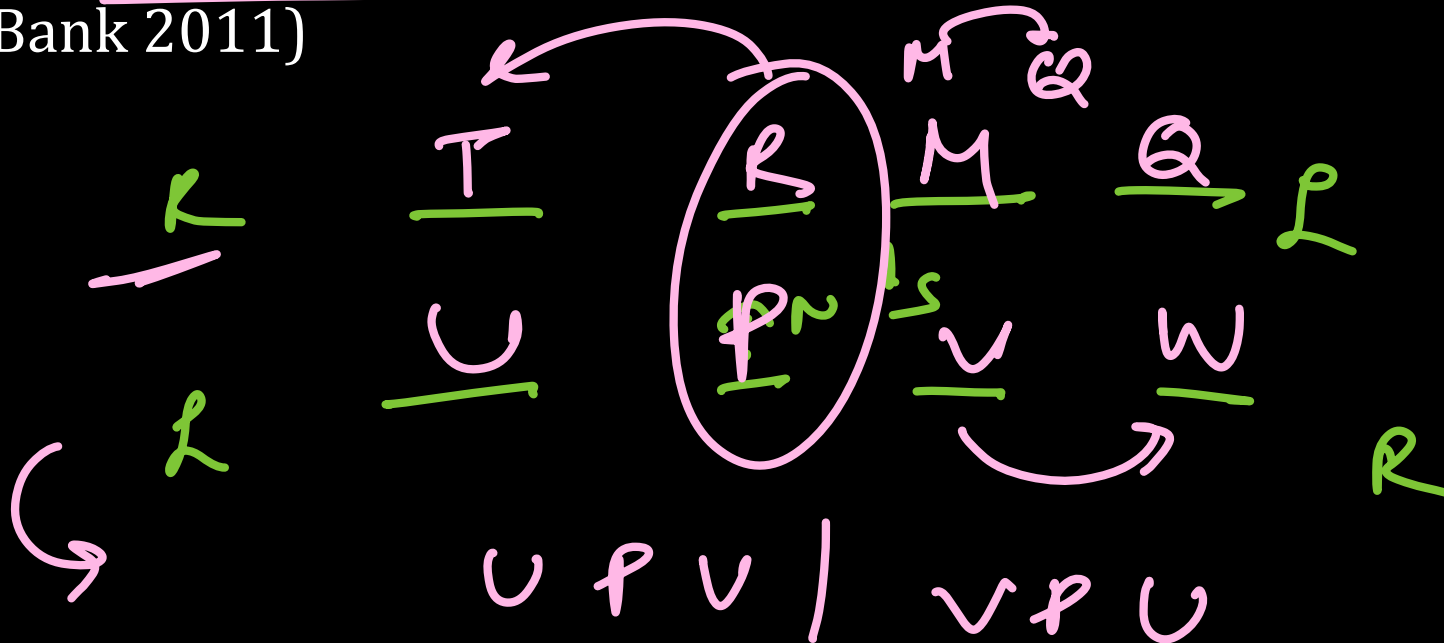
Who is sitting in front of R?

A   U

B   Q

C   V

D   P

Who is to the immediate right of R?

A M

B U

C M or T

D None of these → only T

In which of the following pairs, persons are sitting in front of each other?

A   MV

B   RV

C   TV

D   UR

In a line, P is sitting 13th from left. Q is sitting 24th from the right and $3rd$ left from P. How many people are sitting in the line?

[June 2022]

A 34

B 31

C 32

D 33
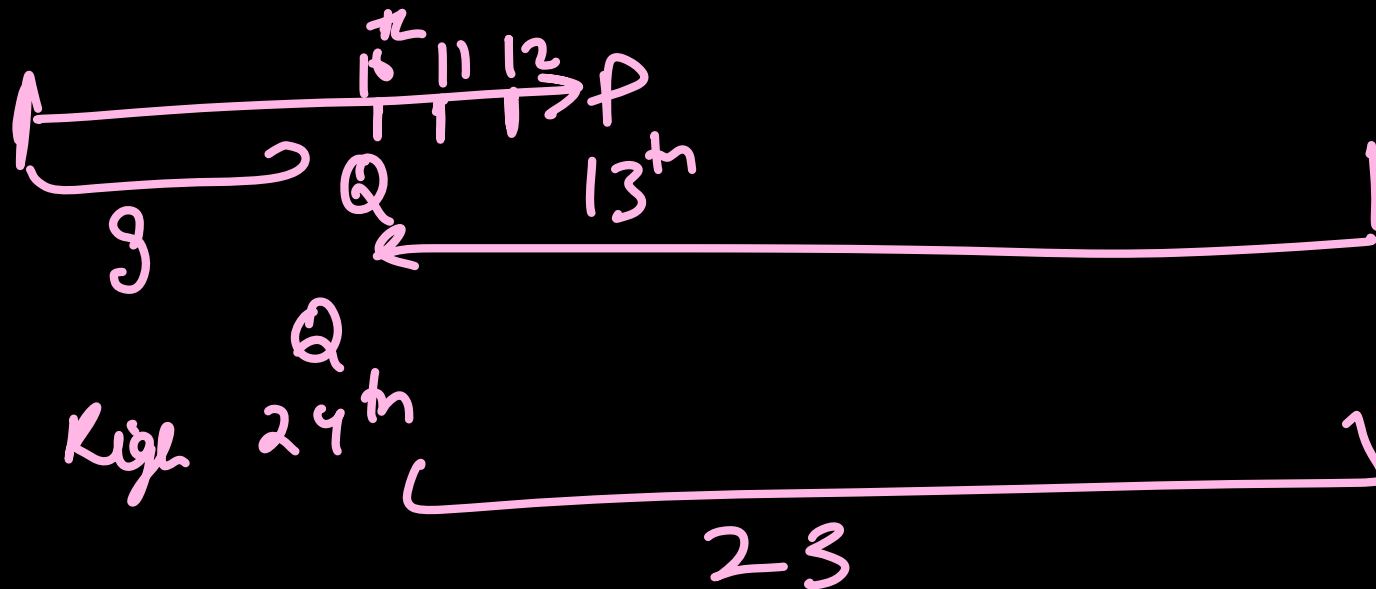
$$9 + 1 + 23 = 33$$

COMMON DATA FOR (53-55)

Read the following information carefully and then answer the questions 53, 54 and 55.

Six friends A, B, C, D, E and F are sitting on a bench, facing towards North.

I.   A is sitting next to B.

II.   C is sitting left to D.

III.   D is not sitting with E.

IV.   E is on the left end of the bench.

V.   C is third position from right.

VI.   A is on the right side of B and to the right side of E.

VII.   A and C are sitting together.

VIII. F is sitting Right of D.
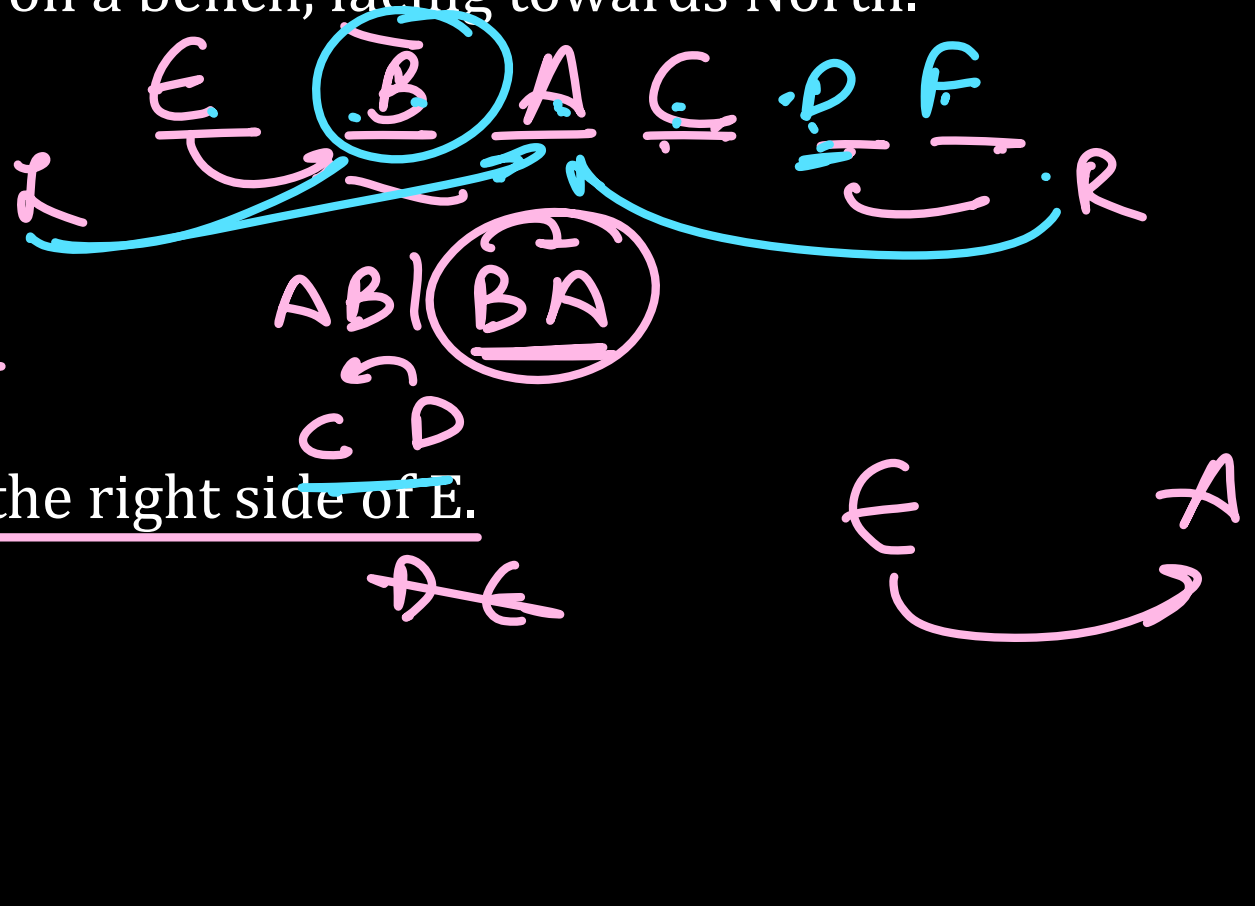
At what position A is sitting?

A Between B and C

B Between D and C

C Between E and D

D Between C and E

What is position of B?

A Second from right

B Centre

C Extreme left

D Second from left

What is position of D?

A Extreme from left

B Extreme right

C Third from left

D Second from right.

Blood Relations

P and Q are brothers. R and S are sister. P's son is S's brother. How is Q related to R?

A Uncle

B Brother

C Father

D Grandfather

$P^+ - Q^+$

$R^- - S^-$

$P's \, Son - S^- - R^-$
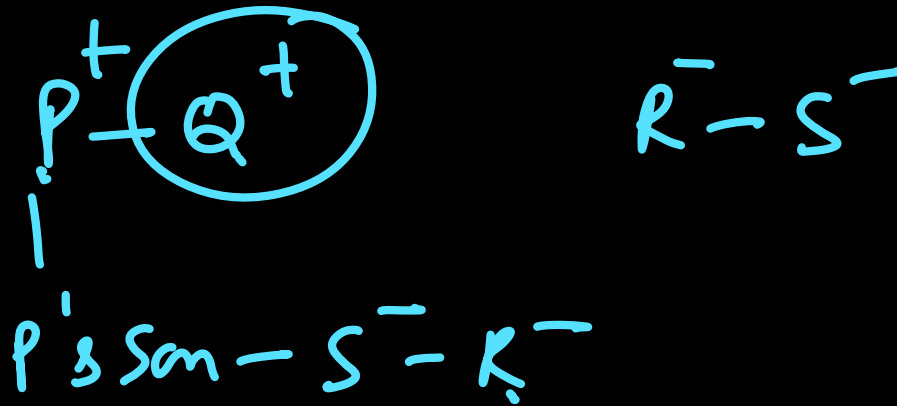
Q is $\underline{Uncle}$ of R

Given that

1. A is mother of B.
2. C is son of A.
3. D is brother of E.
4. E is daughter of B.

The grandmother of D is
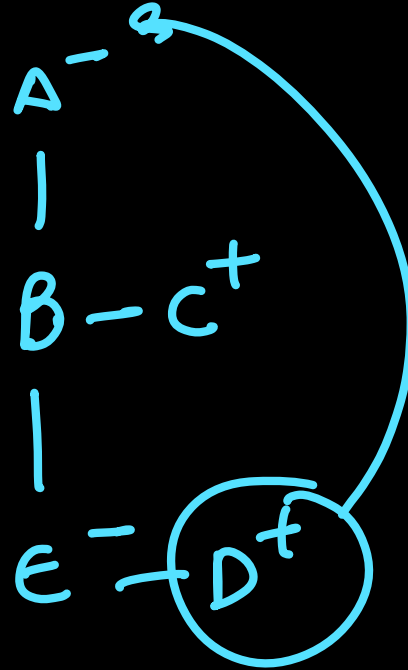
MTP Series 2 (JAN 2025)

A A

B B

C C

D E

P is the son of Q while Q & R are sisters to one another. T is the mother of R. If S is son of T, how S is related to P?
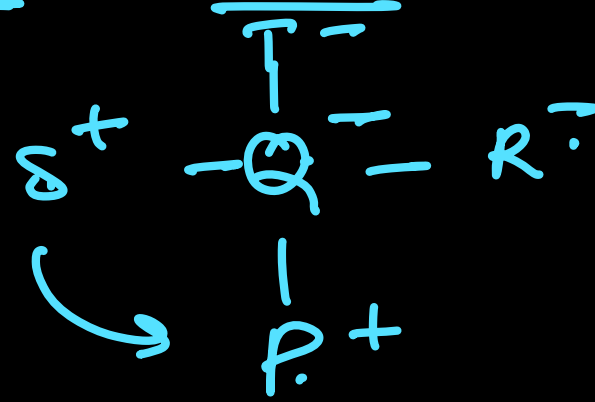
A   Brother

B   Maternal uncle

C   Cousin

D   Nephew

$$T^-$$
$$S^+ - Q^- - R^-$$
$$P^+$$

S is Uncle of P

When Rani saw Vinit, she recollected that "He is the brother of my grandfather's son". How is Rani related to Vinit?

A Aunt

B Mother

C Sister

D Niece

Vinit

Rani

② RV

① R U⁺ / RF

GF⁺

RM⁻ — R U⁺ — RU⁺

K

GF
|
RF
|
R

RU⁺
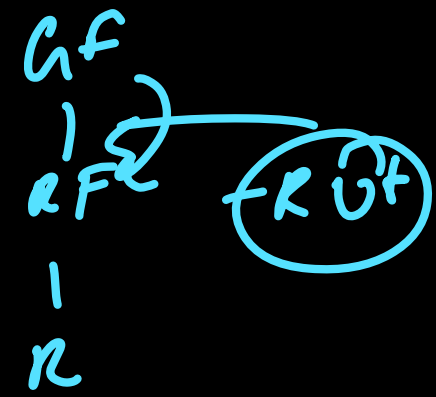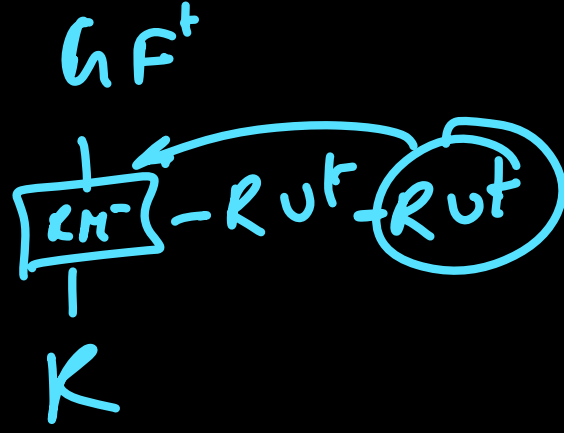
∴ Rani is Niece of vinit

Pointing to a lady, a man said, "The son of her only brother is the brother of my wife". How is lady is related to man?

