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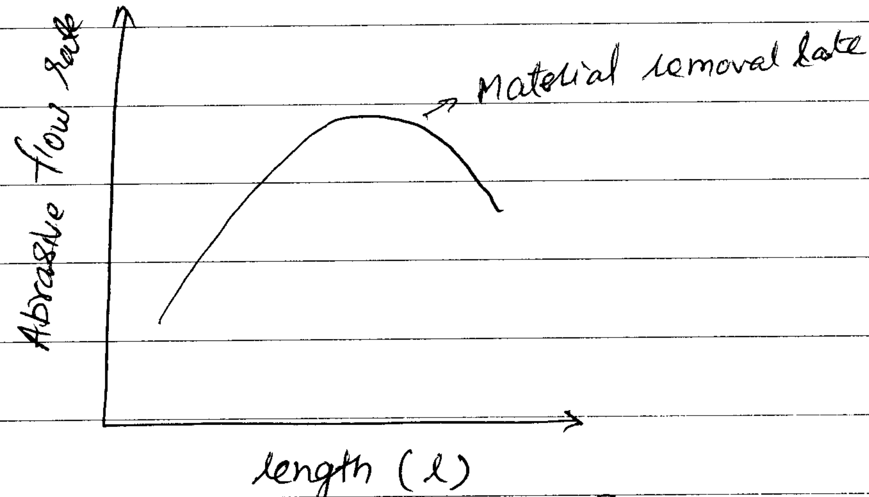
Heading

Sol:-1 Option (D) is correct.

~~Graph~~



Graph for abrasive jet machining ~~is between~~ for the distance between the Nozzle tip and work surface (l) and Abrasive flow rate is given in fig.

It is clear from the graph that the material removal rate is first increases because of area of jet increase than becomes stable and then decreases due to decrease in jet velocity.

Heading

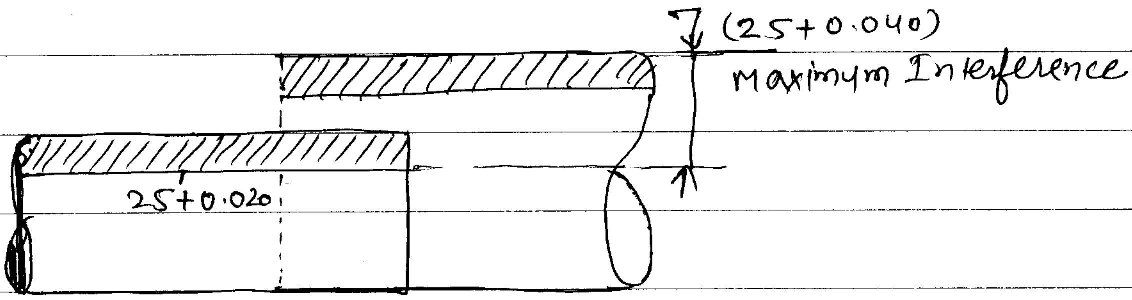
Que:-2 ~~Sol:-2~~ Option (A) is correct

Metal forming Process	Types of Stress
1. Coining	S. Compressive
2. Wire drawing	P. Tensile
3. Blanking	Q. Shear
4. Deep Drawing	R. Tensile and compressive

Hence : (A) 1-S, 2-P, 3-Q, 4-R

Sol:-3 Option (c) is correct

An Interference fit for Shaft and hole is as given in fig. below



Maximum Interference = Maximum limit of Shaft − Minimum limit of hole

$= (25+0.040) - (25+0.020)$

$= 0.02\ mm$

$=$ 20 microns

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Sol:- 4

Normalising involves prolonged heating just above the critical temperature to produce globular form of carbine and then cooling in air.

~~From~~

Correct option is C

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Heading

~~Ques~~ Sol:- 5 Option (A) is correct.

from Darcy weischback equation head loss

$$h = f \times \frac{L}{D} \times \frac{V^2}{2g} \longrightarrow (1)$$

Given that $L = 500\,m$, $D = \frac{200}{1000} = 0.2\,m$

$f = 0.0225$; ~~V = ∞~~

Since ~~velocity~~ volumetric flow rate

$\dot{V}$ = Area × velocity of flow (V)

$$V = \frac{\dot{V}}{Area} = \frac{0.2}{\frac{\pi}{4} \times (0.2)^2} = 6.37\ m/s$$

Hence

$$h = 0.0225 \times \frac{500}{0.2} \times \frac{(6.37)^2}{2 \times 9.81}$$

$$h = \underline{\underline{116.33\ m}} \simeq 116.18\ m$$

Heading

Sol:-6 Option (c) is correct.

The first law of thermodynamics requires that the sum of the absorbed, reflected and transmitted radiation be equal to ~~the~~

$$\alpha + \rho + \tau = 1$$

α - absorpivity, ρ = Reflectivity, τ = Transmissivity.

For an opaque surfaces ~~such~~ such as most soilds and liquids $\tau = 0$, and Thus

$$\alpha + \rho = 1$$

Page (19)

Sol:-(18) Option (A) is correct.

The Performance of the fins is judged on the basis of the enhancement ~~of~~ in heat transfer relative to the no-fin case. The fin effectiveness

$$\varepsilon_{fin} = \frac{\text{Heat tranfer rate from the fin of base Area } A_b}{\text{Heat tranfer rate from the surface of Area}}$$

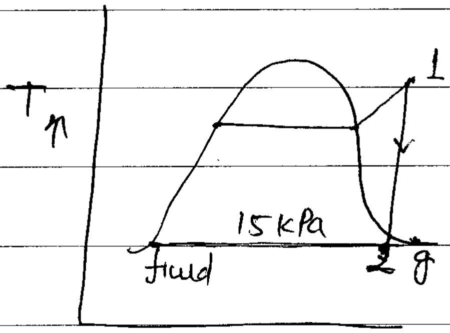
When determining the rate of heat transfer from a finned surface, we must consider the unfinned portion of the surface as well as the fins. and No. of fins.

~~For~~ Thin and closely spaced fin configuration, the ~~f~~unfinned portion of surface is reduced and No. of fins is ~~more~~ increased. Hence The fin effactiveness ~~is Maxi~~ will be maximum for Thin and closely spaced fins.

Heading

Sol:-7 Option (B) is correct.

For adiabatic expansion of ~~turb~~ steam in turbine



Given $h_1 = 3251.0$ kJ/kg, $\dot{m} = 10$ kg/s

$x = 0.9$ (dryness fraction)

At 15 kPa

enthalpy of liquid $h_f = 225.94$ kJ/kg

enthalpy of vapour $h_g = 2598.3$ kJ/kg

Since Power output of ~~shaft~~ turbine

$$P = \dot{m}(h_1 - h_2) \quad \text{——} (1) \quad [\because \text{KE and PE} \Rightarrow \text{negligible}]$$

$$h_2 = h_f + x h_{fg} = h_f + x(h_g - h_f)$$

$$= 225.94 + 0.9(2598.3 - 225.94)$$

$$h_2 = 2361.064 \text{ kJ/kg}$$

from eq (1)

$$P = \dot{m}(3251.0 - 2361.064)$$

$$= 10 \times (3251.0 - 2361.064)$$

$$= 8899 \text{ kW} = \underline{8.9 \text{ MW}}$$

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Heading

Sol:- 8 option (B) is correct.

For Helical gears

$$\frac{N_1}{N_2} = \frac{D_2}{D_1} \times \frac{\cos\beta_2}{\cos\beta_1} \quad \text{——— (1)}$$

$N_1 = 1440$ r.p.m $\quad D_1 = 80$ mm , $D_2 = 120$ mm

$\beta_1 = 30^\circ$, $\beta_2 = 22.5^\circ$

Hence from eq (1)

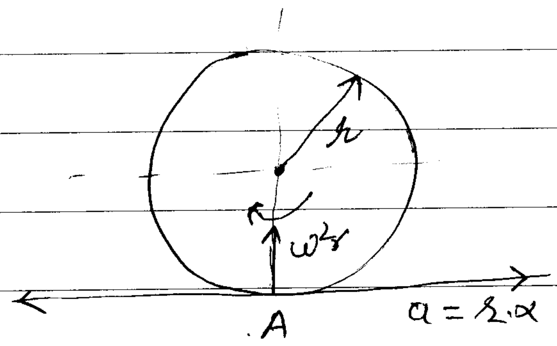
$$N_2 = \frac{D_1}{D_2} \times \frac{\cos\beta_1}{\cos\beta_2} \times N_1$$

$$= \frac{80}{120} \times \frac{\cos 30^\circ}{\cos 22.5^\circ} \times 1440$$

$$N_2 = 899.88 \simeq \underline{900 \text{ r.p.m}}$$

Heading

Sol:- 9 Option (D) is correct.



