ANSWER KEY

1.	(C)	13.	(A)	25.	(C)	37.	(86 – 90)	49.	(C)	61.	(C)
2.	(B)	14.	(C)	26.	(0.12 – 0.126)	38.	(3)	50.	(A)	62.	(C)
3.	(12)	15.	(C)	27.	(2)	39.	(0.142 – 0.152)	51.	(D)	63.	(480)
4.	(B)	16.	(C)	28.	(71 – 72)	40.	(15 – 16)	52.	(132.88)	64.	(B)
5.	(A)	17.	(D)	29.	(A)	41.	(D)	53.	(9.7 – 9.9)	65.	(12)
6.	(A)	18.	(D)	30.	(D)	42.	(A)	54.	(B)		
7.	(B)	19.	(D)	31.	(1.21)	43.	(14250 – 14250)	55.	(D)		
8.	(A)	20.	(A)	32.	(B)	44.	(126 – 128)	56.	(B)		
9.	(0.25)	21.	(A)	33.	(D)	45.	(A)	57.	(D)		
10.	(A)	22.	(D)	34.	(B)	46.	(B)	58.	(18)		
11.	(0.2)	23.	(D)	35.	(C)	47.	(3.8 – 4.2)	59.	(B)		
12.	(A)	24.	(D)	36.	(D)	48.	(A)	60.	(19)		

SOLUTIONS

1. (C)
Parallel to dislocation line

2. (B)
Holes 'H' with shafts 'a' to 'g' $\rightarrow$ clearance fit
'p' to 'z_c' $\rightarrow$ Interference fit
'h' to 'n' $\rightarrow$ Transition fit

3. (12)
Number of Non-Basic variables
$= m \cdot n - (m+n-1) = 5\times 4 - (5+4-1) = 12$

4. (B)
increased MRR and increased surface roughness

5. (A)

6. (A)

$H.G.L.$ contains $\left(\frac{P}{\rho g} + z\right)$

$T.E.L.$ contains $\left(\frac{P}{\rho g} + z + \frac{v^2}{2g}\right)$

7. (B)
$\tau = \frac{-R}{2}\left(\frac{\partial P}{\partial x}\right)$
$\tau \propto R$
So, the relation is linear.

8. (A)
Linear strain

9. (0.25)
$\Delta T_{Hot} = 180 - 160 = 20°C$
$\Delta T_{Cold} = 110°C - 30°C = 80°C$
$C = \frac{\Delta T_{Hot}}{\Delta T_{Cold}} = \frac{20}{80} = 0.25 \left(\because C = \frac{C_{\min}}{C_{\max}}\right)$

10. (A)
Arrival distribution and service time distribution

11. (0.2)
$F_4 = F_3 + \alpha[D_3 - F_3]$
$\Rightarrow 496 = 500 + \alpha[480 - 500]$
$\Rightarrow \alpha = 0.2$

12. (A)
WE know, $\frac{V}{\cos(\phi - \alpha)} = \frac{V_C}{\sin\phi}$
$\therefore V_C = \frac{35\times\sin 45°}{\cos 30°} = 28.57 m/\min$

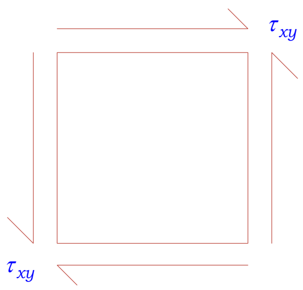
13. (A)
$DOF = 0$
Gibbs phase rule fails at critical point.

14. (C)
$\lambda^2 - \lambda(3) + (2-2) = 0$
$\therefore \lambda^2 - 3\lambda = 0$ is the characteristic equation.