MTP Series 2 (JAN 2025)

A Mother's sister

B Grandmother

C Sister of father-in-law

D Maternal Aunt

Lady

Lady Nephew

Man

③

②

MBIL

① MW⁻

L — LB

Lady

LB⁺ — Lady⁻

M = MW⁻ — MBIL | Lady Nephew
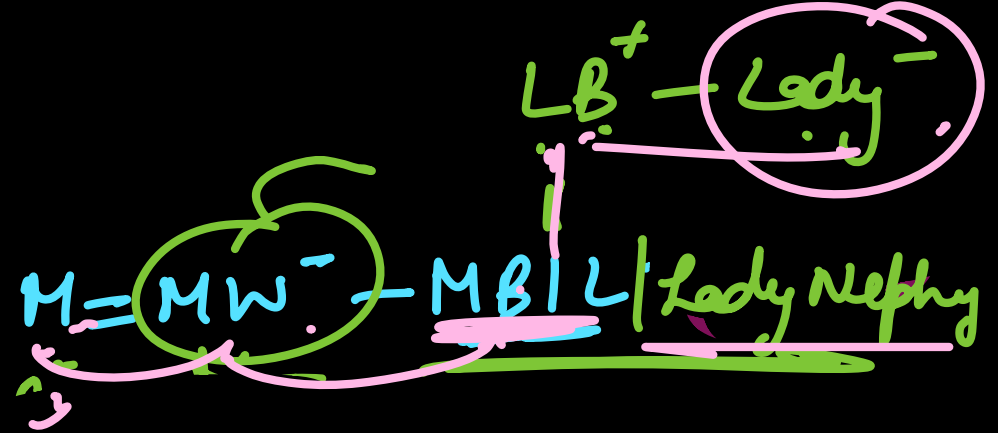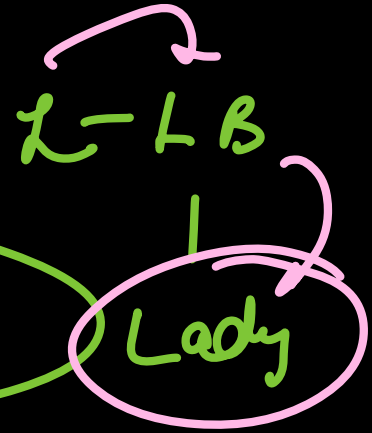
Lady is Sister of FIL of Man

A family has a man, his wife, their four sons and their wives. The family of every son also 3 sons and one daughter. Find out the total number of male members in the whole family?

A. 4

B. 8

C. 12

D. 17

$$M \rightarrow 1 \qquad L \rightarrow 1$$
$$+ \quad M \rightarrow 4 \qquad L \rightarrow 4$$
$$+ M \quad (4 \times 3) = 12 \quad L \rightarrow 4 \times 1 = 4$$
$$1 + 4 + 12 = 17$$

Read the following information and answer the question

'A+B' means 'A is the daughter of B'.

'A ×B' means 'A is the son of B'.

'A – B' means 'A is the wife of B'.

If P × Q-S, which of the following is true

MTP Series 2 (JAN 2025)

A   S is wife of P

B   S is father of P

C   P is daughter of Q

D   Q is father of P

Read the following information.

I.   In a family six members A, B, C, D, E and F, there are two married couples.

II.   D is the Grand mother of A and mother B.

III.   C is wife of B and mother of F

IV.   F is grand daughter of E

Who is C to A

MTP Series 2 (JAN 2025)

A Daughter

B Grandmother

C Mother

D Cannot be determined

Read the following information.

I.   In a family six members A, B, C, D, E and F, there are two married couples.

II.   D is the Grand mother of A and mother B.

III.   C is wife of B and mother of F

IV.   F is grand daughter of E

How many male members are in the family   **MTP Series 2 (JAN 2025)**

A Two

B Three

C Four

D Cannot be determined

21:45

Statistical Description of Data

Frequency density corresponding to a class interval is ratio of :

A Class frequency to class length

B Class frequency to total frequency

C Class frequency to Cumulative frequency

D Class length to class frequency

[Dec. 2023]

$$FD = \frac{Class\ freq}{Class\ length}$$

A sample study of the people of an area revealed that total number of women were 40% and the percentage of coffee drinkers were 45 as a whole and the percentage of male coffee drinkers was 20. What was the percentage of female non-coffee drinkers?

A 10

B 15

C 18

D 20

	CD	NCD	
M	20		60
W	25	15	40
	45	55	

The share holding pattern of ABC ltd. is as follows :-

Share holders	Promoters	FII	MF	Others	Public
No. of shares in Millions	120	25	20	20	15

Total [June 2023]

200

What is the difference between central angles of Promoters and Public in pie chart?

A   216

B   189

C   180

D   99

$$Prom = \frac{120}{200} \times 360 = 216$$

$$Pub = \frac{15}{200} \times 360 = 27$$

$$\overline{\qquad 189 \qquad}$$

Which one of the following is a source of primary data ?

A   Government records

[Dec 2022]

B   Research Articles

C   Journals

D   Questionnaire filled by enumerators

Which one of the following is a continuous variable?

A   The quantum of days to get a cure from illness

B   The quantum of oxygen cylinders used to treat a patient

C   The quantum of drug injected in to a patient

D   The quantum of tablets prescribe to a patient

[Dec 2022]

→ Cont variable

We get ___ by plotting cumulative frequency against the respective class boundary

[June 2022]

A Histogram

B Polygon

C Pie chart

D Ogives
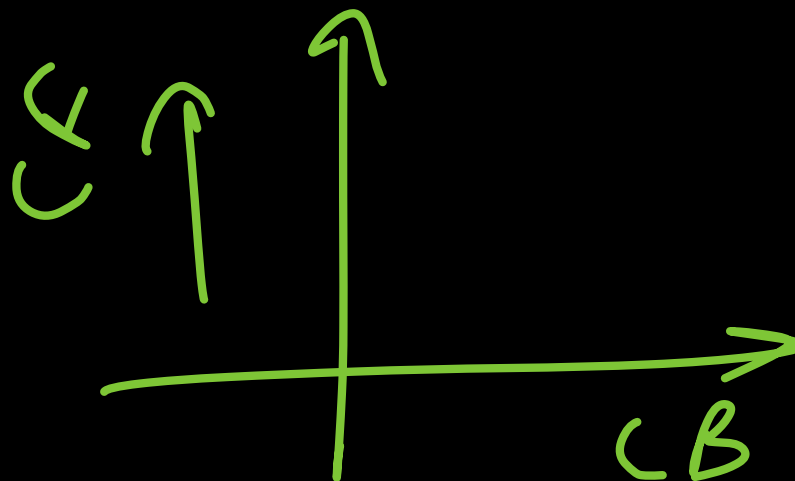
The following data relate to the marks of 48 students in statistics

[June 2022]

56	10	54	38	21	43	12	22
48	51	39	26	12	17	36	19
48	36	15	33	30	62	57	17
5	17	45	46	43	55	57	38
43	28	32	35	54	27	17	16
11	43	45	2	16	46	28	45

$$30\text{-}39$$

$$\frac{Freq}{C.L} = \frac{9}{10} = 0.9$$

$$29.5 - 39.5$$

What are the frequency densities for the class intervals 30-39, 40-49, 50-59?

A 0.20, 0.50, 0.90

B 0.70, 0.90, 1.10

C 0.1875, 0.1667, 0.2083

D 0.90, 1.00, 0.80

Multiple axis line chart is considered when   **[June 2022]**

A There is more than one time series

B The units of the variables are different

C In any case

D If there are more than one time series and unit of variables are different
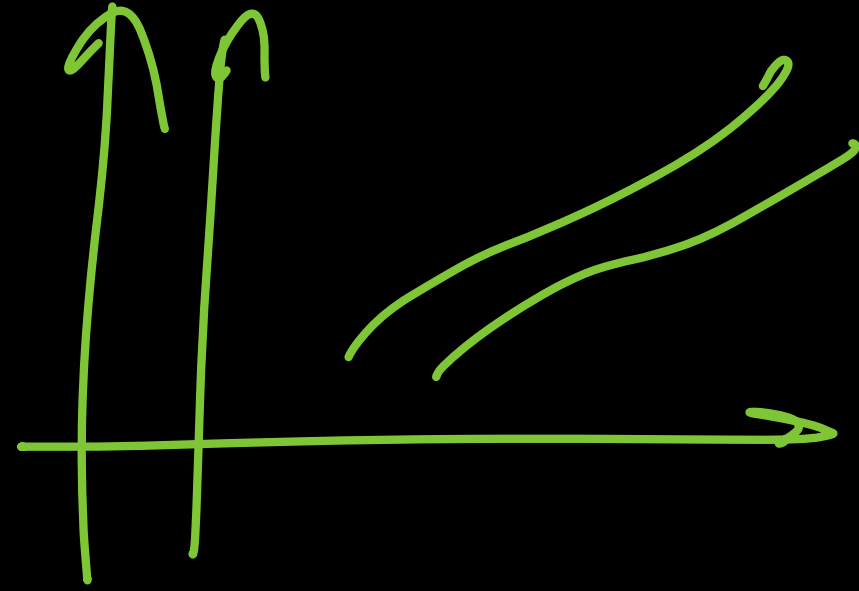
Find the number of observations between 250 and 300 from the following data:

Value:	No. of observations:
More than 200	56
More than 250	38
More than 300	15
More than 350	0

A 56

B 23

C 15

D 8

More than 250 — More tha 30

38 — 15 = 23

Median of a distribution can be obtained from

A Frequency polygon

B Histogram

C Less than type ogives

D None of these.

MOC and MOD

Measure of Central Tendency

	ARITHMETIC MEAN	GEOMETRIC MEAN	HARMONIC MEAN	MODE
Individual Observation	$$\bar{x} = \frac{x_1 + x_2 + x_3 + \cdots + x_n}{n}$$ $$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$	GM= $(x_1 \times x_2 \times x_3 \dots \times x_n)^{1/n}$ Logarithm of G for a set of observations is the AM of the logarithm of the observations; i.e. $$\log GM = \frac{\sum \log x}{n}$$ G.M. = Antilog $\frac{\sum \log x}{n}$	H.M.=$\dfrac{n}{\Sigma\left(\frac{1}{x_i}\right)}$ $= \dfrac{n}{\frac{1}{x_1} + \frac{1}{x_2} + \frac{1}{x_3} - - - \frac{1}{x_n}}$	The value that occurs the maximum number of times
Frequency Distribution	$$\bar{x} = \frac{x_1 f_1 + x_2 f_2 + x_3 f_3 + \cdots + x_n f_n}{f_1 + f_2 + f_3 + \cdots + f_n}$$	GM = $(x_1^{f_1} \times x_2^{f_2} \times x_3^{f_3} \dots \times x_n^{f_n})^{1/n}$ $\left(x_1^{f_1} \times x_2^{f_2} \times x_3^{f_3} - x_n^{f_n}\right)^{\frac{1}{n}}$	H.M.=$\dfrac{N}{\Sigma\left(\frac{f_i}{x_i}\right)}$	Mode $=l_1 + \left(\frac{f_0 - f_{-1}}{2f_0 - f_1 - f_{-1}}\right) \times c$ Where, l_1 = LCB of the modal class i.e. the class containing mode. f_0 = frequency of the modal class f_{-1} = frequency of the pre-modal f_1 = frequency of the post modal class C = class length of the modal class

Measure of Central Tendency

$$\overline{y} = a + b\overline{x}$$

	ARITHMETIC MEAN	GEOMETRIC MEAN	HARMONIC MEAN	MODE
Relationship variables	$\bar{y} = a + b\bar{x}$	if $z = xy$, then GM of $z = (GM$ of $x) \times (GM$ of $y)$ if $z = x/y$ then GM of $z = (GM$ of $x)/(GM$ of $y)$		$y_{mo} = a + bx_{mo}$
Weighted Mean	Weighted A.M $= \frac{\Sigma x_i w_t}{\Sigma w_t}$	Weighted G.M $= $ Antilog $\frac{\sum w_i \log x_i}{\sum w_i}$	Weighted $H.M = \frac{\Sigma w_i}{\Sigma\left(\frac{w_i}{x_i}\right)}$	
Combined Mean	Combined $A \cdot M.$ $\bar{x}_{12} = \frac{n_1 \bar{x}_1 + n_2 \bar{x}_2}{n_1 + n_2}$		Combined H.M $= \frac{n_1 + n_2}{\frac{n_1}{H_1} + \frac{n_2}{H_2}}$	

Measure of Central Tendency

$$Q_K = \left[k\left(\frac{n+1}{4}\right) \right]^{th}$$

	MEDIAN	QUARTILES (Q_1, Q_2 & Q_3)	DECILES ($D_1, D_2, D_3 \ldots D_9$)	PERCENTILES ($P_1, P_2, P_3, \ldots, P_{99}$)
Discrete Series/Unclassified Data	Median = Size of $\left(\frac{N+1}{2}\right)^{th}$ item	Q_1 quartile is given by the $\frac{1}{4}(N+1)$ th value the Q_n quartile is given by the $\frac{n}{4}(N+1)$ th value	The D_1 Decile is given by the $\frac{1}{10}(N+1)$ th value D_n Decile is given by the $\frac{n}{10}(N+1)th$ value	The P_1 Percentile is given by the $\frac{1}{100}(N+1)$ th value P_n Percentile is given by the $\frac{n}{100}(N+1)$ th value
Group Frequency Distribution	Median $= l_1 + \left(\frac{\frac{N}{2} - CF}{f}\right) \times C$ l_1 = lower class boundary of the median class i.e. the class containing median. N = total frequency. CF = less than cumulative frequency corresponding to $l1$. (Pre median class) f= frequency of the median class $C = l_2 - l_1$ = length of the median class.	$Q_n = l_1 + \left(\frac{N \cdot p - CF_l}{f}\right) \times C$ l^1 = lower class boundaty of the Quartile class i.e. the class containing Quartile. N = total frequency. p = $\frac{1}{4}, \frac{2}{4}, \frac{3}{4}$ for Q_1, Q_2, Q_3 respectively CF = less than cumulative frequency corresponding to $l1$. (Pre Quartile class) F = frequency of the Quartile class. $C = l_2 - l_1$ = length of the Quartile class.	$D_n = l_1 + \left(\frac{N \cdot p - CF_l}{f}\right) \times C$ l_1 = lower class boundary of the Decile class i.e. the class containing Decile. N = total frequency. $p = \frac{1}{10}, \frac{2}{10}, \frac{3}{10}, \ldots, \frac{9}{10}$ for $D_1, D_2, D_3, \ldots, D_9$ respectively CF = less than cumulative frequency corresponding to l_1. (Pre Decile class) F = frequency of the Decile class. $C = l_2 - l_1$ = length of the Decile class.	$P_n = l_1 + \left(\frac{N \cdot p - CF_l}{f}\right) \times C$ l_1 = lower class boundary of the Percentile class i.e. the class containing Percentile. N = total frequency $p = \frac{1}{100}, \frac{2}{100}, \frac{3}{100}, \ldots, \frac{99}{100}$ for $P_1, P_2, P_3, \ldots, P_{99}$ respectively CF = less than cumulative frequency corresponding to l_1. (Pre Percentile class) F = frequency of the Decile class. $C = l_2 - l_1$ = length of the Percentile class.

Note:- 1. $y_{me} = a + bx_{me}$ 2. $\sum |(x_i - A)|$ is minimum if we choose A as the median.

