



GATE 2026

Mechanical Engineering

Afternoon Session

**Memory Based
Questions & Solutions**

Exam held on 14-02-2026

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SECTION - A GENERAL APTITUDE

1. $\log_2 x + \log_{\sqrt{2}} x = 48$

the value of x is _____.

Ans. (2^{16})

$$\log_2 x + \log_{\sqrt{2}} x = 48$$

$$\frac{\log x}{\log 2} = \frac{\log x}{\log \sqrt{2}} = \log(48) \Rightarrow x = 2^{16}$$

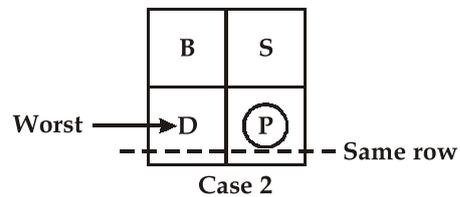
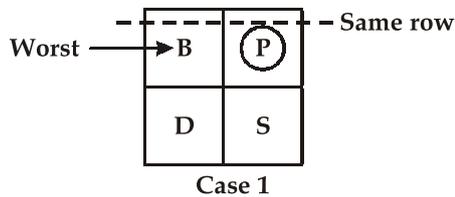
End of Solution

2. A person, his brother, his daughter and his son have oratory skill but not of the same level. They sat in a 2×2 matrix arrangement in such a way that
- I. His brother and daughter sat in same column.
 - II. His son sat diagonally across sibling of the worst orator.
 - III. Best orator and worst orator sit in the same row.

Who is the best orator?

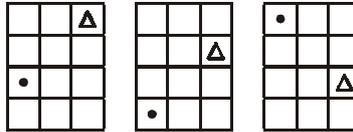
- (a) Person
- (b) His brother
- (c) His daughter
- (d) His son

Ans. (a)

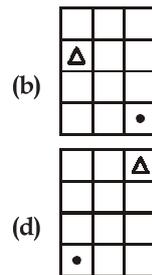
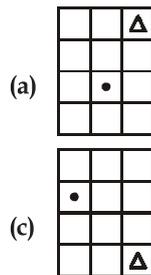


End of Solution

3. Consider the below diagram:



The next figure in the sequence is



Ans. (c)
 • Moving down
 △ Moving down

End of Solution

4. The incident that happened is that an animal has fallen into _____ pit, and the animal is _____ elephant. It is very surprising to see that the elephant is in pain _____ miserable as it has to look _____ the crowd.
 (a) a, an, and, at (b) a, a, and, for
 (c) an, a, at, and (d) and, a, an, at

Ans. (a)
 an elephant

End of Solution

5. Choose the correct option to complete the sentence:
 The team __ 250 runs in 20 overs __ the rainy day.
 (a) scored, despite (b) scoring, in spite of
 (c) scoring, despite (d) score, despite

Ans. (a)
 Scored, Despite

End of Solution



SECTION - B

TECHNICAL

6. $\int_0^4 \frac{dx}{(x+1)} = N$; and the value by trapezoidal rule considering 4 equal intervals is M,
 then the value of $M-N$ is _____.

Ans. (0.0739)

$$\int_0^4 \frac{dx}{(x+1)} = N$$

$$\int_0^4 \frac{dx}{(x+1)} dx = N$$

$$\begin{aligned} \ln(1+x) \Big|_0^4 & \\ &= \ln(5) - 0 \\ &= \ln(5) \end{aligned}$$

By trapezoidal

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

x	0	1	2	3	4
y	1	$\frac{1}{2}$	$\frac{1}{3}$	$\frac{1}{4}$	$\frac{1}{5}$
	\downarrow	\downarrow	\downarrow	\downarrow	\downarrow
	y_0	y_1	y_2	y_3	y_n

$$h = 1$$

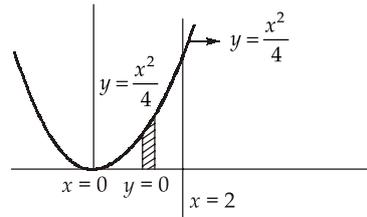
$$\begin{aligned} \int_0^4 \frac{1}{1+x} dx &= \frac{h}{2} [(y_0 + y_n) + 2(y_1 + y_2 + y_3)] \\ &= \frac{1}{2} \left[\left(1 + \frac{1}{5}\right) + 2 \times \left(\frac{1}{2} + \frac{1}{3} + \frac{1}{4}\right) \right] \\ &= \frac{1}{2} \left[\frac{6}{5} + 2 \times \frac{6+4+3}{12} \right] \\ &= \frac{1}{2} \left[\frac{6}{5} + \frac{26}{12} \right] = 1.6823 \\ &= 1.6823 - \ln 5 = 0.0739 \end{aligned}$$

End of Solution

7. Evaluate the integral.

$$\iint_A y dx dy, \quad x^2 = 4y, \quad x = 2 \quad \text{and} \quad x\text{-axis}$$

Ans. (0.2)



$$\int_{x=0}^2 \int_{y=0}^{y=\frac{x^2}{4}} y dy dx$$

$$\int_{x=0}^2 \left[\frac{y^2}{2} \right]_0^{\frac{x^2}{4}} dx$$

$$\int_{x=0}^2 \frac{x^4}{32} dx = \left[\frac{x^5}{5 \times 32} \right]_0^2 = \frac{2^5}{5 \times 32} = \frac{32}{5 \times 32} = \frac{1}{5} = 0.2$$

End of Solution

8. $\frac{dy}{dx} = 3 \frac{dy}{dt} + y$

$$y(x, 0) = 10e^{-2x}$$

$$y(x, t) = ?$$

Ans. $(10e^{-2x-t})$

$$Y = XT$$

$$Y(x, t) = X_{(x)} T_{(t)}$$

$$\frac{\partial y}{\partial x} = XT', \quad \frac{\partial y}{\partial t} = XT''$$

$$X'T = 3XT' + XT''$$

$$X'T = X(3T' + T'')$$

$$\frac{X'}{X} = \frac{3T' + T''}{T} = k(\text{Let})$$

$$X' = kX$$

$$X' - kX = 0$$

$$m - k = 0$$

$$m = k$$

AE

$$X = C_1 e^{kx}$$

$$\frac{3T' + T}{T} = k$$

$$3T' + T = kT$$

$$3T' + T - kT = 0$$

$$3T' + (1 - k)T = 0$$

$$T' + \frac{1-k}{3}T = 0$$

AE

$$m + \frac{1-k}{3} = 0$$

$$m = \frac{k-1}{3}$$

$$T = C_2 e^{\frac{k-1}{3}t}$$

Now, $y = C_1 e^{kx} \cdot C_2 e^{\frac{k-1}{3}t}$

$$y = C e^{kx} \cdot e^{\left(\frac{k-1}{3}\right)t}$$

$$y(x, t) = C e^{kx + \frac{k-1}{3}t}$$

$$y(x, 0) = C e^{kx} = 10e^{-2x}$$

$$C = 10, \quad k = -2$$

$$y(x, t) = 10e^{-2x-t}$$

End of Solution

9. Laplace transform of $\sin 2t \sin 4t$ is _____.

Ans. $\left[\frac{16s}{(s^2 + 4)(s^2 + 36)} \right]$

$$\sin 2t \sin 4t = \frac{1}{2} [\cos(2t - 4t) - \cos(2t + 4t)]$$

$$= \frac{1}{2} [\cos(-2t) - \cos(6t)] = \frac{1}{2} [\cos(2t) - \cos(6t)]$$

$$L\{\sin 2t \sin 4t\} = L\left\{ \frac{1}{2} [\cos 2t - \cos 6t] \right\}$$

$$= \frac{1}{2} \left[\frac{s}{s^2 + 4} - \frac{s}{s^2 + 36} \right] = \frac{16s}{(s^2 + 4)(s^2 + 36)}$$

