



Engineers Hub

For GATE, ESE & PSUs

Engineers Hub

where Quality Matters...

GATE - 2021

Mechanical Engineering (ME)

Afternoon Session

Questions & Solutions (Memory Based)

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

1. *HT

Stanton Number

$$St = \frac{Nu}{Re \times Pr}$$

2. * FM

$$\frac{\partial(u^2)}{\partial x} + \frac{\partial(uv)}{\partial y}$$

Incompressible flow

$$2u \frac{\partial u}{\partial x} + u \frac{\partial v}{\partial y} + v \frac{\partial u}{\partial y} = u \cdot \frac{\partial u}{\partial x} + u \left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} \right) + v \cdot \frac{\partial u}{\partial y}$$

0

$$= u \cdot \frac{\partial u}{\partial x} + v \cdot \frac{\partial u}{\partial y}$$

3. ATD

$$P_t = 101 \text{ kPa}$$

$$T = 300 \text{ K}$$

$$RH = 60\%$$

$$(P_s)_{300 \text{ K}} = 3.6 \text{ kPa}$$

$$\omega = ?$$

$$\omega = 0.622 \frac{P_v}{P_t - P_v}$$

$$RH = \frac{P_v}{P_s}$$

$$0.60 \times 3.6 = P_v$$

$$P_v = 2.16 \text{ kPa}$$

$$\omega = 0.622 \times \frac{2.16}{101 - 2.16}$$

$$\omega = 0.01359 \frac{\text{kg of W.V}}{\text{kg of d.a}} = 13.59 \frac{\text{grams of W.V}}{\text{kg of d.a}}$$

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

4. * FM

$$u = 2xyt$$

$$v = -y^2t$$

$$(1, 1)$$

$$\frac{dx}{u} = \frac{dy}{v}$$

$$\frac{dx}{2xyt} = \frac{dy}{-y^2t}$$

$$\frac{dx}{x} = -2 \frac{dy}{y}$$

$$\frac{dx}{x} + 2 \frac{dy}{y} = 0$$

$$\ln xy^2 = \ln c$$

$$xy^2 = C$$

$$\text{At } (1,1)$$

$$C = 1$$

$$xy^2 = 1$$

5. *ATD

$$\text{COP} = 10, \text{R. C.} = 150 \frac{\text{kJ}}{\text{kg}} = \text{RE}$$

$$\text{H. R. F} = \frac{Q_R}{\text{RE}} = 1 + \frac{1}{\text{COP}}$$

$$\frac{Q_R}{150} = 1 + \frac{1}{10}$$

$$Q_R = 165 \frac{\text{kJ}}{\text{kg}}$$



Engineers Hub



GATE/ESE/PSUs/APPSC

ME | CE | EC | EE | CS | CH | XE | BT | IN

New Batches for GATE-2022/2023

- Long Term Weekend Classroom
- Regular Classroom
- Summer Crash Course
- Online LIVE Classes

Dedicated Batch for GATE - XE 2022

Ticket to IIT!

- Complete study material (in hardcopy).
- Coverage of complete syllabus as per the **GATE** pattern.
- Online Test series.

Offline

Online

Online+Offline

www.engineers-hub.com

Contact us : ☎ 0891 - 6664766, 95503 48886

4th Floor Leela Plaza, Opp. Nellore Mess Dabagardens, Vizag - 20

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

6. *FM

- Air (Ideal gas)

$$V = 300 \text{ m/s}$$

$$T = 330 \text{ K}$$

$$P = 180 \text{ kPa}$$

$$C_p = 1.005 \text{ kJ/kg} - \text{K}$$

Stagnation Temperature

$$(T_0) = ?$$

$$h_0 = h + \frac{V^2}{2}$$

$$C_p T_0 = C_p T + \frac{V^2}{2}$$

$$T_0 = T + \frac{V^2}{2C_p}$$

$$= \frac{300^2}{2 \times 1005}$$

$$374.77 \text{ K}$$

7.

$$L^{-1} \left\{ \frac{s+3}{(s+1)(s+2)} \right\}, f(0) = ?$$

$$\frac{s+3}{(s+1)(s+2)} = \frac{A}{s+1} + \frac{B}{s+2}$$

$$\frac{s+3}{(s+1)(s+2)} = \frac{As+2A+Bs+B}{(s+1)(s+2)}$$

$$s + 3 = (A + B)s + 2A + B$$

$$A + B = 1 \quad 2A + B = 3$$

$$B = 1 - A \quad 2A + 1 - A = 3$$

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

$$A + 1 = 3$$

$$A = 2, B = 1 - 2 = -1$$

$$L^{-1} \left\{ \frac{s+3}{(s+1)(s+2)} \right\} = L^{-1} \left\{ \frac{2}{s+1} - \frac{1}{s+2} \right\}$$

$$= 2L^{-1} \left\{ \frac{1}{s+1} \right\} - 1 L^{-1} \left\{ \frac{1}{s+2} \right\}$$

$$= 2e^{-t} - 1.e^t$$

$$f(0) = 2 - 1 = 1$$

8.

$$(1 + i)^8$$

$$z = 1 + i$$

$$|z| = \sqrt{1^2 + 1^2} = \sqrt{2}$$

$$\tan \theta = \frac{1}{1} = \frac{y}{x}$$

$$\theta = \frac{\pi}{4}$$

$$z = |z| [\cos \theta + i \sin \theta]$$

$$z = \sqrt{2} \left[\cos \frac{\pi}{4} + i \sin \frac{\pi}{4} \right]$$

$$z^8 = (\sqrt{2})^8 \left[\cos \frac{\pi}{4} + i \sin \frac{\pi}{4} \right]^8$$

$$D.M.T$$

$$= 16 \left[\cos \left(8 \times \frac{\pi}{4} \right) + i \sin 8 \left(\frac{\pi}{4} \right) \right]$$

$$= 16$$

9.

