ANSWER KEY

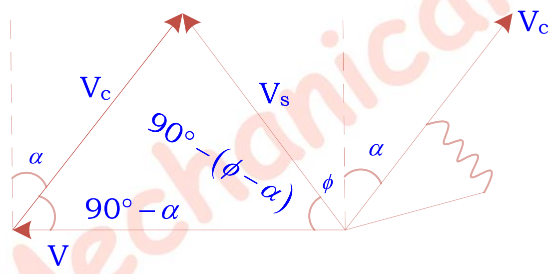
1.	(D)	13.	(63–64)	25.	(A)	37.	(200)	49.	(B)	61.	(120)
2.	(C)	14.	(A)	26.	(3910 – 3940)	38.	(0.75)	50.	(2.3–2.5)	62.	(D)
3.	(C)	15.	(0.075-0.081)	27.	(D)	39.	(4)	51.	(2.8-3.0)	63.	(A)
4.	(D)	16.	(A)	28.	(D)	40.	(479.42)	52.	(1168-1170)	64.	(B)
5.	(4.98 – 5.00)	17.	(387-391)	29.	(D)	41.	(B)	53.	(784-786)	65.	(B)
6.	(B)	18.	(B)	30.	(A)	42.	(55)	54.	(B)		
7.	(A)	19.	(D)	31.	(375-379)	43.	(1.485 – 1.495)	55.	(D)		
8.	(20547–20548)	20.	(B)	32.	(D)	44.	(1.398 – 1.418)	56.	(D)		
9.	(A)	21.	(D)	33.	(D)	45.	(C)	57.	(B)		
10.	(A)	22.	(C)	34.	(4470-4475)	46.	(254-258)	58.	(B)		
11.	(A)	23.	(D)	35.	(5.1-5.3)	47.	(C)	59.	(D)		
12.	(B)	24.	(A)	36.	(4.35-4.60)	48.	(B)	60.	(D)		

SOLUTIONS

1. **(D)**
Precipitation hardening is also known as age hardening and is found most important strengthening mechanism for non-ferrous alloys.

2. **(C)**
Velocities in metal cutting, by applying sine rule,

$$\frac{V}{\cos(\phi-\alpha)} = \frac{V_c}{\sin\phi} = \frac{V_s}{\cos\alpha}$$



3. **(C)**

Compression ratio, $r_k = \frac{V_1}{V_2}$

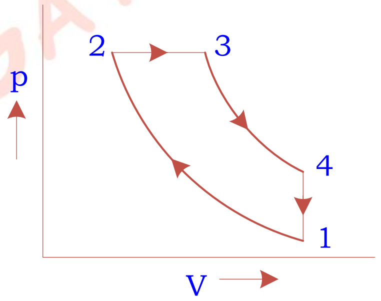
Expansion ratio, $r_e = \frac{V_4}{V_3} = \frac{V_1}{V_3} (\because V_1 = V_4)$

Cut-off ratio, $r_c = \frac{V_3}{V_2}$

$\therefore r_k = r_e \times r_c$

$14 = 7 \times r_c$

$\therefore r_c = 2$



4. **(D)**
Continuity equation is based on the principle of conservation of mass.

5. **[4.995(4.98–5.00)]**

$$V_{max} = \frac{3}{2} V_{mean}$$

$$\therefore V_{max} = \frac{3}{2} \times 3.33 = 4.995 m/s$$

6. **(B)**
The Peclet number is dimensionless number used in calculations involving convective heat transfer. It is the ratio of the thermal energy convected to the fluid to the thermal energy conducted within the fluid. Peclet number is the ratio of heat flow rate by convection to heat flow rate by conduction under a unit temperature gradient and through thickness l.

$$Q_{conv.} = mC_p\Delta T = [\rho AV]C_p\Delta T$$

$$Q_{cond.} = \frac{kA\Delta T}{l}$$

$$Pe = \frac{Q_{conv}}{Q_{cond}} = \frac{[\rho A\Delta]C_p}{kA/l} = \frac{\rho C_p}{k} lV = \frac{lV}{\alpha}$$