For A solid disc ~~so~~ of radius (r) as given in figure, rolls without slipping on a horizontal floor with angular velocity ω. and angular acceleration α.

The magnitude of the acceleration of the point of contact (A) on the disc is ~~of~~ only by centripetal acceleration

Because, For No slip condition

$V = \omega r$ — ①

By differentiating eq ① w.r.t (t)

$\frac{dv}{dt} = r \frac{d\omega}{dt} = r.\alpha$ $\left(\because \frac{d\omega}{dt} = \alpha, \frac{dv}{dt} = a \right)$

$\Rightarrow a = r.\alpha$

Instantaneous velocity of point A is = zero

so at point A, Instantaneous tangential acceleration = zero therefore only centripetal acceleration is there at point A.

centripetal acceleration = $\underline{\underline{r\omega^2}}$

Sol:- ~~Option C~~ (10) option (D) is correct.

~~Given~~:- for thin walled spherical shell circumferential (hoop) stress is

$$\sigma = \frac{pd}{4t} = \frac{pr}{2t}$$

For Initial condition let radius $= r_1$ and thickness $= t_1$, then

$$\sigma_1 = \frac{pr_1}{2t_1} \quad \text{--- (1)}$$

~~After increase~~ for Final condition

radius r_2 increased by 1%, then

$$r_2 = r_1 + \frac{r_1}{100} = 1.01\, r_1$$

thickness t_2 decreased by 1% then

$$t_2 = t_1 - \frac{t_1}{100} = 0.99 t_1$$

and

$$\sigma_2 = \frac{pr_2}{2t_2} = \frac{p \times 1.01 r_1}{2 \times 0.99 t_1} = 1.0202 \frac{pr_1}{2t_1}$$

from eq (1)

$$\Rightarrow \sigma_2 = 1.0202 \times \sigma_1$$

Change in hoop stress (%)

$$\sigma_c = \frac{\sigma_2 - \sigma_1}{\sigma_1} \times 100 = \frac{1.0202\, \sigma_1 - \sigma_1}{\sigma_1} \times 100$$

$$= 2.02\,\%$$

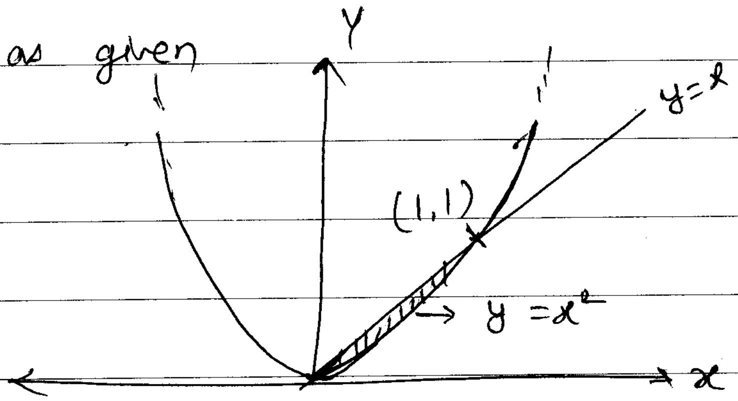
Heading

Sol:- 11 Option (A) is correct.

for $y = x$ straight line and

$y = x^2$ parabola

Curve is as given



~~Both the~~ Intersect point for these curves

$$y = x, \quad y = x^2$$

$$x = x^2$$

$$1 = x$$

$$\Rightarrow y = 1$$

Intersect point is (1, 1)

~~Area under the enclosed between line and parabola from (0,0) to (1,1)~~

Area under the ~~line~~ straight line from (0,0) to (1,1)

~~A~~.

$$A_1 = \int_0^1 y\,dx = \int_0^1 x\,dx .$$

$$= \left[\frac{x^2}{2}\right]_0^1 = \frac{1}{2}$$

Heading

Area under the curve $y=x^2$

$$A_2 = \int_0^1 y\,dx = \int_0^1 x^2\,dx$$

$$A_2 = \left[\frac{x^3}{3}\right]_0^1 = \frac{1}{3}$$

Area enclosed between line and curve

$$= A_1 - A_2$$

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

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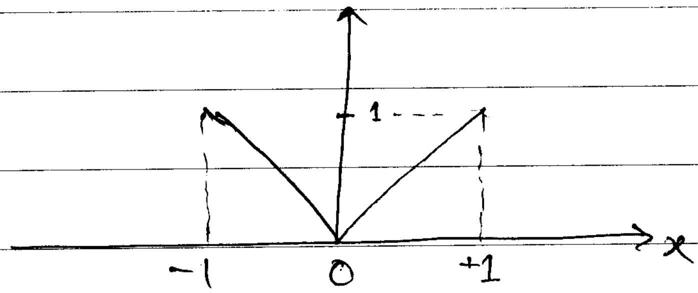
Heading

Sol:- 12 option (c) is correct.

Given $f(x) = |x|$ (in $-1 \le x \le 1$)

for this function the plot is as given below



At $x=0$, function is continuous but not differentiable because

~~When~~ for $x>0$ and $x<0$

$\Rightarrow f'(x) = 1$ $f'(x) = -1$

$\Rightarrow \lim_{x \to 0^+} f'(x) = 1$ and $\lim_{x \to 0^-} f'(x) = -1$

R.H.S. Limit $= 1$ and L.H.S limit $= -1$

Therefore it is not differentiable.

Sol:- 13 Option (A) is correct

costs Relevant to aggregate Production Planning: is as give below.

(a) Basic Production cost: Material costs, direct labor costs, and overhead cost.

(b) costs associated with changes in Production rate:- costs involving in hiring, training and laying off personnel, as well as, overtime compensation.

(c) Inventory Related costs.

Hence, from above option (A) is Not related to These cost. Therefore Option (A) is Not a decision ~~taking the~~ during the APP.

Heading

Sol: 14 Option (B) is correct.

$$\lim_{x \to 0} \frac{(1-\cos x)}{x^2}$$

It forms $\left[\frac{0}{0}\right]$ condition. Hence by L- Hosptial rule

$$\lim_{x \to 0} \frac{d/dx\,(1-\cos x)}{d/dx\,(x)^2}$$

$$= \lim_{x \to 0} \frac{\sin x}{2x}$$

Still ~~these~~ gives $\left[\frac{0}{0}\right]$ ~~form~~ condition, so again Appling L- Hospital rule

$$\Rightarrow \lim_{x \to 0} \frac{d/dx\,(\sin x)}{2 \times d/dx\,(x)}$$

$$\lim_{x \to 0} \frac{\cos x}{2}$$

$$= \frac{\cos 0}{2} = \frac{1}{2}$$

Heading

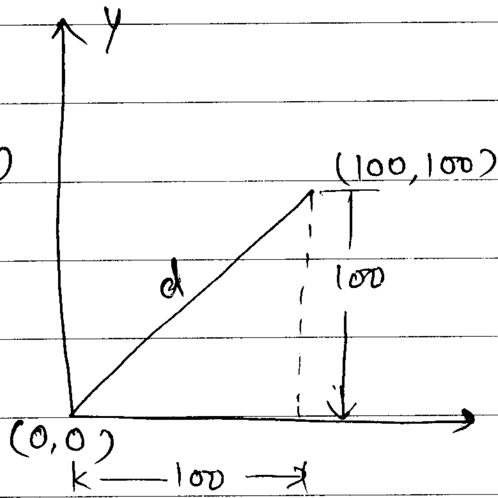
Sol: 15 Option (B) is correct.

Given ~~(b) = 10 mm~~ width (b) = 10 mm

~~t~~ depth (t) = 2 mm

Distance travelled for cut between points (0, 0) and (100, 00)

By Pithogorus theorm



$$d^{\cancel{2}} = \sqrt{100^2 + 100^2}$$

$$d = 141.42 \text{ mm}$$

feed rate $f = 50 \text{ mm/min}$

$$= 50/60 = 0.833 \text{ mm/sec}$$

Time required to cut distance (d)

$$t = \frac{d}{f} = \frac{141.42}{0.833}$$

$$t = 169.7 \simeq 170 \text{ seconds}$$

Heading

Sol:- 16 Option (D) is correct.

Since volume of cylinder Remains same therefore

Volume before forging = Volume after forging

$$\pi \frac{d_1^2}{4} \times h_1 = \pi \frac{d_2^2}{4} \times h_2$$

$$\pi \times \frac{100^2}{4} \times 50 = \pi \times \frac{d_2^2}{4} \times 25$$

$$d_2^2 = (100)^2 \times 2$$

$$d_2 = 100 \times \sqrt{2} = 141.42$$

change in diameter (%)

$$= \frac{d_2 - d_1}{d_1} \times 100 = \frac{141.42 - 100}{100} \times 100$$

% change in (d) = 41.42%

Heading

Sol:- 17 Option (C) is correct.

