1. Ans.(d)

2. Ans.(b)

3. Ans.(d)

4. Ans.(a)

5. Ans.(d)

6. Ans.(b)

7. Ans.(a)

8. Ans. (b)

$$Cp=1005j/kg^{\circ}c=\frac{R\gamma}{\gamma-1}=\frac{287\times\gamma}{(\gamma-1)}$$

So $\gamma=1.399\approx1.4$

$$T_2=T_1+\frac{V^2}{2C_P}$$

$$T_2=358.95\text{ K}$$

$$p_2=p_1\left(\frac{T_2}{T_1}\right)^{\frac{1.4}{.4}}=10$$

$$\times\left(\frac{358.95}{298}\right)^{3.5}=192\text{ KPa}$$

9. Ans.(d)

10. Ans.(a)

11. Ans.(c)

Since the deflection in both the ropes is same and the lengths are unequal, then

$$\frac{P_1}{P_2}=\frac{L_2}{L_1}=\frac{6}{8}=3/4$$

12. **Ans.(b)**

As hinge does not take any moment, therefore reaction at B will be (R_B)

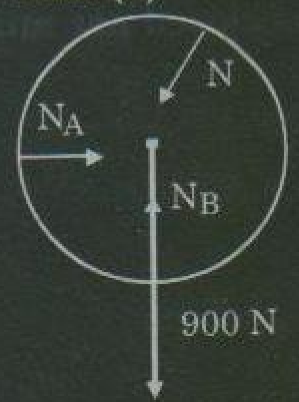
$$4W = 5R_E$$

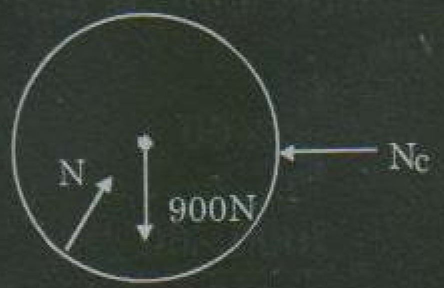
$$10R_E + 3R_B - 9W = 0$$

$$R_B = \frac{W}{3}$$

13. **Ans.(d)**

14. **Ans.(c)**





$$\frac{N}{\sqrt{2}} = 900$$

$$N_c = N/\sqrt{2} = 900N$$

$$N_A = \frac{N}{\sqrt{2}} = 900N,\ N_B = 900 + \frac{N}{\sqrt{2}} = 1800N$$

15. **Ans.(c)**

16. **Ans.(d)**

17. **Ans.(d)**

18. **Ans.(c)**

19. **Ans.(b)**

$$\text{Time} = \frac{20 \times 60}{.2 \times 300} = 20\text{sec}$$

20. **Ans.(a)**

Let B.E.Q be 'Q' then

Total cost=80000+10Q

Revenue=30Q

30Q=80000+10Q

20Q=80000

Q=4000

21. **Ans. (b)**

22. **Ans.(b)**

$$F(x) = 3.46\text{Sin}x + 2\text{Cos}x = 4\text{Sin}(x + \pi/6)$$

Has maximum at $x = \pi/6$

23. **Ans.(d)**

24. **Ans.(c)**

$$\frac{dz}{d\omega} = \frac{\partial z}{\partial u} = i e^{-v} (\text{Cos}u + i\text{Sin}u) = iz$$

So $\frac{d\omega}{dz} = \frac{1}{iz}$

So ω ceases to be analytic for z=0

25. **Ans.(c)**

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

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

$$\frac{1}{a^2} + \frac{y\frac{d^2y}{dx^2}}{b^2} + \frac{\left(\frac{dy}{dx}\right)^2}{b^2} = 0$$

Eliminating a and b from the equations we get

$$xy\frac{d^2y}{dx^2} + x\left(\frac{dy}{dx}\right)^2 - y\left(\frac{dy}{dx}\right) = 0$$

26. **Ans.(b)**

Solution: $\sum \lambda_i$ =Trace(A)

$\lambda_1 + \lambda_2 + \lambda_3$ =trace(A)

=2+(-1)+0=1

$\lambda_1 = 3$

Now

$\therefore 3 + \lambda_2 + \lambda_3 = 1$

$= \lambda_2 + \lambda_3 = -2$

Only choice(b) satisfies this condition

27. **Ans.(b)**

Solution: $\frac{dy}{dx} = \frac{y}{x}\left[\log(\frac{y}{x}) + 1\right]$, putting $v = \frac{y}{x}$

We get $\frac{dy}{dx} = v + x\frac{dy}{dx}$

$$\frac{dx}{x} = \frac{dv}{v\log v}$$

$\text{Logx}+\text{logc}=\log(\log v)$

$v = e^{cx}$

$Y = xe^{xc}$

28. Ans.(d)

Solution: Both f(x) and f(-x) changes their sign once. Hence there are only one real root on both positive and negative sides on x-axis.