7. **(A)**

8. **[20547.72(20547.00–20548.00)]**

Given:
$D = 400;\ C = ₹50;\ C_0 = ₹75;\ Ch = 0.1 \times 50 = 5$ per wek

Total cost $= D \times C + \sqrt{2 \times D \times C_0 \times C_h}$

$= 400 \times 50 + \sqrt{2 \times 400 \times 75 \times 5} = ₹20547.72$

9. (A)

$$(COP)_{max} = \frac{(-7+273)}{(273+25)-(273-7)} = 8.31$$

Minimum power required $= \dfrac{80/60}{8.31} = 0.16kW$

Irreversibility = Actual power – Minimum power
$= 0.5 - 0.16 = 0.34kW$

10. (A)

Using conservation of mass,
$Vt_0 = V_c t_c$

$$\therefore V_c = \frac{Vt_0}{t_c} = 10 \times \frac{1}{1.5} = 6.67m/s$$

11. (A)

12. (B)

13. [63(63.0–64.0)]

Maximum possible reduction in Ideal condition:

$$\frac{\sigma_2}{\sigma_1} = 1 = \ln\left(\frac{A_0}{A_1}\right)$$

$$\therefore \frac{A_0}{A_1} = e^1 = 2.72 = K$$

$$J = 1 - \frac{A_1}{A_0} = \left(1 - \frac{1}{2.72}\right) \times 100 = 63.23\% \approx 63\%$$

14. (A)

$\lambda = 3\,\text{day}^{-1}$

$\mu = 6\,\text{day}^{-1}$

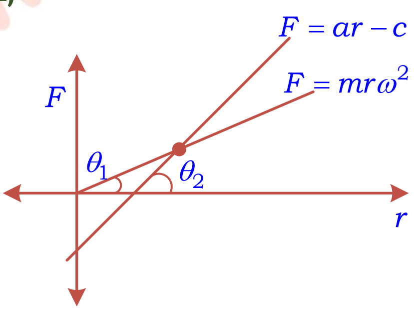
$$P_n = \left(1 - \frac{\lambda}{\mu}\right)\left(\frac{\lambda}{\mu}\right)^n$$

$$= \left(1 - \frac{3}{6}\right)\left(\frac{3}{6}\right)^2 = 0.125$$

15. [0.079(0.075–0.081)]

$F_d = \pi D t \sigma_y$
$= \pi \times 30 \times 1.5 \times 560$
$= 0.079MN$

16. (A)



For a stable governor $\dfrac{dF}{dr} > m\omega^2$

From graph we can conclude
$\theta_2 > \theta_1$

$$\therefore \frac{dF}{dr} > m\omega^2$$

$\therefore$ It is a stable governor

17. [389(387–391)]

For maximum work output

$T_2 = \sqrt{T_1 T_3}$

$= \sqrt{(273+1200)(273+25)}$

$= 662.5K = 389°C$

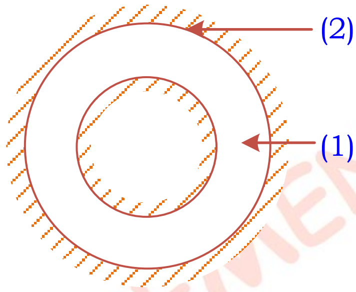
18. (B)

For both principal stresses having opposite nature in a plane stress condition, Tresca's theory i.e. maximum shear stress theory is the most conservative theory.