Degree of Reaction

$$R = 1 - \frac{(V_1^2 - V_2^2)}{(V_1^2 - V_2)^2 + (u_1^2 - u_2^2) + (W_2^2 - W_1^2)}$$

where - V_1 & V_2 are absolute velocitys

- W_1 & W_2 are relative velocities

- $u_1 = u_2 = u$ for given fig.

Given $W_2 = V_1$, $W_1 = V_2$

Hence

$$R = 1 - \frac{(V_1^2 - V_2^2)}{(V_1^2 - V_2^2) + (u^2 - u^2) + (V_1^2 - V_2^2)}$$

$$= 1 - \frac{(V_1^2 - V_2^2)}{2(V_1^2 - V_2^2)}$$

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

$R = 0.5$

Heading

Sol: 19 option (B) is correct.

~~for~~ we know that

$$Tds = du + Pdv \longrightarrow (1)$$

~~for isothermal process (du = 0) T=~~

$$\cancel{Tds = Pdv}$$

$$Pv = mRT \text{ for ideal gas.}$$

for isothermal process (T = constant)

for reversible process (du = 0)

then from eq (1)

$$ds = \frac{p\,dv}{T} = \frac{mRT}{T}\frac{dv}{v}$$

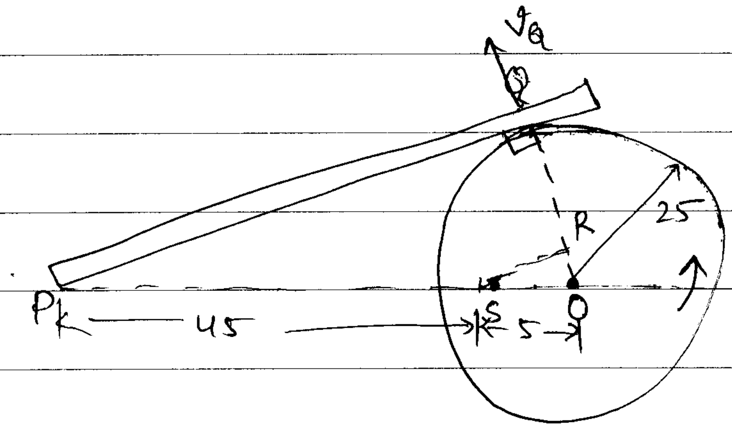
$$ds = mR\frac{dv}{v}$$

$$\int ds = \Delta s = mR\int_{v_1}^{v_2}\frac{dv}{v} = mR\ln\frac{V_2}{V_1}$$

$$\Delta s = mR\ln\frac{P_1}{P_2} \qquad \left[\because \frac{P_1}{P_2} = \frac{V_2}{V_1}\right]$$

Heading

Sol:- 20 Option (B) is correct.



~~Draw~~ from Δ PQO and Δ SRO (from similarity)

$$\frac{PQ}{SR} = \frac{PO}{SO} \quad \text{——} (1)$$

$$\because \quad PQ = \sqrt{(50)^2 - (25)^2} = 43.3 \text{ mm}$$

from eq (1)

$$\frac{43.3}{SR} = \frac{50}{5}$$

$$SR = \frac{43.3 \times 5}{50} = 4.33 \text{ mm}$$

Velocity of Q = Velocity of R

$$V_Q = V_R = SR \times \omega = 4.33 \times 1 = 4.33 \text{ m/s}$$

Angular velocity of PQ

$$\omega_{PQ} = \frac{V_Q}{PQ} = \frac{4.33}{43.3} = 0.1 \text{ rad/s}$$

Heading

Sol: 21 Option (B) is correct.

for flywheel

$$K.E = \frac{1}{2} I \omega^2$$

$$\omega = \frac{2\pi N}{60} = \frac{2 \times \pi \times 600}{60}$$

I - for solid circular disk $= \frac{1}{2} mR^2$

$$= \frac{1}{2} \times 20 \times (0.2)^2$$

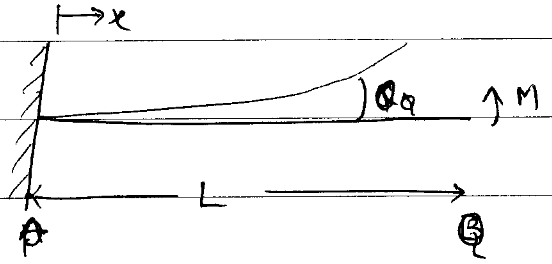
Hence

$$K.E = \frac{1}{2} \times \left(\frac{1}{2} \times 20 \times (0.2)^2\right) \times \left(\frac{2\pi \times 600}{60}\right)^2$$

$= 789.6 \simeq 790$ Joules.

Heading

Sol:- 22 option (A) is correct



Since $EI\dfrac{d^2y}{dx^2} = M$

By integrating

$$EI\frac{dy}{dx} = Mx + c_1 \rightarrow (1)$$

At $x = 0$, $\dfrac{dy}{dx} = 0$ (~~deflection~~)

so

$$EI(0) = M(0) + c_1$$

$$c_1 = 0$$

Hence eq (1) becomes

$$EI\frac{dy}{dx} = mx$$

again integrate

$$EIy = \frac{mx^2}{2} + c_2 \rightarrow (2)$$

At $x = 0$, $y = 0$

$$EI(0) = \frac{m(0)^2}{2} + c_2$$

$$c_2 = 0$$

Then eq (2) becomes

$$EIy = \frac{Mx^2}{2}$$

$$y = \frac{Mx^2}{2EI} \Rightarrow y_{max} = \frac{ML^2}{2EI} \quad \left[\because y_{max} \text{ At } x = L\right]$$

Heading

Sol:- Q23) Option (c) is correct.

Critical buckling load

$$= \frac{\pi E I}{L^2} \rightarrow (1)$$

for both ends clamped $L = \frac{L}{2}$

for both ends hinged $L = L$

Hence

Ratio for both ends clamped to both ends hinged

$$= \frac{\frac{\cancel{\pi E I}}{(L/2)^2}}{\frac{\cancel{\pi E I}}{L^2}} = \frac{4}{L^2} \times \frac{L^2}{1} = \underline{\underline{4}}$$

Heading

~~Op~~ Sol:-24 Option (D) is correct.

$$f(x) = x^3+1$$

$$f'(x) = 3x^2+0$$

~~At $x=0$~~

~~$f'(0) = 3x^2$~~

By ~~putting~~ ~~first~~ $f'(x)$ equal to zero

$$f'(x) = 0$$

$$\Rightarrow 3x^2+0 = 0$$

$$x = 0$$

Now $f''(x) = 6x$

at $x=0$, $f''(0) = 6\times 0 = 0$

Hence $x=0$ is the point of inflection.

Heading

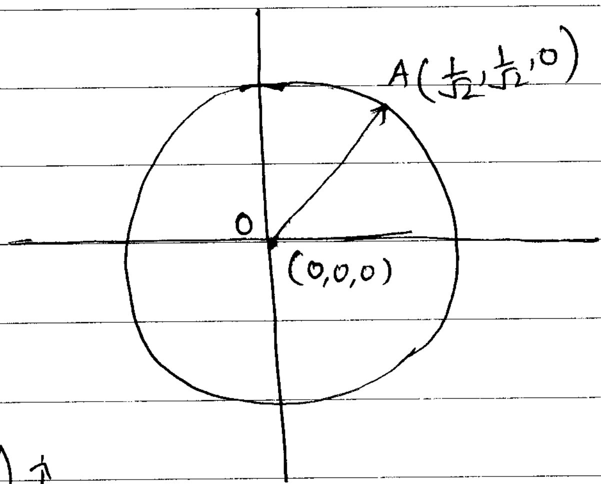
Sol:- 25 Option (A) is correct.

Given

$$x^2 + y^2 + z^2 = 1$$

This eq is of a sphere with radius ; $r = 1$

The unit Normal vector at point $\left(\frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 0\right)$



is $\overrightarrow{OA}$

Hence

$$\overrightarrow{OA} = \left(\frac{1}{\sqrt{2}} - 0\right)\hat{i} + \left(\frac{1}{\sqrt{2}} - 0\right)\hat{j} + (0 - 0)\hat{k}$$

$$\overrightarrow{OA} = \frac{1}{\sqrt{2}}\hat{i} + \frac{1}{\sqrt{2}}\hat{j}$$

Heading

Sol:- 26 Option (B) is correct.