$$f(x) = x^3 - x - 3 = 0$$

$$N - R, x_2 = ?$$

$$x_0 = 2 \rightarrow \text{given}$$

$$\Rightarrow N - R$$

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

$$x_1 = x_0 - \frac{f(x_0)}{f'(x_0)}$$

$$f'(x) = 3x^2 - 1$$

$$f'(2) = 3 \times (2)^2 - 1 = 11$$

$$f(2) = 2^3 - 2 - 3 \Rightarrow 3$$

$$x_1 = 2 - \frac{f(2)}{11} = 3 = \frac{19}{11}$$

$$x_1 = \frac{19}{11}$$

$$x_2 = x_1 - \frac{f(x_1)}{f'(x_1)}$$

$$f\left(\frac{19}{11}\right) = 0.425$$

$$f'\left(\frac{19}{11}\right) = 7.950$$

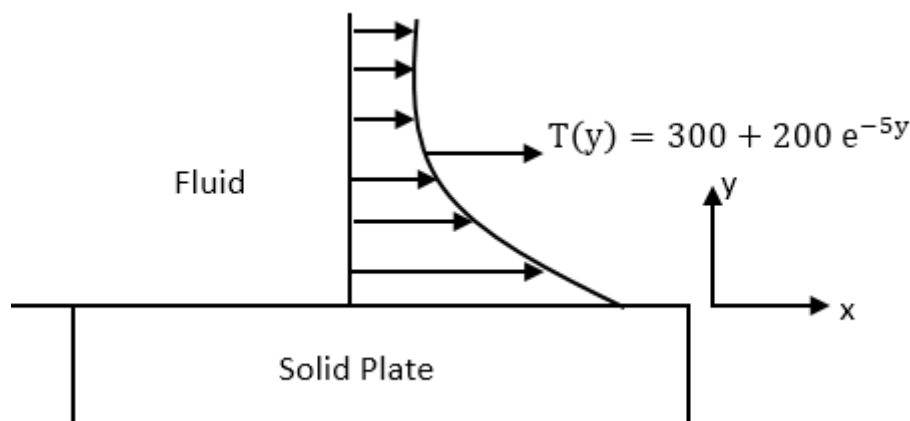
$$x_2 = \frac{19}{11} - \frac{0.425}{7.950}$$

$$= 1.673$$

10. *HT

$$k_f = 1 \frac{W}{mK}$$

$$k_s = 100 \frac{W}{mK}$$





Engineers Hub
For GATE, ESE & PSUs

Engineers Hub

Where Quality Matters...

GATE/ESE/PSUs/APPSC/SSC-JE

**FREE SCHOLARSHIP TEST
cum SEMINAR**

GATE-2022/2023 on 21st Feb @ 10 am

SYLLABUS : Quantitative Aptitude,
Reasoning & English

AVAIL UPTO

100%

SCHOLARSHIP
on tuition fee



Super Long Term Weekend Batch

(For up coming 2/2 & 3/2 students)

MECH | CIVIL | ECE | EEE | CS/IT | CHEM

Batches from 21st February 2021

◆ Toppers discounts, CGPA / Percentage based discounts,
Group discounts & College discounts are available.

www.engineers-hub.com

Contact us : ☎ 0891 - 6664766, 📞 95503 48886

4th Floor Leela Plaza, Opp. Nellore Mess Dabagardens, Vizag - 20

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

$$\left[\frac{dT}{dy} \right]_{y=0} \Big|_{\text{solid}} \quad \dot{Q}_{\text{cond}}|_F = \dot{Q}_{\text{cond}}|_{\text{solid}}$$

$$-k_f A \left[\frac{dT}{dy} \right]_{y=0} \Big|_F = -k_s A \left[\left(\frac{dT}{dy} \right)_{(y=0)} \right]_{\text{solid}}$$

$$\frac{dT}{dy} = 200 \times (-5)e^{-5y}$$

$$\left[\frac{dT}{dy} \right]_{(y=0)} \Big|_F = -1000 \frac{\text{K}}{\text{m}}$$

$$\left[\frac{dT}{dy} \right]_{y=0} \Big|_s = 10 \text{ K/m}$$

11. HT

$$T_{ci} = 300 \text{ K}$$

$$\dot{m}_c = 100 \text{ kg/s}$$

$$U = 1500 \frac{\text{W}}{\text{m}^2\text{-K}}$$

$$A = 400 \text{ m}^2$$

$$T_{hi} = T_{ho} = 350 \text{ K}$$

$$c_{pc} = 4000 \text{ J/kg-K}$$

$$T_{co} = ?$$

$$NTU = \frac{UA}{(\dot{m}c_p)_{\min}}$$

$$\frac{1500 \times 400}{100 \times 4000}$$

$$NTU = 1.5$$

Phase change HE

$$\varepsilon = 1 - e^{-NTU}$$

$$\frac{T_{co} - T_{ci}}{T_{hi} - T_{ci}} = 1 - e^{-NTU}$$

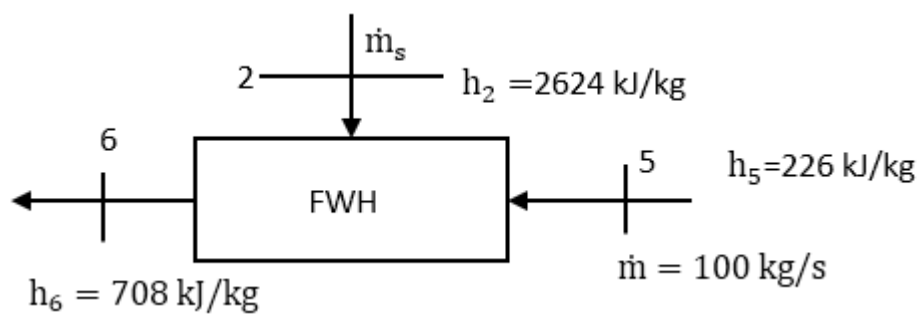
ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

$$\frac{T_{co}-300}{350-300} = 1 - e^{-1.5}$$

$$T_{co} = 338.84 \text{ K}$$

12.