15. (C)
$A = \sqrt{A_1 A_2}$
$A = \sqrt{2\times 8} = 4m^2$

16. (C)
shear stress & rate of strain

17. (D)



In pure shear $\begin{bmatrix} 0 & \tau_{xy} \\ -\tau_{xy} & 0 \end{bmatrix}$

18. (D)
M is above G

19. (D)
efficiency increases effectiveness decreases

20. (A)

$$3\times\frac{\pi}{4}d^2\times\tau=3\times d\times t\times\sigma_c$$

$$d=\frac{4t}{\pi}\times\frac{\sigma_c}{\tau}=\frac{4\times 6}{\pi}\times\frac{50}{25}=\frac{48}{\pi}$$

21. (A)

$$\text{Jerk}=\frac{d^3s}{dt^3}$$

$$\frac{ds}{dt}=\frac{4}{2}\times\frac{\pi}{\beta}\sin\left(\frac{\pi\theta}{\beta}\right)$$

$$\frac{d^2s}{dt^2}=\frac{h}{2}\times\frac{\pi^2}{\beta^2}\cos\left(\frac{\pi\theta}{\beta}\right)$$

$$\frac{d^3s}{dt^3}=-\frac{h}{2}\times\frac{\pi^3}{\beta^3}\sin\left(\frac{\pi\theta}{\beta}\right)$$

22. (D)

23. (D)
Elastic Modulus is the one which depends on composition

24. (D)

We have $f(z)=\tan z=\dfrac{\sin z}{\cos z}$

At $z=\frac{\pi}{2}$; Res $f\frac{\pi}{2}=\underset{z\to\frac{\pi}{2}}{Lt}=\left(\dfrac{\sin z}{\frac{d}{dz}(\cos z)}\right)$

$$\underset{z\to\frac{\pi}{2}}{Lt}\left(\frac{\sin z}{-\sin z}\right)=-1$$

25. (C)
For an ideal gas, enthalpy is function of temperature. In an isenthalpic process, enthalpy remains constant and hence temperature. remains constant.
The rise in temperature is highest for isochoric as the slope of constant volume lines is greater than the slope of constant pressure lines

26. [0.1228(0.12 – 0.126)]
Modulus of resilience = A under the $\sigma-\in$ curve till the yield point.

So, $MOR=\frac{1}{2}\times 2\times 14=14$

Modulus of toughness = Area under $\sigma-\in$ curve till the fracture point.

$$MOT=\frac{1}{2}\times 2\times 14+\frac{1}{2}\times 4\times(20+14)+\frac{1}{2}\times 2\times(20+12)$$

$$MOT=14+68+32=114$$

So, $\dfrac{MOR}{MOT}=\dfrac{14}{114}=0.1228$

27. (2)

$$U_1=\frac{P^2L}{2AE}$$

$$U_2=\frac{P^2(2L/3)}{8AE}+\frac{P^2(L/3)}{2AE}=\frac{3P^2L}{12AE}$$

So, $\dfrac{U_1}{U_2}=\dfrac{P^2L}{2AE}\times\dfrac{12AE}{3P^2L}=2$

28. [71.43(71–72)]
28. (71.43(71–72))
For displacement Δx of block, along the incline
Output work $=mg(\Delta x)\sin 45°$
Input work
$=F(\Delta x)=mg(\Delta x)\sin 45°+\mu mg(\Delta x)\cos 45°$

$\therefore$ Mechanical efficiency, $\eta_m=\dfrac{\text{Output work}}{\text{Input work}}$

$$\Rightarrow \eta_m=\frac{mg(\Delta x)\sin 45°}{[mg(\Delta x)\sin 45°+\mu mg(\Delta x)\cos 45°]}$$

$$=\frac{1}{1+\mu\cot 45°}$$

$$\therefore \eta_m=\frac{1}{1+(0.4\times 1)}=\frac{1}{1.4}=0.7143=71.43\%$$

29. (A)
Given, $\sigma=0.0725N/m$

$\Delta P=0.02N/cm^2=0.02\times 10^4 N/m^2$

Now, $\Delta P=\dfrac{4\sigma}{d}$

or, $d=\dfrac{4\sigma}{d}=\dfrac{4\times 0.0725}{0.02\times 10^4}=0.00145m$

$\therefore d=0.145cm$

30. (D)
Given, $\phi=x(2y-1)$

Now, $\dfrac{-\partial\phi}{\partial x}=u$

So, $u=-2y+1$

$v=-2x$

Also, $\dfrac{\partial\psi}{\partial x}=-2x$

$\psi=-x^2+f(y)$

Now, $\dfrac{\partial\psi}{\partial y}=f'(y)=-2y+1$

So, $f(y)=y^2-y$

$\psi=y^2-x^2-y$

At $(4,5)$ $\psi=5^2-4^2-5=4$

31. (1.21)
$P_A=$ Vapour pressure $=4.00kPa(abs)$

$P_1=P_2=$ atmospheric pressure $=95.47kPa(abs)$

By applying Bernoulli;s equation to point 1 and A.