According to Von Mises Yield Criterion

$$\sigma_y^2 = \frac{1}{2}\left[(\sigma_x-\sigma_y)^2 + (\sigma_y-\sigma_z)^2 + (\sigma_z-\sigma_x)^2 + 6(\tau_{xy}^2 + \tau_{yz}^2 + \tau_{zx}^2)\right]$$

Given

$$T = \begin{pmatrix} 10 & 5 & 0 \\ 5 & 20 & 0 \\ 0 & 0 & -10 \end{pmatrix}$$

from given Matrix

$\sigma_x = 10$ $\quad\tau_{xy} = 5$

$\sigma_y = 20$ $\quad\tau_{yz} = 0$

$\sigma_z = -10$ $\quad\tau_{zx} = 0$

So,

$$\sigma_y^2 = \frac{1}{2}\left[(10-20)^2 + (20+10)^2 + (-10-10)^2 + 6(5^2 + 0^2 + 0^2)\right]$$

$$= \frac{1}{2} \times \left[100 + 900 + 400 + (6 \times 25)\right]$$

$\sigma_y = 27.83$ MPa.

Heading

Shear yield stress

$$\sigma_{sy} = \frac{\sigma_y}{\sqrt{3}} = \frac{27.83}{\sqrt{3}}$$

$$\sigma_{sy} = \underline{\underline{16.06\ MPa}}$$

Heading

Sol:- 27 option (c) is correct.

The shear strain rate

$$= \frac{\cos\alpha}{\cos(\phi-\alpha)} \times \frac{V}{\Delta y}$$

where α = Rake angle = 10°

v = cutting speed = 2.5 m/s

Δy = Mean thickness of Primary shear zone

= 25 microns = 25×10^{-6} m

ϕ = shear angle

so shear Angle

$$\tan\phi = \frac{r\cos\alpha}{1-r\sin\alpha}$$

where r = chip thickness ratio = 0.4

$$\tan\phi = \frac{0.4 \times \cos 10^\circ}{1-0.4\sin 10^\circ} = 0.4233$$

$$\phi = \tan^{-1}(0.4233) \simeq 23^\circ$$

Hence

Shear Strain rate

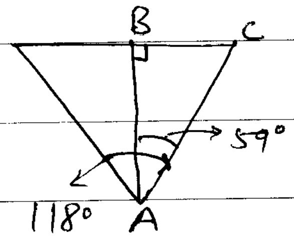
$$= \frac{\cos 10^\circ}{\cos(23-10)} \times \frac{2.5}{25 \times 10^{-6}}$$

$$= 1.0104 \times 10^5 \ s^{-1}$$

Heading

Sol: 28 Option (A) is correct.

Drill bit ~~end~~ tip is shown as below.



BC = radius of hole or drill ϕ bit = ~~7.5 mm~~ $R = \left(\frac{15}{2} = 7.5\text{ mm}\right)$

from above ΔABC

$$\tan 59^\circ = \frac{BC}{AB} = \frac{7.5}{AB}$$

$$AB = \frac{7.5\text{mm}}{\tan 59^\circ} = 4.506\text{ mm}$$

Travel distance of drill bit

l = thickness of steel plate (t) + Clearance at approach (a)

+ clearance at exit (c) + AB

= 50 mm + 2 + 2 + 4.506

= 58.506

Total drill time = $\frac{\text{distance}}{\text{feed rate}}$

$$f = 0.2\text{ mm/rev} = \frac{0.2 \times 500\text{ r.p.m}}{60} = \frac{0.2 \times 500}{60}$$

$$= 1.66\text{ mm/s}$$

Hence drill time

$$t = \frac{58.506}{1.66} = 35.~~1036~~\text{ seconds}$$

Heading

$s = D/2 \quad D =$

Sol:- 29 Option (D) is correct

According to Reciprocity ~~or Rect~~ Relation

$$A_1 F_{1-2} = A_2 F_{2-1}$$

which yields

$$F_{21} = \frac{A_1}{A_2} \times F_{12} = \frac{\cancel{4\pi r_1^2}\ \pi D_1 L}{\cancel{4\pi r_2^2}\ \pi D_2 L} \times 1 = \left(\frac{r_1}{r_2}\right)^2 \text{ or } \left(\frac{D_1}{D_2}\right)$$

$F_{11} = 0$ since No radiation leaving surface 1 strikes 1

$F_{12} = 1$, since all radiation leaving surface 1 strikes 2

The view factor F_{22} is determined by appling summation rule to surface 2.

$$F_{21} + F_{22} = 1$$

and thus

$$F_{22} = 1 - F_{21}$$

$$= 1 - \left(\frac{D_1}{D_2}\right)$$

Heading

Sol:- (30) Option (C) is correct.

For flat plate with zero pressure gradient.

Boundary layer thickness

$$\delta(x) = 5.0\sqrt{\frac{\nu(x)}{\cancel{U_\infty}\, \delta v}}$$

$$\Rightarrow \delta \propto \frac{x^{1/2}}{\cancel{U}^{1/2}}$$ ~~at same~~ for a same location

$$\delta \propto (\cancel{U})^{-1/2}$$

where ~~U~~ V = velocity of fluid

$$\frac{\delta_1}{\delta_2} = \left(\frac{V_1}{V_2}\right)^{-1/2}$$

$$\delta_2 = \left(\frac{V_1}{V_2}\right)^{1/2} \times \delta_1 = \left(\frac{V_1}{4V_1}\right)^{1/2} \times 1$$

$\because$ $V_2 = 4V_1$ (Given)

$$\delta_2 = \left(\frac{1}{4}\right)^{1/2} \times 1 = \frac{1}{2} = \underline{\underline{0.5}}$$

Heading

Sol:- 31 Option (D) is correct.

Given:- $m_{air} = 35$ kg, $m_v = 0.5$ kg.

P = total Pr. = 100 kPa at 25°C

$P_s = 3.17$ kPa → saturation Pressure of water @ 25°C

As we know

$$\text{Absolute Humidity} = \frac{m_v}{m_{air}} = \frac{0.5}{35} = 0.0142857$$

and ~~Relative humidity~~

$$\omega = \frac{0.622 \phi P_s}{P - \phi P_s}$$

solving for Relative humidity

$$0.622 \phi P_s = \omega P - \phi \omega P_s$$

$$\phi \omega P_s + 0.622 \phi P_s = \omega P$$

$$\phi = \frac{\omega P}{(\omega + 0.622) P_s} = \frac{0.01428 \times 100}{(0.01428 + 0.622) \times 3.17}$$

$$\phi = .7082$$

$$\Rightarrow \phi\% = 70.8\% \cong 71\%$$

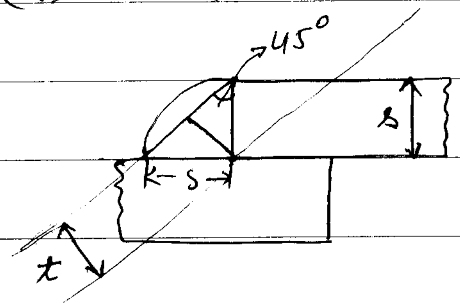
Heading

Solution:- 32 Option (c) is correct.

Given :- width of fillets ~~b = 10 mm~~ $s = 10$ mm

length of weld (l) = 30 (mm)

$\tau = 94$ MPa



for parallel fillet weld

P = Throat Area × Allowable stress

$P = t \times l \times \tau$

from fig. $t = s\sin 45^\circ = 0.707s$

$P = 0.707 \times s \times l \times \tau = 0.707 \times (.01) \times (.03) \times 94 \times 10^6$

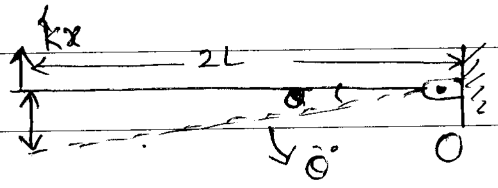
~~$\Rightarrow \tau = \frac{P}{0.707 s \times l} =$~~

$P = 19937$ N or 19.93 kN

Heading

Solution:- 33 Option (D) is correct.