19. (D)

$F_{1-2} = 1$ (from the geometry)

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



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

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

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

$$F_{2-1} = \frac{4\pi r_1^2}{4\pi r_2^2}$$

$$F_{2-1} = \frac{d_1^2}{d_2^2}$$

Using Summation rule,

$F_{2-1} + F_{2-2} = 1$

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

$$F_{2-2} = 1 - \frac{d_1^2}{d_2^2}$$

$$F_{2-2} = 1 - \left(\frac{d_1}{d_2}\right)^2$$

20. (B)

$$\text{Prob. (sum 5)} = \frac{4}{36} = \frac{1}{9} \qquad P(\text{sum is not 5}) = \frac{32}{36}$$

$$\text{Prob. (sum 7)} = \frac{6}{36} = \frac{1}{6} \qquad P(\text{sum is not 7}) = \frac{30}{36}$$

$$\text{Prob. (sum is either 5 nor 7)} = 1 - \frac{4}{36} - \frac{6}{36} = \frac{26}{36}$$

$\therefore$ Prob.

$$(\text{5 comes before 7}) = (\text{5 comes}) + \begin{bmatrix}\text{Neither 5} \\ \text{nor 7}\end{bmatrix} \times [$$

$+ \ldots$

$$= \frac{4}{36} + \frac{26}{36} \times \frac{4}{36} + \frac{26}{36} \times \frac{26}{36} \times \frac{4}{36} + \ldots$$

$$= \frac{4}{36}\left[\frac{1}{1 - 26/36}\right]$$

$$= \frac{2}{36} \times \frac{36}{10} = \frac{2}{5}$$

21. (D)

Euler's buckling load, $P = \frac{\pi^2 EI}{L_e^2}$

For a column with one end fixed and one end free, $(l_e = 2L)$

$$P_1 = \frac{\pi^2 EI}{4L^2}$$

For a column with both ends fixed, $\left(l_e = L/2\right)$

$$P_2 = \frac{4\pi^2 EI}{L^2}$$

$$\frac{P_2}{P_1} = 16$$

22. (C)

For critical flow through pipe,

Re = 2000

$$\therefore \text{Re} = \frac{VD}{\nu} = \frac{V \times 0.2}{0.25 \times 10^{-4}}$$

$$\Rightarrow V = \frac{2000 \times 0.25 \times 10^{-4}}{0.2} = 0.25 m/s$$

23. (D)

24. (A)

Strain energy, $U = \frac{\tau^2}{2G} \times$ Volume of cube

$$= \frac{200^2}{2 \times 100 \times 1000} \times (50)^3 \; N - mm$$

$$= 25 Nm$$

25. (A)

Optimum pressure ratio for maximum work output

$$r_p = \left(\frac{T_{max}}{T_{min}}\right)^{\frac{\gamma}{2(\gamma-1)}} = \left(\frac{1150}{298}\right)^{\frac{1.4}{2(1.4-1)}}$$

$$r_p = 10.62$$

26. (3926.99(3910–3940))

Force due to water jet on the beam

$P = \rho AV(V - 0) = 19634.95 \; N$ (A = Area of water jet)

Now, since it is an impact load, so the stress induced will be

$$\sigma_i = \frac{2P}{A_b} = \frac{2 \times 19634.95}{10} = 3926.99 N/m^2$$

27. (D)

$$BHN = \frac{2P}{\pi D\left(D - \sqrt{D^2 - d^2}\right)}$$

where P is kg

$$\therefore BHN = \frac{2 \times 500 \times 1000}{\pi \times 100\left(100 - \sqrt{100^2 - 10^2}\right)} \times \frac{1}{9.81} = 647$$

28. (D)

Given,

$$\frac{U}{U_\infty} = \left(\frac{y}{\delta}\right)^{\frac{1}{7}}$$

$$\delta^* = \int_0^\delta \left(1 - \frac{U}{U_\infty}\right) dy = \delta - \frac{1}{\delta^{\frac{1}{7}}} \int_0^\delta y^{\frac{1}{7}} dy$$

$$\delta^* = \delta - \frac{7}{8}\delta = \frac{\delta}{8}$$

29. (D)