29. Ans.(c)

Exp. Maximum surface roughness

$$R_a = \frac{f^2}{18\sqrt{3}R}$$

$$f^2 = 18\sqrt{3} \times R \times R_a$$

$$= 18\sqrt{3} \times 1.8 \times 3 \times 10^{-3}$$

$$f^2 = 0.168 \text{ mm / rev}$$

$$f = 0.410 \text{ mm / rev}$$

30. Ans.(d)

Exp. $\because \sigma = K \in^n$

$$\ell n\ \sigma = \ell n\ k + n\ \ell n \in$$

$$n = \frac{\ell n \sigma - \ell n\ k}{\ell n \in} = \frac{\ell n\ 515 - \ell n\ 2015}{\ell n\ 0.1} = 0.592$$

$$n \approx 0.60$$

31. Ans.(a)

Exp. Cauchy's integral theorem is

$$F(a) = \frac{1}{2\pi i}\int_c \frac{f(z)}{z-a}dz$$

i.e. $\int_c \frac{f(z)}{z-a}dz = 2\pi i\, f(a)$

Now $\int_c \frac{z^3-6}{3z-i}dz = \frac{1}{3}\int_c \frac{z^3-6}{\left(z-\frac{i}{3}\right)}$

Applying Cauchy's integral theorem

$$\frac{1}{3}\left[2\pi i\, f\left(\frac{i}{3}\right)\right] = \frac{1}{3}\left\{2\pi i\left[\left(\frac{i}{3}\right)^3 - 6\right]\right\}$$

$$= \frac{1}{3}\left\{2\pi i\left[\left(\frac{i}{3}\right)^3 - 6\right]\right\} = \frac{2\pi}{81}i^4 - 4\pi i$$

$$= \frac{2\pi}{81} - 4\pi i$$

32. Ans.(d)

Exp. Energy supplied by the motor

$$E_2 = 7\text{ k}\omega$$

$$= 7000\ \omega$$

$$= 7000\text{ N.m / sec}$$

But energy absorbed during one riveting operation which takes 1 sec

$$E_1 = 10000\text{ N.m}$$

Number of rivets that can be closed per minute

$$= \frac{E_2}{E_1} \times 60$$

$$= \frac{7000 \times 60}{10000}$$

$$= 42 \text{ Rivets}$$

33. Ans.(b)

Exp. Required probability = $p_7 + p_8$ where

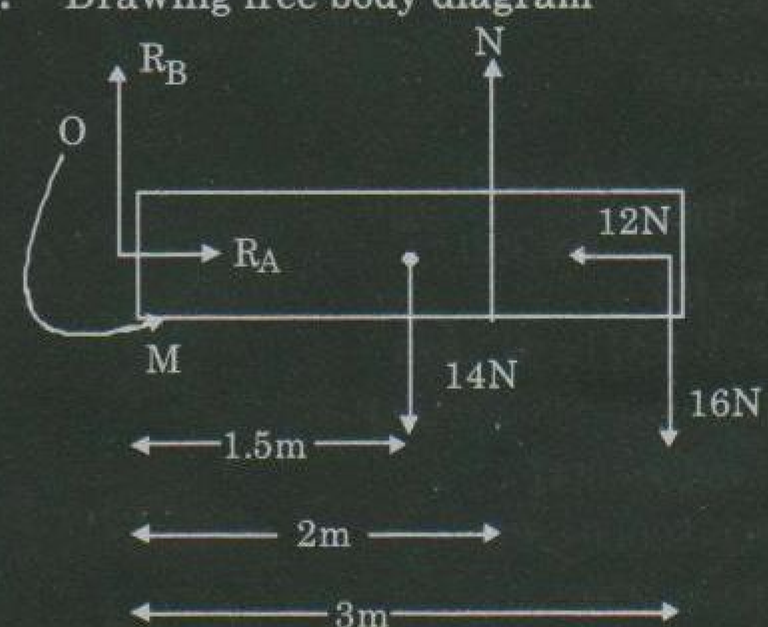
$$p_7 = \frac{1}{2} \times \frac{1}{11} + \frac{1}{2} \times \frac{6}{36} = \frac{1}{2}\left(\frac{1}{11} + \frac{1}{6}\right)$$

$$p_8 = \frac{1}{2} \times \frac{1}{11} + \frac{1}{2} \times \frac{5}{36} = \frac{1}{2}\left(\frac{1}{11} + \frac{5}{36}\right)$$