$$\frac{P_1}{\rho g}+\frac{v_1^2}{2g}+z_1=\frac{P_A}{\rho g}+\frac{v_A^2}{2g}+z_A$$

$$\left(\frac{9548}{9.81}\right)+0+1.5=\left(\frac{4.00}{9.81}\right)+\frac{v_A}{2g}+0$$

$$\frac{v_A^2}{2g}=\frac{95.48-4.00}{9.81}+1.5=10.825m$$

$$v_A=(2\times 9.81\times 10.825)^{1/2}=14.57m/\sec$$

$$v_2=\frac{v_A}{2}=\frac{14.57}{2}=7.28m/\sec$$

By applying Bernoulli's equation to point 1 and 2, with datum at point 2.

$$\frac{P_1}{\rho g}+\frac{v_1^2}{2g}+z_1=\frac{P_2}{\rho g}+\frac{v_2^2}{2g}+z_2$$

$$\frac{95.48}{9.81}+0+(L+1.50)=\left(\frac{95.48}{9.81}\right)+\frac{(7.28)^2}{2\times 9.81}+0$$

$$L=1.21m$$

32. (B)

Life of bearing,

$$L=\left(\frac{C}{P}\right)^3\times 10^6 \text{ Revolution}$$

If N is speed in rmp them life in hours will be

$$L=\left(\frac{C}{P}\right)^3\times 10^6\times\frac{1}{N\times 60}\text{ hours}$$

Now, $16000=\left(\frac{C}{P}\right)^3\times 10^6\times\frac{1}{60\times N}$ ....(1)

And, $L_2=\left(\frac{C}{2P}\right)^3\times 10^6\times\frac{1}{60\times N}$ ....(2)

Dividing (1) and (2) we get,

$$\frac{16000}{L_2}=2^3=8$$

$$\therefore L_2=\frac{16000}{8}=2000\text{ hours}$$

33. (D)

The auxiliary equation is

$$D^3-2D^2+4D-8=0$$

$$(x-2)(x^2+4)=0$$

$$x=2,\pm 2i$$

The solution of equation is,

$$y=C_1e^{2x}+C_2\sin 2x+C_3\cos 2x$$

34. (B)

Combinations produce on odd product with unequal numbers are: (1,3), (1,5), (3,1), (5,1), (3,5), (5,3)

Probability of getting unequal number and numbers with odd product $=\frac{6}{36}$

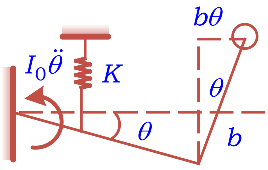
Probability of getting equal numbers or numbers with even product $=1-\frac{6}{36}=\frac{30}{36}$

35. (C)

In equilibrium position,

$$wl=kxa$$

where x is the initial extension. Lets displace the system by a small angle θ



$$\therefore I_0\ddot{\theta}+k(x+a\theta)a=w(l+b\theta)$$

Now using (1) we get,

$$\ddot{\theta}+\frac{(ka^2-wb)\theta}{I_0}=0$$

$$\therefore \infty=\sqrt{\frac{ka^2-wb}{I_0}}$$

36. (D)

Let the CCW direction be positive

Arm	C	D
O	x	–x
y	y+x	y-x

So, $y=8rad/s$

Also, $y+x=0$

$$\Rightarrow x=-8rad/s$$

$$\therefore \omega_D=y-x=8-(-8)=16rad/s$$

Since ω_D is $+16rad/s$, hence it is CCW.

