APSEd

GATE 2020

Forenoon Solutions

E-LEARNING PLATFORM FOR
CIVIL ENGINEERING

APS
Ed

GATE 2020 Forenoon Solution

Q.1) Fuse : Fusion
Use : ?

[A] Uses

[B] Usion

[C] Usage

[D] User

Answer: Option C

Q.2) His hunger for reading is insatiable, he reads indiscriminately. He is most certainly a/an _____ reader.

[A] Wise

[B] Precocious

[C] All-round

[D] Voracious

Answer: Option D

Q.3) There is a common criticism that most of the academicians live in their _____, so they are not aware of the real-life challenges.

[A] Homes

[B] Big flats

[C] Ivory Towers

[D] Glass Palaces

Answer: Option C

Q.4) 5 friends P, Q, R, S and T went camping at night, they had to sleep in a row in a tent. P, Q and T did not want to sleep next to R, as he snored loudly. P and S avoided Q, as he usually hugged people during sleep. In what order did they sleep?

[A] RSPTQ

[B] QRSPT

[C] SPRTQ

[D] QTSPR

Answer: Option A

P, Q and T are away from R. So in between there should be S. So, R and S are adjacent. Either it should be RS at the start or SR at the end.
P, S avoided Q. So Q is not next to P/S. He can be next to R or T.

RSPTQ suits the conditions given.

Q.5) Insert seven number between 2 and 34 such that the resulting sequence including 2 and 34 is in A.P. The sum of those seven inserted numbers is

[A] 120

[B] 124

[C] 126

Answer: Option C

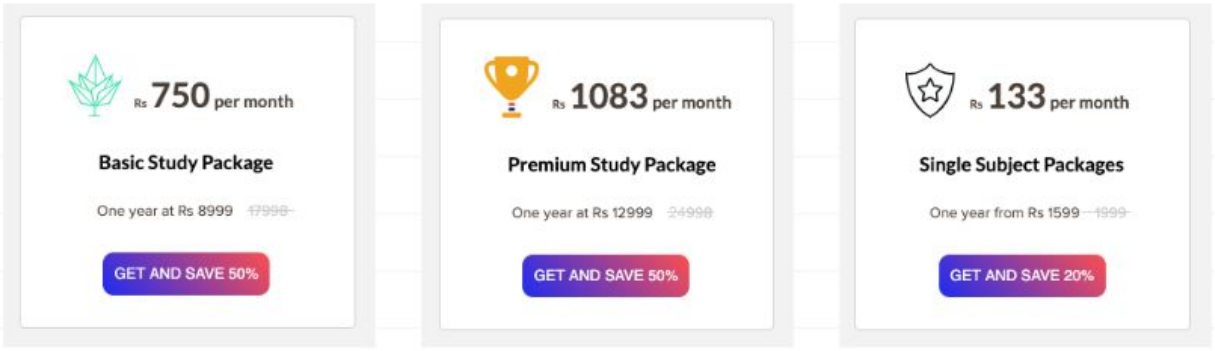
This question can be solved faster by trial and error. The difference between numbers has to be even. It can 2, 4 or 6.

The difference will be 4.