Speed of turbine, $N = 450 rpm$

Head, $H = 120m$

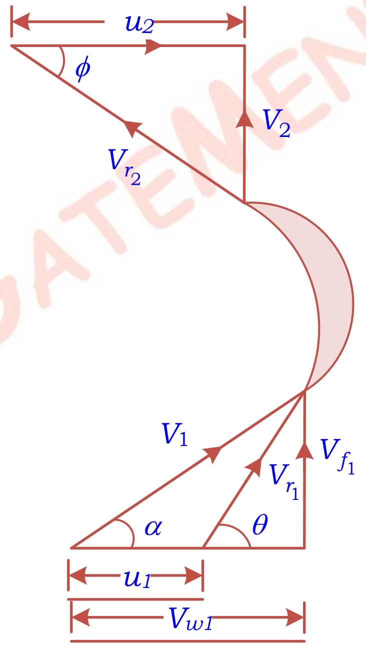
Diameter at inlet, $D_1 = 120cm = 1.2m$

$\alpha = 20°$

$\theta = 60°$

$V_{w2} = 0$

$$u_1 = \frac{\pi D_1 N}{60} = \frac{\pi \times 1.2 \times 450}{60} = 28.27 m/s$$



Now, from inlet velocity triangle,

$\Rightarrow V_{r1} \sin\theta = V_{f1}$

$\Rightarrow V_{r1} \cos\theta = V_{w1} - u_1$

Now, $\tan\theta = \frac{V_{f1}}{V_{w1} - u_1}$

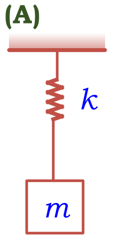
$\Rightarrow \tan\theta = \frac{V_{w1} \tan\alpha}{V_{w1} - u_1} \quad \left[\because \tan\alpha = \frac{V_{f1}}{V_{w1}}\right]$

$\Rightarrow \tan\theta = \frac{V_{w1} \tan 20°}{V_{w1} - 28.27}$

$\Rightarrow V_{w1} = 35.79 m/s$

Hydraulic efficiency, $\eta_h = \frac{V_{w1} u_1}{gH} = \frac{35.79 \times 28.27}{9.81 \times 120} = 0.8595 = 8595\%$

30. (A)



$A = \frac{mg}{k} = \frac{10 \times 10}{1000} = 0.1m = 10cm$

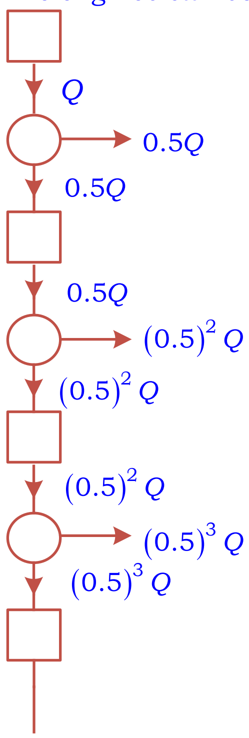
31. [376.99(375–379)]

Blanking force, $F = \tau \times \pi D t$

$\therefore F = \frac{300 \times 200 \times 2 \times \pi}{1000} = 376.99kN$

32. (D)

The engines can be seen as,



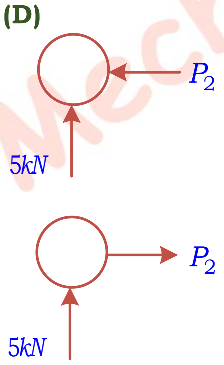
$\therefore \eta_{\text{Combined}} = \frac{\text{Total work}}{\text{Heat input}}$

$\eta_c = \frac{0.5Q + (0.5)^2 Q + \ldots (0.5)^8 Q}{Q}$

Since numerator is in $G.P.$

$\therefore \eta_c = 0.5\left[\frac{1-(0.5)^8}{1-0.5}\right] = 0.9961 = 99.61\%$

33. (D)



$P_2 \times 2r_1 = Pe$

$\therefore P_2 = \frac{Pe}{2r_1}$

$P_2 = \frac{10 \times 1000 \times 300}{2 \times 40} = 37500N$

Now, total shear force,

$F_T = \sqrt{(5000)^2 + (37500)^2}$

$F_T = 37831.86N$

$\therefore \tau_{max} = \frac{F_T}{A} = \frac{4 \times 37831.86}{\pi \times 24^2} = 83.63MPa$

So, $N = \frac{\tau_{per}}{\tau_{max}} = \frac{300}{83.63} = 3.59$

34. [4472.14(4470–4475)]