37. [(87.92(86–90)]

$$P_B+\frac{\rho_0\times g\times 0.06}{1000}+\frac{\rho_m\times g\times 0.08}{1000}$$

$$=P_A+\frac{\rho_w\times g\times 0.05}{1000}$$

$$P_A=77+0.54+10.88-0.5=87.92kPa$$

38. (3)

Let the required number of shields be N.

$$\frac{\text{Without shields heat transfer rate}}{\text{With shields heat transfer rate}}=N+1$$

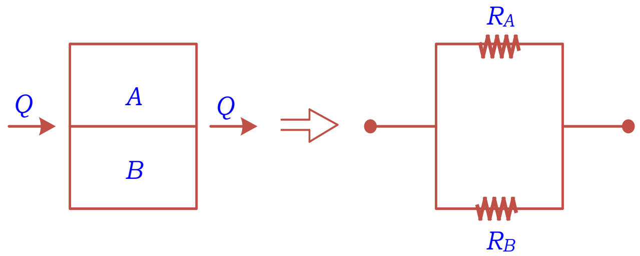
Given $Q_{\text{shielded}}=[1-0.75]Q_{\text{unshielded}}$

$$\Rightarrow\frac{Q_{\text{shielded}}}{Q_{\text{unshielded}}}=0.25$$

$$\Rightarrow\frac{1}{N+1}=0.25$$

$$\Rightarrow N=3$$

39. [0.147(0.142–0.152)]



$$R_A=\frac{\delta_A}{k_AA_A}=\frac{0.08}{30\times(0.1\times 0.03)}=0.89K/W$$

$$R_B=\frac{\delta_B}{k_BA_B}=\frac{0.08}{65\times(0.1\times 0.07)}=0.176K/W$$

$$R_{eq.} = \frac{R_A \times R_B}{R_A + R_B} = \frac{0.89 \times 0.176}{0.89 + 0.176} = 0.147KW$$

40. [15.43(15–16)]

Using modulus method

$M_R = 1.2M_C$

For optimum side riser, $d = h$

$$\therefore M_C = \frac{\text{Volume}}{\text{Surface Area}} = \frac{30 \times 30 \times 6}{2(30 \times 30 + 30 \times 60 \times 2)}$$

$= 2.143cm$

$$\frac{D}{6} = 1.2 \times 2.143$$

$D = 6 \times 1.2 \times 2.143 = 15.43cm$

41. (D)

True strain, $\in = \ln\left(\frac{A_i}{A_f}\right) = \ln\left(\frac{10}{8}\right)^2$

$\therefore \in = 0.446$

Now, mean flow stress,

$$\sigma_m = \frac{k \in^n}{n+1} = \frac{1300}{1.3} \times (0.446)^{0.3} \quad \therefore \sigma_m = 784.84MPa$$

42. (A)

$Z = \sin hu \cos h(iv) + \cos hu \sin h(iv)$

$= \sin h(u + iv)$

$$Z = \sin hw \Rightarrow \frac{dw}{dz} = f'(z) = \frac{1}{\sqrt{1+z^2}}$$

$\therefore w$ is not analytic at $z = \pm i$

43. [1425(14250–1250)]

$$T_{\text{mean}} \times 2\pi = \int_0^{2\pi} T d\theta$$

$$T_{\text{mean}} \times 2\pi = \int_0^{2\pi} (14250 + 2200 \sin 2\theta) d\theta$$

$$= 14250 \times 2\pi + \frac{2200}{2}[-\cos 2\theta]_0^{2\pi} - \frac{1800}{2}(\sin 2\theta)_0^{2\pi}$$

$$T_{\text{mean}} = \frac{14250 \times 2\pi}{2\pi} = 14250Nm$$

44. [127.234(126–128)]

The gyroscopic moment on the rotor will be maximum when the angular velocity of pitching ω_p is maximum. With a harmonic motion, the instantaneous pitch angle is

$\theta_p = \theta_0 \sin(2\pi t / T)$

Where θ_0 is the amplitude and T is the time period. So,

$$\omega_p = \dot{\theta}_p = \frac{2\pi}{T}\theta_0 \cos\frac{2\pi t}{T}$$

The maximum value of ω_p will be

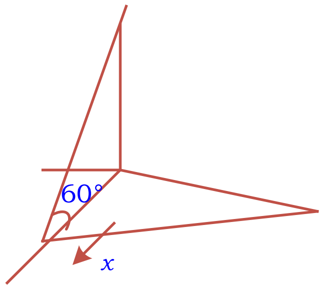
$\omega_{p\max} = 2\pi\theta_0 / T = 0.054 rad/s$