End of Solution



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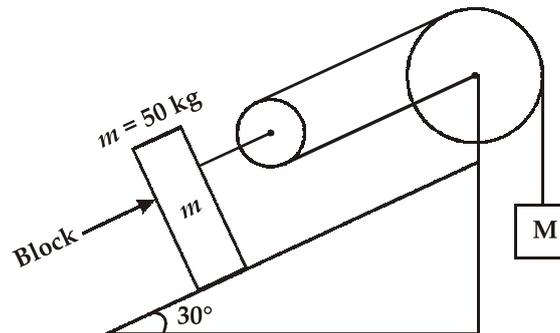
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10. Newton Raphson method is based on
 (a) Power series (b) Fourier series
 (c) Laurent series (d) Taylor series

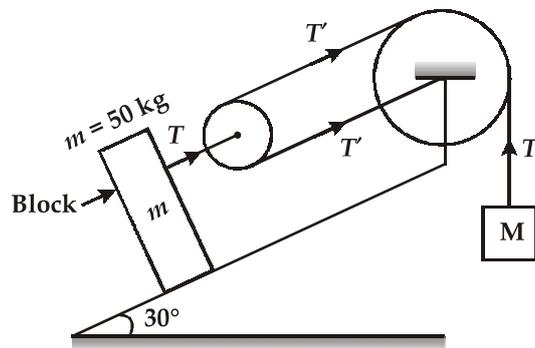
Ans. (d)

End of Solution

11. If $m = 50$ kg and coefficient friction $\mu = 0.3$. If block (m) is start moving upwards, find minimum value of M .



Ans. (18.99)



Given: $m = 50$ kg, $\mu = 0.3$

For upward motion of block, minimum value of M required, when mass M is verge of downward motion.

For verge $\Sigma \vec{F} = 0$

$$T = Mg$$

$$Mg \sin 30^\circ + \mu mg \cos 30^\circ = T$$

and $T = 2T' = 2Mg$

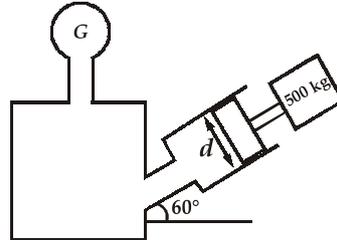
$$\Rightarrow mg \sin 30^\circ + \mu mg \cos 30^\circ = 2Mg$$

$$\Rightarrow M = \frac{50(\sin 30^\circ + \mu \cos 30^\circ)}{2}$$

$$\Rightarrow M = 18.99 \text{ kg}$$

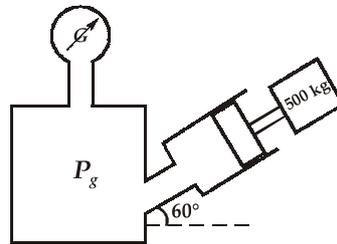
End of Solution

12. A pressure gauge is attached to the container contacting water. For the configuration find the reading of pressure gauge.
 Take, $d = 30 \text{ cm}$; $g = 10 \text{ m/s}^2$.

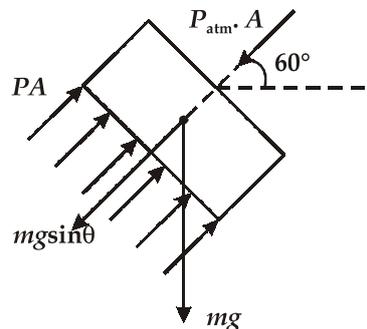


Ans. (61.26)

Given: $m = 500 \text{ kg}$, $d = 30 \text{ cm}$, $g = 10 \text{ cm}^2$.



FBD of piston,



$$\begin{aligned} \therefore P_{\text{gauge}} A &= mg \sin 60^\circ \\ \Rightarrow P_{\text{gauge}} &= \frac{500 \times 10 \times \sqrt{3} \times 4}{2 \times \pi \times 0.3^2} \\ \Rightarrow P_{\text{gauge}} &= 61.26 \text{ kPa} \end{aligned}$$

End of Solution

13. Bernoulli's equation not applicable for
- a steady, incompressible, irrotational flow
 - a steady, incompressible, rotational flow
 - along streamline in a steady, incompressible, irrotational flow.
 - along streamline in a steady, incompressible, rotational flow.

Ans. (b)

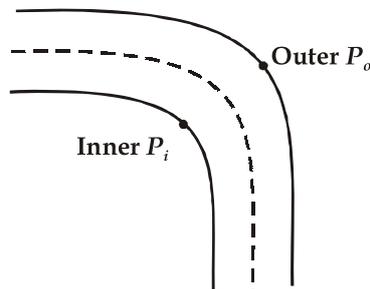
Bernoulli's cannot be applied between two points in a rotational flow.
 But along the streamline, Bernoulli's equation is applicable in rotational flow also.

End of Solution

14. A fluid is flowing in a 90° horizontal pipe bend. If P_i and P_o are pressures at inner and outer radius of bend. Which of the following option is correct regarding radial pressure variation at the bend?
- $P_i < P_o$
 - $P_i > P_o$
 - $(P_i - P_o)$ Varies linearly with bend radius.
 - $(P_i - P_o)$ Varies inversely with bend radius.

Ans. (a)

Bend in horizontal plane,



Pipe bend - Free vortex,

$$V_r = C$$

$$V \propto \frac{1}{r}$$

∴ Velocity at outer side is lower and hence using Bernoulli's equation pressure is higher at outer side.

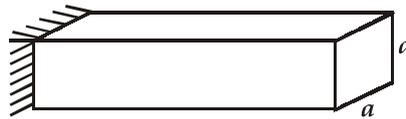
$$\therefore P_o > P_i$$

End of Solution

Ans. (a)

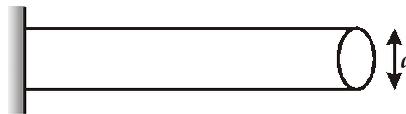
Long fins,  → 1  → 2

For square cross-section,



Given: $a = d$, $P = 4a = 4d$, $A_C = a^2 = d^2$

For circular cross-section,



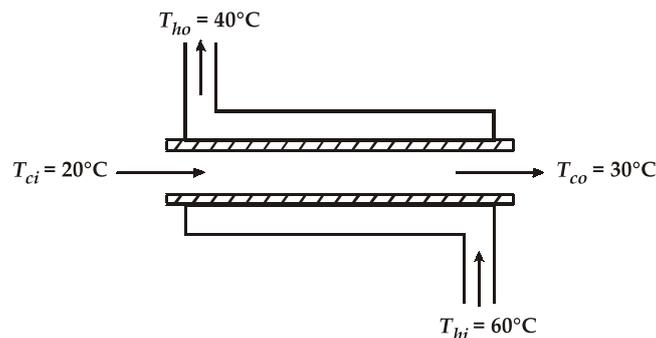
$$P = \pi d$$

$$A_C = \frac{\pi d^2}{4}$$

$$\frac{q_1}{q_2} = \frac{\sqrt{hPkA_C} \theta_b}{\sqrt{hPkA_C} \theta_b} = \sqrt{\frac{16}{\pi^2}} = \frac{4}{\pi}$$

End of Solution

17. Heat exchanger shown in figure, below inner pipe of internal radius 10 mm and thickness 1 mm. The length of heat transfer area is 1 m. Thermal conductivity of inner tube material is 387 W/m°C. The internal and external convective heat transfer coefficient for inner tube are 80 W/m²°C and 50 W/m²°C. Find the value of heat transfer rate.