For a very small Amplitude of vibration



from above fig

change in length of spring

$x = 2L \sin\theta$

$= 2L\theta$ ($\because \theta$ is very small so $\sin\theta \simeq \theta$)

Mass moment of Inertia of mass (m) about O

$I = mL^2$

By Taking Moment about point (O)

$I\ddot{\theta} = -kx \times 2L$

$\Rightarrow mL^2\ddot{\theta} = -k\,2L\theta \times 2L$

$\ddot{\theta} = \dfrac{-4kL^2\theta}{mL^2} = -\dfrac{4k}{m}\theta$

$\Rightarrow \ddot{\theta} + \dfrac{4k}{m}\theta = 0$

By comparing general eq

$\ddot{\theta} + \omega_n^2\theta = 0$

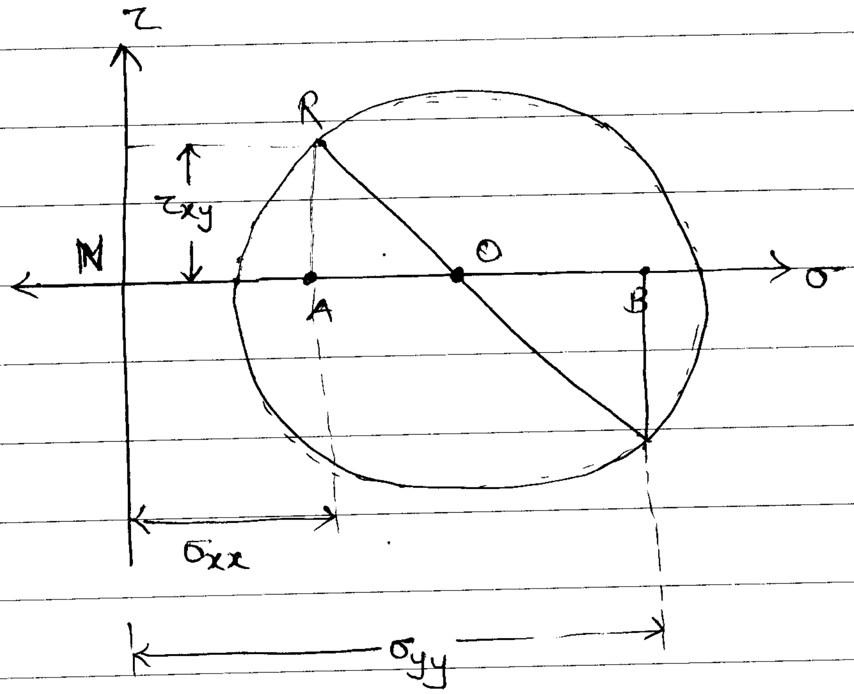
$\omega_n^2 = \dfrac{4k}{m}$

$\omega_n = \sqrt{\dfrac{4k}{m}}$

Heading

Sol:- 34 Option (B) is correct

Diagram for Mohr's circle



Given $\sigma_{xx} = 40\ MPa = AN$

$\sigma_{yy} = 100\ MPa = BN$

$\tau_{xy} = 40\ MPa = AR$

Radius of Mohr's circle

$$OR = \sqrt{(AR)^2 + (AO)^2}$$

$$\because \quad AO = \frac{AB}{2} = \frac{BN - AN}{2} = \frac{100-40}{2} = 30$$

Therefore

$$OR = \sqrt{(40)^2 + (30)^2} = 50\ MPa$$

Heading

Sol:- 35 Option (D) is correct

~~$F(s) = \frac{1}{s(s+1)} = \frac{A}{s} + \frac{B}{s+1}$~~

Inverse Laplace Tranformation

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

$$= \frac{A(s+1) + Bs}{s(s+1)}$$

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

By comparing L.H.R to R.H.S

$(A+B) = 0$ and $A = 1$

$\Rightarrow B = -1$

So $\frac{1}{s(s+1)} = \frac{1}{s} - \frac{1}{s+1}$

$$f(t) = L^{-1}[F(s)]$$

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

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

$$\Rightarrow \underline{\underline{1 - e^{-t}}}$$

Heading

Sol:- 36 Option (B) is correct.

Given
$$A = \begin{bmatrix} 5 & 3 \\ 1 & 3 \end{bmatrix}$$

~~For~~ For finding eigen values

$$|A - \lambda I| = 0$$

$$\Rightarrow \begin{vmatrix} 5-\lambda & 3 \\ 1 & 3-\lambda \end{vmatrix} = 0$$

$$\Rightarrow (5-\lambda)(3-\lambda) - 3 = 0$$

$$\therefore \lambda^2 - 8\lambda + 12 = 0$$

$$(\lambda-6)(\lambda-2) = 0 \qquad \therefore \lambda_1 = 6,\ \lambda_2 = 2$$

Now from characteristic equation for eigen vector

$$[A - \lambda I]\{x\} = \{0\}$$

$\Rightarrow$ For $\lambda_2 = 2$

$$\begin{bmatrix} 5-2 & 3 \\ 1 & 3-2 \end{bmatrix} \begin{Bmatrix} X_1 \\ X_2 \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$$

$$\Rightarrow \begin{bmatrix} 3 & 3 \\ 1 & 1 \end{bmatrix} \begin{Bmatrix} X_1 \\ X_2 \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \end{Bmatrix}$$

$$x_1 + x_2 = 0 \quad \Rightarrow \quad \cancel{X_1 = X_2} \quad X_1 = -X_2$$

Heading

So eigen vector

$$= \begin{Bmatrix} 1 \\ -1 \end{Bmatrix}$$

Magnitude of eigen vector $= \sqrt{(1)^2 + (1)^2} = \sqrt{2}$

$\therefore$ Normalized eigen vector $= \begin{bmatrix} 1/\sqrt{2} \\ -1/\sqrt{2} \end{bmatrix}$

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Heading

Sol:- 37 Option [A] is correct.

Punch dia

$$d = D - 2c - a$$

where D = Blank diameter = 25 mm

c = clearance = 0.06 mm

a = Die allowance = 0.05 mm

Hence

Punch dia $d = 25 - 2 \times 0.06 - 0.05$

$= \underline{\underline{24.83}}$ mm

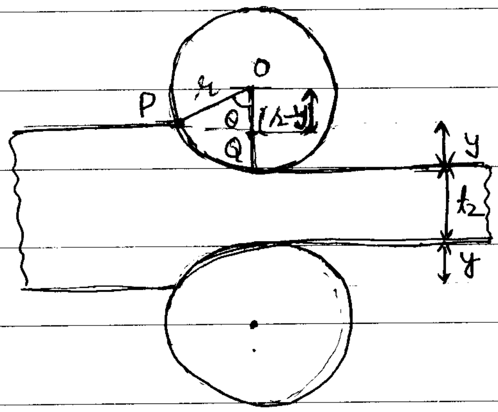
Heading

Sol:- 38 Option (c) is correct.

Given :- $t_1 = 8\,mm$, $d = 410\,mm$, $\Rightarrow r = 205\,mm$

Reduction of thickness $\cdot \Delta = 10\%$ of t_1

$$\Delta = \frac{10}{100} \times 8 = 0.8\,mm$$



$$y = \frac{\Delta}{2} = 0.4\,mm$$

~~Cosθ =~~ from Δ OPQ

$$\cos\theta = \left(\frac{r-y}{r}\right)$$

$$\cos\theta = \left[\frac{205-0.4}{205}\right] = 0.99804$$

$$\theta = \cos^{-1}(0.99804) = 3.58^\circ$$

~~It~~ Angle of bite in radians is

$$\theta = 3.58 \times \frac{\pi}{180} \text{ rad}$$

$$\theta = 0.062 \text{ rad.}$$

Heading

Alternate:-

Angle of bite

$$\theta = \tan^{-1}\left[\sqrt{\frac{t_i - t_f}{r}}\right]$$

Where t_i = Initial thickness = 8 mm

t_f = Final reduced thickness = $8 - 8 \times \frac{10}{100}$ = 7.2 mm

r = radius of Roller = $\frac{410}{2}$ = 205 mm

$$\theta = \tan^{-1}\left[\sqrt{\frac{8 - 7.2}{205}}\right]$$

$$\theta = 3.5798^\circ$$

And In radians

$$\theta = 3.5798 \times \frac{\pi}{180}$$

$$\theta = 0.0624 \text{ rad}$$

Heading

Sol:- 39 Option (c) is correct.

from Power source characteristic,

$$\frac{V}{OCV} + \frac{I}{SCC} = 1 \longrightarrow (1)$$

where v - voltage,

OCV - Open circuit voltage

SCC = Short circuit current

I = current.

from Voltage arc length characteristic

$$V_{arc} = 20 + 5l$$

for $l_1 = 5mm \rightarrow V_1 = 20 + 5 \times 5 = 45$ Volt

for $l_2 = 7mm \rightarrow V_2 = 20 + 5 \times 7 = 55$ volt

and $I_1 = 500$ Amp and $I_2 = 400$ Amp.

substituting these value in eq (1)

$$\frac{V_1}{OCV} + \frac{I_1}{SCC} = 1 \longrightarrow (2)$$

$$= \frac{45}{OCV} + \frac{500}{SCC} = 1 \longrightarrow (2)$$

and $\dfrac{V_2}{OCV} + \dfrac{I_2}{SCC} = 1 \rightarrow \dfrac{55}{OCV} + \dfrac{400}{SCC} = 1 \rightarrow (3)$

By solving eq (2) and (3)

OCV = 95 Volt

SCC = 950 A

Heading

Sol:-40 Option (A) is correct.