2, 6, 10, 14, 18, 22, 26, 30, 34

Sum is 6 + 10 + ... 30 = 126

EXPLORE STUDY PACKAGES



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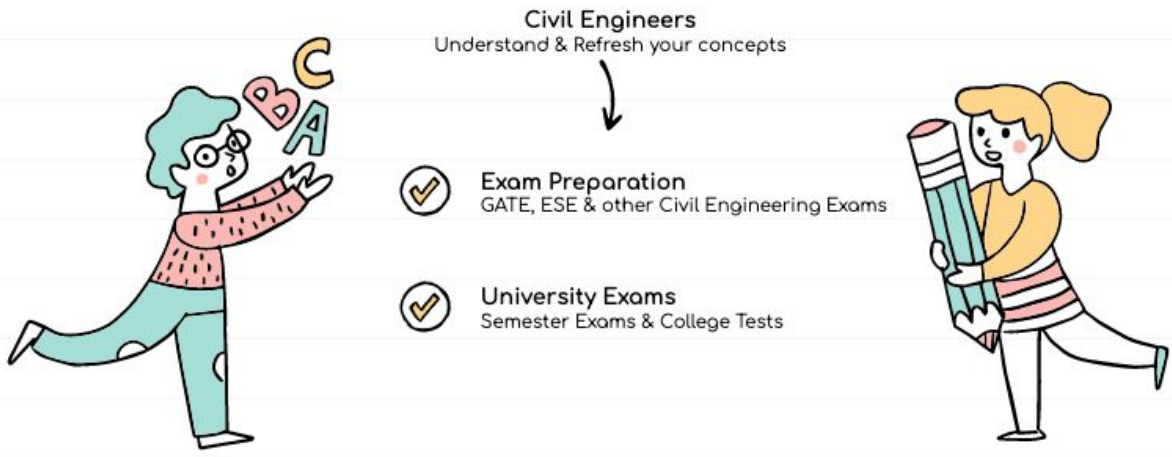


Q.6) The total monthly expenditure of a family is shown in a pie chart. Data as follows:

Health 5%
Transportation 10%
Household items 15%
Education 15%
and so on.

Find the extra money spent on education as compared to transport (in %)

[A] 5

[B] 33.33

[C] 50

[D] 100

Answer: Option C

Q.7) Unit place in 26591749^{110016} is ?

[A] 1

[B] 3

[C] 6

[D] 9

Answer: Option A

Unit place => 9^110016 => 9^(4k+0) => Units digit is 1 (Equalent to 9^4)

(Units place generally repeat in cycles of 4)
Example unit digits: 9^1 => 9, 9^2 => 1, 9^3 => 9, 9^4 => 1, 9^5 => 9
7^1 => 7, 7^2 => 9, 7^3 => 3, 7^4 => 1, 7^5=> 7 and repeats

Education 15% of x
Transportation 10% of x

Extra money on education = (15% of x - 10% of x) * 100/ 10% of x = 50%

Q.8) Sum of two positive number 100, after subtracting 5 from each number, product of the resulting number is 0, one of the original number is

[A] 80

[B] 85

[C] 90

[D] 95

Answer: Option D

x and 100-x

(x - 5)(100 - x - 5) = 0 => (x-5)(95-x) = 0

x is 5 or 95.

Q.9) If 0, 1, 2 .....8,9 are coded as O,P,Q .....W,X then 45 will be coded as?

[A] SS

[B] ST

[C] SU

[D] TS

Answer: Option B

0 - O, 1 - P and so on.
4 - S, 5 - T

Q.10) The probability that a 50 years flood may not occur at all during 25 years life of a project is

Answer: _____

Answer: 0.603

P = 1/50

Probability that a 50 years flood may not occur at all during 25 years life of a project is

(1-1/50)^25 = 0.603

Q.11) Los Angeles test of stone aggregate is done for

[A] Specific gravity

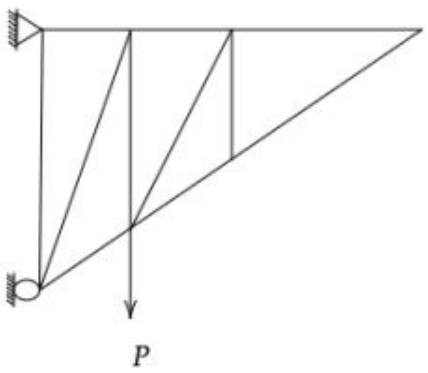
[B] Abrasion Resistance

[C] Crushing Strength

[D] Soundness

Answer: Option B

Q.12) The number of zero force members in this truss is?