Ans. (50.06)

Given: $r_i = 10$ mm, $t = 1$ mm, $r_e = 11$ mm, $L = 1$ m

$$k_{\text{inner tube}} = 387 \text{ W/m}^\circ\text{C}$$

$$h_i = 80 \text{ W/m}^2\text{°C}, h_e = 50 \text{ W/m}^2\text{°C}$$

Conduction resistance of inner tube wall

$$R = \frac{\ln\left(\frac{r_e}{r_i}\right)}{2\pi kl} = \frac{\ln\left(\frac{11}{10}\right)}{2\pi \times 387 \times 1} = 3.92 \times 10^{-5} \text{ k/W}$$



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Overall heat transfer coefficient,

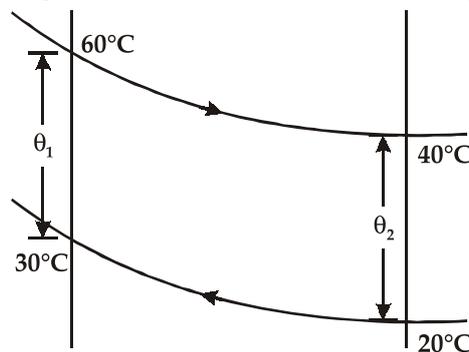
$$\frac{1}{UA} = \frac{1}{h_i A_i} + \frac{1}{h_e A_e} + R_{\text{conduction}}$$

Since, thickness is very less $\Rightarrow A_i \approx A_e$ and $R_{\text{conduction}}$ is also negligible.

$$\therefore \frac{1}{U} = \frac{1}{h_i} + \frac{1}{h_e} = \frac{1}{80} + \frac{1}{50}$$

$$\Rightarrow U = 30.77 \text{ W/m}^2\text{K}$$

Now, the given configuration is counter flow heat exchanger.



$$\theta_1 = T_{hi} - T_{c,o} = 30^\circ\text{C}$$

$$\theta_2 = T_{ho} - T_{c,i} = 20^\circ\text{C}$$

$$\text{LMTD} = \frac{\theta_1 - \theta_2}{\ln\left(\frac{\theta_1}{\theta_2}\right)} = \frac{10}{\ln(1.5)} = 24.66^\circ\text{C}$$

\therefore Heat transfer rate, $q = UA (\text{LMTD})$

$$= U(\pi DL) (\text{LMTD})$$

$$= 30.77 \times (\pi \times 0.021 \times 1) \times 24.66$$

$$q = 50.06 \text{ W}$$

$$\left\{ D = \frac{D_i + D_e}{2} \right\}$$

End of Solution

18. A spherical ball of radius 5 mm is kept in a furnace at 400°C . It is dropped in a water at 20°C . The thermophysical properties of sphere material is given as $\rho = 3000 \text{ kg/m}^3$, $h = 500 \text{ W/m}^2\text{C}$, $C_p = 1000 \text{ J/kgK}$. Find the time required to reach temperature of 50°C .

Ans. (25.39)

Given: $R = 5 \text{ mm}$, $T_i = 400^\circ\text{C}$, $T_\infty = 20^\circ\text{C}$, $\rho = 3000 \text{ kg/m}^3$, $h = 500 \text{ W/m}^2\text{C}$, $c_p = 1000 \text{ J/kgK}$, $T = 50^\circ\text{C}$.

$$L_c = \frac{V}{A} = \frac{R}{3}$$

$$\therefore \frac{T - T_\infty}{T_i - T_\infty} = e^{-\frac{ht}{\rho L_c c_p}}$$

$$\Rightarrow \frac{50 - 20}{400 - 20} = e^{-\left(\frac{500 \times 3}{3000 \times 0.005 \times 1000}\right)t}$$

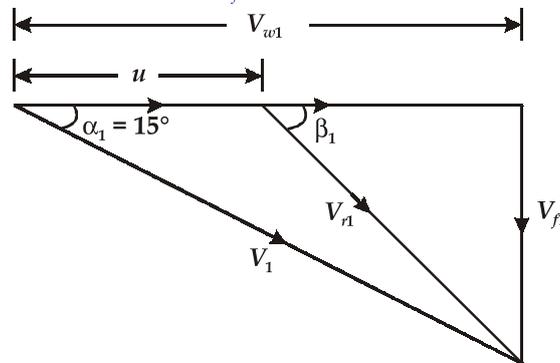
$$\Rightarrow t = \frac{\ln\left(\frac{30}{380}\right)}{0.1} = 25.39 \text{ sec}$$

End of Solution

19. In an inward flow reaction turbine, the outer diameter is 1 m and guide blade angle is 15° and the normal component of absolute velocity at inlet is 10 m/s and the speed of turbine is 600 rpm then the blade angle at inlet is _____.

Ans. (59.44)

Given: $N = 600 \text{ rpm}$, $D_o = 1 \text{ m}$, $V_{f1} = 10 \text{ m/s}$, $\beta_1 = ?$, $\alpha_1 = 15^\circ$.



Inlet Velocity Triangle

$$u_1 = \frac{\pi D_o N}{60} = 10\pi \text{ m/s} = 31.4159 \text{ m/s}$$

$$\tan \alpha_1 = \frac{V_{f1}}{V_{w1}} \Rightarrow \tan 15^\circ = \frac{10}{V_{w1}}$$

$$V_{w1} = \frac{10}{\tan 15^\circ} = 37.3205 \text{ m/s}$$

$$\tan \beta_1 = \frac{V_{f1}}{V_{w1} - u_1} = \frac{10}{37.3205 - 31.4159}$$

$$\beta_1 = 59.44^\circ$$

End of Solution

20. If the demand of a certain product is 10,000 units per year and holding cost is Rs. 0.5 per month and the cost per order is Rs.550 per order. The optimum EOQ (Q^*) is _____ units.

Ans. (1354)

Given: $D = 10000 \text{ units/year}$, $C_h = \text{Rs. } 0.5 / \text{month} = \text{Rs. } 6 / \text{year}$, $C_o = \text{Rs. } 550$

$$Q^* = \sqrt{\frac{2DC_o}{C_h}} = \sqrt{\frac{2 \times 10000 \times 550}{6}} \approx 1354 \text{ units}$$

End of Solution

21. Primal

$$\text{Min } z = 0.07 x_1 + 0.05x_2$$

$$0.1x_1 \geq 0.4$$

$$0.1 x_2 \geq 0.6$$

$$0.1x_1 + 0.2x_2 \geq 2$$

$$0.2x_1 + 0.1x_2 \geq 1.8$$

Find its dual?

Ans.

Primal

$$\begin{aligned} \text{Min } z &= 0.07 x_1 + 0.05x_2 \\ 0.1x_1 &\geq 0.4 \quad] y_1 \\ 0.1 x_2 &\geq 0.6 \quad] y_2 \\ 0.1x_1 + 0.2x_2 &\geq 2 \quad] y_3 \\ 0.2x_1 + 0.1x_2 &\geq 1.8 \quad] y_4 \end{aligned}$$

Dual

Maximize

$$W = 0.4y_1 + 0.6y_2 + 2y_3 + 1.8y_4$$

Subjected to,

$$0.1y_1 + 0.1y_3 + 0.2y_4 \leq 0.07$$

$$0.1y_2 + 0.2y_3 + 0.1y_4 \leq 0.05$$

$$y_1, y_2, y_3, y_4 \geq 0$$

End of Solution

22. Demand of a certain commodity in January 2026 and February 2026 are 500 and 635 units respectively and the forecast for the month of January is 250. If the smoothing coefficient is 0.7 then the forecast for the month of March is

Ans. (572)

Given, $\alpha = 0.7$

	D	F	e
Jan	500	250	250
FEB	635	425	210
March		572	

$$F_t = F_{t-1} + \alpha e_{t-1}$$

Forecast for the month of March = 572

End of Solution

23. The time estimate of the following activities are given below:

Activity	t_o	t_m	t_p
1-2	2	4	12
1-3	2	4	6
1-4	3	4	11
3-4	2	5	14
3-5	3	3	3
2-5	3	6	9
4-5	3	6	15
5-6	2	5	8

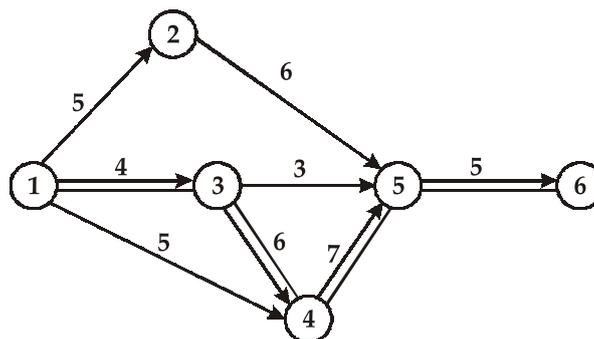
The minimum project completion time is ___.