Relation among Average

- For Given two positive numbers (A.M) $\mathbf{x}(\mathbf{H} \cdot \mathbf{M}) = (\mathbf{G} \cdot \mathbf{M})^2$

$$AM = \frac{a+b}{2}$$

$$GM = \sqrt{ab}$$

$$HM = \frac{2ab}{a+b}$$

- $AM \geq \mathbf{GM} \geq \mathbf{HM}$ The equality sign occurs, as we have already seen, when all the observations are equal.

$$AM > GM > HM \rightarrow distinct$$
$$AM = GM = HM \rightarrow same$$

- Mode = 3 Median −2 Mean   or   Mean− Mode =3 (Mean – Median)

Measure of Dispersion

	Absolute	Relative	If y = a + bx
RANGE (R)	Range = Largest (L) – Smallest (S)	Co efficient of Range = $\frac{L-S}{L+S} \times 100$	$R_y = |b| \times R_x$
MEAN DEVIATION (M.D) about A	$M.\, D_A = \frac{1}{n} \sum |x - A|$	Co efficient of M.D from A = $\frac{M.D\ about\ A}{A} \times 100$	$M.\, D_y = |b| \times M.D\ D_x$
MEAN DEVIATION (M.D) about A.M ($\bar{x}$)	M.D about Mean = $\frac{1}{n} \sum |x_i - \bar{X}|$	Co efficient of M.D from A.M = $\frac{M.D\ about\ \bar{x}}{\bar{x}} \times 100$	$M.\, D_y = |b| \times M \cdot D_x$
MEAN DEVIATION (M.D) about Median	M.D about Median = $\frac{1}{n} \sum |x_i - Med|$	Co efficient of M.D from Median $= \frac{M.D\ about\ Med}{Med} \times 100$	$M.\, D_y = |b| \times M \cdot D_x$

$$\bar{x}\ or\ x_m$$

$$n_1 \to \bar{x}_1$$
$$n_2 \to \bar{x}_2$$
$$\bar{x} = \frac{n_1 \bar{x}_1 + n_2 \bar{x}_2}{n_1 + n_2}$$

$$y = a + bx$$
$$MD_y = |b| \, MD_x$$

Measure of Dispersion

	Absolute	Relative	If y = a + bx
Standard Deviation (σ)	$\sigma = \sqrt{\dfrac{\sum(x_i - \bar{X})^2}{n}}$ $\sigma = \sqrt{\dfrac{\sum x_i^2}{n} - \bar{X}^2}$	Co efficient of Variation $= \dfrac{\sigma}{x} \times 100$	$\sigma_y = \lvert b \rvert \times \sigma_x$
	Standard Deviations for first n Natural numbers, $\sigma = \sqrt{\dfrac{n^2-1}{12}}$	Combined Standard Deviation, $\sigma_{12} = \sqrt{\dfrac{n_1 \sigma_1^2 + n_2 \sigma_2^2 + n_1 d_1^2 + n_2 d_2^2}{n_1 + n_2}}$ Where $d_1 = \bar{x}_1 - \bar{x}_{12}$, $d_2 = \bar{x}_2 - \bar{x}_{12}$	
Quartile Deviation (QD)	$QD = \dfrac{Q_3 - Q_1}{2}$	Co-efficient of Q.D $= \dfrac{Q_3 - Q_1}{Q_3 + Q_1} \times 100$ Or Co-efficient of Q.D $= \dfrac{Q.D}{Median} \times 100$ (for Symm. Distribution)	
Variance (σ^2)	Variance means Square of standard Deviation		

(handwritten annotations)

Uniformity

a, b

$\sigma = \dfrac{\lvert a - b \rvert}{2}$

Mean = Median = Mode

If x and y are related by x–y–10 = 0 and mode of x is known to be 23, then the mode of y is

A 20

B 13

C 3

D 23

$$x_{mod} - y_{mod} - 10 = 0$$

$$23 - y_{mod} - 10 = 0$$

$$y_{mod} = 23 - 10 = 13$$

The average salary of a group of unskilled workers is ₹ 10,000 and that of a group of skilled workers is ₹ 15,000. If the combined salary is ₹ 12,000, then what is the percentage of skilled workers?

Q11, Exercise Set- B (ICAI)

A   40%

B   50%

C   60%

D   None of these

U.S   Sk.

10,000   15,000

$(100-x)\%$. $x\%$

12000

100%

$$\frac{10000(100-x) + 15000 \cdot x = 12000}{100}$$

$x \to 40\%$

If Arithmetic mean between two numbers is 5 and Geometric mean is 4 then what is the value of Harmonic mean?

A 3.2

B 3.4

C 3.5

D 3.6

$2nd. \rightarrow a \& b$

$GM^2 = AM \times HM$

$\Rightarrow 4^2 = 5 \times HM$

$= \boxed{HM = \dfrac{16}{5} = 3.2}$

Mean and S.D. of x is 50 and 5 respectively, Find mean and S.D. of $\frac{x-50}{5}$

A (1,0)

B (0,1)

C (1, 1)

D (0,1)

$$\bar{x} = 50$$

$$\sigma = 5$$

$$y = \frac{x - 50}{5}$$

$$\bar{y} = \frac{\bar{x} - 50}{5} = \frac{50 - 50}{5} = 0$$

$$y = \frac{x}{5} - \frac{50}{5}$$

$$SD_y = \frac{SD_x}{5} = \frac{5}{5} = 1$$

A perpendicular drawn from the point of intersection of two Ogive on the horizontal axis gives the value of

[Dec. 2023]

A 2nd Quartile

B 3rd Quartile

C Mode

D 1st Quartile

Median = 2nd Quartile
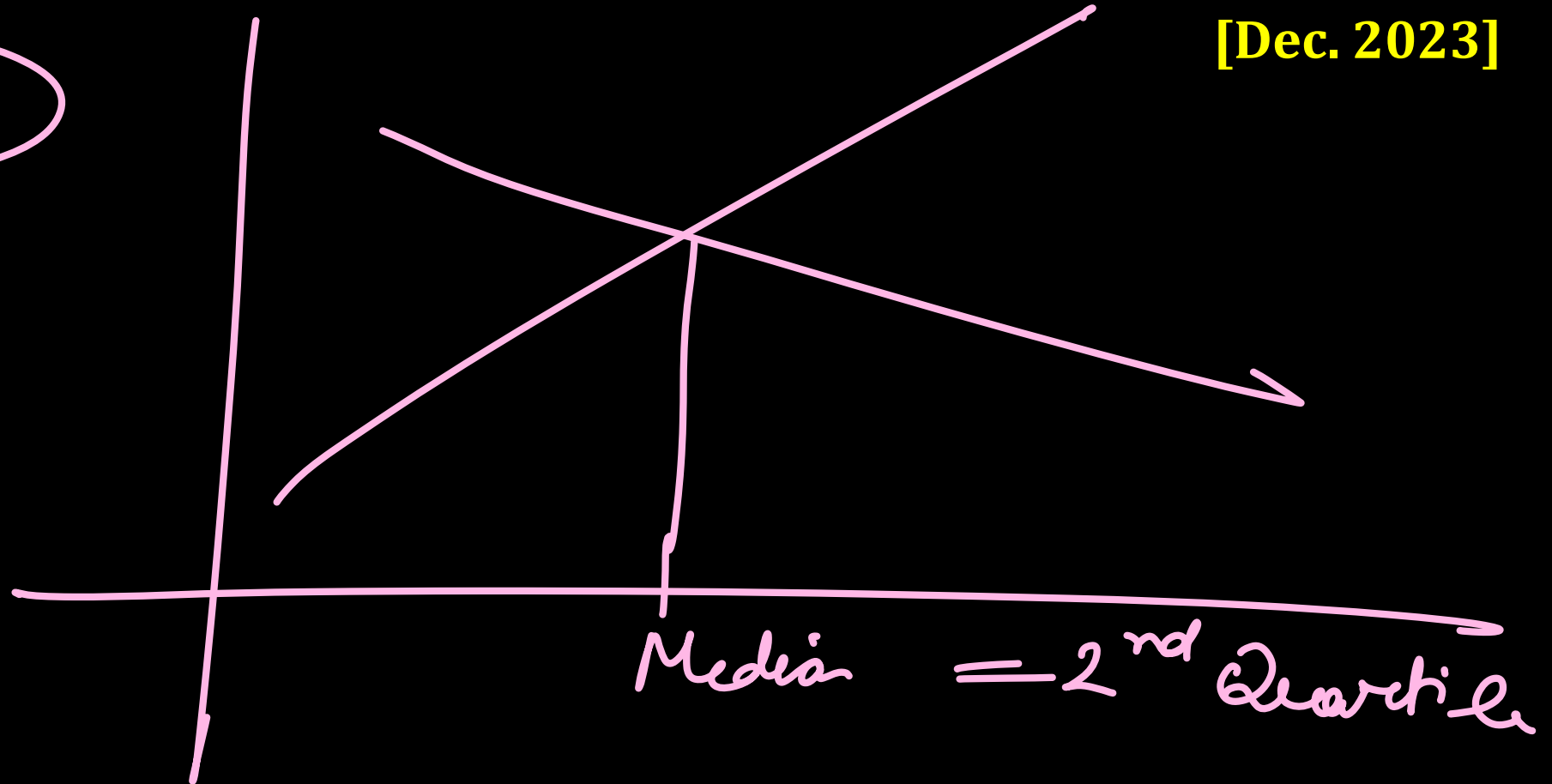
If the first quartile is 42.75 and the third quartile is 74.25 , then the coefficient of quartile deviation is:

[June 2023]

A) 29.62

B) 15.75

C) 17.57

D) 26.92

$$Q_3 = 74.25$$

$$Q_1 = 42.75$$

$$C.O\ QD = \frac{Q_3 - Q_1}{Q_3 + Q_1} \times 100$$

$$= \frac{74.25 - 42.75}{74.25 + 42.75} \times 100$$

$$= \frac{31.5}{117} \times 100$$

$$= 26.92$$

Find the mode of the following data

X	$25 - 30$	$30 - 35$	$35 - 40$	$40 - 45$	$45 - 50$	$50 - 55$
$f(x)$	20	53	42	42	41	43

[June 2023]

A   31.75

B   30.75

C   33.75

D   35.75

$$X_{mod} = 30 + \frac{53 - 20}{2 \times 53 - 20 - 42} \times (35 - 30)$$

$$= 30 + \frac{33}{44} \times 5 = 33.75$$

The Geometric Mean of 3,7,11,15,24,28,30,0 is

[June 2023]

A   6

B   0

C   9

D   12

For open-end classification, which of the following is the best measure of central tendency?

MTP Series 2 (JAN 2025)

A AM

B GM

C Median

D Mode

In case of an even number of observations which of the following is median?

A Any of the two middle-most value

B The simple average of these two middle values

C The weighted average of these two middle values

D Any of these

Two variables x and y are given by y = 2x – 3.

If the median of x is 20, what is the median of y?

A   20

B   40

C   37

D   35

$$y_{med} = 2x_{med} - 3$$
$$= 2(20) - 3 = 40 - 3 = 37$$

The appropriate measure of dispersion for open-end classification is

MTP Series 2 (JAN 2025)

A Standard deviation

B Mean deviation

C Quartile deviation

D All these measures

If R_x and R_y denote ranges of x and y respectively where x and y are related by

3x + 2y + 10 = 0, what would be the relation between x and y?

MTP Series 2 (JAN 2025)

$3x + 2y + 10 = 0$

$3R_x = 2R_y$

A $R_x = R_y$

B $2 R_x = 3 R_y$

C $3 R_x = 2 R_y$

D $R_x = 2 R_y$

If x and y are related as 3x + 4y = 20 and the quartile deviation of x is 16, then the quartile deviation of y is

A 16

B 14

C 10

D 12

$$3QD_x = 4QD_y$$

$$\Rightarrow 3 \times 16 = 4\,QD_y$$

$$\Rightarrow QD_y = 12$$

If x and y are related by $y = 2x + 5$ and the SD and AM of x are known to be 5 and 10 respectively, then the coefficient of variation of y is

MTP Series 2 (JAN 2025)

A. 25

B. 30

C. 40

D. 20

$$\sigma_x = 5$$

$$\bar{x} = 10 \longrightarrow \bar{y} = 2\bar{x} + 5 = 2 \times 10 + 5 = 25$$

$$y = 2x + 5$$

$$\sigma_y = 2\sigma_x$$

$$\Rightarrow \sigma_y = 2 \times 5 = 10$$

$$Cov_y = \frac{\sigma_y}{\bar{y}} \times 100$$

$$= \frac{10}{25} \times 100 = 40$$

Index Numbers

(1) Price Index Number:-

$$P_{on} = \frac{P_n}{P_o} \times 100$$

(2) Quantity Index Number:-

$$Q_{on} = \frac{Q_n}{Q_o} \times 100$$

(3) Value Index Number:-

$$V_{on} = \frac{V_n}{V_o} \times 100$$

Index Number

Method	Price Index	Quantity Index
1. Simple Aggregate	$P_{on} = \dfrac{\sum P_n}{\sum P_0}$	$\dfrac{\sum Q_n}{\sum Q_0}$
2. Simple Average	$\dfrac{\sum\left(\dfrac{P_n}{P_0}\right)}{n}$	$\dfrac{\sum\left(\dfrac{Q_n}{Q_0}\right)}{n}$
3. Weighted Aggregate		
(a) With base year weight (Laspeyre's index)	$\dfrac{\sum P_n Q_0}{\sum P_0 Q_0}$	$\dfrac{\sum Q_n P_0}{\sum Q_0 P_0}$
(b) With current year weight (Paasche's index)	$\dfrac{\sum P_n Q_n}{\sum P_0 Q_n}$	$\dfrac{\sum Q_n P_n}{\sum Q_0 P_n}$
(c) Fisher's Ideal [Geometric mean of Laspeyere's and Paasche's]	$\sqrt{\dfrac{\sum P_n Q_0}{\sum P_0 Q_0} \times \dfrac{\sum P_n Q_n}{\sum P_0 Q_n}}$	$\sqrt{\dfrac{\sum Q_n P_0}{\sum Q_0 P_0} \times \dfrac{\sum Q_n P_n}{\sum Q_0 P_n}}$
4. Weighted Average W = Weights = Base Year or Current Year Price Weights	$\dfrac{\sum\left(\dfrac{P_n}{P_0} W\right)}{\sum W}$	$\dfrac{\sum\left(\dfrac{Q_n}{Q_0} W\right)}{\sum W}$

Bowley's $= P_{on} = \dfrac{L+P}{2}$

General Index $= \dfrac{\Sigma I.W}{\Sigma W}$

- Chain Index $= \dfrac{\text{Link relative of current year} \times \text{Chain Index of the previous year}}{100}$

Deflated Value $= \dfrac{\text{Current Value}}{\text{Price Index of the current year}}$ or Current Value $\times \dfrac{\text{Base Price } (P_0)}{\text{Current Price } (P_n)}$

Shifted Price Index $= \dfrac{\text{Original Price Index}}{\text{Price Index of the year on which it has to be shifted}} \times 100$

- Splicing of Index Number $\rightarrow$ When new commodity
- Test of Adequacy
  - (1) Unit test $\rightarrow$
  - (2) Time reversal Test $\rightarrow$ $P_{01} \times P_{10} = 1 \rightarrow M \in$ & Fisch
  - (3) Factor reversal test $\rightarrow$ $P_{01} \times Q_{01} = V_{01} \rightarrow$ Fischer
  - (4) Circular Test – Simple GM of Price Relatives and Weighted Agg. With fixed weights

If Fisher's index = 150 and Paasche's Index = 144, then Laspeyre's index is

A. 147

B. 156.25

C. 104.17

D. 138

$$(150)^2 = \left(\sqrt{L \times 144}\right)^2$$

$$22500 = L \times 144$$

$$\Rightarrow L = \frac{22500}{144} = 156.25$$

Circular Test is satisfied by:

A Paasche's Index Number

B The simple geometric mean of price relatives and the weighted aggregative with fixed weights

C Laspeyre's Index Number

D None of these

If the 2018 index with base 2015 is 250 and 2015 index with base 2012 is 150, the index 2018 on base 2012 will be:

A. 800

B. 375

C. 600

D. None

2015   100 I.f 2012   100
                           2015

2018   250   2018   150

                                     375

250×1.5
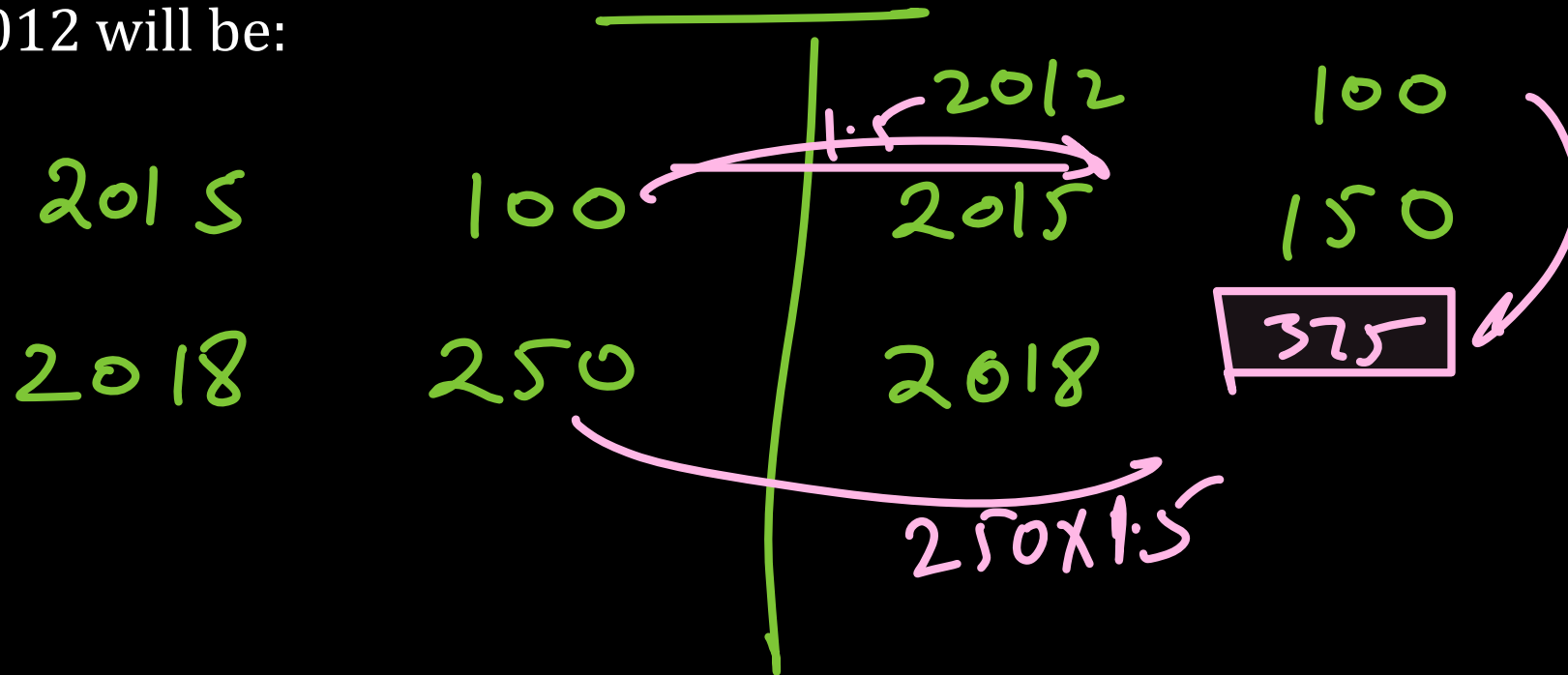
QUESTION 119

Consider the data

Year	Base year		Current Year	
Commodities	Prices P_0	Quantity Q_0	Price P_n	Quantity Q_n
A	10	5	20	2
B	15	4	25	8
C	40	2	60	6
D	25	3	40	4

[June. 2023]

$P_n Q_0 \qquad P_0 Q_0$

$\Sigma P_n Q_0 = 440 \qquad \Sigma P_0 Q_0 = 265$

Laspeyre's index is

$P_{01} = \dfrac{\Sigma P_n Q_0}{\Sigma P_0 Q_0} = \dfrac{440}{265} \times 100 = 166.04$

- **(A)** 166.04
- **(B)** 166.40
- **(C)** 164.04
- **(D)** 164.40

Which one of the following test is not applied for selecting an appropriate index number ?