The magnitude of maximum gyroscopic couple is found out to be

$G = I\omega\omega_p = 20{,}000 \times 0.75^2 \times (2000 \times 2\pi / 60) \times 0.054$

$= 127{,}234.5025N-m \approx 127kN-m$

45. (A)



Let the mass 'm' is displaced by distance 'x' along the spring (1), so that the spring '1' get compressed by 'x'

Elongation of spring $(2) = x \cos 60 = \frac{x}{2}$

Elongation of spring $(3) = \frac{\pi}{2}$

Bet force along displaced 'x' direction

F_{net} = force due to spring (1) + Force due to spring (2) + Force due spring (3)

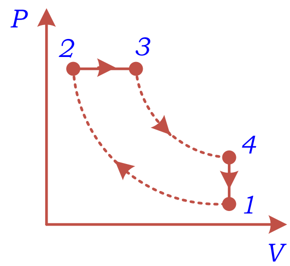
$$= -kx - k \times \frac{x}{2} \times \cos 60 - k \times \frac{x}{2} \times \cos 60$$

$$F_{\text{net}} = \frac{-3k}{2}x$$

$$\frac{d^2x}{dt^2} = -\frac{3k}{2m}x$$

$$\omega_n = \sqrt{\frac{3k}{2m}}$$

46. (B)



The piston displacement (swept volume)

$$V_s = \left(\frac{\pi}{4}\right)d^2L = \left(\frac{\pi}{4}\right) \times (25)^2 \times (37.5) = 18408cc$$

Total volume

$V_1 = V_s + V_c = 18408 + 1500 = 19908cc$

Compression ratio, $r = \frac{V_1}{V_2} = \frac{19908}{1500} = 13.27$

Since $V_3 = 1500 + 0.05 \times 18408 = 2420.5$

Cut-off ratio $\rho = \frac{V_3}{V_2} = \frac{2420.4}{1500} = 1.613$

The air standard efficiency of the cycle is

$$\eta_{\text{Diesel}} = 1 - \frac{1}{r^{\gamma-1}}\left(\frac{(\rho^\gamma - 1)}{\gamma(\rho - 1)}\right)$$

Substituting the values, we get $\eta_{\text{Diesel}} = 60.52\%$

47. [4(3.8–4.2)]

Let RH = Relative humidity;

VP = Vapour pressure;

SVP = Saturation vapour pressure

$RH = 40\%$

$V_1 = 10 \times 10^{-6} m^3$

$RH = \dfrac{VP}{SVP} = 0.4$

Let $SVP = P_0$

Condensation occurs when $VP = P_0$

$\Rightarrow P_1 = 0.4P_0$

$\Rightarrow P_2 = P_0$

Since the process is isothermal

$P_1V_1 = P_2V_2$

$\Rightarrow V_2 = \dfrac{P_1V_1}{P_2}$

$\Rightarrow V_2 = \dfrac{0.4P_0 \times 10 \times 10^{-6}}{P_0}$

$\Rightarrow V_2 = 4.0 \times 10^{-6} \Rightarrow V_2 = 4.0cm^3$

48. (A)

$\dfrac{L_p}{L_m} = \dfrac{50}{1}; V_m = 2\dfrac{m}{sec}, Q_m = 2.4\dfrac{m^3}{sec}$

Froude model holds good.

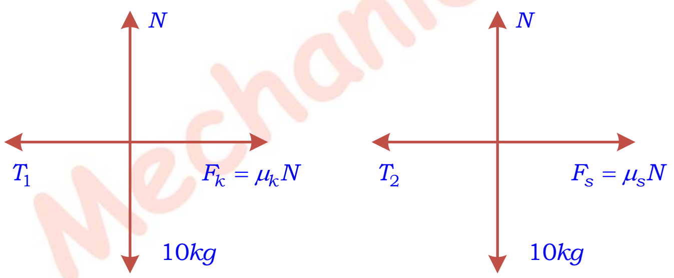
$\therefore \dfrac{V_m}{\sqrt{g_m L_m}} = \dfrac{V_p}{\sqrt{g_p L_p}} \quad g_m = g_p$