Reg. Rankine Cycle



$$\dot{m}_s = ?$$

$$\dot{E}_{in} = \dot{E}_{out}$$

$$\dot{m}_s \times h_2 + \dot{m} \times h_5$$

$$= (\dot{m} + \dot{m}_s) \times h_6$$

$$\dot{m}_s \times h_2 + \dot{m} \times h_5 = \dot{m} \times h_6 + \dot{m}_s \times h_6$$

$$\dot{m}_s [h_2 - h_6] = \dot{m} [h_6 - h_5]$$

$$\dot{m}_s = \left(\frac{h_6 - h_5}{h_2 - h_6} \right) \dot{m}$$

$$\dot{m}_s = 0.2515 \frac{\text{kg}}{\text{s}} \times 100$$

$$= 25.15 \text{ kg/s}$$

13. * FM

Eddy Viscosity

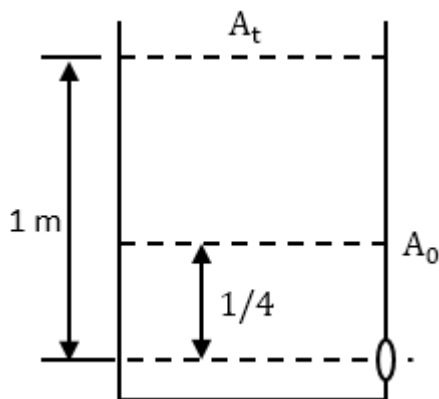


Reynolds Stresses

14. FM

$$A_t = 1 \text{ m}^2$$

$$A_0 = 1 \text{ cm}^2$$



$$T = \frac{A_t}{A_0} \sqrt{\frac{2}{g}} [\sqrt{H_1} - \sqrt{H_2}]$$

$$T = 10^4 \sqrt{\frac{2}{9.8}} \left[\sqrt{1} - \sqrt{\frac{1}{4}} \right]$$

$$T = 2258.76 \text{ sec}$$

15. FM

$$M = 0.6$$

Ideal gas

$$T = 350 \text{ K}$$

$$R = 320 \text{ J/kg} - \text{K}$$

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

$$\gamma = 1.3$$

$$M = \frac{V}{c}$$

$$M = \frac{V}{\sqrt{\gamma RT}}$$

$$V = M \sqrt{\gamma RT}$$

$$V = 0.6 \sqrt{1.3 \times 32 \times 350}$$

$$V = 228.945 \text{ m/s}$$

16. $(1 + y) \frac{dy}{dx} = y$

$$y(1) = 1$$

Solution:

$$\left(\frac{1}{y} + 1\right) \frac{dy}{dx} = 1$$

$$\int \frac{1}{y} dy + \int dy = \int dx$$

$$\ln y + y = x + c$$

$$x = 1, u = 1$$

$$\ln 1 + 1 = 1 + c$$

$$C = 0$$

$$\ln y + y = x$$

$$\ln y + \ln e^y = \ln e^x$$

$$\ln(y \cdot e^y) = \ln e^x$$

$$y \cdot e^y = e^x$$

BEST **GENUINE CLASSROOM** RESULTS

22 Ranks in below 2000, With Top Rank AIR-1

AIR
1



DEVENDRA SINGH NEGI
MANAGING DIRECTOR, EH
GATE SCORE - 1000 (XE)

AIR
11



SAURABH KUMAR
CIVIL - NIT TRICHY
MT - IOCL

AIR
14



JITENDRA KUMAR
MECH - SANKETIKA
M.Tech, IIT - Bombay

AIR
76



M. MANIKANTA
MECH - ANITS
M.Tech, IIT-Bombay

AIR
176



S. MANIKANTA
MECH - IIT GUWAHATI
GT - ONGC

AIR
204



BURELA VENKATESH
MECH - BEC BAPATLA
M.Tech, NIT-Surat

AIR
235



GRANDHI SRIKAR
MECH - SRKR
GT - ONGC

AIR
276



N. TEJA HIMA PRIYA
ECE - JNTU KAKINADA
M.Tech, IIT - Delhi

AIR
346



G. AKHILESH
MECH - MVGR COE
MT - IOCL

AIR
436



K. BALA THARUNKUMAR
MECH - GVP COE
MT - HPCL

AIR
476



BURDE NIKHIL SURESH
MECH - JNTU-K
AE - MSEB

AIR
589



B. SURYA BHAARAT
MECH - VISHNU
M.TECH, IIT - Madras

AIR
674



SATYA PRAKASH SINGH
MECH - IERT - ALLAHABAD
M.TECH, IIT - Bombay

AIR
869



KARRI LOKESH
MECH - VIGNAN'S-IIT
MT - RINL

AIR
892



G. SAI CHAITANYA
MECH - AU COE
M.TECH, IIT - Kanpur

AIR
900



M. PRAVEEN KUMAR
ECE - GVP COE
M.TECH, NIT-Trichy

AIR
947



P. VENKAT VIVEK
MECH - AU COE
M.TECH, IIT-KGP

For **FREE** Online Classes & Tests Install **INFINITY** App



Contact Us



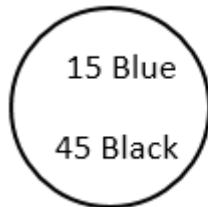
0891 - 6664766



95503 48886

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

17.



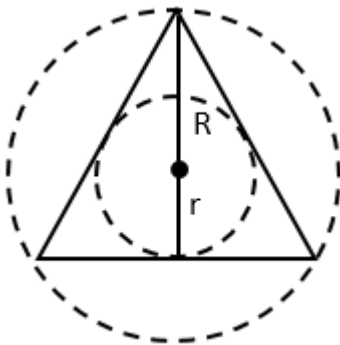
Two balls are picked
one after the other
without replacement

$P[\text{Blue and Black ball}] \Rightarrow P(\text{Blue}) \text{ and } P(\text{Black})$

$$= \frac{15}{60} \times \frac{45}{59}$$

$$= \frac{45}{236}$$

18.



In Equilateral

Median = Angle bisector = Altitude

↓

2: 1

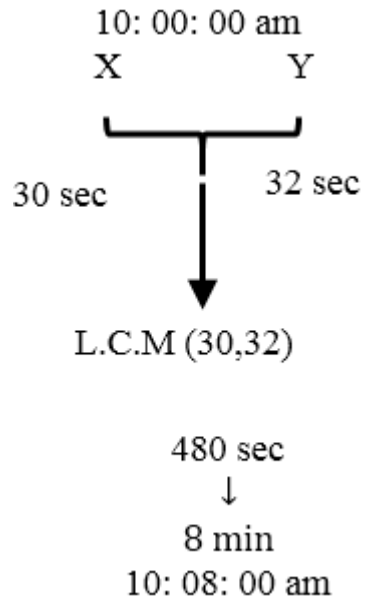
R: r

$\pi R^2: \pi r^2$

4: 1

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

19.