Ans. (22)

We know that, $t_e = \frac{t_o + 4t_m + t_p}{6}$

Activities	Expected time(t_e)
1-2	5
1-3	4
1-4	5
3-4	6
3-5	3
2-5	6
4-5	7
5-6	5

Network

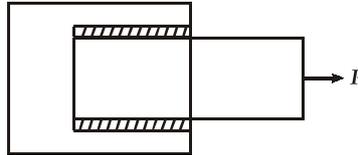


Critical path : 1-3-4-5-6

$$(T_e)_{\text{project}} = 22$$

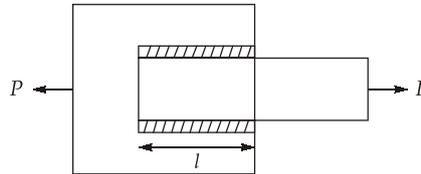
End of Solution

24. A plate is joined using double parallel fillet weld and subject to load P . The maximum permissible shear stress is τ_{all} . Weld leg size is h and weld length is l . Then the maximum permissible load P is _____.



- (a) $\frac{hl\tau_{all}}{\sqrt{2}}$ (b) $\sqrt{2}hl\tau_{all}$
 (c) $2hl\tau_{all}$ (d) $hl\tau_{all}$

Ans. (b)



Load, $P = \text{Area of weld} \times \tau_{allowable}$

Load, $P = \frac{h}{\sqrt{2}} \times (2l)\tau_{all}$, (if single fillet length is l)

$$P = \sqrt{2}hl\tau_{all}$$

Load, $P = \frac{h}{\sqrt{2}} \times (l)\tau_{all}$, (if total fillet length is l)

End of Solution

25. A closed coil helical spring of mean diameter D and wire diameter d is subjected to axial load F . The maximum value of shear stress at the wire cross-section is

- (a) $\left(\frac{4F}{\pi d^2} + \frac{8FD}{\pi d^3} \right)$ (b) $\left(\frac{2F}{\pi d^2} + \frac{8FD}{\pi d^3} \right)$
 (c) $\left(\frac{2F}{\pi d^2} + \frac{16FD}{\pi d^3} \right)$ (d) $\left(\frac{4F}{\pi d^2} + \frac{16FD}{\pi d^3} \right)$

Ans. (a)

$$\begin{aligned} \tau_{max} &= \tau_d + \tau_t \\ &= \frac{F}{\pi d^2} + \frac{16FD/2}{\pi d^3} \\ &= \frac{4F}{\pi d^2} + \frac{8FD}{\pi d^3} \end{aligned}$$

End of Solution



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26. During orthogonal turning by using a single point cutting tool, feed rate is 0.24 mm/rev. The uncut chip thickness is 0.23 mm, the shear angle 20° , tangential force component and radial force component 800 N, 150 N respectively. The value of shear force is _____ N.

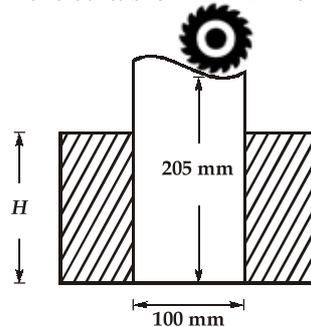
Ans. (700.451)

Given: $f = 0.24$ mm/rev, $\phi = 20^\circ$, $t_1 = 0.23$ mm, $F_T = 150$ N, $F_C = 800$ N.

$$\begin{aligned} F_S &= F_C \cos\theta - F_T \sin\theta \\ &= 800 \cos 20^\circ - 150 \sin 20^\circ \\ &= 700.451 \text{ N} \end{aligned}$$

End of Solution

27. For the mailing operation the suitable value of height of fixture H is



- (a) 70
 (b) 210
 (c) 205
 (d) 150

Ans. (b)

End of Solution

28. In Deep drawing operation of rectangular sheet metal, 30% stretching in length in 15% reduction in thickness. Assume volume to be constant, the normal Anisotropy of sheet metal is _____.

Ans. (0.61)

$$\begin{aligned} \epsilon_v &= 0 \\ \epsilon_l + \epsilon_t + \epsilon_w &= 0 \end{aligned} \quad \dots (i)$$

$$\epsilon_l = \ln\left(\frac{l_f}{l_o}\right) = \ln\left(\frac{1.3l_o}{l_o}\right) = 0.2623$$

$$\epsilon_t = \ln\left(\frac{t_f}{t_o}\right) = \ln\left(\frac{0.85t_o}{t_o}\right) = -0.1625$$

$$\epsilon_w = -(\epsilon_t + \epsilon_l) \quad \text{[From (i)]}$$

$$\epsilon_w = -0.0988$$

$$\text{Normal anisotropy, } r = \frac{\epsilon_w}{\epsilon_r} = \frac{-0.0988}{-0.1625} \cong 0.61$$

End of Solution

29. In a drilling operation if 150 through holes are produced from a sheet at 200 rpm and 60 holes are produced at 300 rpm. Find the value of tool life exponent (n)

Ans. (0.3067)

Given data:

Number of holes	Rotation speed (RPM)
150	200
60	300

For drilling operation,

$$N_1 T_1^n = N_2 T_2^n$$

$$\text{Tool life} = \text{Number of holes} \left(\frac{L}{s \times N} \right)$$

$$\Rightarrow 200 \left[150 \times \frac{L}{s \times 200} \right]^n = 300 \left[60 \times \frac{L}{s \times 300} \right]^n$$

$$\Rightarrow (0.75)^n = 1.5 (0.2)^n$$

$$\Rightarrow n = \frac{\ln 1.5}{\ln 3.75} = 0.3067$$

End of Solution

30. The value of 5 peaks = 6.7, 8.3, 6.3, 6.9, 6.2

The value of 5 valleys = 1.92, 1.97, 2.01, 2.81, 2.82

The average roughness value is _____.

Ans. (4.57)

10 point average

$$R_z = \frac{\Sigma P - \Sigma V}{5} = 4.57$$

End of Solution

31. The common Stereolithography STL file error is

- (a) non manifold topology (b) staircase appearances
 (c) degenerate facet (d) missing facets

Ans. (d)

End of Solution

32. Match List-I (Casting defects) with List-II (Definitions).

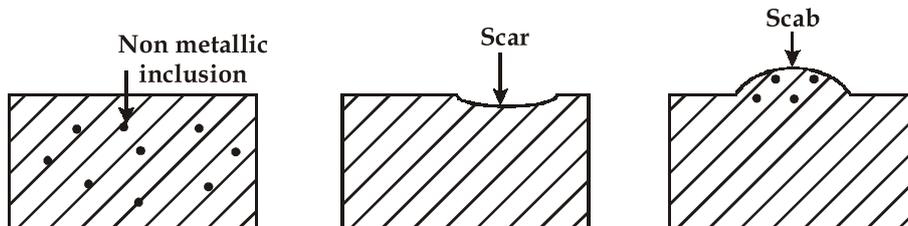
- | List-I | List-II |
|----------|--|
| P. Dross | 1. A shallow, often shiny cavity or depression on a flat casting surface. |
| Q. Scar | 2. Lighter impurities appearing on the casting surface |
| R. Scab | 3. A rough, irregular, slightly raised protrusion on the casting surface, often covered by a thin layer of sand and connected to the main body |
- (a) P-1, Q-2, R-3 (b) P-2, Q-1, R-3
 (c) P-2, Q-3, R-1 (d) P-1, Q-3, R-2

Ans. (c)

Dross - Metal oxide formation, or non metallic inclusion.

Scar - Shallow depression

Scab - Rough thin layer of metal protruding above casting surface.



End of Solution

33. An FCC Metal has a density of 2.71 g/cm³, Atomic weight = 26.98 g/mol, Avogadro no. = 6.023 × 10²³. Find the atomic radius in nm.