$V_p = V_m \times \sqrt{\dfrac{L_p}{L_m}} = \sqrt{50} \times 2 = 14.14\, m/sec$

$\dfrac{Q_p}{Q_m} = \text{Discharge ratio} = \left(\dfrac{L_p}{L_m}\right)^{2.5}$

$\Rightarrow Q_p = 2.4 \times (50)^{2.5} = 42426\dfrac{m^3}{sec}$

49. (C)



$\mu_s > \mu_k \Rightarrow T_1 < T_2$

$\Rightarrow$ minimum tension required will be more in IInd case

50. (A)

Given

$y^1 + 0.4y = 3e^{-x}$. $y(0) = 5$ is

i.e., $\dfrac{dy}{dx} = 3e^{-x} - 0.4y; \quad x_0 = 0;\ y_0 = 5$ and

$f(x,y) = 3e^{-x} - 0.4y$

$\therefore y(1.5) = 2,\ h = 1.5$

From Runge-Kutta second order, we have

$\therefore y_1 = y_0 + \dfrac{1}{2}(k_1 + k_2);$ where $k_1 = hf(x_0, y_0)$

$= 1.5.f(0,5)$

$k_1 = 1.5\left(3e^{-0} - 0.4(5)\right)$

$k_1 = 1.5\left(3e^{-0} - 0.4(5)\right)$

$k_1 = 1.5 \quad \& \ k_2 = f(x_0 + h, y_0 + k_1)$

$= 1.5f(1.5, 5 + 1.5) = 1.5f(1.5, 6.5)$

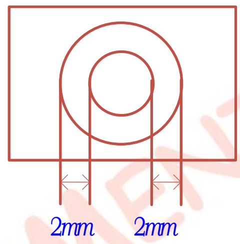
$= 1.5\left[3e^{-1.5} - 0.4(6.5)\right] = -2.8959$

$\therefore y_1 = 5 + \dfrac{1}{2}(1.5 - 2.8959) = 4.302$

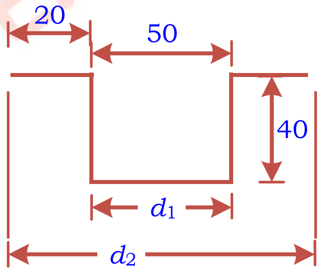
51. (D)

96

$100 - (2 \times 2) = 96mm$



52. (132.88)



Given data:

$d_1 = 50mm$

$d_2 = 50 + 20 + 20 = 90mm$

Blank diameter,

$D = \sqrt{d_2^2 + 4d_1h} + 2(\text{Trimming allowance})$

$= \sqrt{90^2 + 4 \times 50 \times 40} + 2 \times 3 = 132.88mm$

53. [9.8(9.7–9.9)]

Using conservation of energy, $mgh = \dfrac{1}{2}kx^2$

$\Rightarrow x = \sqrt{\dfrac{2mgh}{k}} = \sqrt{\dfrac{2 \times 0.04 \times 9.81 \times 4.9}{400}}$

$\therefore x = 0.098m = 9.8cm$

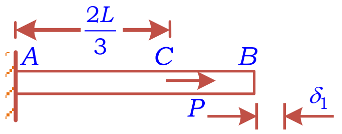
54. (B)

$\dfrac{Q}{A} = \dfrac{\sigma\left(T_1^4 - T_2^4\right)}{\dfrac{1}{\epsilon_1} + \dfrac{1}{\epsilon_2} - 1} = \dfrac{5.67 \times 10^{-8}\left(1000^4 - 800^4\right)}{\dfrac{1}{0.8} + \dfrac{1}{0.5} - 1}$

$= 14878W/m^2 = 14.878kW/m^2$

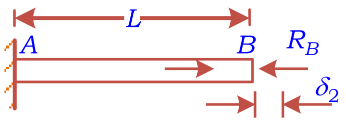
55. (D)

Consider an effect of applied load 'P' and the retain force at support B separately. When a bar AB is subjected to applied load 'P' only and is free to expand, point B is deflected by δ_1 towards right.