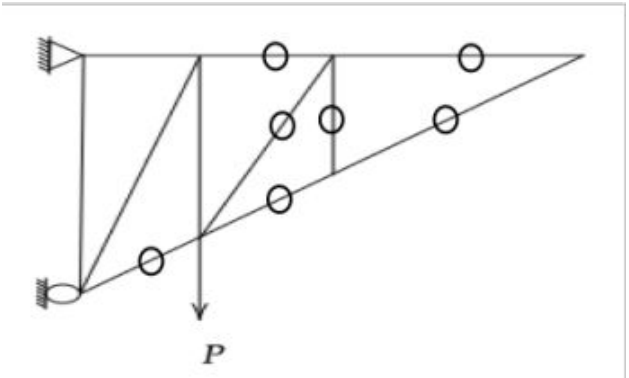
[A] 6

[B] 7

[C] 8

[D] 9

Answer: Option B



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Q.13) Aqueous chlorine reacts rapidly with water to form Cl–, HOCL and H+. The most active disinfectant in the chlorination process is

[A] HOCl

[B] H^+

[C] H_20

[D] OH

Answer: Option A

Q.14) A floating body in liquid is in a state of equilibrium if its

[A] Metacentre is above the center of gravity

[B] Metacentre is below the center of gravity

[C] Center of gravity is below the center of buoyancy

[D] Metacentre coincides with the center of gravity

Answer: Option A

Q.15) Velocity of flow is proportional to the first power of hydraulic gradient in Darcy's law. The law is applicable to

[A] Turbulent flow in porous media

[B] Transitional flow in porous media

[C] Laminar flow in porous media

[D] Laminar as well as turbulent flow in porous media

Answer: Option C

Q.16) In drained triaxial test, a sample of sand fails at σ_d = 150 kPa under confining stress of 50 kPa, find internal angle of friction___?

Answer: _____

Answer: 36.87 degrees

In case of a drained test

$c = 0$ $\quad \sigma_d = 150$ MPa

$\sigma_c = 50$ MPa

$\sigma_1 = 150 + 50 = 200$ MPa

$$\sigma_1 = \sigma_3 \tan^2\left(45 + \frac{\phi}{2}\right)$$

$$\frac{200}{50} = \tan^2\left(45 + \frac{\phi}{2}\right)$$

$$\phi = 36.87^\circ$$

Q.17) A fully submerged infinite sandy slope has an inclination of 30° with the horizontal. ysat and effective angle of internal friction of sand are 18 kN/m^3 and 38°, γ_ω = 10 kN/m3 seepage is parallel to slope. FOS against shear failure is?