Ans. (0.1429)

FCC crystal structure ($n_{av} = 4$), $\rho = 2.71 \text{ g/cm}^3$, $M = 26.98 \text{ g/mol}$.

$$\rho = \frac{n_{av} \times \text{At. Weight}}{6.02 \times 10^{23} \times \left(\frac{4r}{\sqrt{2}}\right)^3}; \quad \left\{ \because \text{For FCC, } a = \frac{4r}{\sqrt{2}} \right\}$$

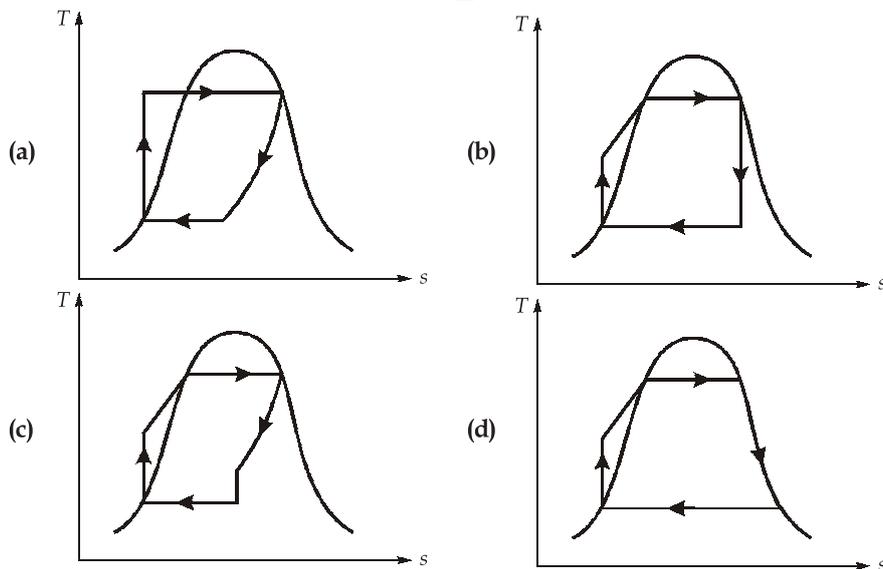
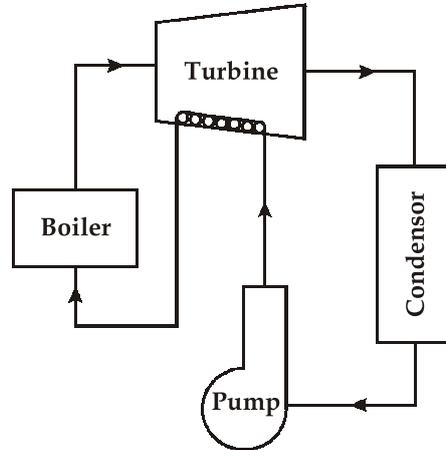
$$2.71 \text{ g/cm}^3 = \frac{4 \times 26.98}{6.02 \times 10^{23} \times \left(\frac{4r}{\sqrt{2}}\right)^3}$$

$$r^3 = 0.292159 \times 10^{-23} \text{ cm}^3$$

$$r = 0.1429 \text{ nm}$$

End of Solution

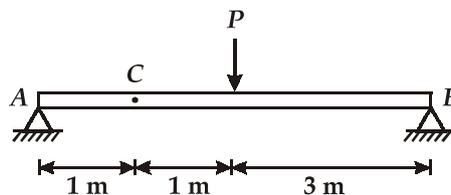
34. Which of the following T-s diagram is correct for Simple Rankine cycle?



Ans. (b)

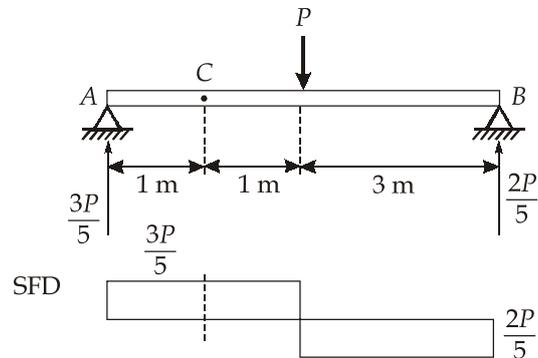
End of Solution

35. A simply supported beam of cross-section $20 \text{ mm} \times 45 \text{ mm}$. Point C is at neutral layer in the simply supported beam. Find load P if shear stress at C is 3 MPa .



Ans. (3)

Given: Dimension of cross-section = $20 \text{ mm} \times 45 \text{ mm}$
 τ at point C = 3 MPa



$$\text{shear force at } c, = \frac{3P}{5}$$

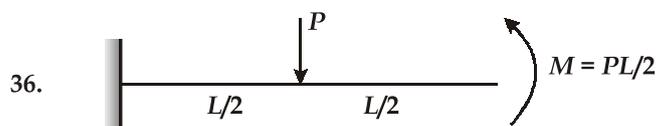
$$\tau_c = 1.5 \frac{S_c}{A_c}$$

$$3 = \frac{1.5 \times \frac{3P}{5}}{20 \times 45}$$

$$P = 3000 \text{ N}$$

$$P = 3 \text{ kN}$$

End of Solution



Choose the correct option for SFD and BMD.

- | | |
|-----|-----|
| (a) | (b) |
| (c) | (d) |



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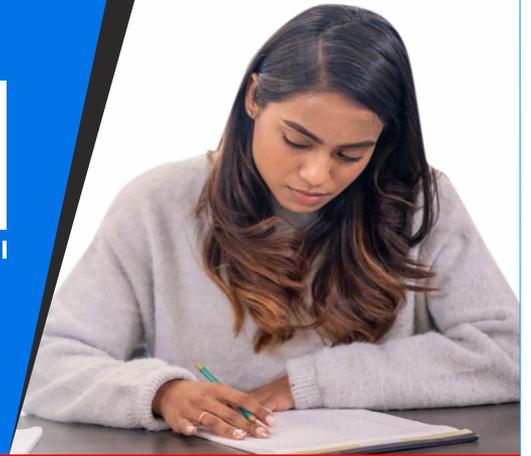


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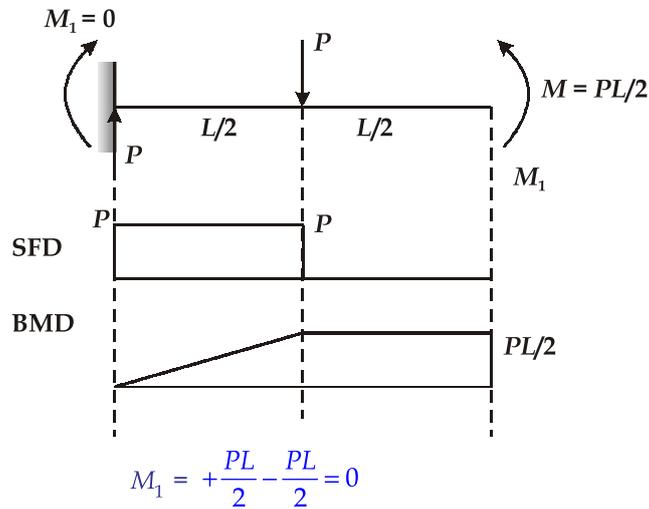
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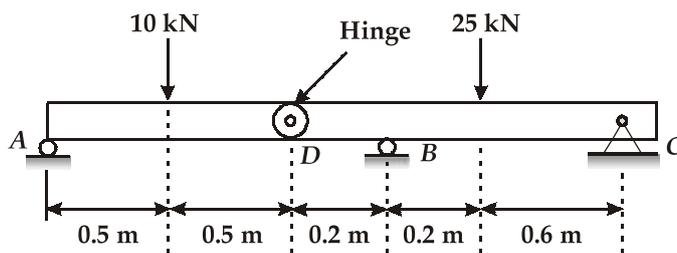
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Ans. (b)



End of Solution

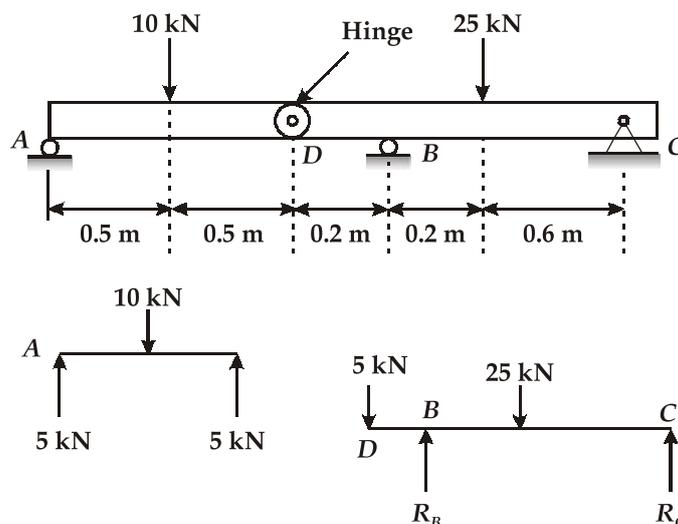
37.