20.

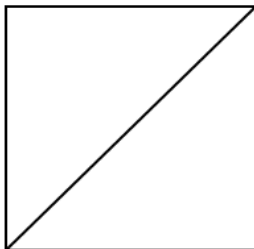
A number – Plural

are

The number – Singular

is

21.



Diagonal

$$\frac{1}{2}$$

Symmetry

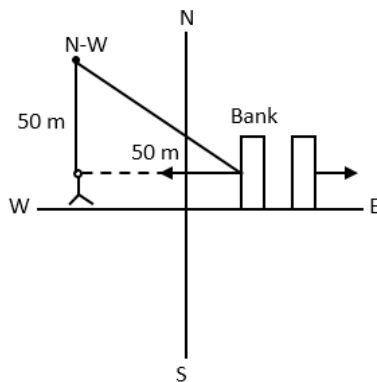
ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

$$\frac{1}{4}$$

Symmetry

$$\frac{1}{8}$$

22.



23.B. $N \rightarrow (n, p)$:-

$$\text{Mean} = nP$$

$$\text{Variance} = npq$$

$$= np(1 - p)$$

24.

$$\int_4^{5.2} \ln x \, dx, h = 0.3$$

$$\frac{1}{3} \text{rd Rule: } \frac{h}{3} [(\text{First term} + \text{Last term}) + 4 (\text{odd no. of term}) + 2(\text{even term})]$$

$$\text{No. of sub-interval} = \frac{5.2-4}{0.3} = 4$$

$$= \frac{h}{3} [(y_0 + y_4) + 4(y_1 + y_3) + 2(y_2)]$$

$$= 1.82773$$



Engineers Hub
For GATE, ESE & PSUs

Engineers Hub

Where Quality Matters...

GATE MECHANICAL Mentors



Devendra Singh Negi

M.Tech, IIT-Bombay,
GATE AIR-1, BNPM AIR-1
FM & HM, Thermal,
Heat Transfer
Teaching Experience 7 Yrs.



Amit Dixit

M.Tech, IIT-Delhi,
GATE AIR-1,
Working with BHEL
Operations Research
Teaching Experience 10 Yrs.



V. Gowtham Reddy

Ph.D, IIT-Madras
Engineering Mechanics, Theory
of Machines & Vibrations
Teaching Experience 7 Yrs.



Aditya Pal

B.Tech, IIT-Delhi
Production Technology-I
Teaching Experience 9 Yrs.



Devi Shankar Goyal

M.Tech, DCE
ESE AIR-57
Production Technology-II
Teaching Experience 10 Yrs.



T. Apuroop

M.Tech, IIT-Kharagpur
Strength of Materials &
Machine Design
Teaching Experience 7 Yrs.



L. Vinay Kumar

M.Tech, (Ph.D) IIT-Madras
Engineering Mathematics &
Thermal Engineering
Teaching Experience 3 Yrs.



N.L.N. Sharma

MBA, IIM-Indore,
PhD. ISB Hyderabad
Engineering Aptitude
Teaching Experience 7 Yrs.

K. Venkata Sivareddy

B.Tech, JNTU-K
Engineering Mechanics &
Theory of Machines
Teaching Experience 5Yrs.

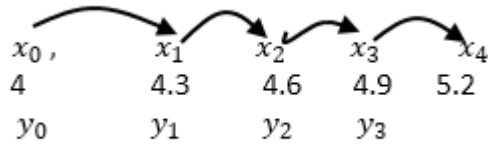


0891 - 6664766

www.engineers-hub.com

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

25.



$$\ln 4 \quad \ln 4.3 \quad \ln 4.6 \quad \ln 4.9 \quad \ln 5.2$$

$$1.3863 \quad 1.4586 \quad 1.526 \quad 1.589 \quad 1.6486$$

26. $r, T \Rightarrow n \times 1$

$$Q \Rightarrow n \times n$$

$$f(x) = \frac{1}{2} \times T_Q x - r^T x$$

Stationary point of $f(x) = ?$

Solution:

$$n = 1$$

$$f(x) = \frac{1}{2} Q_{xx} - rx$$

$$f(x) = \frac{1}{2} Qx^2 - rx$$

For stationary point

$$f'(x) = 0$$

$$f'(x) = \frac{1}{2} \cdot 2Qx - r$$

$$f'(x) = 0$$

$$Qx = r$$

$$x = \frac{r}{Q}$$

27. Eigen Value $A^2 = ??$

$$n \times n \Rightarrow \text{matrix}$$

$$Ap = \alpha^2 p$$

$$\alpha \notin \{1, 0, 1\}$$

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

Solution:

$$AX = \lambda X$$

$$\lambda = \alpha^2$$

$\lambda \Rightarrow$ Eigen value of matrix A

$$A \Rightarrow \lambda = \alpha^2$$

$$A^2 \Rightarrow \lambda^2 = (\alpha^2)^2$$

$$= \alpha^4$$

28. * TD

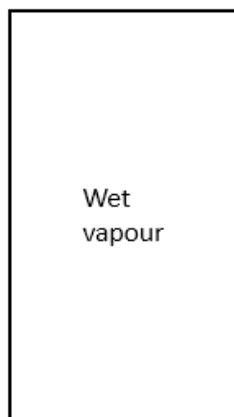
$$V = 50 \text{ m}^3$$

$$\left. \begin{array}{l} \% \text{ of Liquid} = 20\% \\ \% \text{ of vapour} = 80\% \end{array} \right\} x=0.8$$

$$v_f = 0.001 \text{ m}^3/\text{kg}$$

$$v_g = 0.46 \text{ m}^3/\text{kg}$$

$$m = ?$$



$$v = \frac{V}{m}$$

$$m = \frac{V}{v}$$

$$v = v_f + xv_g$$

$$v = 0.001 + 0.8(0.46 - 0.001)$$

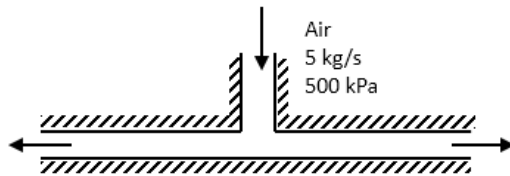
ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