[June. 2022]

A Time reversal

B Price Relative

C Factor Reversal

D Circular

Index numbers are not helpful in

[Dec. 2021]

A Framing economic policies

B Revealing trend

C Forecasting

D Identifying errors

Fisher's index number satisfies the _____ tests.

A Time Reversal Test

B Factor Reversal Test

C both

D none
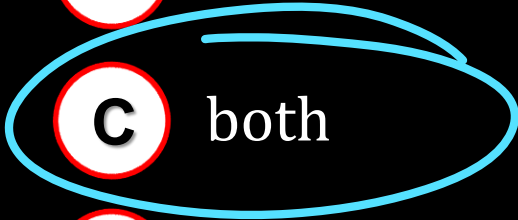
Fisher's ideal index number is:

A The Median of Laspeyre's and Paasche's index numbers

B The Arithmetic Mean of Laspeyre's and Paasche's index numbers

C The Geometric Mean of Laspeyre's and Paasche's index numbers

D None of these

The Cost-of-Living Index (CLI) is always

A Weighted Index

B Price Index

C Quantity Index

D None of these

The whole sale price index number for agricultural commodities in a given region at a given date is 280. The percentage increase in prices of agricultural commodities over the base year is:

MTP Series 2 (JAN 2025)

A 380

B 280

C 180

D 80

100

$280 - 100 = 180$

280

Equations

Quadratic Equation $\rightarrow ax^2 + bx + c = 0$

$b^2 - 4ac = 0 \rightarrow$ equal

$b^2 - 4ac \rightarrow$ perf $\rightarrow$ Ratio

sq

$b^2 - 4ac > 0 \rightarrow$ Real

- The roots of a quadratic equation: $x = -\dfrac{b \pm \sqrt{b^2 - 4ac}}{2a}$

Sum of roots $= -\dfrac{b}{a} = -\dfrac{-coefficient\ of\ x}{\text{coeffient of } x^2}$

Some results to remember

$\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$

$(\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta$

$\alpha^3 + \beta^3 = (\alpha + \beta)(\alpha^2 + \beta^2 - \alpha\beta)$

$\alpha^3 - \beta^3 = (\alpha - \beta)(\alpha^2 + \beta^2 - \alpha\beta)$

Product of the roots $= \dfrac{c}{a} = \dfrac{constant\ term}{\text{coeffient of } x^2}$

- To construct a quadratic equation for we have

- :- x^2 -(Sum of the roots) x + Product of the roots = 0

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

  i) If $b^2 - 4ac = 0$ the roots are real and equal;

  ii) If $b^2 - 4ac > 0$ then the roots are real and unequal (or distinct)

  iii) If $b^2 - 4ac < 0$ then the roots are imaginary;

  iv) If $b^2 - 4ac > 0$ is a perfect square ($\neq 0$) the roots are real, rational and unequal (distinct);

  v) If $b^2 - 4ac > 0$ but not a perfect square the rots are real, irrational and unequal.

Cubic Equation $\rightarrow ax^3 + bx^2 + cx + d = 0$

- Sum of Roots and Product of Roots:-

$$\alpha + \beta + \gamma = -\frac{b}{a}$$

$$\alpha.\beta + \beta.\gamma + \alpha.\gamma = \frac{c}{a}$$

$$\alpha.\beta.\gamma = -\frac{d}{a}$$

The denominator of a fraction exceeds the numerator by 2. If 5 be added to the numerator the fraction increases by unity. The fraction is.

Q8, Exercise 2(B), (ICAI)

A. 5/7

B. 1/3

C. 7/9

D. 3/5

$$\frac{x}{x+2} + 1 = \frac{x+5}{x+2}$$

$$\frac{x+5}{x+2} - \frac{x}{x+2} = 1$$

$$\Rightarrow \frac{x+5-x}{x+2} = 1$$

$$\Rightarrow 5 = 1 \times (x+2)$$

$$\Rightarrow x+2 = 5 \Rightarrow x = 5-2 = 3$$

Divide 50 into two parts such that the sum of their reciprocals is 1/12. The numbers are

Q6, Exercise 2(H), (ICAI)

A $(24, 26)$

B $(28, 22)$

C $(27, 23)$

D $(20, 30)$

$$50$$
$$x \qquad y$$
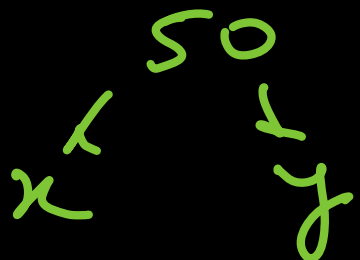
$$x + y = 50$$

$$\frac{1}{x} + \frac{1}{y} = \frac{1}{12}$$

$$\frac{y + x}{xy} = \frac{1}{12}$$

$$\Rightarrow \frac{50}{xy} = \frac{1}{12}$$

$$\Rightarrow xy = 50 \times 12 = 600$$

The wages of 8 men and 6 boys amount to 33. If 4 men earn 4.50 more than 5 boys determine the wages of each man and boy.

$\overset{x}{\underline{8\ men}}$ $\overset{y}{\underline{6\ boys}}$ $\overset{4x}{\underline{4\ men}}$ $\overset{5y}{\underline{5\ boys}}$

Q 5, Exercise 2(E), (ICAI)

A (₹ 1.50, ₹ 3)

B (₹ 3, ₹ 1.50)

C (₹ 2.50, ₹ 2)

D (₹ 2, ₹ 2.50)

$$8x + 6y = 33$$

$$4x = 5y + 4.5$$

$$4x - 5y = 4.5 \quad \text{②}$$

$$8x + 6y = 33 \quad \text{①}$$

GBC

33

a) $8 \times 1.5 + 6 \times 3 = 30 \ne 33$

b) $8 \times 3 + 6 \times 1.5 = 33 \checkmark$

$4 \times 3 - 5(1.5) = 4.5 \checkmark$

$$\frac{xy}{x+y} = 20, \quad \frac{yz}{y+z} = 40, \quad \frac{zx}{z+x} = 24$$

A   (120, 60, 30)

B   (60, 30, 120)

C   (30, 120, 60)

D   (30, 60, 120)

x   y   z

a) $\dfrac{120 \times 60}{120 + 60} = 40 \neq 20$

b) $\dfrac{60 \times 30}{60 + 30} = 20$ $\dfrac{30 \times 120}{30 + 120} = 24 \neq 40$

c) $\dfrac{30 \times 120}{30 + 120} = 24 \neq 20$

D

The roots of the quadratic equation $x^2 - 4x + k = 0$ are coincident if → equal

MTP Series 2 (JAN 2025)

A $k = 4$

B $k = 3$

C $k = 2$

D $k = 1$

$$b^2 - 4ac = 0$$

$$(-4)^2 - 4 \times 1 \times k = 0$$

$$\Rightarrow 16 - 4k = 0$$

$$\Rightarrow \quad 4k = 16$$

$$\Rightarrow \quad k = \frac{16}{4} = 4$$

The roots of the cubic equation $x^3 - 6x^2 + 9x - 4 = 0$ are **Q8, Exercise 2(I), (ICAI)**

A   (4, 1, -1)

$4 + 1 - 1 \neq 6$

B   (-4, -1, 21)

$-4 - 1 - 1 = -6 \neq 6$

C   (-4, -1, 1)

$-4 + 1 + 1 = -4 \neq 6$

D   (1, 1, 4)

$1 + 1 + 4 = 6$

$$\alpha + \beta + \gamma = \frac{-(-6)}{1} = 6$$

Two squares have sides p cm and (p + 5) cms. The sum of their squares is 625 sq. cm. The sides of the squares are

A. (10 cm, 30 cm)

B. (12 cm, 25 cm)

C. (15 cm, 20 cm)

D. None of these

$$p^2 + (p+5)^2 = 625$$

$$15^2 + (20)^2 = 225 + 400 = 625$$

+5

The values of $4 + \cfrac{1}{4 + \cfrac{1}{4 + \cfrac{1}{4 + \ldots \infty}}}$

A $\quad 1 \pm \sqrt{2}$

B $\quad 2 + \sqrt{5}$

C $\quad 2 \pm \sqrt{5}$

D $\quad$ None of these

$y + ve > y$

$= x$

$4 + \dfrac{1}{x} = x$

$\Rightarrow \dfrac{4x + 1}{x} = x$

$\Rightarrow x^2 - 4x - 1 = 0$

$x = \dfrac{-(-4) \pm \sqrt{(-4)^2 - 4 \times 1 \times 1}}{2a} = 2 + \sqrt{5} \ \& \ 2 - \sqrt{5}$ ignore

$2 + \sqrt{5} = (2 + 2.1) > 4$

$2 - \sqrt{5} = 2 - 2.1 = -0.1 < 4$

The three roots of the cubic equation $x^3 + 9x^2 - x - 9 = 0$ is

$$\alpha + \beta + \gamma = -\frac{9}{1} = -9$$

A $-1, +1,$ and 9 → $-1 + 1 + 9 \neq -9$

B $-1, +1$ and -9 → $-1 + 1 - 9 = -9$

C $-1, +1$ and $1/9$ → $-1 + 1 + \frac{1}{9} \neq -9$

D $-1, +1$ and $1/9$ → $-1 + 1 + \frac{1}{9}$

QUESTION 135

Given the quadratic equation $2x^{1/3} + 2x^{-1/3} = 5$. Its roots are. **MTP Series 2 (JAN 2025)**

A. 2 and ½

B. 4 and ¼

C. 8 and 1/8

D. 16 and 1/16

$$2x^{\frac{1}{3}} + 2\left(\frac{1}{x^{\frac{1}{3}}}\right) = 5$$

$$\Rightarrow \frac{2x^{\frac{2}{3}} + 2}{} = 5 \times x^{\frac{1}{3}}$$

$$\Rightarrow 2y^2 + 2 = 5y$$

$$\Rightarrow 2y^2 - 5y + 2 = 0$$

$$\Rightarrow 2y^2 - 4y - y + 2 = 0$$

$$\Rightarrow 2y(y-2) - 1(y-2) = 0$$

$$x^{\frac{1}{3}} = y$$

$$y^2 = \left(x^{\frac{1}{3}}\right)^2 = x^{\frac{2}{3}}$$

$$y = 2 \text{ or } \frac{1}{2}$$

$$\left(x^{\frac{1}{3}}\right)^3 = (2)^3 \text{ or } x^{\frac{1}{3}} = \frac{1}{2}$$

$$x = 2^3 = 8$$

Linear Inequalities

x

y

On the average experienced person does 5 units of work while a fresh one 3 units of work daily but the employer has to maintain an output of at least 30 units of work per day. This situation can be expressed as,   **MTP Series 2 (JAN 2025)**

$5x + 3y \geq 30$

$x \geq 0, y \geq 0$

A 5x + 3y <30

B 5x + 3y >30

C 5x+3y≥30 x ≥0, y ≥0

D None of these

The union employees x experienced and y freshman worker however forbids him to employ less than 2 experienced person to each fresh person. This situation can be expressed as

Q1, (iv) Exercise 3(A), (ICAI)

A. $x \leq y/2$

B. $y \leq x/2$

C. $y \geq x/2$

D. $x > 2y$

$$exp \qquad fresh$$

$$x \geq 2y \rightarrow 2y \leq x$$

$$y \leq \frac{x}{2}$$

Solve for x of the inequalities $2 \leq \dfrac{3x-2}{5} \leq 4$ where $x \in N$

A $\{5, 6, 7\}$

B $\{3, 4, 5, 6\}$

C $\{4, 5, 6\}$

D $\{4, 5, 6, 7\}$

$\dfrac{3x-2}{5} \geq 2 \times 5$ & $\dfrac{3x-2}{5} \leq 4$

$3x - 2 \geq 10$ & $3x - 2 \leq 20$

$3x \geq 10 + 2$ & $3x \leq 22$

$x \geq \dfrac{12}{3}$ & $x \leq \dfrac{22}{3}$

$x \geq 4$ & $x \leq 7.33$

If $2x + 5 > 3x + 2$ and $2x - 3 \leq 4x - 5$, then x takes which of the following value?

A 4

B −1

C 2

D −2

$2x - 3x > 2 - 5$

$\Rightarrow -x \fbox{$>$} -3$

$x < 3$

$2x - 4x \leq -5 + 3$

$\Rightarrow \dfrac{-2x}{-2} \fbox{$\leq$} \dfrac{-2}{-2}$

$\Rightarrow x \geq 1$

A small manufacturing firm produces two types of gadgets A and B, which are first processed in the foundry then sent to the machine shop for finishing. The number of man-hours of labour required in each shop for the production of each unit of A and B, and the number of man-hours the firm has available per week are as follows:

Gadget	Foundry	Machine-Shop
A	10	5
B	6	4
Firm's Capacity per week	1000	600

Let the firm manufactures x units of A and y units of B. The constraints are:

A $10x + 6y \leq 1000$, $5x + 4y \leq 600$, $x \geq 0$ $y \leq 0$

B $10x + 6y \leq 1000$, $5x + 4y \leq 600$ $x \geq 0$ $y \geq 0$

C $10x + 6y > 1000$, $5x + 4y \leq 600$ $x \leq 0$ $y \leq 0$

D $10x + 6y \leq 1000$, $5x + 4y \geq 600$, $x \leq 0$ $y \leq 0$

Graph of the following linear inequalities:

A DCHAD

B BCGB

C ABCDEFA

D EDKE

Mark the common region.
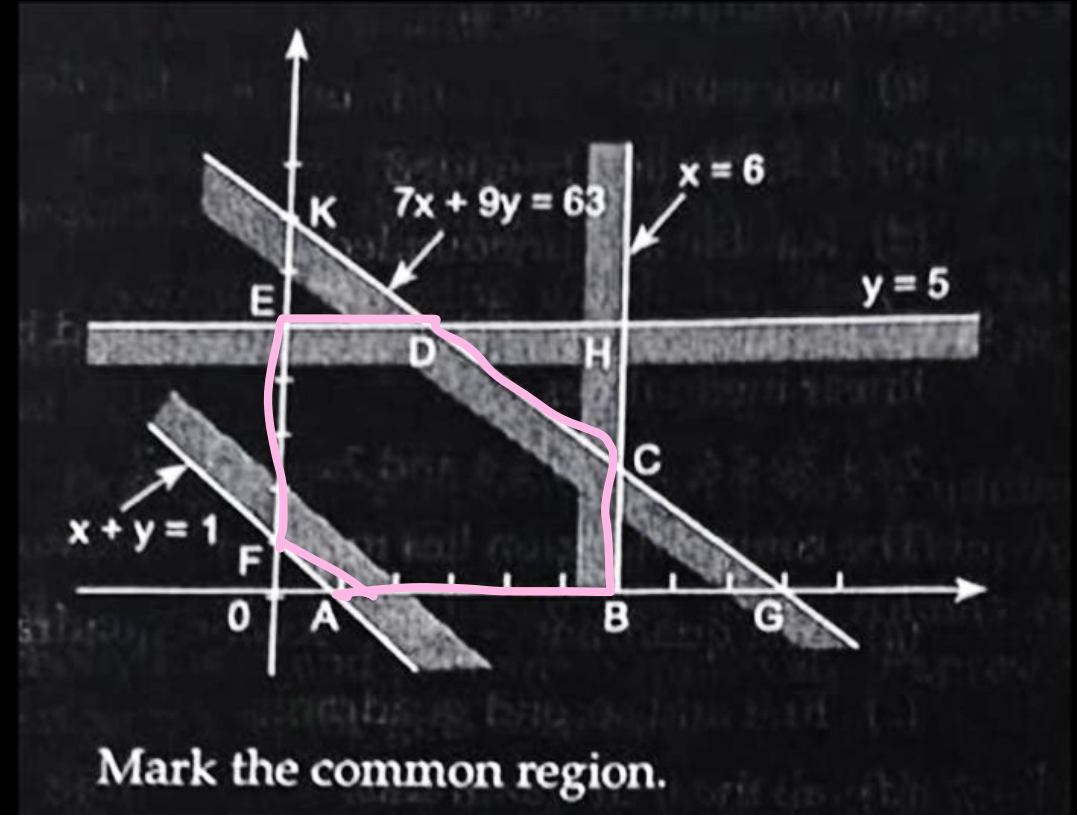
$$2(2)+5(3)=19 \ne 20$$

$$2x + 5y = 20$$

x	0	10
y	4	0

$$3x + 2y = 12$$

x	0	4
y	6	0

On solving the inequalities $2x + 5y \leq 20$, $3x + 2y \leq 12$, $x \leq 0$, $y \leq 0$, we get the following situation

$$0 + 0 \leq 20 \qquad 0 + 0 \leq 12$$

MTP Series 2 (JAN 2025)

A $(0, 0)$, $(0, 4)$, $(4, 0)$ and $(20/11, 36/11)$

B $(0, 0)$, $(10, 0)$, $(0, 6)$ and $(20/11, 36/11)$

C $(0, 0)$, $(0, 4)$, $(4, 0)$ and $(2, 3)$

D $(0, 0)$, $(10, 0)$, $(0, 6)$ and $(2, 3)$

$(0,6)$

$(0,4)$

$(0,0)$ $(4,0)$ $(10,0)$
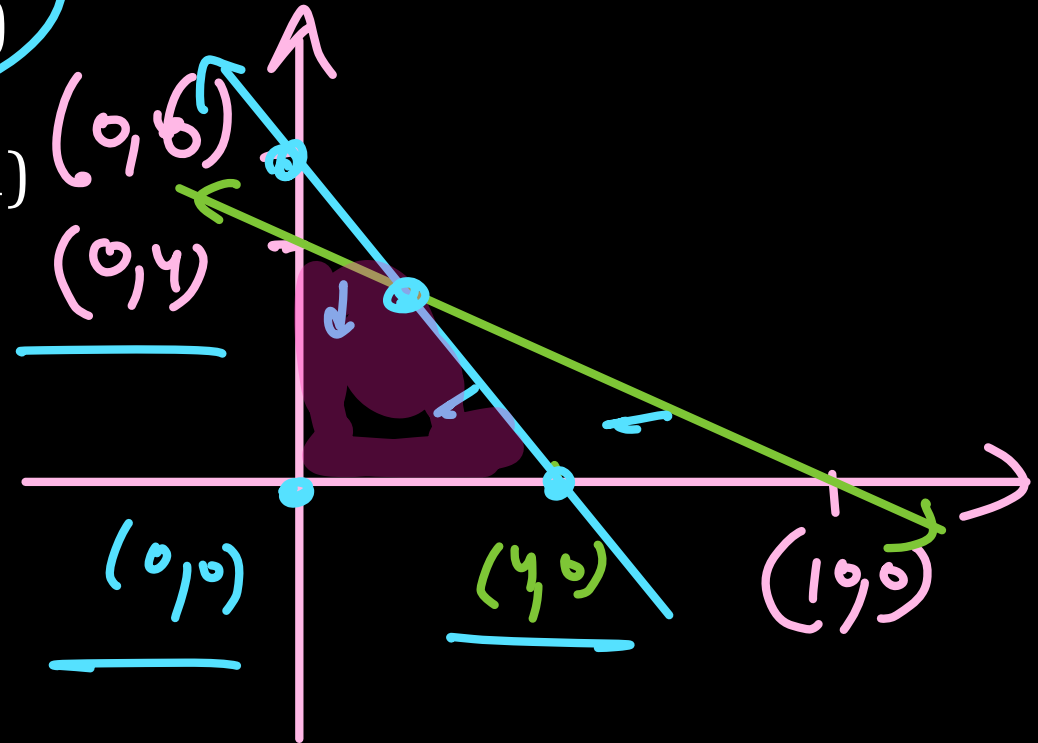
Permutation and Combination

Fundamental principles of counting

- **Multiplication Rule:** If certain thing may be done in 'm' different ways and when it has been done, a second thing can be done in 'n' different ways then total number of ways of doing both things simultaneously = m × n.

  Addition Rule : It there are two alternative jobs which can be done in 'm' ways and in 'n' ways respectively then either of two jobs can be done in (m + n) ways.

The number of permutations of n things chosen r at a time is given by - $^nP_r = n!/ n-r!$

Arranging n things in circular arrangement is given by :(n-1)!

The number of necklaces formed with n beads of different colours $= \frac{1}{2}$ (n-1)!

Number of permutations of n distinct objects taken r at a time when a particular object is not taken in any arrangement is $^{n-1}p_r$.

Number of permutations of r objects out of n distinct objects when a particular object is always included in any arrangement is $r.\,^{n-1}P_{r-1}$.

Combinations

- $^nC_r = n! / r!\, n\text{-}r\,!$

- $^nC_r = {}^nC_{n-r}$

- $^nC_0 = 1$ and $^nC_n = 1$.

- $^{n+1}C_r = {}^nC_r + {}^nC_{r-1}$

$$^nC_r = \frac{n!}{r!\,(n-r)!}$$

$$^8C_3 = {}^8C_5$$

$$^8C_0 = 1 = {}^8C_8$$

$$^8C_5 + {}^8C_4 = {}^9C_5$$

$$\text{ROOM} \rightarrow \frac{4!}{2!}$$

o $^{n}P_r = {}^{n-1}P_r + r \cdot {}^{n-1}P_{r-1}$

o Permutations when some of the things are alike, taken all at a time

$P = n! / n_1! \, n_2! \, n_3!$

o Permutations of r things out of n when each thing may be repeated once, twice,…upto r times in any arrangement = n^r

o The total number of ways in which it is possible to form groups by taking some or all of n things $(2^n - 1)$.

$$^5C_1 + {}^5C_2 + {}^5C_3 + {}^5C_4 + {}^5C_5 = 2^5 - 1$$

- The total, number of ways in which it is possible to make groups by taking some or all out of n $(= n_1 + n_2 + n_3 + ...)$ things, where n_1 things are alike of one kind and so on, is given by

$$\{(n_1 + 1)(n_2 + 1)(n_3 + 1)...\} - 1$$

5 - Chℴ → (5+1)

4 — waf. (4+1)

3 → last (3+1) −1

- The combinations of selecting r_1 things from a set having n_1 objects and r_2 things from a set having n_2 objects where combination of r_1 things, r_2 things are independent is given by

$$^{n_1}C_{r1} \times {}^{n_2}C_{r2}$$

4 digit numbers to be formed out of the figures 0, 1, 2, 3, 4 (no digit is repeated) then number of such numbers is

Q21, Exercise 5(A), (ICAI)

A 120

B 20

C 96

D None of thes

$$4 \times \,^4P_3 = 4 \times 4 \times 3 \times 2$$

$$=$$
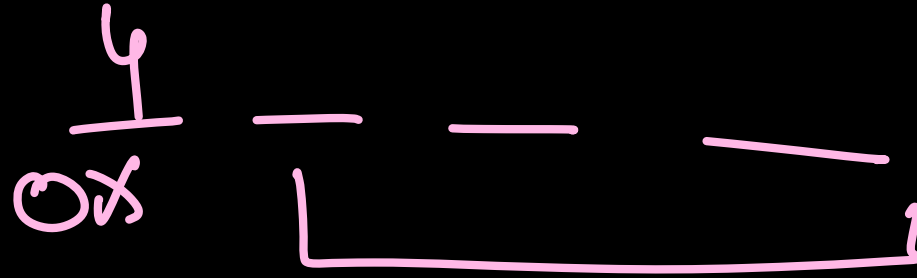
If $15_{C_{3r}} = 15_{C_{r+3}}$, then 'r' is equal to

A 2

B 3

C 4

D 5

$3r + r + 3 = 15$

$\Rightarrow 4r + 3 = 15$

$\Rightarrow 4r = 15 - 3$

$\Rightarrow$ $r = \dfrac{12}{4} = 3$

There are 10 flights operating between City-A to City-B. The number of ways in which a person can travel from City-A to City-B and return by a different flight is

[June 2021]

A 90

B 95

C 80

D 78

$$^{10}C_1$$

$$A \qquad \& \qquad B$$

$$^9C_1$$
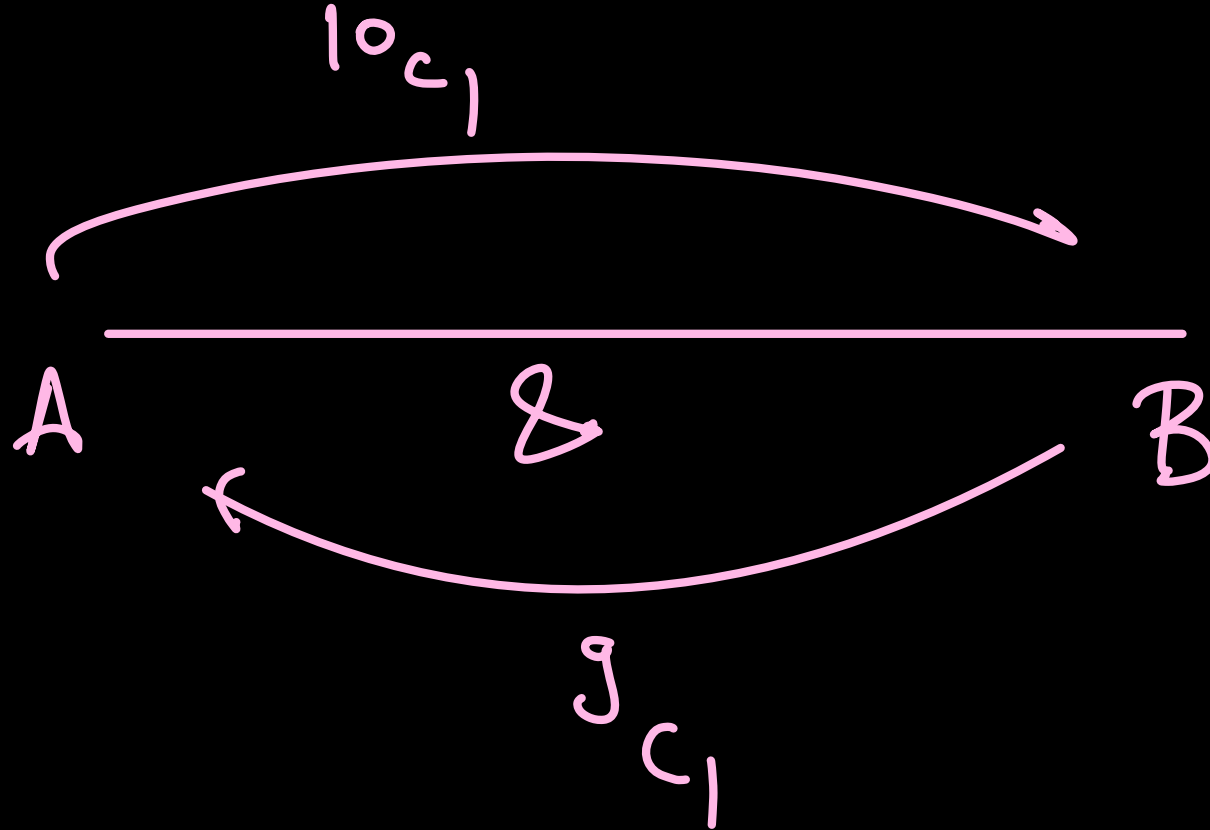
$$^{10}C_1 \times {^9}C_1 = 10 \times 9 = 90$$

3 ladies and 3 gents can be seated at a round table so that any two and only two of the ladies sit together. The number of ways is

A 70

B 27

C 72

D None of these

$$3_{c_2} \times {}^2p_2 \times {}^2p_1 \times {}^3p_3$$

$$= \frac{3 \times 2}{2 \times 1} \times 2 \times 1 \times 2 \times 3 \times 2 \times 1 = 72$$

Out of 7 gents and 4 ladies a committee of 5 is to be formed. The number of committees such that each committee includes at least one lady is

A. 400

B. 440

C. 441

D. None of these

Atleast one = Total way without Cond^n − no lady

$$= {}^{11}C_5 - {}^{7}C_5 \times {}^{4}C_0$$

$$= \frac{11 \times 10 \times 9 \times 8 \times 7}{5 \times 4 \times 3 \times 2 \times 1} - \frac{7 \times 6}{2 \times 1} \times 1$$

$$= 462 - 21 = 441$$

The number of ways in which a person can chose one or more of the four electrical appliances : T.V. , Refrigerator, Washing Machine and a cooler is

Q6, Exercise 5(C), (ICAI)

A. 15

B. 25

C. 24

D. None of these

$$(1+1) \cdot (1+1) \cdot (1+1) \cdot (1+1) - 1 = 2 \times 2 \times 2 \times 2 - 1 = 16 - 1 = 15$$

A polygon has 44 diagonals then the number of sides are

A. 6

B. 7

C. 8

D. 11

$$^nC_2 - n = 44$$

$$\Rightarrow \frac{n(n-1)}{2} - n = 44$$

a) $\frac{6 \times 5}{2} - 6 \neq 44$

b) $\frac{7 \times 6}{2} - 6 \neq 44$

c) $\frac{8 \times 7}{2} - 6 \neq 44$

d) $\frac{11 \times 10}{2} - 11 = 44$

How many 3-digit odd numbers can be formed using the digits 5, 6, 7, 8, 9. If the digits can be repeated ?   **[Dec. 2022]**

A 55

B 75

C 65

D 85

$5 \text{ or } 7 \text{ or } 9$

$5 \times \quad 5 \times \underline{3} \quad = 75$

2

There are 20 points in a plane area. How many triangles can be formed by these points if 5 points are collinear?