For the given internally Hinged beam configuration, determine the reaction at support C.

- (a) 5 kN
 (b) 10 kN
 (c) 15 kN
 (d) 25 kN

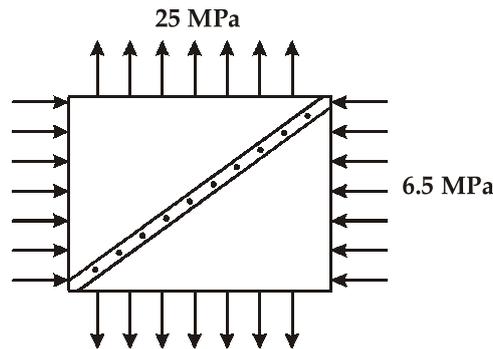
Ans. (a)



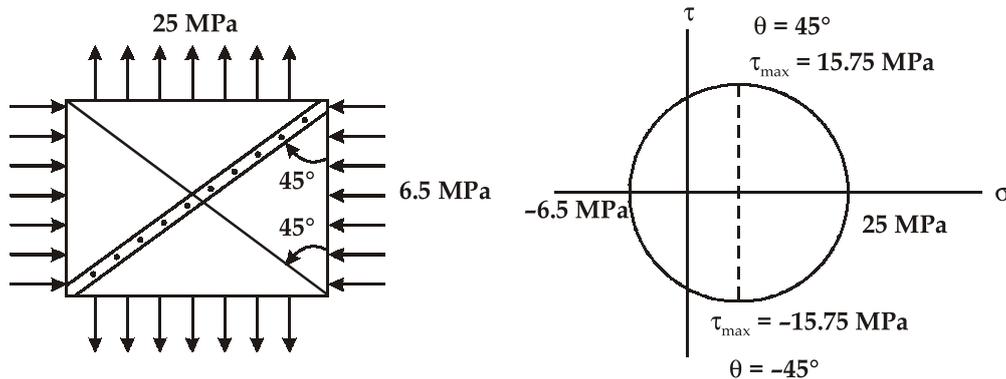
$$\begin{aligned}\Sigma M_B &= 0 \\ 5 \times 0.2 + R_C \times 0.8 &= 25 \times 0.2 \\ R_C &= 5 \text{ kN}\end{aligned}$$

End of Solution

38. A square plate of dimension 1 m × 1 m is welded along diagonal. Ratio of normal stress to shear stress on the plane normal to weld is _____.



Ans. (0.5873)



$$\theta = -45 \text{ or } 135^\circ$$

$$(\sigma_n)_{\theta = -45^\circ} = \frac{25 + (-6.5)}{2}$$

$$(\sigma_n)_{\theta = -45^\circ} = 9.25 \text{ MPa}$$

$$(\tau_s)_{\theta = -45^\circ} = -\left(\frac{25 - (-6.5)}{2}\right) = -15.75 \text{ MPa}$$

$$\frac{\sigma_n}{\tau_s} = -\frac{9.25}{15.75} = -0.5873$$

$$\left|\frac{\sigma_n}{\tau_s}\right| = 0.5873$$

Ans.

End of Solution

39. If $\sigma_1 = \sigma$, $\sigma_2 = -2\sigma$
 Yield shear stress, $s_{ys} = 550$ MPa, Factor of safety, FOS = 2.
 Using MDET, find σ ?

Ans. (103.94)

Given data: $\sigma_1 = \sigma$, $\sigma_2 = -2\sigma$, $S_{yt} = 550$ MPa, FOS = 2

$$\text{Using MDET, } \sigma_1^2 + \sigma_2^2 - \sigma_1\sigma_2 = \left[\frac{S_{yt}}{\text{FOS}} \right]^2$$

$$\sigma^2 + (-2\sigma)^2 + 2\sigma^2 = \left(\frac{550}{2} \right)^2$$

$$\sigma = 103.94 \text{ MPa}$$

End of Solution

40. Cylindrical pressure vessel with diameter 2 m, thickness = 15 mm, $E = 210$ MPa, $\mu = 0.3$.
 Maximum allowable strain on surface is 0.00034. Maximum permissible pressure
 _____ in kPa.

Ans. (840)

Given data: $E = 210$ GPa, $\mu = 0.3$, $t = 15$ mm, $d = 3$ m, $\epsilon_h = 0.00034$.

$$\text{Now, } \epsilon_h = \frac{pd}{4tE}(2 - \mu)$$

$$0.00034 = \frac{p(300)(2 - 0.3)}{(4)(15) \times 210 \times 10^3}$$

$$p = 0.84 \text{ MPa}$$

$$p = 840 \text{ kPa}$$

End of Solution

41. An ideal gas is at state 1 and then it brings to state 2 and state 3. Both the end states
 2 and 3 are on the same isotherms.

If P and h are the pressure and enthalpy respectively, the choose the correct statements

- (a) $P_2h_3 = P_3h_2$ (b) $P_2h_2 > P_3h_3$ or $P_2h_2 < P_3h_3$
 (c) $h_2 = h_3$ (d) $h_2 > h_3$ or $h_2 < h_3$

Ans. (c)

$$\text{As, } h = C_p T$$

$$\text{Given } T_2 = T_3 \text{ (2 and 3 on same isotherm)}$$

$$\therefore h_2 = h_3$$

End of Solution

42. In an isothermal process net heat transfer is equal to net work transfer. Choose the correct statement .
- (a) The process is possible
 - (b) The process is not possible as it violates 1st law of thermodynamics
 - (c) The process is not possible as it violates 2nd law of thermodynamics.
 - (d) Process is possible, it Violates 2nd law of thermodynamics.

Ans. (a)

$$Q = \Delta U + W$$

$$\Delta U = 0 \text{ (for isothermal process)}$$

$$Q = W$$

Also, the process is possible.

End of Solution

43. An ideal gas passes isothermally through a long horizontal uniform cross section under steady flow. Pressure gradient in the pipe is sufficient for a finite change in density of gas. If flow of gas is purely pressure driven and subsonic throughout then average flow velocity.
- (a) Increases in hydrodynamic entrance region and then decreases
 - (b) Decreases along flow
 - (c) Does not change
 - (d) Increases along flow

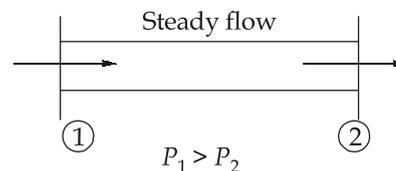
Ans. (d)

For steady flow,

$$\rho AV = \text{constant}$$

$$\rho \cdot V = \text{constant}$$

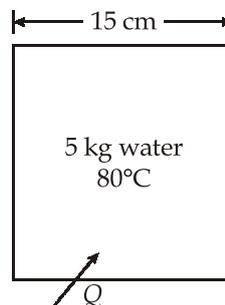
$$V_2 > V_1 = (\because \rho_1 > \rho_2)$$



End of Solution

44. Following data is given
 $x_1 = 0.1, T_1 = 80^\circ\text{C}, T_2 = 130^\circ\text{C}$

@ 80°C (m ³ /kg)	@ 130°C (m ³ /kg)
$v_f = 0.001029$	$v_f = 0.001069$
$v_g = 3.4053$	$v_g = 0.668$



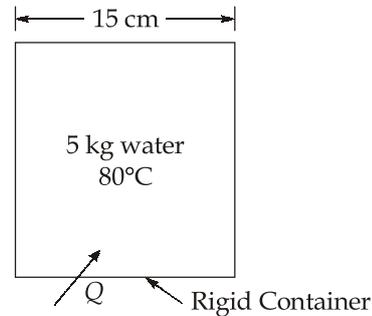
Find the change in the height of the liquid level (in cm) in the cylinder, when it is heated from state 1 to state 2 in closed container.