$p_7 + p_8 = 0.244$

34. Ans.(d)

Exp. Drawing free body diagram



$R_A = 12\text{N}$

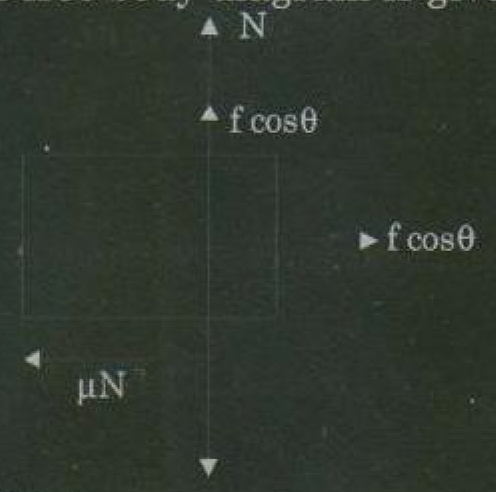
$R_3 + \text{N} = 16 + 14 = 30\text{N}$

Moment about 0, we have M+n×3+14×15 =48+21

4 Unknowns but only 3 equations

35. Ans.(d)

Exp. The free body diagram is given as



N=10-fSinθ

When it leaves surfaces

$N=0=10-4\ t_1\ \mathrm{Sin}\theta$

$=t_1=\dfrac{2}{\sin\theta}$

For sliding μ N=f cosθ=8-4 t_2 Sinθ=5 t_2 cosθ

$t_2>t_1=\dfrac{8}{4\sin\theta+5\cos\theta}>\dfrac{2}{\sin\theta}$

$\Rightarrow \cos\theta<0$

$\Rightarrow \theta_{min}=90^{\circ}$

36. Ans.(b)

Exp. $\omega=\dfrac{2\pi\times1500}{60}$=157.08rad/sec

$$TR=\sqrt{\frac{1+(2\xi r)^2}{(1-r^2)^2+(2\xi r)^2}}$$

$$0.15=\sqrt{\frac{1+\left(2\times0.08r\right)^2}{(1-r^2)^2+(2\times0.08r)^2}}$$

r = 2.816

$r=\dfrac{\omega}{\omega_n}$

$\omega_n=\dfrac{\omega}{r}=\dfrac{157.08}{2.816}$=55.78rad/sec

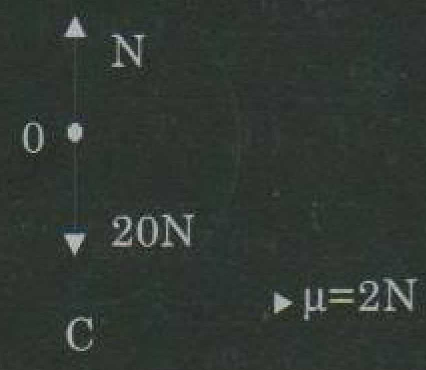
$\because \omega_n=\sqrt{\dfrac{k}{m}}$

$\therefore k=650\times55.78^2$

K=2.02MN/m

37. Ans.(c)

Exp. The free body diagram is given as



$a=\dfrac{2N}{2}=1m/\ s^2$

$\mu=\dfrac{1}{0.1}=10rad/s^2$

The frictional force becomes non-dissipative and negligible when instantaneous velocity of c becomes zero.

i.e $v-\omega r=0$

$\Rightarrow at-(\omega_0-\mu t)r=0$

So 10-20t=0

$\Rightarrow$t=0.5sec

38. Ans.(b)

39. Ans.(c)

Exp.C> $2\sqrt{km}=2\ \sqrt{500}\Rightarrow 50$ over damped system

$$s_1, s_2=-\frac{100}{2\times5}\pm\left(\frac{100^2}{4\times25}-\frac{100}{5}\right)^{1/2}$$