$5 > 3$ $15 \to 0$

all three point cannot be collinear

[Dec 2022]

A   550

B   560

C   1130

D   1140

$$^{20}C_3 - ^{5}C_3 \cdot ^{15}C_0$$

$$= \frac{20 \times 19 \times 18^{3}}{3 \times 2 \times 1} - \frac{5 \times 4^{2}}{2 \times 1} \times 1$$

$$= 1140 - 10 = 1130$$

The number of ways the letters of the word 'COMPUTER' can be rearranged is

A 40,320

B 40,319

C 40,318

D None of these

$$^8P_8 - 1$$

$$= 8! - 1$$

$$= 40320 - 1 = 40319$$

5 persons are sitting in a round table in such way that Tallest Person is always on the right-side of the shortest person; the number of such arrangements is

MTP Series 2 (JAN 2025)

A 6

B 8

C 24

D None of these

$$1 \times 1 \times \frac{3}{3}$$

$$= 1 \times 1 \times 3!$$

$$= 6$$
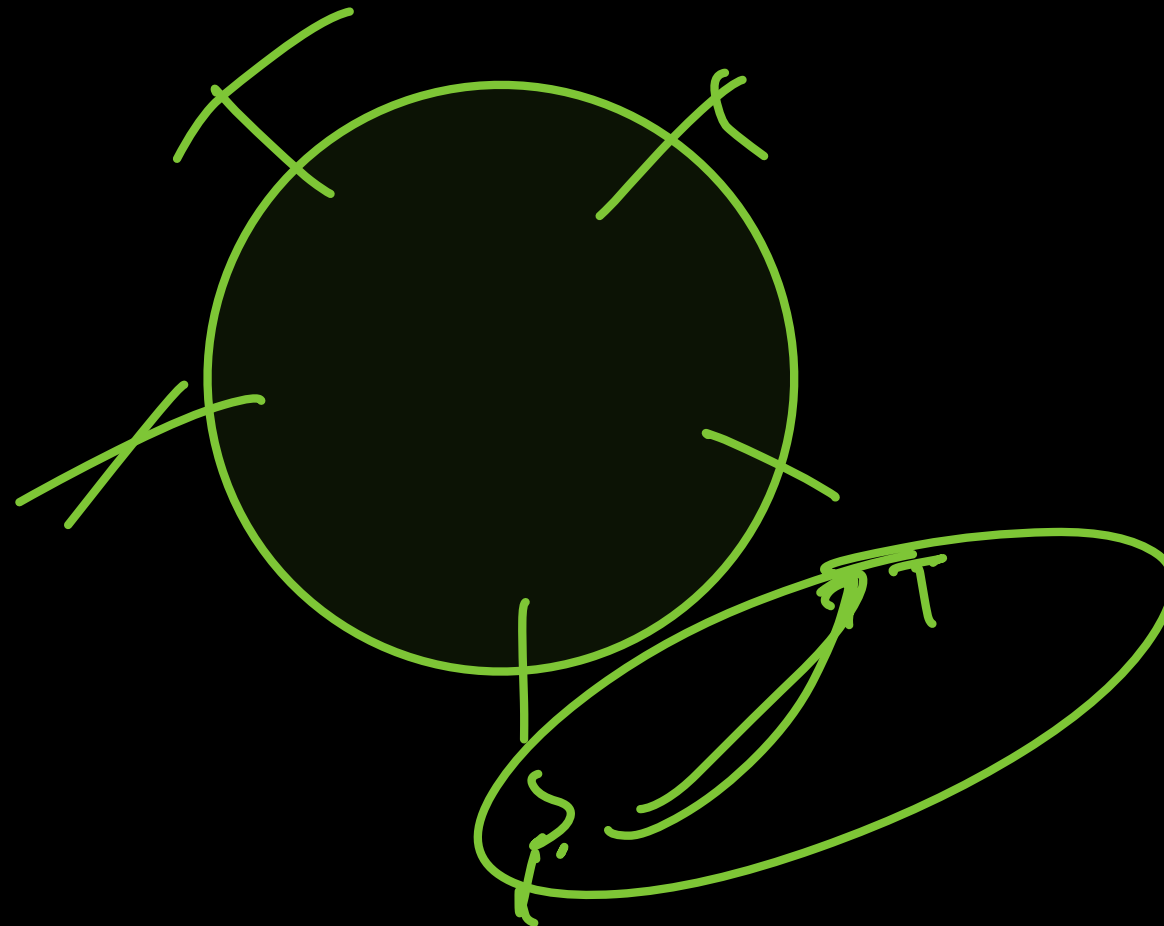
If 12 school teams are participating in a quiz contest, then the number of ways the first, second and third positions may be won is

MTP Series 2 (JAN 2025)

A 1,230

B 1,320

C 3,210

D None of these

$$12$$

$$1 \quad 2 \quad 3$$

$$\underline{12} \times \underline{11} \times \underline{10} = 1320$$

Sequence and Series

Arithmetic Progression

○ A sequence a_1, a_2, a_3, ..., an is called an Arithmetic Progression (A.P.) when

$$a_2 - a_1 = a_3 - a_2 = ... = a_n - a_{n-1} = d$$

○ n^{th} term (t_n) = a + (n − 1) d,

○ Sum of n terms of AP:- $S_n = \frac{n}{2}[2a + (n-1)d]$ $\rightarrow S_n = \frac{n}{2}(a+l)$

○ $t_{n} = S_n - S_{n-1}$

Sum of the first n terms

- Sum of 1st n natural or counting numbers: $S = n\dfrac{(n+1)}{2}$ $= 1 + 2 + 3 + 4 + \cdots + n$

- Sum of 1st n odd number : $S = n^2$

  $1 + 3 + 5 + \cdots + (2n-1)$

  $1^2 + 2^2 + 3^2 + \cdots + n^2$

- Sum of 1st n even number : $S = n(n+1)$

  $2 + 4 + 6 + 8 + \cdots + 2n$

- Sum of the Squares of the first, n natural numbers: $\dfrac{n(n+1)(2n+1)}{6}$

- Sum of the squares of the first, n natural numbers is $\left\{\dfrac{n(n+1)}{2}\right\}^2$

  $1^3 + 2^3 + 3^3 + \cdots + n^3$

Geometric Progression (G.P)

- n^{th} term of a GP = ar^{n-1}

- Sum of first n terms of a G P

$$S_n = a \frac{(1-r^{\wedge}n)}{(1-r)} \text{ / when } r < 1$$

$$S_n = a \frac{(r^{\wedge}n-1)}{(r-1)} \text{ when } r > 1$$

- Sum of infinite geometric series

$$S_\infty = \frac{a}{1-r}, \quad r < 1$$

$$a, \; ar, \; ar^2, \; ar^3 \; \text{---} \; \text{---} \; ar^{n-1}$$

$$t_n = a r^{n-1}$$

$$S_n = a \left[\frac{1-r^n}{1-r} \right] \quad r < 1$$

$$S_n = a \left[\frac{r^n - 1}{r - 1} \right] \rightarrow r > 1$$

Which term of the progression -1, -3, -5,.... is-39

A   21st

B   20th

C   19th

D   None of these

$$d = -3-(-1) = -5-(-3) = -2$$

$$-39 = -1 + (n-1)(-2)$$

$$\Rightarrow -39 + 1 = -2n + 2$$

$$\Rightarrow -38 = -2n + 2$$

$$\Rightarrow -38 - 2 = -2n$$

$$\Rightarrow n = +\frac{\overset{20}{\cancel{40}}}{\cancel{-2}} = 20$$

The second term of a G P is 24 and the fifth term is 81. The series is

Q11, Exercise 6(B), (ICAI)

A 16, 36, 24, 54,..

B 24, 36, 53,...

C 16, 24, 36, 54,..

D None of these

$$a_5 = \overset{27}{\underset{2}{\cancel{54}}} \times 3 = 81$$

$$\frac{24}{16} = \frac{36}{24} = \frac{3}{2}$$

$\times \frac{3}{2}$
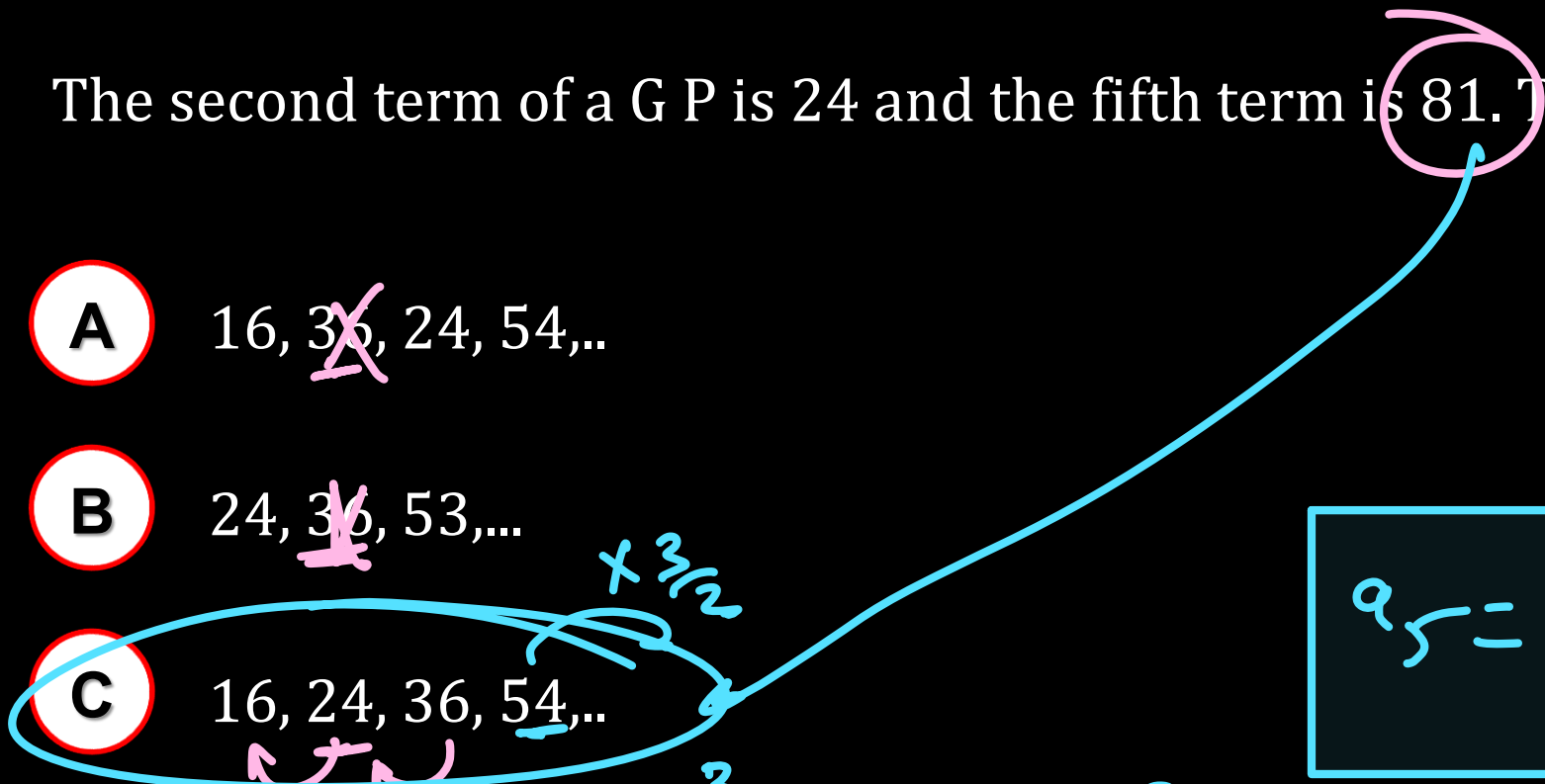
If the terms 2x, (x + 10) and (3x +2) be in A.P., the value of x is

Q9, Exercise 6(C), (ICAI)

A 7

B 10

C 6

D None of these

$$x + 10 - 2x = 3x + 2 - (x + 10)$$

$$\Rightarrow 10 - x = 3x + 2 - x - 10$$

$$\Rightarrow 10 - x = 2x - 8$$

$$\Rightarrow 10 + 8 = 2x + x$$

$$\Rightarrow 18 = 3x$$

$$\Rightarrow x = \frac{18}{3} = 6$$

Find the numbers whose GM is 5 and AM is 7.5.

$\sqrt{12 \times 13} \neq 5$

A 12 and 13

$GM = \sqrt{a \times b} = 5$

B ~~13.09 and 1.91~~

$\sqrt{13.09 \times 1.91} = 5$

$AM = \dfrac{a+b}{2}$

C 14 amd 11

D 17 and 19

The sum of the following series 4 + 44 + 444 + ... + to n terms is

A $\dfrac{4}{9}\left[\dfrac{10(10^n - 1)}{9} - n\right]$

B $\dfrac{4}{9}\left[\dfrac{10(10^n - 1)}{9} + n\right]$

C $\dfrac{10(10^n - 1)}{9} + n$

D None of these

$\dfrac{9 \times 4}{9}\left(1 + 11 + 111 + \_\_\_\_\right)$

$\dfrac{4}{9}\left(9 + 99 + 999 + \_\_\_\right)$

$\Rightarrow \dfrac{4}{9}\left(\dfrac{10(10^n - 1)}{9} - n\right)$

The sum upto infinity of the series $S = \frac{1}{2} + \frac{1}{6} + \frac{1}{18} + \ldots\ldots$ is

A 5/4

B 3/4

C 7/3

D None of these

$$S = \frac{a}{1-r} = \frac{\frac{1}{2}}{1-\frac{1}{3}} = \frac{\frac{1}{2}}{\frac{2}{3}} = \frac{3}{4}$$

$$r = \frac{\frac{1}{6}}{\frac{1}{2}} = \frac{\frac{1}{18}}{\frac{1}{6}} = \frac{1}{3}$$

→ GBC

Three numbers are in AP and their sum is 21. If 1, 5, 15 are added to them respectively, they form a G. P. The numbers are:

MTP Series 2 (JAN 2025)

$$n^2 \quad n^2$$

$a-d \qquad a \qquad a+d$

A 5, 7, 9

$$\frac{-y}{n^2} \quad n^2$$

B 9, 5, 7

$$n^{-2}$$

C 7, 5, 9

$$y$$

D None of these.

$$5 + 7 + 9 = 21$$
$$+1 \quad +5$$

$$5+1 \to 6$$
$$7+5 \to 12 \Big\}^{2 \times 2}$$
$$9+15 \to 24 \Big\}^{2 \times 2}$$

The sum of three numbers in G.P. is 70. If the two extremes by multiplied each by 4 and the mean by 5, the products are in AP. The numbers are **MTP Series 2 (JAN 2025)**

$GP = a_1 + a_2 + a_3$

A 12, 18, 40

B 10, 20, 40

C 40, 20, 15

D none of these

$$10 \qquad 20 \qquad 40$$
$$\times 4 \qquad \times 5 \qquad \times 4$$
$$\downarrow \qquad \downarrow \qquad \downarrow$$
$$40 \qquad 100 \qquad 160$$

60   60
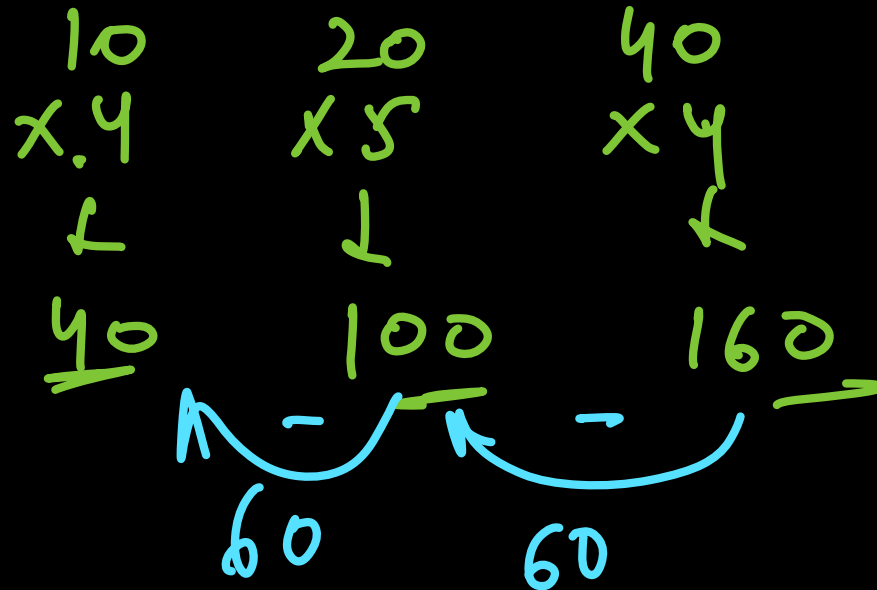
The first and the last term of an AP are –4 and 146. The sum of the terms is 7171. The number of terms is

a → first term
e → last term

A. 101

B. 100

C. 99

D. None of these

$$S_n = \frac{n}{2}(a + e)$$

$$\Rightarrow 7171 = \frac{n}{2}(-4 + 146)$$

$$\Rightarrow 7171 = \frac{n}{2}(142)^{71}$$

$$\Rightarrow n = 7171 \div 101$$

Sets, Relations and Functions

n

- No. of sets for n number of elements :- 2^n subsets.

Proper Subset $= 2^n - 1$

- Power Set :- The collection of all possible subsets of a given set A is called the power set of A, to be denoted by P(A). $= 2^n$

- Proper Subset and Super Set :-

- A set containing n elements has 2^n-1 proper subsets
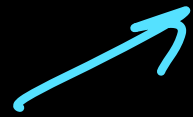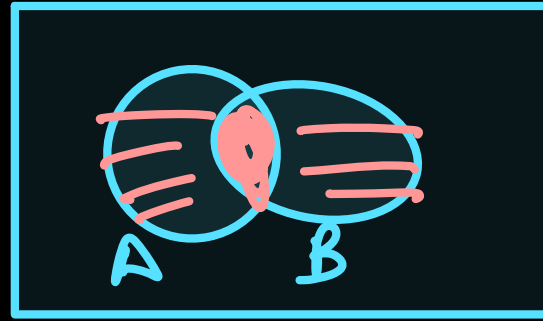
(1) $n(A \cup B) = n(A) + n(B) - n(A \cap B)$

(2) $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(A \cap C) + n(A \cap B \cap C)$

$-n(A \cap B)$

(3) $n(A - B) = n(A) - n(A \cap B)$

(4) $n(B - A) = n(B) - n(A \cap B)$

If A = {p, q, r, s}, B = {q, s, t}, C = {m, q, n}. Find C – [A ∩ B].