Ans. (11.4)

Given data

$$x_1 = 0.1; \quad T_1 = 80^\circ; \quad T_2 = 130^\circ\text{C}$$

@ 80°C (m ³ /kg)	@ 130°C (m ³ /kg)
$v_f = 0.001029$	$v_f = 0.001069$
$v_g = 3.4053$	$v_g = 0.668$



$$v_1 = v_f + x_1 v_{fg} = 0.34145 \text{ m}^3/\text{kg}$$

$$v_1 = v_2$$

$$0.34145 = v_f + x_2(v_{fg})$$

$$x_2 = 0.5104$$

$$x_1 = \frac{m_v}{m_v + m_l}$$

$$1 - x_1 = 1 - \frac{m_v}{m_l + m_v} = \frac{m_l}{m_l + m_v}$$

$$1 - 0.1 = \frac{m_{l1}}{5} \Rightarrow m_{l1} = 4.5 \text{ kg}$$

$$1 - x_2 = \frac{m_{l2}}{5}$$

$$m_{l2} = 2.448 \text{ kg}$$

$$V_{l1} = m_{l1} \times (0.001029) = 4.63 \times 10^{-3} \text{ m}^3$$

$$V_{l2} = m_{l2} \times (0.001069) = 2.6169 \times 10^{-3} \text{ m}^3$$

$$V_{l1} - V_{l2} = 2.0131 \times 10^{-3} \text{ m}^3$$

$$(H_1 - H_2) \times A = V_1 - V_2$$

$$(H_1 - H_2) \frac{\pi}{4} (0.15)^2 = 2.0136 \times 10^{-3}$$

$$\text{Change in height of the liquid level} = 114 \times 10^{-3} \text{ m} = 11.4 \text{ cm}$$

End of Solution



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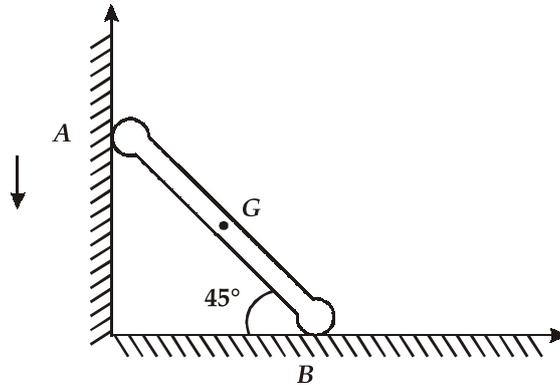
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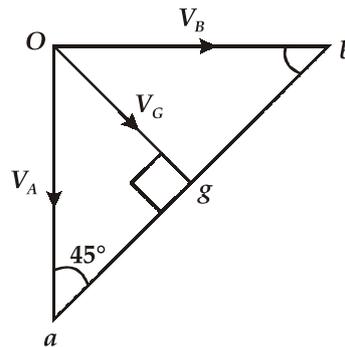
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45. If the velocity of point A is 6 m/s. Find velocity of midpoint G.



Ans. (4.24)

Given: $V_A = 6$ m/s.
 Velocity diagram



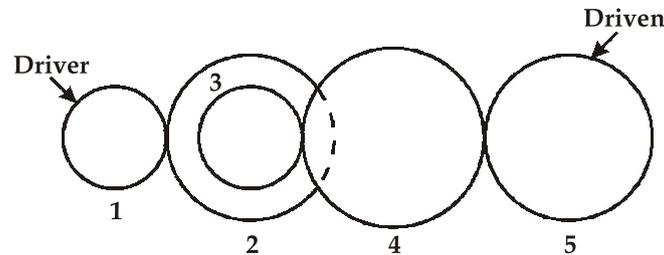
$$\sin 45^\circ = \frac{V_G}{V_A} = \frac{V_G}{6}$$

$$\Rightarrow \frac{1}{\sqrt{2}} = \frac{V_G}{6}$$

$$\Rightarrow V_G = \frac{6}{\sqrt{2}} = 4.24 \text{ m/s}$$

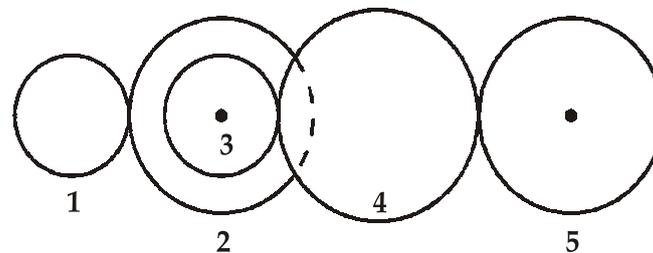
End of Solution

46. Which of the following gear is idle gear? [Gear 2 and Gear 3 are mounted on same shaft]



- (a) 1
 (b) 2
 (c) 3
 (d) 4

Ans. (d)



Gear 4 is connecting left and right both.
 \Rightarrow Gear 4 : Idler

End of Solution

47. Critical damping coefficient is 350 Ns/m and damping coefficient is 35 Ns/m. Find the logarithmic decrement.

Ans. (0.6314)

Given: Damping coefficient, $C = 35 \text{ N/m/s}$
 Critical damping coefficient, $C_c = 350 \text{ N/m/s}$

We know that, $\xi = \frac{C}{C_c} = \frac{35}{350} = 0.1$

Logarithmic decrement, $\delta = \frac{2\pi\xi}{\sqrt{1-\xi^2}} = \frac{2\pi \times 0.1}{\sqrt{1-(0.1)^2}} = 0.6314$

End of Solution

48. A disc having radial slot in which a body is sliding at a velocity of 0.2 m/s relative to the slot and disc is rotating anticlockwise with the angular velocity of 3 rad/s then the magnitude of coriolis acceleration is

- (a) 1.2 m/s²
 (b) 1.5 m/s²
 (c) 2.3 m/s²
 (d) 3.1 m/s²

Ans. (a)

Given: $\omega = 3 \text{ rad/s}$, $V_{\text{sliding}} = 0.2 \text{ m/s}$
 Coriolis acceleration, $a^c = 2V_{\text{sliding}}\omega$
 $= 2 \times 0.2 \times 3 = 1.2 \text{ m/s}^2$

End of Solution

49. Worm gear are used in power transmission between
 (a) parallel shaft (b) not parallel nor intersecting shaft
 (c) intersecting shaft (d) parallel or intersecting shaft

Ans. (b)

Worm gear is used for connecting. Neither parallel nor intersecting shafts.

End of Solution

50. An air plane is moving at a speed of 1200 km/hr and take a left turn of radius 2 km. If the moment of inertia is 0.1 kgm² and propeller is rotating at an angular speed of 500 rpm then the gyroscopic couple is

Ans. (8.723)

Given: $V = 1200 \text{ km/hr} = 1200 \times \frac{5}{18} = 333.33 \text{ m/s}$, $I = 1 \text{ kg/m}^2$, $R = 2 \text{ km} = 2000 \text{ m}$.