$\delta_1 = \dfrac{P\left(\dfrac{2L}{3}\right)}{EA}$

When a bar AB is subjected to reaction R_B only, point B is deflected by δ_2 towards left.



$\delta_2 = \dfrac{RI_B}{EA}$

The net deflection of point B is $\delta_1 - \delta_2$.

Now, the compatibility equation is,

$\delta_1 - \delta_2 = \delta$

$\therefore \dfrac{2PL}{3EA} - \dfrac{R_B L}{EA} = \delta \quad .... (1)$

$P = R_A + R_B$

Reactions must be equal.

$\therefore R_A = R_B,\ P = 2R_B,\ R_B = \dfrac{P}{2}$

Substitute for R_B in equation (1)

$\dfrac{2PL}{3EA} - \dfrac{PL}{2EA} = \delta \qquad \therefore \delta = \dfrac{PL}{6EA}$

56. (B)

Option (B) is the correct option. The use of "(,)" after the word to be filled indicates that the word has to be something to with RIGIDITY or DOGMATIC. The speaker is becoming arrogant and trying to justify the stand taken by him/her.

57. (D)

Option (D) is the correct option. The meaning of the word OUTLANDISH is <u>strange or</u> <u>unconventional or not traditional</u>. CONVENTIONAL is the opposite of this word.

58. (18)

A careful look will tell you that each subsequent term is made by multiplying the digits of the number i.e. 77 is followed by $7 \times 7 = 49$ which is followed by $4 \times 9 = 36$ and that leads us to the next number being $3 \times 6 = 18$.

59. (B)

Initial content of milk = 100 litres

When 20% of milk is removed and replaced by water, the existing milk content is 80% of initial content. When this replacement process is done 2 more times, the milk always becomes 80% of previous milk content.

Remaining milk content

$= 100 \times \dfrac{80}{100} \times \dfrac{80}{100} \times \dfrac{80}{100} = 51.2 \text{ litres}$

60. (19)

$N = 15! - 13! = 13!(15 \times 14 - 1) = 13! \times (210 - 1)$

$= 13! \times 209 = 13! \times 11 \times 19$ giving 19 as the highest prime divisor of N.

61. (C)

The trains starts at 6:00 AM, 7:00 AM, 8:00AM… from both the statins

Mumbai —— Pune

The trains reach at 10:30 AM, 11:30 AM, 12:30 PM

The train which starts at 12 PM from Mumbai will reach the Pune by 4:30 PM. This train first meets a train moving towards Mumbai to reach the destination by 12:30 PM, which started in Pune at 8:00 AM.

The train crosses the trains which starts from Pune between 8:00 AM and 4:30 PM.

$\Rightarrow$ Total number of trains is 9.

62. (C)

Let a and b be the work done by a man and a woman in one day respectively

$6a + 8b = \dfrac{1}{10} \ldots \text{(i)}$

Also, $26a + 48b = \dfrac{1}{2} \ldots \text{(ii)}$

From (i) and (ii) we have, $a = \dfrac{1}{100}$ and $b = \dfrac{1}{200}$

So, work done by 15 men and 20 women in one day $= \left(\dfrac{15}{100}\right) + \left(\dfrac{20}{200}\right) = \dfrac{1}{4}$

$\therefore$ Required time = 4 days.

63. (480)

Let the number of students in group A	$6x$	$8x$	$10x$
The number of students in group B	$9x$	$12x$	$15x$

$15x - 10x = 40 \Rightarrow x = 8$

Total number of students

$= (6 + 8 + 10 + 9 + 12 + 15) \times 8 = 480$

64. (B)

Given, $3^a = 4$, means $4^b = \left(3^a\right)^b = 3^{ab}$; likewise keep replacing successive values.

We will end up getting $3^{abcdef} = 9 = 2^2$ or $abcdef = 2$.

65. (12)

The angle traversed by hour hand

$= 6 \times 30° + 15° = 195°$

The angle traversed by minute hand

$= 6 \times 360° + 180° = 2340° \Rightarrow \text{Ratio} = \dfrac{2340}{195} = 12$

•••◈•••