$$v = 0.37 \text{ m}^3/\text{kg}$$

$$m = \frac{50}{0.37}$$

$$m \cong 135 \text{ kg}$$

29. * TD



Hot air

3 kg/s

100 kPa

340 K

Cold air

2 kg/s

100 kPa

240 K

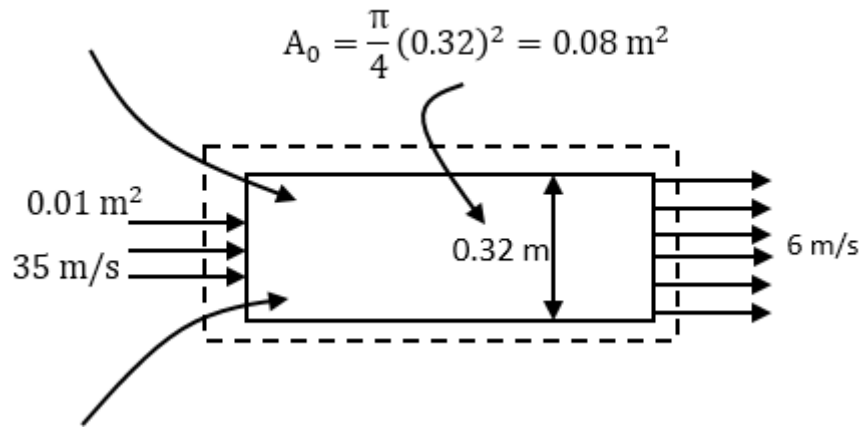
$$\begin{aligned} \Delta \dot{S}_{cv} + \Delta \dot{S}_f &= \dot{S}_{t,Q} + \dot{S}_{g,cv} \\ \dot{S}_{g,cv} &= \Delta \dot{S}_f \end{aligned}$$

Hot

$$\begin{aligned} &3 \left[1.005 \ln \left(\frac{340}{300} \right) - 0.287 \ln \left(\frac{100}{500} \right) \right] + 2 \left[1.005 \ln \left(\frac{100}{300} \right) - 0.287 \ln \left(\frac{240}{300} \right) \right] \\ &\Rightarrow 2.238 \text{ kW/K} \end{aligned}$$

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

30. FM



Steady Flow

$$\dot{m}_i = \dot{m}_o$$

$$Q_i = Q_o$$

$$0.01 \times 35 + Q = 0.08 \times 6$$

$$Q = 0.1325 \text{ m}^3/\text{s}$$

$$Q = 132.5 \text{ L/s}$$

31.

$$\text{Given } T = 1200 + 2500 \sin 2\theta \text{ N-m}$$

$$N = 120 \text{ rpm and } \omega = 2\pi \frac{N}{60} \text{ rad/s}$$

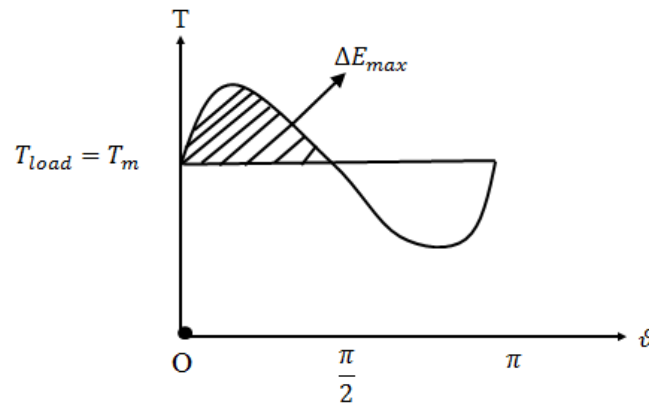
$$C_s = \pm 0.5\% \Rightarrow 1\% \frac{1}{100}$$

$$I = \text{ kg-m}^2 = ?$$

$$T_a = 12000 + 2500 \sin 2\theta$$

$$\text{Time period } \frac{2\pi}{\omega} = \pi$$

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION



$$\Delta E_{\max} = \int_0^{\frac{\pi}{2}} (T_a - T_m) d\theta$$

$$\Delta E_{\max} = \int_0^{\frac{\pi}{2}} (2500 \sin 2\theta) d\theta$$

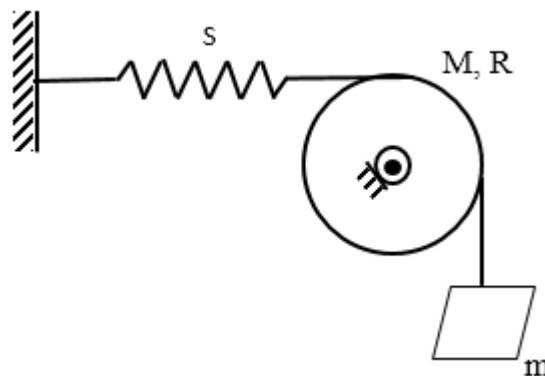
$$\Delta E_{\max} = 2500 \text{ N-m}$$

$$\Rightarrow 2500 = I \times 2\pi \times \left(\frac{120}{60}\right) \times 0.01$$

$$\Rightarrow I = 569.94 \text{ kg-m}^2$$

Vibration

$$32. \quad \omega_n = \sqrt{\frac{s}{m + \left(\frac{M}{2}\right)}}$$





Engineers Hub
For GATE, ESE & PSUs

Engineers Hub

Where Quality Matters...