Answer: _____

Answer: 0.60

For fully submerged infinite slope

$$\text{FOS} = \frac{\gamma_{sub} \tan\phi}{\gamma_{sat} \tan\beta}$$

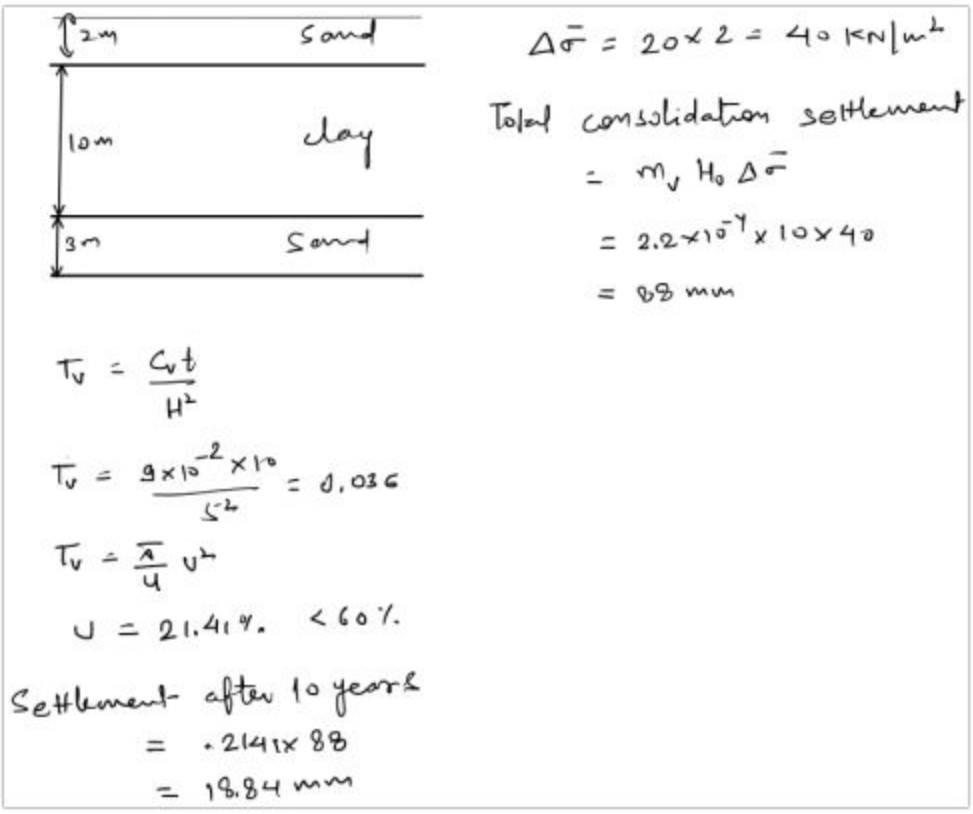
$$= \frac{(18-10)\tan 38}{18 \tan 30}$$

$$= 0.60$$

Q.18) A fill of 2m thick sand with unit weight of 20 kN/m^3 is placed above the clay layer to accelerate the rate of consolidation of clay, CV = 9 × 10^{-2} m^2/yr. m_v = 2.2 × 10^{-4} m^2/kN. The settlement of clay layer, 10 years after the construction is? (in mm)

Answer: _____

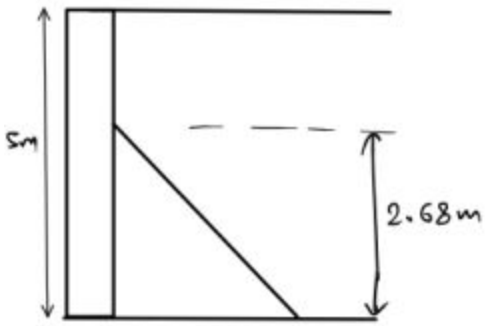
Answer: 18.84mm



Q.19) A vertical retaining wall of 5 m height has to support soil of y = 18 kN/m^3; Effective Cohesion = 12 kN/m^2; Effective Friction angle 30°. As per Rankine assuming that tension crack has occurred the lateral active thrust on wall per m length is?

Answer: _____

Answer: **Answer**: 21.32



$$k_a = \frac{1-\sin 30}{1+\sin 30} = 0.33$$

$$P_a = k_a \gamma z - 2c\sqrt{k_a}$$

For $P_a = 0$

$$z = \frac{2c}{\gamma\sqrt{k_a}} = \frac{2\times 12}{18\times\sqrt{0.33}}$$

$$= 2.32 \text{ m}$$

at 5-m depth

$$P_a = 0.33 \times 18 \times 5 - 2 \times 12 \times \sqrt{0.33}$$

$$= 15.91 \text{ kN/m}^2$$

Active thrust

$$= \frac{1}{2} \times 2.68 \times 15.91$$

$$= 21.32 \text{ kN/m}$$

Q.20) The singly reinforced beam is made of M25 grade concrete and Fe500 steel. The total cross-sectional area of steel is 945 mm^2. As per LSM, the design moment capacity of the beam section is _____ kN-m