Take ~~s~~ point ① at top and point ② at bottom

By Bernoullie eqn between ① & ②

$$P_1 + \rho_1 g h_1 + \rho_2 g h_2 + \rho_3 g h_3 + \frac{v_1^2(\rho_1+\rho_2+\rho_3)}{2g} = P_{atm} + \frac{V_2^2}{2g} \times \cancel{\rho_{air}}$$

At Reference level at ② $z_2 = 0$ and $v_1 = 0$ ~~sin~~ at point ①

Therefore

$$\Rightarrow P_1 + \rho_1 g h_1 + \rho_2 g h_2 + \rho_3 g h_3 = P_{atm} + \frac{V_2^2}{2g} \times \cancel{\rho_{air}} \quad — ①$$

$$\Rightarrow \text{as} \quad V_2 = \sqrt{\cancel{\frac{2(P_1 - P_{atm})}{\rho_{air}}} \times [\rho_1 g h_1 \cancel{+ \rho_2 g h_2 + \rho_3 g h_3}]}$$

$$V_2 = \sqrt{\cancel{\frac{2\rho_{air} g h}{\rho_{air}}} \times [\rho_1 g h_1 \cancel{+ \rho_2 g h_2 + \rho_3 g h_3}]}$$

~~Since~~ ∵ P_1 = ~~Presser~~ atmospheric Presseure (becouse tank is open)

Hence $P_1 = P_{atm}$.

Therefore

$$V_2 = \sqrt{2g \times [\rho_1 g h_1 + \rho_2 g h_2 + \rho_3 g h_3]}$$

By Rearranging

$$V_2 = \sqrt{2g \times \left[\frac{\rho_1 g h_1}{\rho_3 g} + \frac{\rho_2 g h_2}{\rho_3 g} + h_3\right]}$$

Heading

$$V_2 = \sqrt{2g \times \left[\frac{\rho_1 h_1}{\rho_3} + \frac{\rho_2 h_2}{\rho_3} + h_3\right]}$$

$$V_2 = \sqrt{2gh_3 \times \left[1 + \frac{\rho_1 h_1}{\rho_3 h_3} + \frac{\rho_2 h_2}{\rho_3 h_3}\right]}$$

Sol:- 41 Option (C) is correct

Given:

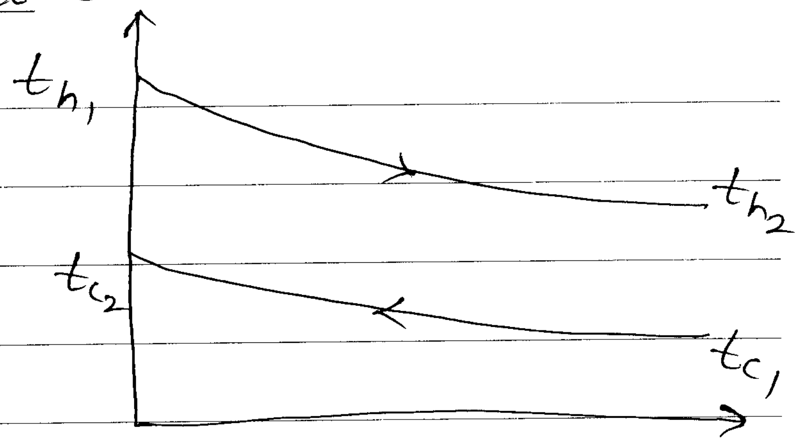
$t_{h_1} = 80°C$

$t_{c_1} = 30°C$

$\dot{m}_h = 0.5$ kg/Sec.

$\dot{m}_c = 2.09$ kg/Sec.

$\epsilon = 0.8$



Capacity rate, for hot fluid

$$C_h = 4.18 \times 0.5 = 2.09 \text{ KJ/Ksec}$$

&

$$C_c = 1 \times 2.09 = 2.09 \text{ KJ/Ksec.}$$

So, $C_h = C_c$

&

effectiveness $\epsilon = \dfrac{\dot{Q}}{\dot{Q}_{max.}} = \dfrac{(t_{h_1} - t_{h_2})C_h}{(t_{h_1} - t_{c_1})C_c}$

$$0.8 = \frac{80 - t_{h2}}{80 - 30}$$

$$\Rightarrow 80 - t_{h2} = 40$$

$$t_{h2} = 40°C$$

From energy balance,

$$C_h(t_{h_1} - t_{h_2}) = C_c(t_{c_2} - t_{c_1})$$

$$80 - 40 = t_{c_2} - 30$$

$$t_{c_2} = 70°C$$

~~Next~~

Heading: Now LMTD

$$\theta_m = \frac{\theta_1 - \theta_2}{\ln \frac{\theta_1}{\theta_2}} \quad ---(1')$$

$\theta_1 = t_{h_1} - t_{c_2} = 80 - 70 = 10^\circ C$

$\theta_2 = t_{h_2} - t_{c_1} = 40 - 30 = 10^\circ C$

So LMTD is undefined

let $\frac{\theta_1}{\theta_2} = x \Rightarrow \theta_1 = x\theta_2$

Put in equation (i), so

$$\theta_m = \lim_{x \to 0} \frac{x\theta_2 - \theta_2}{\ln \frac{x\theta_2}{\theta_2}} = \lim_{x \to 0} \frac{\theta_2(x-1)}{\ln x}$$

it is a $\left[\frac{0}{0}\right]$ ~~from~~ form, Applying L-Hospital rule

$\theta_m = \theta_1 = t_{h_1} - t_{c_2}$

$= 80 - 70$

$= 10^\circ C$

Correct option is (c)

Heading

Sol:- 42 Option (A) is correct.

For a solid cube strain in x, y and z axis are

$$\epsilon_x = \frac{\sigma_x}{E} - \frac{\nu(\sigma_y + \sigma_z)}{E}$$

$$\epsilon_y = \frac{\sigma_y}{E} - \frac{\nu(\sigma_x + \sigma_z)}{E}$$

$$\epsilon_z = \frac{\sigma_y}{E} - \frac{\nu(\sigma_x + \sigma_y)}{E}$$

Form symmetry of cube

$\epsilon_x = \epsilon_y = \epsilon_z$ and

$\sigma_x = \sigma_y = \sigma_y$

So $\epsilon = \frac{(1-2\nu)}{E} \times \sigma$

Where

$\epsilon = -\alpha \Delta T$ ~~for~~ (Thermal compression stress)

therefore

$$\sigma = \cancel{(1-2\nu)} \frac{\epsilon \times E}{(1-2\nu)} = \frac{-\alpha \Delta T E}{(1-2\nu)}$$

$$\boxed{\sigma = -\frac{\alpha \Delta T E}{(1-2\nu)}}$$

Heading

Sol:- 43 Option (B) is correct.

As we know

$$F.O.S = \frac{\text{Allowable shear stress}}{\text{Design shear stress}}$$

Design shear stress: for solid circular shaft

$$\cancel{\sigma = \frac{\pi d^3}{16T}}$$

$$T = \frac{\pi d^3}{16} \times \sigma$$

$$\sigma = \frac{16T}{\pi d^3} = \frac{16 \times 50 \times 10^3}{\pi d^3}$$

Therefore

$$F.O.S = \frac{140 \times \pi d^3}{16 \times 50 \times 10^3}$$

$$\Rightarrow 2 = \frac{140 \times \pi d^3}{16 \times 50 \times 10^3}$$

$$d^3 = \frac{2 \times 16 \times 50 \times 10^3}{140 \times \pi}$$

$$d = 15.38 \text{ m}$$

$$d \cong \underline{16 \text{ mm}}$$

Heading

Sol:- 44 Option (B) is correct

Given:- $T_1 = 400\ N$, $\mu = 0.25$

$\theta = 180^\circ = 180^\circ \times \frac{\pi}{180^\circ} = \pi\ rad$, $D = 0.5m$, $r = \frac{D}{2} = 0.25m$

As we know

$$\frac{T_1}{T_2} = e^{\mu\theta}$$

$$\frac{400}{T_2} = e^{0.25 \times \pi} = 2.1932$$

$$T_2 = \frac{400}{2.1932} = 182.68\ N$$

For Band-drum brake

Braking Torque

$$B.T. = (T_1 - T_2) \times r$$

$$= (400 - 182.68) \times 0.25$$

$$B.T = \underline{\underline{54.33}}\ N.m$$

Heading

Sol:- 45 Option (D) is correct.