How to Crack GATE in First Attempt

by GATE AIR - 1 & IITians

**Seminar Cum Scholarship Test
on 21 Feb, (Sun) @ 10:00 am**



Engineers hub, Dabagardens, Vizag-20

Offline

Online

Online+Offline

Up to **100%** Scholarship on Tuition fee
with Minimum **75%** Scholarship Assured



Viresh Sir

NITIE | IIT Bombay
NIT Jalandhar



NEGI Sir

GATE AIR - 1 (XE) 19 & 20
M.Tech - IIT Bombay



Vinay Sir

IIT Madras
(Ph.D)

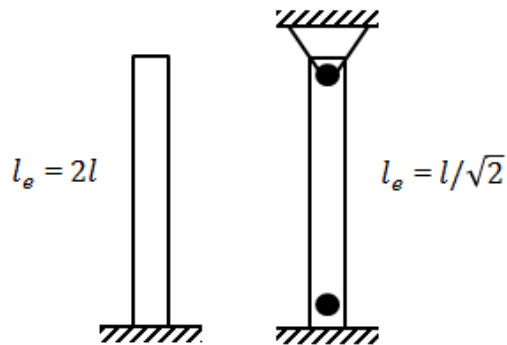
www.engineers-hub.com

Contact us :  0891 - 6664766, 95503 48886

4th Floor Leela Plaza, Opp. Nellore Mess Dabagardens, Vizag - 20

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

33.



$$P = 100 \text{ kN} \quad \frac{\pi^2 EI}{l^2} = 400$$

$$\frac{\pi^2 EI}{4l^2} = 100 \Rightarrow \frac{\pi^2 EI}{l^2} = 400$$

$$P = \frac{2\pi^2 EI}{l^2}$$

$$P = 2 \times 400$$

$$= 800 \text{ kN}$$

34. Steel cube block side = 200 mm

$$\text{Hydrostatic } p^r = 250 \text{ N/mm}^2$$

$$E = 2 \times (10)^5 \text{ N/mm}^2$$

$$\mu = 0.3$$

Reduction in side _____ mm

$$\epsilon_v = \frac{\sigma_x + \sigma_y + \sigma_z}{2} (1 - 2\mu)$$

$$\epsilon_x = \frac{\sigma_x}{E} (1 - 2\mu)$$

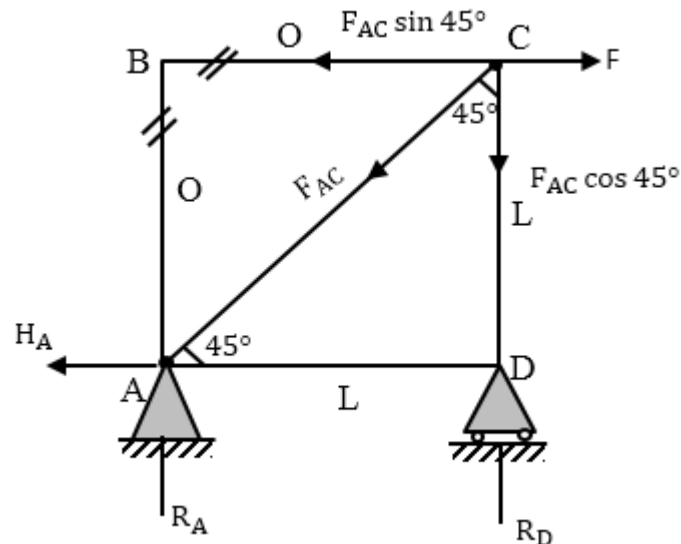
$$\frac{\Delta L}{L} = \frac{250}{2 \times (10)^5} (1 - 2 \times 0.3)$$

$$\Delta L = \left(\frac{250}{2 \times (10)^5} (1 - 2 \times 0.3) \right) \times 200$$

$$\Delta L = 0.1 \text{ mm}$$

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

35.



$$F_{AC} = ? \text{ \& } F_{CD} = ?$$

$$F_{AC} = \sin 45^\circ = F$$

$$F_{AC} = F \sqrt{2} \text{ (Tensile)}$$

$$F_{AC} = \cos 45^\circ + F_{CD} = 0$$

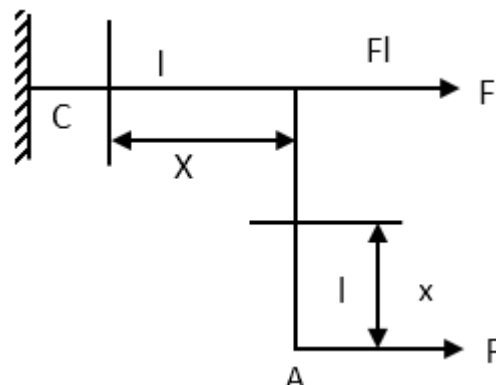
$$F_{AC} = \cos 45^\circ + F_{CD}$$

$$F_{CD} = F \sqrt{2} + \times 1/\sqrt{2}$$

$$F_{CD} = -F$$

$$F_{CD} = F \text{ (comp)}$$

36.



ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

$$M_{AB} = F x$$

$$M_{BC} = Fl$$

$$x_A = \int \frac{M \frac{\partial M}{\partial F} dx}{EI}$$

$$x_A = \int_0^l \frac{(Fx)x dx}{EI} + \int_0^l \frac{(Fl)l dx}{EI}$$

$$x_A = \frac{Fl^3}{3EI} + \frac{Fl^3}{EI}$$

$$x_A = ?$$

$$x_A = \frac{4 Fl^3}{3 EI}$$

37.



$$EI = 200 \times 10^6 \text{ Nm}^2$$

Area of BMD between

$$AB = 10000 \text{ Nm}^2$$

$$\theta_A = ?$$

(micro – radian)

$$\theta_A - \theta_B = \frac{A_{AB}}{EI}$$

$$\theta_A = \frac{10000}{200 \times 10^6} = 5 \times 10^{-5} \text{ rad}$$

$$\theta_A = 50 \times 10^{-6} \text{ rad}$$

$$\theta_A = 50 \text{ micro – rad}$$



Engineers Hub

For GATE, ESE & PSUs

Engineers Hub

Where Quality Matters...