Given:

Demand, $D = 1000000$ per year

Order cost, $C_0 =$ ₹ 1500

Holding cost, $C_h =$ ₹ 150

$\Rightarrow \quad EOQ = \sqrt{\frac{2DC_0}{C_h}} = \sqrt{\frac{2 \times 1000000 \times 1500}{150}}$

$\therefore \quad EOQ = 4472.14$ units

35. [5.18(5.1–5.3)]

Projected area,

$A_p = L_p \times b = \sqrt{R \times \Delta H} \times b = \sqrt{300 \times 3} \times 120 = 3600mm^2$

Roll separating force,

$F = \sigma \times A_p = 290 \times 3600 = 1044000N$

Arm length, $a = 0.5\ L_p = 0.5 \times 30 = 15mm$

Torque per roller,

$T = F \times a = 1044000 \times 0.15Nm = 15660Nm$

$\therefore$ Total power for two roller, $P = 2T\omega$

$\Rightarrow 17 \times 1000 = 2 \times 15660 \times \omega$

$\Rightarrow \omega = \frac{17000}{2 \times 15660} = 0.543 rad/s$

$\therefore$ Rotational speed

$N = \frac{\omega \times 60}{2\pi} = \frac{0.543 \times 60}{2\pi} = 5.18rpm$

36. [4.47(4.35–4.60)]

$\vec{r} = \left(4t - \frac{t^2}{2}\right)\hat{i} + \left(3 + 6t - \frac{t^3}{6}\right)\hat{j}$

$\vec{v} = \frac{d\vec{r}}{dt} = (4-t)\hat{i} + \left(6 - \frac{t^2}{2}\right)\hat{j}$

$\vec{v}\big|_{t=2} = 2\hat{i} + 4\hat{j}$

$|\vec{v}|_{t=2} = \sqrt{2^2 + 4^2} = 4.47m/s$

37. (200)

We have, $\frac{V}{400} + \frac{I}{400} = 1$

$\Rightarrow V + I = 400 \quad \ldots(1)$

Now, $P = VI = V(400 - V) = 400V - V^2$

For maximum power,

$\frac{dP}{dV} = 0$

$\Rightarrow 400 - 2V = 0$

$\Rightarrow V = 200V$

38. (0.75)

The duct is very long and so the radiation lost out at the end of the duct can be neglected.

From the summation rule for flat surfaces 1 and 3.

$F_{12} + F_{13} = 1$

$F_{31} + F_{32} = 1$

By symmetry,

$F_{31} = F_{32}$

$\therefore F_{31} = 0.5$

Now,

$F_{13} = F_{31} \times \frac{A_3}{A_1} = 0.5 \times \frac{l \times 2}{l \times 4} = 0.25$

$F_{12} = 1 - F_{13} = 1 - 0.25 = 0.75$

39. (4)

For given fin,

Perimeter, $P = 4 \times 0.5 = 2mm = 2 \times 10^{-3} m$

Area, $A_c = 0.5 \times 0.5 = 0.25mm^2 = 0.25 \times 10^{-6} m^2$

$m = \sqrt{\frac{hP}{kA_c}} = \sqrt{\frac{45 \times 2 \times 10^{-3}}{690 \times 0.25 \times 10^{-6}}} = 22.84m^{-1}$

$Q_{fin} = kA_C m[t_0 - t_a] \tanh ml$

$= 690 \times 0.25 \times 10^{-6} \times 22.84(75-30)\tanh[22.84 \times 0.01a]$

$= 39.77 \times 10^{-3} kJ/hr$ per fin

Number of fins

$= \frac{Q}{Q_{\text{per fin}}} = \frac{0.159}{39.77 \times 10^{-3}} = 3.998 \simeq 4$

40. [479.42(478.80–480.8)]

$F_S = F_c \cos\phi - F_t \sin\phi$

$\therefore F_S = 900\cos 30° - 600 \sin 30°$

$= 479.42N$

41. (B)

Given:

$D_i = 15mm;\ D_f = 13.4mm;\ \sigma_0 = 400MPa$

$\sigma_d = \sigma_0 \ln\left(\frac{A_i}{A_f}\right) = 2 \times \sigma_0 \ln\left(\frac{D_i}{D_f}\right)$

$= 2 \times 40 \times \ln\left(\frac{15}{13.4}\right) = 90.23MPa$

Ideal drawing force $= \sigma_d \times A_{fa}$

$= 90.23 \times \frac{\pi}{4} \times d_f^2 = 90.23 \times \frac{\pi}{4} \times (13.4)^2 = 12.724kN$

42. (55)

Bend allowance $= \alpha(R + kt)$

$\alpha =$ Bend angle (in Radian)

$= 0.33$ where, $R < 2t$

$= 0.50$ where, $R > 2t$

$\therefore$ Bend allowance $= 1 \times (50 + 0.5 \times 10) = 55mm$

43. [1.491(1.485–1.495)]

$h_A = \frac{f_A}{\tan 45° + \cot 10°}$

and $h_B = \frac{f_B}{\tan 15° + \cot 12°}$

$\therefore \frac{h_A}{h_B} = \frac{f_A}{f_B} \times \left(\frac{\tan 15° + \cot 12°}{\tan 45° + \cot 10°}\right)$

$\Rightarrow \frac{h_A}{h_B} = 2 \times \left(\frac{4.9726}{6.6713}\right) = 1.491$

44. [1.409(1.398–1.418)]

$\frac{100}{\rho_{eq}} = \sum\left(\frac{x_i}{\rho_i}\right) = \frac{70}{8.9} + \frac{20}{7.19} + \frac{5}{7.86} + \frac{5}{4.51}$

$\Rightarrow \rho_{eq} = 8.069 g/cm^3$

Also

$\frac{100}{E_{eq}} = \sum\left(\frac{x_i v_i}{A_i}\right) = \frac{70 \times 2}{58.71} + \frac{20 \times 2}{51.99} + \frac{5 \times 2}{55.85} + \frac{5 \times 3}{47.9}$

$\Rightarrow E_{eq} = 27.426$

Now, Rate of dissolution

$= \frac{E_{eq} I}{\rho_{eq} F(\text{Area})} = \left(\frac{27.426 \times 1000}{8.069 \times 96500 \times 1500}\right) \times 1000$

$= 0.023mm/\sec = 1.409mm/\min$

45. (C)

$N = 4, j = 3, h = 1$

$F = 3(N-1) - 2j - h$

$= 3(4-1) - 2 \times 3 - 1 = 2$

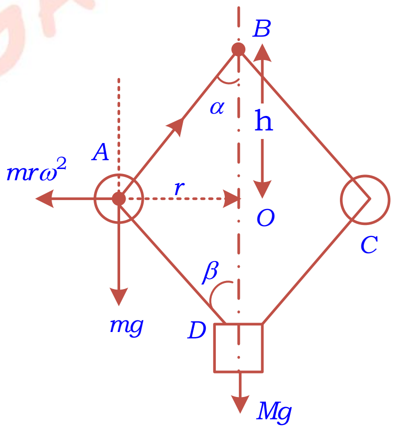
46. [256.12(254–258)]

Since the links are equal and form parallelogram in all positions, the upper and lower arms have to be pivoted on the axis of rotation and links form a Rhombus whose diagonals intersect at right angles.

Since arms are equal, $\alpha = \beta \Rightarrow k = \frac{\tan\beta}{\tan\alpha} = 1$

$m = 2kg, M = 20kg, r = 200mm$

$h = \sqrt{250^2 - 200^2} = 150mm = 0.15m$



$h = \frac{g}{\omega^2}\left(\frac{m+M}{m}\right)$

$\omega^2 = \frac{9.81}{0.15}\left(\frac{2+20}{2}\right)$

$\omega = 26.82 rad/\sec$

$N = \frac{26.82 \times 60}{2\pi} = 256.12rpm$

47. (C)