Answer: _____

Answer: 158.69

Depth of NA

$0.36 f_{ck} b x_u = 0.87 f_y A_{st}$

$x_u = \frac{0.87 \times 500 \times 945}{0.36 \times 25 \times 300}$

$= 152.25$ mm

$x_{u\,max} = 0.46 \times 450$

$= 207$ mm

$x_u < x_{u\,max}$ under-reinforced

$M_u = 0.36 f_{ck} b x_u (d - 0.42 x_u)$

$= 0.36 \times 25 \times 300 \times 152.25 \times (450 - 0.42 \times 152.25)$

$= 158.69$ kNm

Q.21) On a highway, the gradient is 4.5% and a radius of 100 m. Compensated grade is? (in percentage)

Answer: _____

Answer: 4

Gradient compensation is minimum of (30+R)/R or 75/R. In this case 0.75%

Compensated grade = 4.5 - 0.75 = 3.75%

IRC recommends that if gradient is 4%, no need of compensation. So compensated gradient will be 4%.

Q.22) The traverse details are as follows for a polygon PQRS. Length of SP is? (in m)

PQ 40m 80^o

QR 50m 10^0

RS 30m 210^0

Answer: _____

Answer: 44.8

$$\sum L = 0$$

$$\sum L = 40.cos80^0 + 50.cos10^0 + 30.cos210^0 + SP.cos\theta$$

$$\sum D = 0$$

$$\sum D = 40.sin80^0 + 50.sin10^0 + 30.sin210^0 + SP.sin\theta$$

Solving, $SP = 44.8m$

$(Use\ relation\ sin^2\theta + cos^2\theta = 1)$

Q.23) A rectangular channel of width 4 m having flow rate of 6 m^3/sec. Manning's constant for open channel flow is 0.02, take g as 9.81 m/s^2. The critical velocity of rectangular channel is ____ ? (in m/s)

Answer: 2.45

$B = 4m \quad Q = 6\ m^3/s \quad q = 1.5\ m^2/s$

$n = 0.02 \quad V_c = ?$

$$y_c = \left(\frac{q^2}{g}\right)^{1/3}$$

$$= 0.61\ m$$

$$V_c = \sqrt{g y_c}$$

$$= 2.45\ m/s$$

Q.24) As per IRC 86-1983, desirable minimum width of median for an urban area is

Answer: _____

Answer: 5m

grade. Even greater widths are required for U-turns. Absolute minimum width of median in urban areas is 1.2 m; a desirable minimum is 5 m.

Q.25) Q = 12m^3/sec, B = 6m. Hydraulic jump is formed. upstream depth = 30 cm, g = 9.81 m/s^2, ρw = 1000 Kg/m^3. Energy loss in jump ? (in kW)

Answer: _____

Answer: 115.36 kW

$Q = 12\ m^3/s \quad y_1 = 30\ cm$

$B = 6\ m$

$V_1 = \frac{12}{.3 \times 6} = 6.67\ m/s$

$F_1 = \frac{6.67}{\sqrt{9.81 \times .3}} = 3.89$

$\frac{y_2}{y_1} = \frac{1}{2}\left(-1 + \sqrt{1+8F_1^2}\right)$

$y_2 = 1.51\ m$

$H_L = \frac{(y_2 - y_1)^3}{4 y_1 y_2}$

$= 0.98\ m$

$E_L = \rho g Q H$

$= 1000 \times 9.81 \times 12 \times 0.98$

$= 115.36\ kW$

Q.26) SOR (Surface overflow rate) of primary settling tank (discrete) is 20000 l/m^2 per day. Kinematic viscosity = 1.01 × 10^{-2} cm^2 /s. G = 2.64. The minimum diameter of particle that will be removed with 80% of efficiency is? (in micrometres)

Answer: _____

Answer: 0.144

Settling efficiency

$\eta = \frac{V_s}{V_o}$

$0.8 = \frac{V_s}{20000\ l/m^2/d}$

$V_s = 1.85 \times 10^{-4}\ m/s$

$V_s = \frac{9.81}{18}(G_s - 1)\frac{d^2}{\nu}$

$1.85 \times 10^{-4} = \frac{9.81}{18}(2.64 - 1)\frac{d^2}{1.01 \times 10^{-6}}$

$d = 1.44 \times 10^{-5}\ m$

Q.27) In a 2D stress analysis, the state of stress at a point P is

$$\sigma = \begin{pmatrix} \sigma_{xx} & \tau_{xy} \\ \tau_{xy} & \sigma_{yy} \end{pmatrix}$$

The necessary and sufficient condition for the existence of the state of pure shear at point P is?