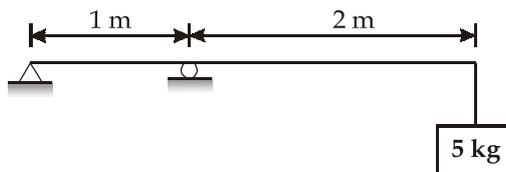
$$(\omega_p)_{\text{turning}} = \frac{V}{R} = \frac{333.33}{2000} = 0.1666 \text{ rad/s}$$

$$\omega = \frac{2\pi N}{60} = 2\pi \times \frac{500}{60} = 52.3598 \text{ rad/s}$$

$$C = I\omega\omega_p = 1 \times 52.3598 \times 0.1666 = 8.723 \text{ N-m}$$

End of Solution

51. For arrangement shown below find the natural frequency.



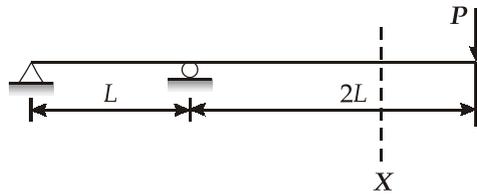
$E = 210 \text{ GPa}$

$I = 10^{-8} \text{ m}^4$

- (a) 10/3 rad/s (b) 20/3 rad/s
 (c) 4 rad/s (d) 10 rad/s

Ans. (d)

Given data: $E = 200000 \text{ MPa}$, $I = 10^{-8} \text{ m}^4$, $m = 5 \text{ kg}$,
 $EI = 200000 \times 10^{-8} \times 10^6 \text{ N/m}^2$
 $= 2000 \text{ N/m}^2$



Here,

$$L = 1 \text{ m}$$

$$P = mg$$

$$U = U_1 + U_2$$

$$U = \int_0^{2L} \frac{(Px)^2}{2EI} dx + \int_{2L}^{3L} \frac{(Px - 3P(x-2L))^2}{2EI} dx$$

$$= \int_0^{2L} \frac{P^2 x^2}{2EI} dx + \int_{2L}^{3L} \frac{(6PL - 2Px)^2}{2EI} dx$$

$$= \frac{8P^2 L^3}{6EI} - \left[\frac{4P^2 (3L-x)^3}{6EI} \right]_{2L}^{3L}$$

$$= \frac{4P^2 L^3}{3EI} + \frac{2P^2 L^3}{3EI} = \frac{2P^2 L^3}{EI}$$

$$\delta_{st} = \frac{\partial U}{\partial P} = \frac{4PL^3}{EI}$$

$$\omega_n = \sqrt{\frac{g}{\delta_{st}}} = \sqrt{\frac{gEI}{4PL^3}}$$

Substituting values, $\omega_n = \sqrt{\frac{gEI}{4mgL^3}} = \sqrt{\frac{2000}{4 \times 5 \times 1}} = 10 \text{ rad/s}$

■■■■

MADE EASY students top in ESE 2025

4 Streams 4 Toppers
all 4 MADE EASY Students

39 selections
in Top 10

434 selections out of
458 Vacancies (95% Selections)

CE 9 in Top 10	1 AIR MOHAMMAD SHAQUIB Live Online Foundation Course	2 AIR PRAKHAR SHRI Classroom Foundation Course	3 AIR ARJUN SHARMA Mains Online Course	4 AIR BOLLA U NANDAN Classroom Foundation Course	5 AIR KESHAV Test Series & IGP	7 AIR TUSHAR AGGARWAL Classroom Foundation Course	8 AIR AYUSH JAIN Classroom Foundation Course	9 AIR ADITYA P SINGH Test Series & IGP	10 AIR PUSHPENDRA RATHORE Test Series & IGP	
ME 10 in Top 10	1 AIR NIMESH CHANDRA Classroom Foundation Course	2 AIR ASHOK KUMAR Classroom Foundation Course	3 AIR HARI SINGH Mains Online Course	4 AIR SIDDESH RAO GS Online Course	5 AIR GOLLANGI SATEESH Mains Online Course	6 AIR AVINASH VERMA Mains Online Course	7 AIR PRASHANT SINGH Mains Offline Course	8 AIR MONU KUMAR Classroom Foundation Course	9 AIR NIKHIL KUMAR SAHA Test Series & IGP	10 AIR AMIT KUMAR SINGH Classroom Foundation Course
EE 10 in Top 10	1 AIR RAJAN KUMAR Classroom Foundation Course	2 AIR VISHNU SAINI Live Online Foundation Course	3 AIR OMPRAKASH RAJPUT Classroom Foundation Course	4 AIR TUSHAR CHAUDHARY Classroom Foundation Course	5 AIR RAM KUMAR Test Series & IGP	6 AIR PUNIT MEENA Classroom Foundation Course	7 AIR JYOTI K. PANDA Classroom Foundation Course	8 AIR D A SAI RAM REDDY Test Series & IGP	9 AIR DHURUV KAWAT Classroom Foundation Course	10 AIR AKSHIT PARASHARI Live Online Foundation Course
E&T 10 in Top 10	1 AIR UTKARSH PATHAK Live Online Foundation Course	2 AIR RAJESH TIWARI Live Online Foundation Course	3 AIR PRASHANT LAVANIA Classroom Foundation Course	4 AIR PRADEEP SHUKLA Mains Online Course	5 AIR ASHISH SINGH PATEL Classroom Foundation Course	6 AIR TANYA TYAGI Mains Online Course	7 AIR PALAK MISHRA Mains Online Course	8 AIR HAYAT ALI Classroom Foundation Course	9 AIR VIDHU SHREE Live Online Foundation Course	10 AIR RAM PAL SINGH Classroom Foundation Course

MADE EASY students top in GATE 2025

5 All India Rank 1
(CE, ME, IN, ES & EE)

45 Selections
in Top 10

399 Selections
in Top 100

1 AIR CE Abhay Singh Classroom Course	1 AIR ME Rajneesh Bijarniya Classroom Course	1 AIR EE Pradip Chauhan Test Series	1 AIR IN Kailash Goyal Classroom Course	1 AIR ES Yash Jain Classroom Course	2 AIR CE Harshvardhan Singh Classroom Course	2 AIR ME Gollangi Sateesh Online Course	2 AIR EE Kailash Goyal Classroom Course	2 AIR EC Ankush Philip John Postal Package & Test Series	
2 AIR IN S. Bhattacharya Test Series	2 AIR ES Jitesh Choudhary Classroom Course	2 AIR ES Tarun Yadav Classroom Course	3 AIR CE Pankaj Meena Classroom Course	3 AIR ME Nimesh Chandra Classroom Course	3 AIR PI Aditya Kr. Prasad Classroom Course	3 AIR XE Rohan Kr. Biswal Test Series	5 AIR CE Kartik Pokhriyal Classroom Course		
5 AIR PI Kuldeep Singh Naruka Classroom Course	5 AIR IN Sachin Yadav Test Series	5 AIR EC M. M. Nafeez Test Series	5 AIR ES Sachin Kumar Classroom Course	6 AIR PI Kaushal Kr. Kaushik Online Course	6 AIR CE Shivnand Chaurasia Online Course	6 AIR CE Nimish Upadhyay Online Course	6 AIR EE Puneet Soni Test Series	6 AIR EE Shivam Kr. Gupta Test Series	
6 AIR EC Pentela J. Bhavani Test Series	6 AIR IN Utkarsh P. Patil Classroom Course	7 AIR PI Waleed Shaikh Test Series	7 AIR ME Abhinn Online Course	7 AIR IN Dev J. Patel Test Series	7 AIR ES Ankit Kumar Classroom Course	8 AIR ME Goutam Kumar Test Series	9 AIR CE Tarun Yadav Classroom Course	9 AIR CS Omhari Test Series	9 AIR EC Chilukuri S. Charan Test Series
9 AIR XE Apar Harsh Chandra Classroom Course	10 AIR CE Adnan Quasain Classroom Course	10 AIR CE Rahul Singh Online Course	10 AIR ME Ashutosh Kumar Classroom Course	10 AIR ME Jetti Ganateja Test Series	10 AIR ME Muhammed Sinan K Test Series	10 AIR ME Pitchika Kr. Vasu Online Course	10 AIR PI M Gopu Ganesh Test Series	10 AIR EE Neelava Mukherjee Postal Package & Test Series	

Course-wise details of "top 100 rank holders of GATE 2025" and "selected candidates of ESE 2025 from MADE EASY" are available on our website.

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