A   {m, n}

B   {p, q}

C   {r, s}

D   {p, r}

$$\Rightarrow \{m, q, n\} - \langle q, s)$$

$$\Rightarrow \{m, n\}$$

If A = {0, 1, 2, 3, 4, 5} then the number of subsets of A is

A 64

B 63

C 61

D 60

$$2^6 = 64$$

(AUB)' is equal to

A   (A' ∪ B)'

B   A' ∩ B'

C   A' ∪ B'

D   None of these

$$(A \cup B)' = A' \cap B'$$

$$(A \cap B)' = A' \cup B'$$

If $f(x): N \to R$ is a function defined as $f(x) = 4x + 3, \forall x \in N$, then $f^{-1}(x)$ is :

A $4 + \dfrac{x+3}{4}$

B $\dfrac{x+3}{4}$

C $\dfrac{x-3}{4}$

D $\dfrac{3x+4}{4}$

$f(x) = y$

$\to f^{-1}(y) = x$

$y = 4x + 3$

$4x = y - 3$

$\Rightarrow x = \dfrac{y-3}{4}$

$\Rightarrow f^{-1}(y) = \dfrac{y-3}{4} \Rightarrow f^{-1}(x) = \dfrac{x-3}{4}$

In a survey of 100 boys it was found that 50 used white shirts, 40 red shirts and 30 blue shirts. 20 were habituated in using both white and red shirts. 15 were using both red and blue shirts and 10 were using blue and white shirts. Find the number of boys who are using all colours.

[Dec. 2023]

A 20

B 25

C 30

D 35

$$n(R \cup W \cup B) = 100 = n(U)$$

$$n(W) = 50$$

$$n(R) = 40$$

$$n(B) = 30$$

$$n(R \cap W) = 20$$

$$n(R \cap B) = 15$$

$$n(B \cap W) = 10$$

$$n(B \cap R \cap W) = x$$

$$100 = 50 + 40 + 30 - 20 - 15 - 10 + x$$

$$100 = 75 + x$$

$$x = 100 - 75 = 25$$

If A = {1, 2, 3, 4, 5, 7, 8, 9} and B = {2, 4, 6, 7, 9} then how many proper subset of A ∩ B can be created. **[Dec 2022]**

A 16

B 15

C 32

D 31

$A \cap B = \{2, 4, 7, 9\}$

$Proper\ Subset = 2^4 - 1 = 16 - 1 = 15$

If f(x) = $\dfrac{x}{1-x}$ and g(x) = $\dfrac{x+1}{x}$, then gof(x) is

A x – 1

B x

C 1/x

D None of these

$$g \circ f(x) = g(f(x)) = \frac{f(x)+1}{f(x)} = \frac{\frac{x}{1-x}+1}{\frac{x}{1-x}}$$

$$= \frac{\frac{x+1-x}{1-x}}{\frac{x}{1-x}} = \frac{\frac{1}{1-x}}{\frac{x}{1-x}} = \frac{1}{x}$$

A town has a total population of 50,000. Out of it 28,000 read the newspaper X and 23,000 read Y while 4,000 read both the papers. The number of persons not reading X and Y both is

A 2,000

B 3,000

C 2,500

D None of these

$n(X) = 28000$

$n(Y) = 23000$

$n(X \cap Y) = 4006$

$n(X \cup Y) = 28000 + 23000 - 4000 = 47000$

$n(X \cap Y)' = n(U) - n(X \cup Y)$

$= 50000 - 47000 = 3000$
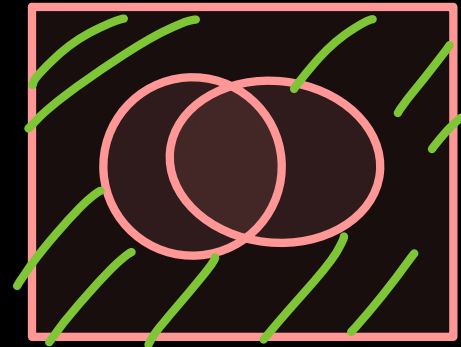
Probability

$$P(A) = \frac{n_A}{n} = \frac{\text{No. of eqally likely events favourable to A}}{\text{Total no. of equally likely events}}$$

- The probability of an event lies between 0 and 1, both inclusive. i.e. $0 \leq P(A) \leq 1$

- When P(A) = 0, A is known to be an impossible event and when P(A) = 1, A is known to be a sure event.

- Odds in favour of A $= m_A : (m - m_A)$

- Odds in against A $= (m - m_A) : m_A$

Probability

- For any two events A and B,   i.e. $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

- For any three events A, B and C, the probability that at least one of the
- events occurs is given by

$$P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B) - P(A \cap C) - P(B \cap C) + P(A \cap B \cap C)$$

Probability

- **Conditional Probability**

$$P\left(\frac{B}{A}\right) = \frac{P(B \cap A)}{P(A)} \ or \ \frac{P(A \cap B)}{P(A)}$$

$$P\left(\frac{A}{B}\right) = \frac{P(A \cap B)}{P(B)}$$

- **Compound Probability or Joint Proability**

$$P(A \cap B) = P(A) \times P(B/A) \ \text{Provided } P(A) > 0$$

$$\sum p = 1 \qquad 0 \leq P_i \leq 1$$

- Expected value : $E(x) = \sum x_i . p_i$

- **When x is a discrete random variable with probability mass function $f(x)$, then its expected value is given by**

$$E(x) = \mu = \sum xf(x)$$

  and its variance is

$$\sigma^2 = E(x^2) - \mu^2$$

  Where $E(x^2) = \sum x^2 f(x)$

Properties of Expected Values

(i)   Expectation of a constant k is k i.e.
(ii) E(k) = k for any constant k.
(ii) E(x + y) = E(x) + E(y) for any two random variables x and y.
(iii) E(kx) = k · E(x) for any constant k
(iv) E(xy) = E(x) × E(y)
      Whenever x and y are independent.

If a number is selected at random from the first 50 natural numbers, what will be the probability that the selected number is a multiple of 3 and 4?

A   5/50

B   2/25

C   3/50

D   4/25

$1, 2, 3, 4, - - - \quad 50$

$L \cdot CM = 3 \times 4 = 12$

$12, 24, 36, 48$

$$\frac{4}{50} = \frac{2}{25}$$

A box contain 20 electrical bulbs out of which 4 are defective. Two bulbs are chosen at random from this box. The probability that at least one of them is defective.

[Dec. 2023]

A 7/19

B 4/19

C 12/19

D 15/19

$20 <^{16}_{\ 4}$

$1 dy$ $2 def$ $0 def$

$$\frac{^{20}C_2 - {}^{16}C_2 \times {}^4C_0}{^{20}C_2}$$

$$= \frac{\dfrac{\overset{10}{\cancel{20}} \times 19}{\cancel{2} \times 1} - \dfrac{\overset{8}{\cancel{16}} \times 15}{\cancel{2} \times 1} \times 1}{\dfrac{\overset{10}{\cancel{20}} \times 19}{\cancel{2} \times 1}} = \frac{190 - 120}{\overset{10}{\cancel{20}} \times 19} = \frac{\overset{7}{\cancel{70}}}{\underset{1}{\cancel{10}} \times 19} = \frac{7}{19}$$

If a random variable X has the following probability distribution, then the expected value of X is: ~~If a random variable X has the following probability distribution, then the expected value of X is:~~

[June 2023]

X	-1	-2	0	1	2
$f(x)$	$\dfrac{1}{3}$	$\dfrac{1}{6}$	$\dfrac{1}{5}$	$\dfrac{1}{6}$	$\dfrac{1}{3}$

A 3/2

B 1/2

C 1/6

D 1/5

$$-1 \times \frac{1}{3} + -2 \times \frac{1}{6} + 0 \times \frac{1}{5} + 1 \times \frac{1}{6} + 2 \times \frac{1}{3}$$

$$= -\frac{1}{3} - \frac{1}{3} + 0 + \frac{1}{6} + \frac{2}{3}$$

$$= \frac{1}{6}$$

The odds in favour of event A in a trial is 3 : 1. In a three independent trials, the probability of no occurrence of the event A is

[June 2022]

A 1/64

B 1/32

C 1/27

D 1/8

1 independ trial → non occ · prob = $\dfrac{1}{3+1} = \dfrac{1}{4}$

$$P(T_1 \cap T_2 \cap T_3)$$

$$= P(T_1) \cdot P(T_2) \cdot P(T_3)$$

$$= \frac{1}{4} \times \frac{1}{4} \times \frac{1}{4} = \frac{1}{64}$$

Two balanced dice are rolled. The probability of getting 1 in at least one dice is x/36 where x is

A. 12

B. 1

C. 11

D. 2

$$P(D_1 \cup D_2) = P(D_1) + P(D_2) - P(D_1 \cap D_2)$$

$$= \frac{6}{36} + \frac{6}{36} - \frac{1}{36}$$

$$= \frac{11}{36}$$

$$6 \times 6 = 36$$

$$P(A) + P(B) + P(C) = 1$$

$$P(A) = P(B) = P(C) = \frac{1}{3}$$

Three events A, B and C are mutually exclusive, exhaustive and equally likely.

What is the probably of the complementary event of A?

MTP Series 2 (JAN 2025)

A 1/3

B 2/3

C 3/7

D 10

$$P(A') = 1 - P(A) = 1 - \frac{1}{3} = \frac{2}{3}$$

What is the chance of picking a spade or an ace not of spade from a pack of 52 cards?

A   4/13

B   2/13

C   3/26

D   3/18

$$\frac{13}{52} + \frac{3}{52} = \frac{16}{52} = \frac{4}{13}$$

Find the probability that a four-digit number comprising the digits 2, 5, 6 and 7 would be divisible by 4.

MTP Series 2 (JAN 2025)

A 1/4

B 1/3

C 1/2

D 1

Total cases =

$\_ \_ \_ \_ \rightarrow 4! = 24$

Fav cases

$\boxed{2 \_ \_ \_}$ $\boxed{4 \_ \_ \_}$ $\rightarrow 5 \quad 2$

$= 8 \times 6 \quad \frac{2}{2}$

$\rightarrow 7 \quad 2$

Last 2 digit by 4.

$\times 2 \quad 6$

$\frac{8}{24} = \frac{1}{3}$

$\rightarrow 5 \quad 6$

$\rightarrow 7 \quad 6$
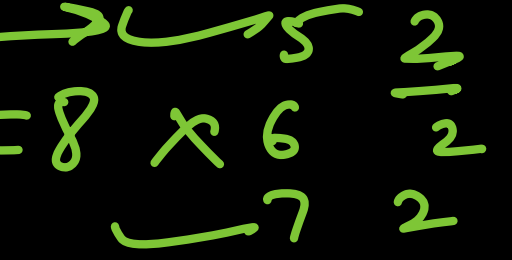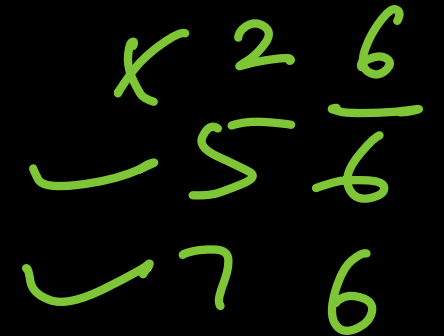
The probability that an Accountant's job applicant has a B. Com. Degree is 0.85, that he is a CA is 0.30 and that he is both B. Com. and CA is 0.25 out of 500 applicants, how many would be B. Com. or CA?

A 0.25

B 0.30

C 0.10

D 0.90

$$P(B) = 0.85$$

$$P(C) = 0.3$$

$$P(B \cap C) = 0.25$$

$$P(B \cup C) = 0.85 + 0.3 - 0.25$$

$$= 0.9$$

2 men

Rupesh is known to hit a target in 5 out of 9 shots whereas David is known to hit the same target in 6 out of 11 shots. What is the probability that the target would be hit once they both try?

MTP Series 2 (JAN 2025)

A 79/99

B 10/13

C 14/26

D 13/18

$$P(R) = \frac{5}{9}$$

$$P(D) = \frac{6}{11}$$

$$P(R \cap D') + P(R' \cap D) + P(R \cap D)$$

$$= P(R) \cdot P(D') + P(R') \cdot P(D) + P(R) \cdot P(D)$$

$$= \frac{5}{9} \times \frac{5}{11} + \frac{4}{9} \times \frac{6}{11} + \frac{5}{9} \times \frac{6}{11} = \frac{79}{99}$$

In a business venture, a man can make a profit of ₹ 50,000 or incur a loss of ₹ 20,000. The probabilities of making profit or incurring loss, from the past experience, are known to be 0.75 and 0.25 respectively. What is his expected profit?

A ₹ 33,500

B ₹ 34,500

C ₹ 35,500

D ₹ 32,500

$$50,000 \qquad (20,000)$$
$$\times 0.75 \qquad \times 0.25$$

$$E(P) = 50000 \times 0.75 + (-20000) \times 0.25$$
$$= ₹ 32500$$

Theoretical Distribution

Probability Distribution

Name	Condition	Probability Mass Function	Notation	Mean	Varinace	Mode	Remarks
Binomial Distribution	Trials are independent and each trail has only two outcomes Success & failure.	$P(X = x) =$ $^nC_x \, p^x \, q^{n-x}$	$X \sim B(n, p)$	$\mu = np$	$\sigma^2 = npq$	Mode = (n+1)p if non integer If integer = (n+1)p and (n+1)p -1	p + q = 1
Poisson Distribution	Trials are independent and probability of occurrence is very small in give time.	$P(X = x)$ $= \dfrac{e^{-m} \cdot m^x}{x!}$ For x = 0,1,2,…, n	$X \sim P(m)$	$\mu = m$	$\sigma^2 = m$	Mode = m if non integer If integer = m and m-1	e = 2.71828
Normal or Gaussian Distribution	When distribution is symmetric	$P(X = x)$ $= \dfrac{1}{\sigma\sqrt{2\pi}}\, e^{-(x-\mu)^2}$ For $-\infty < x < +\infty$	X $\sim N(\mu, \sigma^2)$ $Z = \dfrac{x - \mu}{\sigma}$	Mean = Median = Mode = μ	σ^2		Mean Deviation = 0.8σ First Quartile = $\mu - 0.675\sigma$ Third Quartile = $\mu + 0.675\sigma$ Quartile Deviation = 0.675σ Point of Inflexion x = $\mu - \sigma$ and x = $\mu + \sigma$

Relationship for Normal Distribution:- 4SD = 5MD = 6QD

For binomial distribution E(x) = 2, V(x) = 4/3. Find the value of n.

A 3

B 4

C 5

D 6

$$np = 2 \quad \text{—①}$$

$$npq = \frac{4}{3} \quad \text{—②}$$

$$n\left(\frac{1}{3}\right) = 2$$

$$\Rightarrow n = 3 \times 2 = 6$$

$$\frac{②}{①}:$$

$$\frac{npq}{np} = \frac{\frac{4}{3}}{2}$$

$$q = \frac{4}{3} \times \frac{1}{2} = \frac{2}{3}$$

$$p = 1 - q = 1 - \frac{2}{3} = \frac{1}{3}$$

The variance of a normal distribution is given to be 16. The mean deviation about mode is

A   3.2

B   8

C   12.8

D   12

$$\sigma^2 = 16$$

$$\sigma = 4$$

$$MD = 0.8\,\sigma = 0.8 \times 4 = 3.2$$

Poison dis

Between 9 AM and 10 AM the average number of phone calls per minute coming into the switchboard of a company is 4. Find the probability that during one particular minute, there will be either 2 phone calls or no phone calls (given $e^{-4} = 0.018316$)

[June 2023]

A. 0.156

B. 0.165

C. 0.149

D. 0.194

$m = 4$

$P(X = 2 \text{ or } X = 0) = P(X = 2) + P(X = 0)$

$$= \frac{e^{-4} 4^2}{2!} + \frac{e^{-4} 4^0}{0!}$$

$\Rightarrow e^{-4} \left(\frac{16}{2} + 1 \right)$

$\Rightarrow 0.018316 \times 9 = 0.164844$

$$6_{C_4} = 6_{C_2}$$

Find the probability of a success for the binomial distribution satisfying the following relation.

4 P (x = 4) = P (x = 2) and having the parameter n as six. $n = 6$

A 1/3

B 1/2

C 1/5

D 1/8

$$4 \times 6_{C_4} p^4 q^{6-4} = 6_{C_2} p^2 q^{6-2}$$

$$\Rightarrow 4 \times \frac{p^4 q^2}{p^2 q^2} = \frac{p^2 q^4}{p^2 q^2}$$

$$\Rightarrow \sqrt{4p^2} = \sqrt{q^2}$$

$$= \sqrt{(2p)^2} = q$$

$$\Rightarrow 2p = q$$

$$\Rightarrow 2p = 1-p$$

$$\Rightarrow 2p + p = 1$$

$$\Rightarrow p = \frac{1}{3}$$

$3 : 1$

An experiment succeeds thrice as after it fails. If the experiment is repeated 5 times, what is the probability of having no success at all?