[A]

$\sigma_{xx} + \sigma_{yy} = 0$

[B]

$\tau_{xy} = 0$

[C]

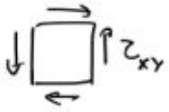
$\sigma_{xx} \cdot \sigma_{yy} - \tau_{xy}^2 = 0$

[D]

$(\sigma_{xx} - \sigma_{yy})^2 + 4\tau_{xy}^2 = 0$

Answer: Option A

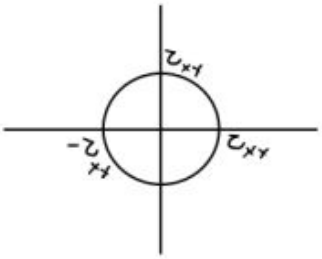
In case of pure shear



$\sigma_1 = \tau_{xy}$

$\sigma_2 = -\tau_{xy}$

$\tau_{max} = \frac{\sigma_1 - \sigma_2}{2} = \tau_{xy}$



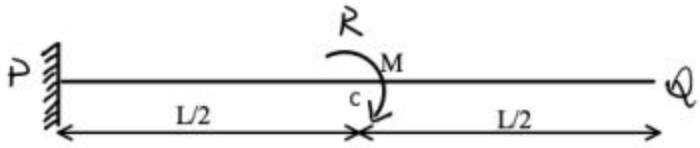
$\sigma_1 = \frac{\sigma_{xx} + \sigma_{yy}}{2} + \sqrt{\left(\frac{\sigma_{xx} - \sigma_{yy}}{2}\right)^2 + \tau_{xy}^2}$

$\tau_{xy} = \frac{\sigma_{xx} + \sigma_{yy}}{2} + \tau_{xy} \Rightarrow \boxed{\sigma_{xx} + \sigma_{yy} = 0}$

$-\tau_{xy} = \frac{\sigma_{xx} + \sigma_{yy}}{2} - \tau_{xy}$

$\boxed{\sigma_{xx} + \sigma_{yy} = 0}$

Q.28) A cantilever beam PQ of uniform flexure rigidity is subjected to a concentrated moment M at R. Deflection at free end Q is?



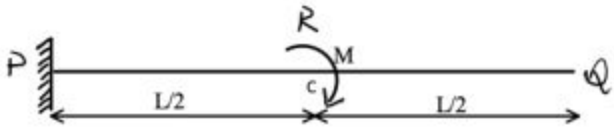
[A] $3ML^2/4EI$

[B] $3ML^2/8EI$

[C] $ML^2/4EI$

[D] $ML^2/6EI$

Answer: Option B



Deflection at free end

$$= \delta_R + \theta_R \times \frac{L}{2}$$

$$= \frac{M\left(\frac{L}{2}\right)^2}{2EI} + \frac{M\frac{L}{2}}{EI} \times \frac{L}{2}$$

$$\delta_Q = \frac{3ML^2}{8EI}$$

Q.29) Distributed loads of 50 kN/m may occupy any position on the grid. Maximum negative bending movement is? (kNm)