=-18.94, -1.06

So $x=Ae^{-18.94t}+Be^{-1.06t}$

40. Ans.(a)

41. Ans.(b)

42. Ans.(a)

Exp. $T_e=T_i\left(\dfrac{P_e}{P_i}\right)^{\frac{\gamma-1}{\gamma}}$

$T_e=350\left(\dfrac{1}{4}\right)^{\frac{.4}{1.4}}$

$T_e=235.5\ k$

$\because C_P=\dfrac{\gamma R}{\gamma-1}$

$\therefore C_P=\dfrac{8.314\times1.4}{0.4}$

$C_P=29.1\ J/mol-k$

$$\bar{C}_P = \frac{29.1}{29\times10^{-3}} = 1.0034\ KJ/kg-k$$

$$V_e = \sqrt{2C_P(T_i - T_e)}$$

$$V_e = \sqrt{2\times1.0034(350-235.5)\times10^3}$$

$$\boxed{V_e = 479.35\ m/s}$$

43. Ans.(d)

44. Ans. (a)

Exp. Discharge passing between the stream lines is given by

$\psi_1 - \psi_2$

$\psi_1(1,3) = 6$

$\psi_2(5,5) = 0$

$\therefore \psi_1 - \psi_2 = 6$ unit

45. Ans. (b)

Exp. $u_1 = 200\ KJ/kg$ (given)

$U_2 = mu_1 \Rightarrow U_1 = .25\times200$

$U_1 = 50\ KJ$

$u_2 = 300\ KJ/kg$ (given)

$U_2 = mu_2 \Rightarrow U_2 = .75\times300$

$U_2 = 255\ KJ$

Total $U = U_1 + U_2$

$U = 275\ KJ \quad U = u\times m$

$u = \frac{U}{m} \quad u = \frac{275}{1}$

$$\boxed{u = 275\ KJ/kg}$$

46. Ans. (d)

Exp. Shear stress $(f_s) = \frac{P}{2b.t}$

$$f_s = \frac{60\times10^3}{2\times40\times15}$$

$$f_s = \frac{60\times10^3}{2\times600} \quad f_s = \frac{1}{2}\times10^3$$

$$\boxed{f_s = 50\ N/mm^2}$$

47. Ans. (a)

Exp. $\omega_D = (2V_1\cos\propto - V_b)V_b$

$= [2\times700\times½ - 300]\times300$

$= 120\ kw$

48. Ans.(d)

Exp. Maximum shear force = vertical reaction at A

$$V_A = \frac{1}{3}\times8\times5 = 13.33\ KN$$

49. Ans.(a)

Exp. Maximum SF occurs at the level of neutral axis at the section of maximum SF. for square sections.

$$\tau_{max} = \frac{3}{2}\times\tau_{avg} = \frac{3}{2}\times\frac{13.33\times10^3}{(40\times40)} = 12.5\ N/mm^2$$

50. Ans. (c)

Exp. $u = -\frac{\partial\psi}{\partial y} = -4x$

$v = \frac{\partial\psi}{\partial x} = 4y$

For point B,

$x = 3m \qquad y = 1\ m$

$u = -\ 0.12$ cm/sec $\qquad v = 0.04$ cm/sec

$$v = \sqrt{u^2+v^2} = 0.126\ cm/sec^2$$

51. Ans.(d)

Exp. The convective acceleration

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

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

$$\frac{\partial u}{\partial x} = -4, \frac{\partial u}{\partial y} = 0 \text{ and } \frac{\partial v}{\partial x} = 0, \frac{\partial v}{\partial y} = 4$$

$$a_x = -0.12(-4)\times10^{-4} = 48\times10^{-6}\ cm/s^2$$

$$a_y = 0.04\times4\times10^{-4} = 16\times10^{-6}\ cm/s^2$$

$$a = \sqrt{a_x^2 + a_y^2} = 50.6\times10^{-6}\ cm/s^2$$

52. Ans.(d)

Exp. By interpolation degree of super heat

$$\bar{C}_P = \frac{29.1}{29\times10^{-3}} = 1.0034 \text{ KJ/kg-k}$$

$$V_e = \sqrt{2C_P(T_i - T_e)}$$

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Total $U = U_1 + U_2$

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$$f_s = \frac{60\times10^3}{2\times600} \quad f_s = \frac{1}{2}\times10^3$$

$$\boxed{f_s = 50 \text{ N/mm}^2}$$

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$$= [2\times700\times½ - 300]\times300$$

$$= 120 \text{ kw}$$

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$$a_x = -0.12(-4)\times10^{-4} = 48\times10^{-6} \text{ cm/s}^2$$

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