MTP Series 2 (JAN 2025)

A 1/1023

B 1/1024

C 1/1005

D 1/1008

$p \rightarrow P(A) = \dfrac{3}{3+1} = \dfrac{3}{4}, q = P(A') = \dfrac{1}{4}$

$\begin{matrix} n=5 \\ x=0 \end{matrix} \Big] \rightarrow P(x=0) = {}^{5}C_{0}\left(\dfrac{3}{4}\right)^{0}\left(\dfrac{1}{4}\right)^{5-0}$

$= 1 \times 1 \times \left(\dfrac{1}{4}\right)^{5} = \dfrac{1^{5}}{4^{5}} = \dfrac{1}{1024}$

If the two quartiles of a normal distribution are 47.30 and 52.70 respectively, find the mean deviation about median of this distribution.

A   3.80

B   3.40

C   3.20

D   4.20

$$Q_3 = 52.7 \qquad Q_1 = 47.3$$

$$QD = \frac{52.7 - 47.3}{2} = 2.7$$

$$\Rightarrow 0.675 \, \sigma = 2.7$$

$$\Rightarrow \sigma = 4$$

$$\Rightarrow MD = 0.8 \, \sigma = 0.8 \times 4 = 3.2$$

X follows normal distribution with mean as 50 and variance as 100. What is P(x ≥ 60)?
[Given φ(1) = 0.8413]

$\sigma = \sqrt{100} = 10$

A 0.20

B 0.40

C 0.16

D 0.30

$$P(X \geq 60) \Rightarrow P\left(\frac{X-\mu}{\sigma} \geq \frac{60-50}{10}\right)$$

$$\Rightarrow P(Z \geq 1) = 1 - P(Z \leq 1)$$

$\phi(1)$

$$= 1 - \phi(1)$$

$$= 1 - 0.8413$$

$$= 0.1587$$

Number of misprints per page of a thick book follows:

A Normal distribution

B Poisson distribution

C Binomial distribution

D Standard normal distribution

If the points of inflexion of a normal curve are 40 and 60 respectively, then its mean deviation is.

A 40

B 45

C 50

D 60

$$\mu - \sigma = 40$$
$$\mu + \sigma = 60$$
$$- \qquad -$$
$$+2\sigma = +20$$
$$\sigma = \frac{20}{2} = 10$$

$$MD = 0.8\sigma$$
$$= 0.8 \times 10 = 8$$

$$\mu - \sigma = 40$$
$$\mu + \sigma = 60$$
$$2\mu = 100$$
$$\mu = 50$$

Correlation and Regression

Correlation

➢ The following table shows degrees of correlation according to various values of r.

Degree of Correlation	Positive	Negative
Perfect correlation	+1	-1
Very high degree of correlation	+ 0.9 to + 1	- 0.9 to – 1
Fairly high degree of correlation	+ 0.75 to + 0.9	- 0.75 to - 0.9
Moderate degree of correlation	+ 0.50 to + 0.75	- 0.50 to - 0.75
Low degree of correlation	+ 0.25 to + 0.50	- 0.25 to - 0.5
Very low degree of correlation	0 to + 0.25	- 0.25 to 0
No correlation	0	0

Correlation

KARL PEARSON'S PRODUCT MOMENT CORRELATION COEFFICIENT	SPEARMAN'S RANK CORRELATION COEFFICIENT	COEFFICIENT OF CONCURRENT DEVIATIONS
$$r = r_{xy} = \frac{Cov\,(x\,,y)}{\sigma_x \times \sigma_y}$$ Where, $$Cov\,(x\,,y) = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{n}$$ $$\text{or } = \frac{\sum x_i y_i}{n} - \bar{x}\bar{y}$$ $$\sigma_x = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n}} \quad \sigma_y = \sqrt{\frac{\sum (y_i - \bar{y})^2}{n}}$$ $$r = \frac{n\sum x_i y_i - \sum x_i \times \sum y_i}{\sqrt{\left[n\sum x_i^2 - (\sum x_i)^2\right] \times \left[n\sum y_i^2 - (\sum y_i)^2\right]}}$$ $$r_{xy} = \frac{bd}{|b||d|} r_{uv}$$ where $u = \dfrac{x-a}{b}$ and $v = \dfrac{y-c}{d}$	$$r_R = 1 - \frac{6\sum d_i^2}{n(n^2-1)}$$ For tied ranking, $$r_R = 1 - \frac{6\left[\sum d_i^2 + \sum \frac{(t^3-t)}{12}\right]}{n(n^2-1)}$$	$$r_C = \pm\sqrt{\pm\frac{(2c-m)}{m}}$$ Where c is concurrent deviation, m is one less than number of pairs of observations $$m = n-1$$

REGRESSION ANALYSIS

	Y depends on X	**X depends on Y**
Simple Regression Equation	$y = a + b_{yx}\, x$	$x = a + b_{xy}\, y$
Normal Equations	$\sum y_i = na + b_{yx}\sum x_i$ $\sum x_i y_i = a\sum x_i + b_{yx}\sum x_i^2$	$\sum x_i = na + b_{xy}\sum y_i$ $\sum x_i y_i = a\sum y_i + b_{xy}\sum y_i^2$
Regression Coefficient	$b_{yx} = \dfrac{\text{Cov}(x, y)}{\sigma_x^2}$ $b_{yx} = \dfrac{r\sigma_y}{\sigma_x}$	$b_{xy} = \dfrac{\text{Cov}(x, y)}{\sigma_y^2}$ $b_{xy} = \dfrac{r\sigma_x}{\sigma_y}$
	$b_{yx} = \dfrac{n\sum x_i y_i - \sum x_i \times \sum y_i}{n\sum x_i^2 - (\sum x_i)^2}$	$b_{xy} = \dfrac{n\sum x_i y_i - \sum x_i \times \sum y_i}{n\sum y_i^2 - (\sum y_i)^2}$

Some Important Relation :- Intersection point of these two lines is $\overline{x}, \overline{y}$

REGRESSION ANALYSIS

Some Important Points :-

- $r = \pm\sqrt{b_{yx} \times b_{xy}}$

- $b_{yx} = \dfrac{q}{p} \times b_{vu}$ where $u = \dfrac{x-a}{p}$ and $v = \dfrac{y-c}{q}$

- Coefficient of Determination $= r^2$

- Coefficient of Non $-$ Determination $= 1 - r^2$

$$\sigma_x^2 = 16, \sigma_y^2 = 256$$

If for two variable x and y, the covariance, variance of x and variance of y are 40, 16 and 256 respectively, what is the value of the correlation coefficient?

A   0.01

B   0.625

C   0.4

D   0.5

$$r = \frac{40}{\sqrt{16}\ \sqrt{256}} = \frac{40}{4 \times 16} = 0.625$$

The correlation between two variables x and y is found to be 0.4. What is the correlation between 2x and (-y) ?

A 0.4

B -0.4

C 0.6

D None of these

$u = 2x$

$v = -y$

$r_{uv} = r_{xy}$

$r_{uv} = -r_{xy}$

$= -0.4$

The correlation coefficient between x and y is −1/2. The value of $b_{xy} = -1/8$. Find b_{yx}.

A − 2

B − 4

C 4

D 2

$$b_{xy} = -\frac{1}{8}$$

$$r = -\frac{1}{2}$$

$$r = \sqrt{b_{yx} \times b_{xy}}$$

$$\Rightarrow \left(\frac{-1}{2}\right)^2 = \left(\sqrt{b_{yx} \times \frac{-1}{8}}\right)^2$$

$$= \frac{1}{4} = b_{yx} \times \frac{-1}{\cancel{8}_2}$$
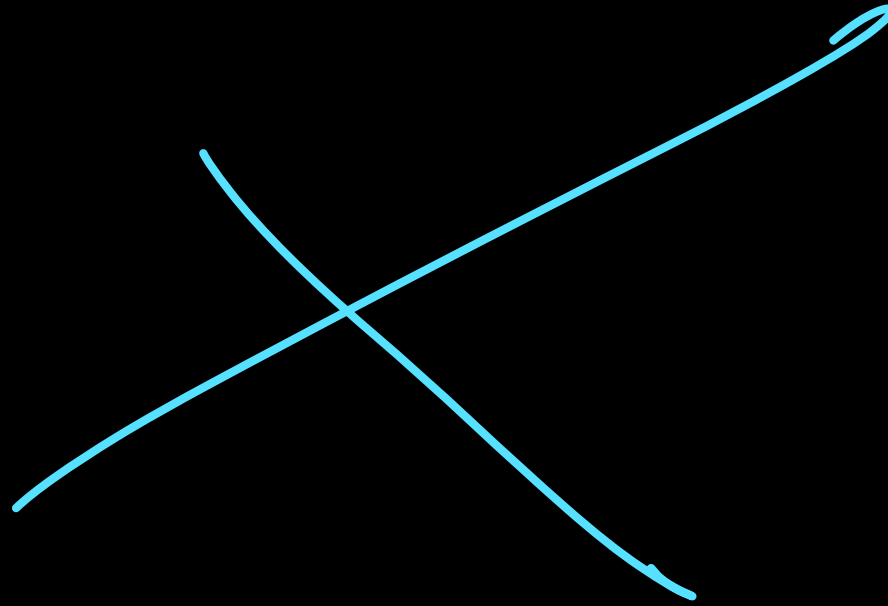
$$\Rightarrow 1 = \frac{-b_{yx}}{2}$$

$$\Rightarrow b_{yx} = -2$$

If two variables are uncorrelated then regression lines are

A Parallel

B Perpendicular

C Coincident

D Inclined at 45°

For variables X and Y, we collect the four observations with
$\sum X = 10; \sum Y = 14; \sum X^2 = 65; \sum Y^2 = 5$ and $\sum XY = 3$. What is the regression line of Y on X ?

[Dec. 2022]

$n = 4$

A $Y = -0.8X - 5.5$

B $Y = 0.8X - 5.5$

C $Y = -0.8X + 5.5$

D $Y = 0.8X + 5.5$

$$y - \bar{y} = b_{yx}(x - \bar{x})$$

$$\rightarrow y - 3.5 = -0.8(x - 2.5) \rightarrow y = -0.8x + 5.5$$

$$b_{yx} = \frac{n\sum xy - \sum x \sum y}{n\sum x^2 - (\sum x)^2} = \frac{4(3) - 10 \times 14}{4(65) - (10)^2} =$$

$$\rightarrow b_{yx} = -\frac{128}{160} = -0.8$$

$$\bar{x} = \frac{10}{4} = 2.5 \; , \; \bar{y} = \frac{14}{4} = 3.5$$

If r = 0.6 then coefficient of non-determination is:

$$1 - r^2 = 1 - (0.6)^2 = 1 - 0.36 = 0.64$$

A 0.4

B −0.6

C 0.36

D 0.64

Sampling

Sampling can be described as a statistical procedure

A To infer about the unknown universe from a knowledge of any sample

B To infer about the known universe from a knowledge of a sample drawn from it

C To infer about the unknown universe from a knowledge of a random sample drawn from it

D

Both (a) and (b).

Sampling Fluctuations may be described as

A The variation in the values of a statistic

B The variation in the values of a sample

C The differences in the values of a parameter

D The variation in the values of observations.

If a random sample of size two is taken without replacement from a population containing the units a, b, c and d then the possible samples are

Q24, Set(A), (ICAI)

A   (a, b), (a, c), (a, d)

B   (a, b), (b, c), (c, d)

C   (a, b), (b, a), (a, c),(c,a), (a, d), (d, a)

D   (a, b), (a, c), (a, d), (b, c), (b, d), (c,d)

a, b, c, d

(a,b) ,(a, c),(a, d), (b,c) (b, d)(c,d)

Parameter is a characteristic of :

A Population

B Sample

C Probability distribution

D Both (a) & (b)

Standard Error can be described as

A The error committed in sampling

B The error committed in a sample survey

C The error committed in estimating parameter.

D Standard deviation of statistic.

Calculus

The $\displaystyle\lim_{x\to 2}\frac{x^2-4x+4}{x-2} = \lim_{x\to 2}\frac{(x-2)^2}{x-2} = 2-2=0$

A   0

B   1

C   2

D   3

If $y = x(x-1)(x-2)$ then $\dfrac{dy}{dx}$ is

$y = x(x^2 - 3x + 2)$

A $3x^2 - 6x + 2$

$\Rightarrow y = x^3 - 3x^2 + 2x$

B $-6x^2 + 2$

$\Rightarrow \dfrac{dy}{dx} = 3x^2 - 6x + 2$

C $3x^2 + 2$

D $3x^3 + 5$

If x = c.t, y = c/t, then dy/dx is equal to :

A 1/t

B $t.e^t$

C $-1/t^2$

D None of these

$$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{\frac{d}{dt}\left(\frac{c}{t}\right)}{\frac{d}{dt}(c \cdot t)} = \frac{-\frac{c}{t^2}}{c}$$

$$\frac{dy}{dt} = \frac{-1}{t^2}$$

The cost function for the production of x units of a commodity by $C(x) = 2x^3 - 15x^2 + 36x + 15$ the cost will be minimum when 'x' is equal to

A 3

B 2

C 1

D 4

$$C'(x) = 2(3x^2) - 15(2x) + 36$$

$$C'(x) = 6x^2 - 30x + 36 = 0$$

$$\Rightarrow 6(x^2 - 5x + 6) = 0$$

$$\Rightarrow x^2 - 5x + 6 = 0$$

$$x = 2 \text{ or } 3$$

$$C''(x) = \frac{d}{dx}(6(x^2 - 5x + 6))$$

$$= 6(2x - 5) \xrightarrow{x=2} 6(2(2)-5) < 0 \rightarrow max$$

$$\rightarrow 6(2(3)-5) > 0 \rightarrow min$$

The equation of the curve in the form y = f(x) if the curve passes through the point (1,0) and Find f'(x) = 2x-1 is

A $y = x^2 - x$

B $x = y^2 - y$

C $y = x^2$

D   None of these

$f(1) = 0$

$$\int f'(x)dx = \int (2x-1)\,dx$$

$$f(x) = \frac{2x^2}{2} - x + c = x^2 - x + c$$

$$\Rightarrow f(1) = 1^2 - 1 + c = 0$$

$$\Rightarrow c = 0$$

$$y = f(x) = x^2 - x + 0$$

If xy = 1, then y² + dy/dx is equal to

[JUNE 23]

A 1

B 0

C −1

D 1/2

$$y = \frac{1}{x} = x^{-1}$$

$$\Rightarrow \frac{dy}{dx} = -1x^{-2} = -\frac{1}{x^2} = -\left(\frac{1}{x}\right)^2 = -y^2$$

$$\Rightarrow \frac{dy}{dx} = -y^2$$

$$\Rightarrow y^2 + \frac{dy}{dx} = 0$$

$$\int e^{ax} \, dx = \frac{e^{ax}}{a} + c$$

A $e^x + c$

B $\dfrac{e^{ax}}{a} + c$

C $\log x + c$

D $e^{ax} + c$

The gradient of the curve $y = 2x^3 - 5x^2 - 3x$ at $x = 0$ is

A 3

B -3

C 1/3

D None of these

$$\frac{dy}{dx}\Big|_{x=0} = \left[2(3x^2) - 5(2x) - 3\right]_{x=0}$$

$$= 6(0)^2 - 5(2(0)) - 3$$

$$= 0 - 0 - 3 = -3$$

Evaluate $\int_1^4 (2x+5)dx$ and the value is

$$\Rightarrow \int 2x\,dx + \int 5\,dx$$

$$2\int_1^4 x\,dx + 5\int_1^4 dx$$

$$\Rightarrow 2\left[\frac{x^2}{2}\right]_1^4 + 5(x)_1^4$$

$$= [4^2 - 1^2] + 5(4-1)$$

$$= 16 - 1 + 5\times 3$$

$$= 15 + 15 = 30$$

A   3

B   10

C   30

D   None of these.

If f(x) = x^2− 6x + 8 then f'(5) − f'(8) is equal to

A f'(2)

B 3. f'(2)

C 2. f'(2)

D None of these.

$$f'(x) = \frac{d}{dx}(x^2 - 6x + 8)$$

$$f'(x) = 2x - 6$$

$$f'(5) = 2(5) - 6 = 10 - 6 = +4$$

$$f'(8) = 2(8) - 6 = 16 - 6 = 10$$

$$f'(5) - f'(8) = +4 - 10 = -6 = 3 f'(2)$$

$$3(-2)$$

$$f'(2) = 2(2) - 6 = -2$$

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