MECH | CIVIL | ECE | EEE | CS/IT

JOIN FOR GATE - 2022/2023

LONG TERM REGULAR BATCH

GATE - 2022 @ VISAKHAPATNAM

(5 Month program for passed out students)

Batches start from

1st, 14th, 28th, June, 12th & 26th July 2021

A Premier GATE Training Institute run by



NEGI Sir

Managing Director - EH
GATE AIR - 1 (XE) 2019 & 2020
M.Tech. IIT-Bombay (Topper)

Register Before 31st May 2021 to get 40% Discount

www.engineers-hub.com

Contact us : ☎ 0891 - 6664766, 0891 - 2534866, 95503 48886

4th Floor Leela Plaza, Opp. Nellore Mess Dabagardens, Vizag - 20

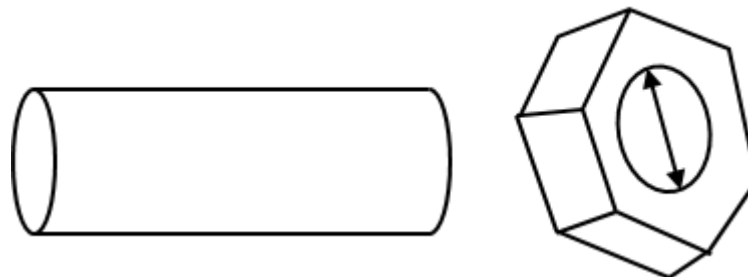
* Hostel facility available

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

38.

$$\begin{aligned}
 P &= 30000/\text{day} \\
 d &= 15000/\text{day} \\
 C_h &= \frac{20}{\text{unit}}/\text{year} \\
 C_o &= 1800/\text{setup} \\
 \text{duration} &= 300 \text{ days} \\
 \text{EOQ} &= \frac{\sqrt{2C_o D}}{C_w} \times \frac{\sqrt{P}}{p-d} \\
 &= \frac{\sqrt{2 \times 1800 \times 300 \times 15000}}{20} \times \frac{\sqrt{30000}}{15000} \\
 &= 40249.22 \text{ units}
 \end{aligned}$$

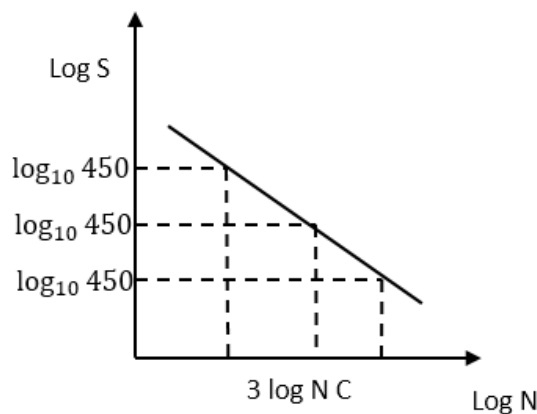
39. Allowance definition = lower limit of Nut hole – upper limit of shaft



40. $S_e = 150 \text{ MPa}$. Fatigue strength for 1000 cycles. Is 450 MPa . No of cycles for $\pm 200 \text{ MPa}$?

$$\frac{\log_{10} 200 - \log_{10} 450}{\log_{10} 150 - \log_{10} 450} = \frac{\log_{10} N - 3}{6 - 3}$$

$$\log_{10} N = 5.2144$$

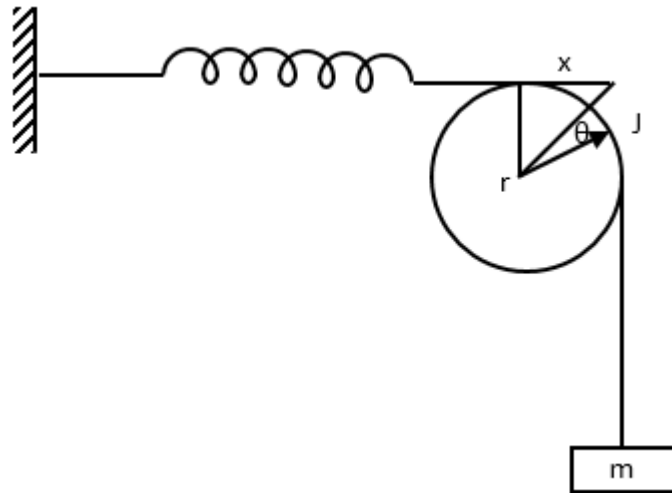


ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

$$N = 10^{5.2144}$$

$$N = 163632.47 \text{ cycles}$$

41.



$$\omega_n = ?$$

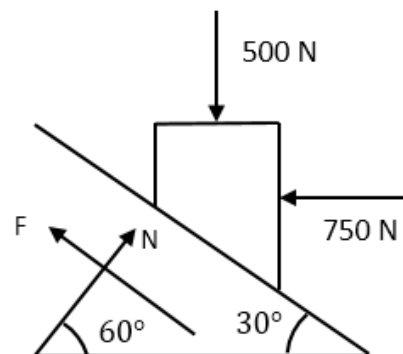
$$x = r \theta$$

$$I \ddot{\theta} + k x r \theta = 0$$

$$[m r^2 + J] \ddot{\theta} + k r^2 \theta = 0$$

$$\omega_n = \sqrt{\frac{k r^2}{m r^2 + J}}$$

42. Find $\mu_s = ?$



$$\Sigma F_x = 0$$

$$N \cos 60^\circ - F \cos 30^\circ - 750 = 0$$

$$\Sigma F_y = 0$$

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

$$N \sin 60^\circ + F \sin 30^\circ - 900 = 0$$

$$N = 1154.42$$

$$F = -199.51$$

$$\frac{\mu N}{N} = \frac{199.51}{1154.42}$$

$$\mu = 0.1728$$

43. PERT

Critical

$$9 \text{ Activities } \sigma = 3 \rightarrow V = \sigma^2 = 9$$

$$V_p = \Sigma V \text{ of CA}$$

$$v_p = 9 \times 9 = 81$$

$$\sigma_p = \sqrt{V_p} = \sqrt{81} = 9$$

$$\sigma_p = 9$$

44. Diameter of Nugget = 5mm.

$$t = 1 \text{ mm}$$

$$\text{time} = 0.1 \text{ sec}$$

$$E = 20 \text{ J/mm}^3$$

$$p = ? \text{ (kW)}$$

$$\eta_{th} = 10\%$$

$$V_n = \frac{\pi}{4} (5)^2 \times 1$$

$$= 19.63 \text{ mm}^3$$

$$E = 20 \times 19.63 = 392.69 \text{ J}$$

$$E = \frac{392.69}{0.1} \text{ J/sec}$$

$$E = 3926.9 \text{ J/sec}$$

$$\text{Power} = 3926.9 \frac{\text{J}}{\text{sec}} \Rightarrow \text{Power} = 39.27 \text{ kW}$$



Engineers Hub

For GATE, ESE & PSUs

Engineers Hub

Where Quality Matters...