Given:- Red balls - 4 ball, Black balls - 6

~~1 Red ball and 2 Black balls are~~

3 balls are selected randomly one after another, without replacement.

1 Red and 2 black balls ~~are~~ will be selected as following

Manners — Probability for these sequences

R B B — $\frac{4}{10} \times \frac{6}{9} \times \frac{5}{8} = \frac{1}{6}$

B R B — $\frac{6}{10} \times \frac{4}{9} \times \frac{5}{8} = \frac{1}{6}$

B B R — $\frac{6}{10} \times \frac{5}{9} \times \frac{4}{8} = \frac{1}{6}$

Hence Total probability of selecting 1 Red and 2 black balls is

$$p = \frac{1}{6} + \frac{1}{6} + \frac{1}{6} = \frac{3}{6} = \frac{1}{2}$$

Heading

Sol:- 46 Option (A) is correct.

Given $x^2 \frac{d^2y}{dx^2} + x\frac{dy}{dx} - 4y = 0 \rightarrow (1)$

⇒ for such type of eqn take

$$y = x^k$$

$$\frac{dy}{dx} = kx^{k-1}$$

$$\frac{d^2y}{dx^2} = k(k-1)x^{k-2}$$

By substituting these in eq (1), becomes

$$x^2 \cdot k(k-1) \times x^{k-2} + x\,kx^{k-1} - 4x^k = 0$$

$$\Rightarrow k(k-1)x^k + kx^k - 4x^k = 0$$

$$\Rightarrow x^k[k(k-1) + k - 4] = 0$$

since $x^k \neq 0$, then $k(k-1) + k - 4 = 0$

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

$$\therefore k = 2, -2$$

General above eq $y = \cancel{a_1 x^k + a_2 x^{k'}}\ a_1 x^2 + a_2 x^{-2} + b$ — (2)

For $y(0) = 0$ eq (2) become

$$0 = a_1(0) + \frac{a_2}{0} + b$$
$\rightarrow \infty$

$\therefore k$ should be 2

$$\Rightarrow 0 = 0 + b$$

$$b = 0$$

Heading

At $y(1) = 1$ eq ② becomes (for $k=2$)

$$1 = a_1(1) + b$$

$$\Rightarrow a_1 = 1$$

There fore eqn ② becomes

$$y = a_1 x^2 + a_2 x^{-2} + b$$

$$= 1 \times x^2 + \text{Not fessible} + 0$$

(for $k=-2$)

$$\underline{\underline{y = x^2}}$$

Heading

Sol:- 47 Option (C) is correct.

For given equation Matrix form is as follows

$$A = \begin{bmatrix} 1 & 2 & 1 \\ 2 & 1 & 2 \\ 1 & -1 & 1 \end{bmatrix}, \quad B = \begin{bmatrix} 4 \\ 5 \\ 1 \end{bmatrix}$$

$$[A \vdots B] = \left[\begin{array}{ccc|c} 1 & 2 & 1 & 4 \\ 2 & 1 & 2 & 5 \\ 1 & -1 & 1 & 1 \end{array}\right]$$ -- Augmented Matrix

$R_2 \to R_2 - 2R_1$, $R_3 \to R_3 - R_1$

$$= \left[\begin{array}{ccc|c} 1 & 2 & 1 & 4 \\ 0 & -3 & 0 & -3 \\ 0 & -3 & 0 & -3 \end{array}\right]$$

$R_3 \to R_3 + R_2$

$$= \left[\begin{array}{ccc|c} 1 & 2 & 1 & 4 \\ 0 & -3 & 0 & -3 \\ 0 & 0 & 0 & 0 \end{array}\right]$$

$R_2 \to R_2/3$

$$\left[\begin{array}{ccc|c} 1 & 2 & 1 & 4 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{array}\right]$$

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This gives rank of A.

$\rho(A) = 2$ and Rank of $(A \vdots B) = \rho(A \vdots B) = 2$

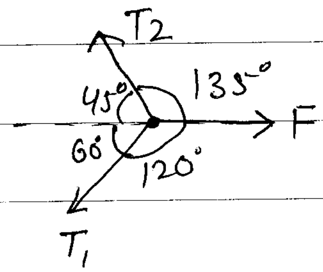
Which is less than the Number of unknowns (3)

$\rho(A) = \rho(A \vdots B) = 2 < 3$

Hence, This gives infinite No. of solutions.

Heading

Sol:- (48) Option (A) is correct



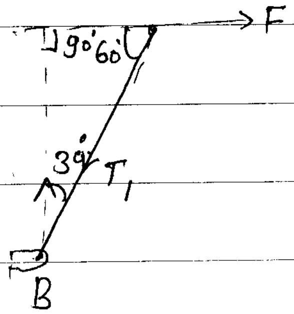
from above figure. There forces are acting on a common point Hence by Lami's theorm

$$\frac{F}{\sin(105^\circ)} = \frac{T_2}{\sin 120^\circ} = \frac{T_1}{\sin 135^\circ}$$

$$\Rightarrow \frac{T_1}{\sin 135} = \frac{F}{\sin(105^\circ)} = \frac{1}{\sin(105^\circ)}$$

$$T_1 = 0.73205\,kN$$

Hence vertical Reaction At B



$$R_{NT_1} = T_1 \cos 30^\circ$$

$$= 0.73205 \times \cos 30^\circ$$

$$R_{NT_1} = \underline{\underline{0.634\,kN}}$$

Heading

Sol:- 49 Option (B) is correct.

From Previous question

$$\frac{F}{\sin 105^\circ} = \frac{T_2}{\sin 120^\circ}$$

$$T_2 = \frac{\sin 120^\circ}{\sin 135} \times F = 0.8965 F$$

and $T_1 = (0.73205) F$

~~Hence~~ $\because T_2 > T_1$

$\sigma = 100$ MPa (given)

As we Know

$F = \text{stress} \times A_1$

~~Stress~~ $\Rightarrow F_{Max} = \text{Stress}_{Max} \times A_1$

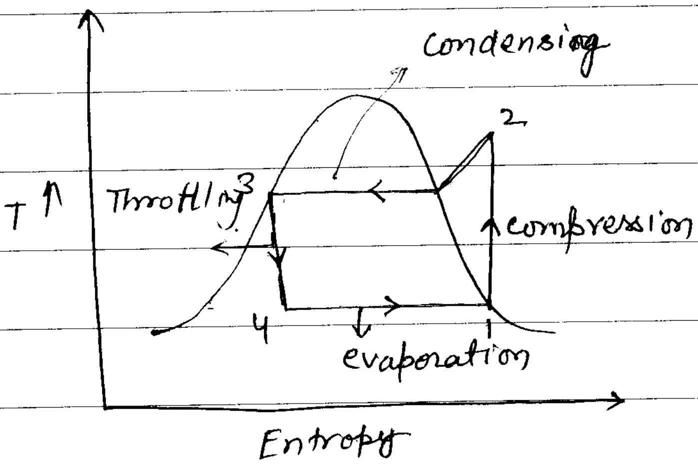
$T_2 = 100 \times 100$

$0.8965 F = 100 \times 100$

$$F = \frac{100 \times 100}{0.8965} = 11154.5 \text{ N}$$

$F = 11.15$ kN

Sol:- so Option (A) is correct.



T-s diagram for given Refrigeration cycle is given above since Heat is extracted in ~~Proce~~ evaporation Process.

So Rate of Heat extracted

$= \dot{m}(h_1 - h_4)$

from above diagram ($h_3 = h_4$) for throttling Process, so

Heat extracted $= \dot{m}(h_1 - h_3)$

from give table

$h_1 = h_g$ at 120 KPa, $h_g = 237$ KJ/kg

$h_3 = h_f$ at 120 KPa, $h_f = 95.5$ KJ/kg

Hence

Heat extracted $= \dot{m}(h_g - h_f)$

$= 0.2 \times (237 - 95.5)$

$= 28.3$ KJ/s

Heading

Solⁿ- 51 Option (~~A~~ C) is correct.