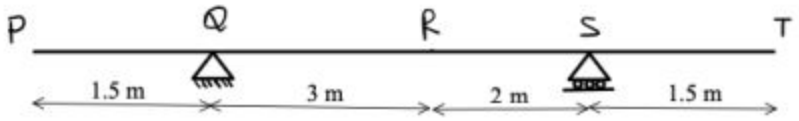
[A] 22.5

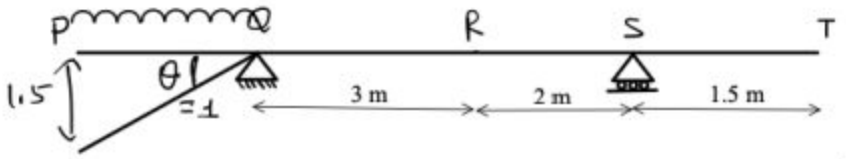
[B] 56.25

[C] 93.75

[D] 150

Answer: Option B





Negative moment will come when the load is either on PQ or ST

$BM = \frac{1}{2} \times 1.5 \times 50 \times 1.5$

$= 56.25$ kNm

Q.30) SPT was conducted at every 1.5 m, interval upto 30m depth. At 3m depth, the observed no. of hammer blows for 3 successive 150mm penetration were 8, 6 and 9. SPT N-value at 3 m depth is

[A] 15

[B] 23

[C] 17

[D] 14

Answer: Option A

SP Value = 9 + 6 = 15

SPT for top 150mm is not considered.

Q.31) A water supply scheme transport 10 MLD water through a 450 mm diameter pipe for a distance of 2.5 km. A chlorine dose of 3.5 mg/l is applied at the starting point. It is demand to increase the flow rate from 10 MLD to 13 MLD in the pipeline. Assume
exponent for cone, n = 0.86 with this increased flow in order to attain the same level of disinfection, the chlorine dose to be applied at starting point ?

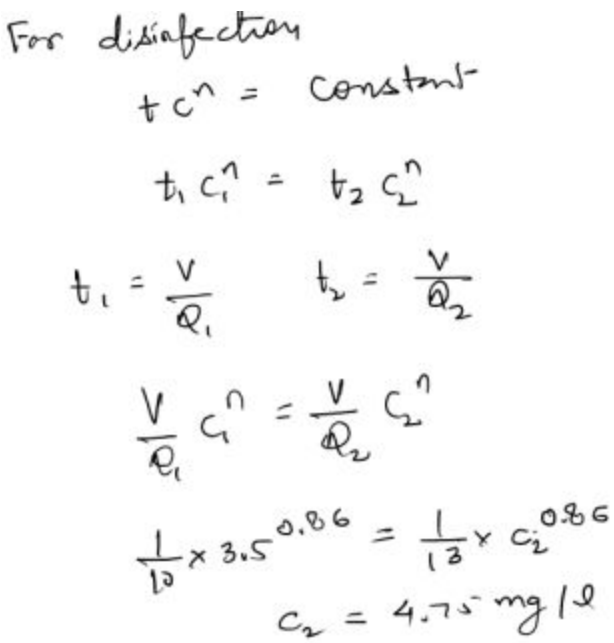
[A] 3.94

[B] 4.40

[C] 4.75

[D] 5.55

Answer: Option C



Q.32) The true value of ln(2) is 0.69. If the value of ln(2) is obtained by linear interpolation between ln(1) and ln(6), the percentage of absolute error is

[A] 84

[B] 69

[C] 48

[D] 36

Answer: Option C

$$y - ln(1) = \frac{ln(6) - ln(1)}{6 - 1} \times (2 - 1)$$

$$y = 0.35835$$

$$Error = \frac{y - 0.69}{0.69} \times 100 = 48\%$$

Q.33) The area of an ellipse represented by below equation is?

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

[A] πab

[B] πab/4

[C] πab/2

Answer: Option A

This is standard equation for ellipse. Area is πab

If we do not remember this formula, this can be solved using double integration.

Q.34) Find the limit

$$\lim_{x \to \infty} \frac{x^2 - 5x + 4}{4x^2 + 2x}$$

[A] 1/2

[B] 1

[C] 1/4

[D] 0

Answer: Option C

$$\lim_{x \to \infty} \frac{x^2 - 5x + 4}{4x^2 + 2x}$$

L'Hospital rule

$$\Longrightarrow \lim_{x \to \infty} \frac{2x - 5}{8x + 2} \Longrightarrow \frac{2}{8} = \frac{1}{4}$$

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