GATE/ESE/PSUs/APPSC/SSC-JE

**FREE SCHOLARSHIP TEST
cum SEMINAR**

GATE-2022/2023 on 21st Feb @ 10 am

**SYLLABUS : Quantitative Aptitude,
Reasoning & English**

AVAIL UPTO

100%

**SCHOLARSHIP
on tuition fee**



Super Long Term Weekend Batch

(For up coming 2/2 & 3/2 students)

MECH | CIVIL | ECE | EEE | CS/IT | CHEM

Batches from 21st February 2021

◆ Toppers discounts, CGPA / Percentage based discounts,
Group discounts & College discounts are available.

www.engineers-hub.com

Contact us : ☎ 0891 - 6664766, 📞 95503 48886

4th Floor Leela Plaza, Opp. Nellore Mess Dabagardens, Vizag - 20

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

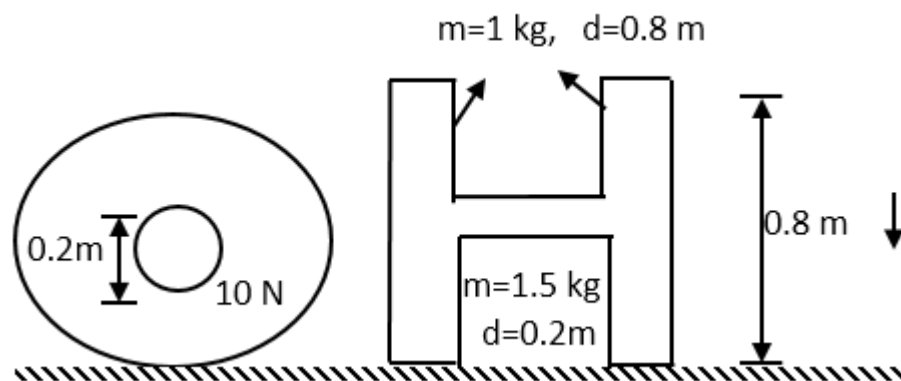
45. $P = 100 \text{ kN}$

$$\pi^2 EI = 100$$

$$\frac{\pi^2 EI}{l^2} = 400$$

$$\begin{aligned} \frac{2\pi^2 EI}{l^2} \\ &= 2 * 400 \\ &= 800 \end{aligned}$$

46. Accⁿ of system – m/s^2



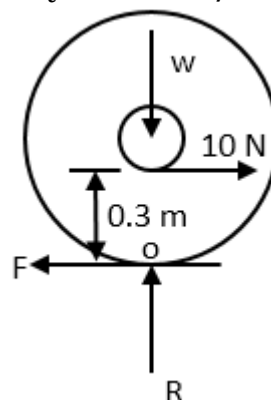
$$\Sigma M_o = I_o \alpha$$

$$10 \times 0.3 = \left[\frac{1.5 \times 0.1^2}{2} + 1.5 \times 0.4^2 + 2 \times \frac{1 \times 0.4^2}{2} + 2 \times 1 \times 0.4^2 \right] \alpha$$

$$\alpha = 4.1237 \text{ rad/s}^2$$

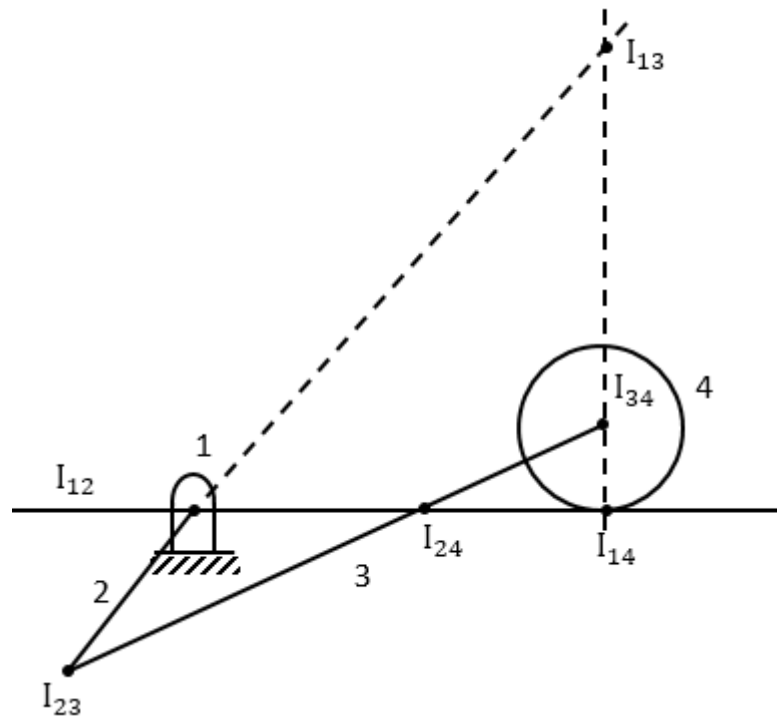
$$a_t = \alpha r = 4.1237 \times 0.4$$

$$a_t = 1.65 \text{ m/s}^2$$



ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

47.

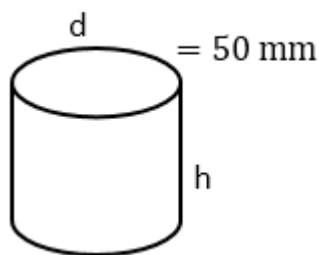


48.

Chvorinov's

$(75 \times 125 \times 20) \text{ mm}$

$t = 2 \text{ min}$



$$t = k \left(\frac{V}{A} \right)^2$$

$$2 = k \left(\frac{75 \times 125 \times 20}{2(75 \times 125 + 125 \times 20 + 75 \times 20)} \right)^2$$

$$k = 0.04$$

$$t = k \left(\frac{V}{A} \right)^2$$

$$t = k \left(\frac{d}{6} \right)^2$$

ME-2021 QUESTION & ANSWERS-AFTERNOON SESSION

$$t = 0.04 \left(\frac{50}{6} \right)^2$$

$$t = 2.78 \text{ sec}$$

49.