Since Power is required for compressor in refrigeration is in compressing cycle (1-2)

Hence

Power required

$$= \dot{m}(h_2 - h_1)$$

$$= \dot{m}(h_2 - h_f)$$

since for isentropic compression process

$s_1 = s_2$ from fig. $= 0.95$

for entropy $s = 0.95$ the ~~corresponds~~ enthalpy $h = 276.45$ KJ/kg

$h = h_2 = 276.45$ (from table)

Hence

Power $= 0.2(276.45 - 237)$

$= 7.89 \simeq \underline{\underline{7.9\ kW}}$

Heading

Sol:- 52 Option (c) is correct.

from energy balance for steady flow system

$E_{in} = E_{out}$

$$\cancel{\dot{m}}\left(h_1 + \frac{V_1^2}{2}\right) = \cancel{\dot{m}}\left(h_2 + \frac{V_2^2}{2}\right) \rightarrow (1)$$

~~where~~ as $h = c_p T$

Hence

eqn (1) becomes

$$c_p T_1 + \frac{V_1^2}{2} = c_p T_2 + \frac{V_2^2}{2}$$

$$T_2 = \left(\frac{V_1^2 - V_2^2}{2 \times c_p}\right) + T_1$$

$$= \frac{10^2 - 180^2}{2 \times 1008} + 500$$

$$T_2 = -16.02 + 500$$

$$T_2 = 483.98 \simeq \underline{\underline{484\ K}}$$

Heading

Sol:- 53 Option (D) is correct.

from mass conservation

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

$$\Rightarrow \frac{V_1 A_1}{v_1} = \frac{V_2 A_2}{v_2} \rightarrow (1)$$

where v = specific volume of air $= \frac{RT}{P}$

Therefore eq (1) becomes

$$\frac{P_1 V_1 A_1}{\cancel{R} T_1} = \frac{P_2 V_2 A_2}{\cancel{R} T_2}$$

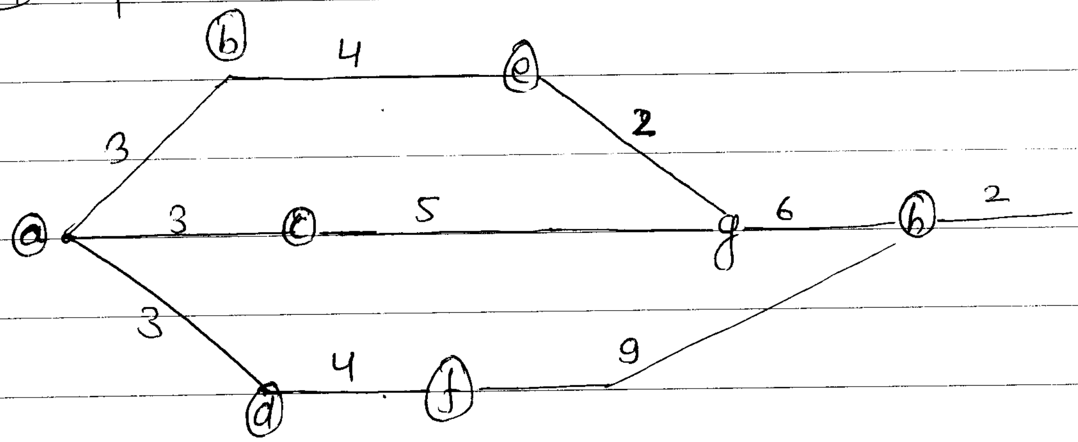
$$\Rightarrow A_2 = \frac{P_1 \times V_1 \times A_1 \times T_2}{P_2 \times V_2 \times T_1}$$

$$= \frac{300 \times 10 \times 80 \times 484}{100 \times 180 \times 500}$$

$$A_2 = 12.9 \text{ cm}^2$$

Heading

sol:- 54 Option (C) is correct.



for path	duration
a - b - e - g - h	= 3 + 4 + 2 + 6 + 2 = 17 days
a - c - g - h	= 3 + 5 + 6 + 2 = 16 days
a - d - f - h	= 3 + 4 + 9 + 2 = 18 days

The critial path is one that takes longest path

Hence path a-d-f-h = 18 days is critial path

Heading

Sol:- 55 Option (A) is correct.

from Previous question

For critical Path

$a-d-f-h = 18$ days, the duration of ~~act~~ activity f alone is changed from 9 to 10 days, then

$a-d-f-h = 3+4+10+2 = 19$ days.

Hence critical path remains same and the total duration to complete the project changes to 19 days

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/ /12	Gate 2012 (ME)		56	/		65

Heading

Sol:- 56 Option (A) is correct.

"Which" is used in a sentence when the person is ~~Kno~~ not known. But here the person means suresh's dog is known ~~ont~~ and "that" is used in a sentence when the person is known. So, That will be used in this sentence.

sol:- 57 Option (A) is correct

Profit is given by,

~~P = Total cost of production~~

P = Selling price − Total cost of production

$$P = 50q - 5q^2$$

Using the principle of maxima – minima

$$\frac{dP}{dq} = 50 - 10q = 0$$

$$\Rightarrow q = \frac{50}{10} = 5$$

& $\frac{d^2P}{dq^2} = -10$ (Maxima)

So, for 5 units the profit is maximum

Date	Ref. Book	Page No.	Ex. No	Chap/Qes	Gen Q No.	Page
/ /12	Gate 2012	ME	58	/		67

Sol:- 58 Option (B) is correct.

Despite several setbacks the mission succeeded in its attempt to resolve the conflict.

Date	Ref. Book	Page No.	Ex. No	Chap/Qes	Gen Q No.	Page
/ /12	Gate 2012	ME	59	/		68

Heading **Sol: - 59** Option (A) is correct

~~The clo~~

From the following options Diminish is the closest meaning to the Mitigate.

Date	Ref. Book	Page No.	Ex. No	Chap/Qes	Gen Q No.	Page
/ /12	Gate 2012 (ME)		60	/		69

Heading Sol:- 60 Option (A) is correct.

The grammatically incorrect sentence is :

(A) They gave us the money less the service charges of three hundred rupees.

Sol:- 61 Option (A) is correct.

Gap of 3 letters — Gap of 5 letters

A B C D E F G H I J K L M N O P Q R S T U V W

Gap of 2 letters — Gap of 4~~3~~ letters — Gap of 6 letters

So, the next term is OV

Sol:- 62 Option (B) is correct

~~Des~~ Not-geneder- Discriminatory

Discriminatory involves the actual behaviors towards groups such as excluding or restricting members of one group from from opportunities that are available to another group.

~~Not-gender di~~ This given advertisement is not exclude or restrict Male or Female members ~~of on~~ from one another. Hence This is Not-gender discriminatory.

Sol:-63 Option (B) is correct.

Correct option is (B)

Given:

$$y = 2x - 0.1x^2 \quad \text{--- (1')}$$

using the principle of maxima-minima

$$\frac{dy}{dx} = 2 - 0.2x = 0$$

$$x = \frac{2}{0.2} = 10$$

and $\frac{d^2y}{dx^2} = -0.2$ (Maxima)

So, for maximum possible height, substitute $x = 10$ in equation (1')

$$y = 2 \times 10 - 0.1 \times (10)^2$$

$$= 20 - 10 = 10 \text{ meter}$$

Sol: 64 Option (B) is correct

Supplier X supplies 60% of shock absorbers, out of which 96% are reliable. So overall reliable fraction of shock absorbers from supplier X,

$$= 0.6 \times 0.96$$

$$= 0.576$$

And for supplier Y, supplies 40% of shock absorbers, out of which 72% are reliable. So ~~total~~ fraction of reliability $= 0.4 \times 0.72 = 0.288$

Total fraction of reliability

$$= 0.576 + 0.288 = 0.864$$

Now probability for randomly chosen shock absorber, which is found to be reliable is made by Y is

$$0.864 \times x = 0.288 \times 1$$

$$x = \frac{0.288}{0.864} = 0.334$$

Sol:- 65 Option (c) is correct.

For statement P:-

Take three variables a, b, c

$$\text{Mean } (m) = \frac{a+b+c}{3}$$

Adding 7 to each entry, $m_1 = \frac{(a+7)+(b+7)+(c+7)}{3}$

$$m_1 = \frac{a+b+c}{3} + \frac{21}{3} = m+7$$

So, it is correct.

(Q) Standard deviation (σ)

$$\sigma = \sqrt{\frac{(a-m)^2+(b-m)^2+(c-m)^2}{3}} \cancel{\neq \sigma + 7}$$

adding 7 to each entry,

$$\sigma_1 = \sqrt{(a-m+7)^2+(b-m+7)^2+(c-m+7)^2} \neq (\sigma+7)$$

It is wrong.

R) By doubling each entry

$$m_1 = \frac{2a+2b+2c}{3} = 2m \quad (\text{it is correct})$$

(S) doubling each entry

$$\sigma_1 = \sqrt{\frac{(m-2a)^2+(m-2b)^2+(m-2c)^2}{3}} \neq (2\sigma)$$

Hence, it is wrong.