$m\ddot{x}R + \frac{MR^2}{2}\ddot{\theta} + ka^2\theta = 0$ (Take moment about O)

$x = R\theta$

$\ddot{x} = R\ddot{\theta}$

$\Rightarrow mR^2\ddot{\theta} + \frac{MR^2\ddot{\theta}}{2} + ka^2\theta = 0$

$\omega_n = \sqrt{\frac{k_{eq}}{m_{eq}}} = \sqrt{\frac{ka^2}{mR^2 + \frac{MR^2}{2}}}$

$$= \sqrt{\frac{100 \times 0.1^2}{0.5 \times 0.2^2 + \frac{1 \times 0.2^2}{2}}} = 5rad/\sec$$

$$\Rightarrow f = \frac{5}{2\pi} = 0.8Hz$$

48. (B)
Otto cycle consists of two isochoric and two isentropic processes.

49. (B)
Given data,
Limiting drawing ratio = 2
Cup diameter $(d) = 30mm$
Height $(h) = 60mm$

Blank diameter $D = \sqrt{d^2 + 4dh}$

$= \sqrt{30^2 + 4 \times 30 \times 60} = 90mm$

$\beta_{\max} = 2$

Draw ratio $(DR) = \frac{\text{Dia before}}{\text{Dia after}}$

$$DR = \frac{D}{d_1} \Rightarrow d_1 = \frac{D}{DR}$$

$$d_1 = \frac{90}{2} = 45$$

$d_1 \le d$ Condition not satisfied

$$d_2 = \frac{d_2}{DR}$$

$$d_2 = \frac{45}{2} = 22.5 < 30mm$$

$\therefore$ So, 2 operations required.

50. [2.41(2.3–2.5)]
$D = 15mm$, $t = 30mm$
$AP = 2mm$, $OR = 2mm$
$f = 0.1mm/rev$, $V = 15m/\min$
$2\beta = 120°$

$$AP_1 = \frac{D}{2\tan\beta} = \frac{15}{2 \times 1.732} = 4.33mm$$

$$N = \frac{1000 \times 15}{\pi \times 15} = 318.5rpm$$

Total length, $(L) = AP + AP_1 + OR + t$

$= 30 + 2 + 2 + 4.33 = 38.33mm$

$$\text{Time/hole} = \frac{38.33}{0.1 \times 318.5} = 1.204mm$$

$\therefore$ For two holes $= 2.41\min$

51. [2.9(2.8–3.0)]
$h = 2.5$, $\lambda = 90°$ Pure orthogonal turning operation
$r = 0.4 = 1/h$, $\alpha = 0$

$$\phi = \tan^{-1}\left(\frac{r\cos\alpha}{1 - r\sin\alpha}\right) = \tan^{-1} r = \tan^{-1}(0.4) = 21.80°$$

Shear strain $(\varepsilon) = \cot\phi + \tan(\phi - \alpha)$

$= \cot(21.80) + \tan(21.80)$

$= 2.9$

52. [1169(1168–1170)]
$f = 0.25mm = t_1$
$d = 4mm = b$
$F_c = 1600N$
$F_T = 800N$
$t_2 = 0.6$
$\alpha = 0°$

$$\tan(\beta - \alpha) = \frac{F_T}{F_C} = \mu = \frac{800}{1600} = 0.5$$

$\beta = \tan^{-1} 0.5 = 26.56°$

$$r = \frac{t_1}{t_2} = \frac{0.25}{0.6} = 0.42$$

$$\phi = \tan^{-1}\left(\frac{r\cos\alpha}{1 - r\sin\alpha}\right) = \tan^{-1}\left(\frac{0.42\cos 0}{1 - 4.2\sin 0}\right) = \tan^{-1} 0.4$$

$$F_S = \frac{F_C}{\cos(\beta - \alpha)} \times \cos(\phi + \beta - \alpha) = \frac{1600}{\cos 26.56} \times \cos 49.2$$

53. [785.4(784–786)]
Given data:
Resistance butt welding,
Shaft diameter $= 10mm$

Unit melt energy $(u) = \frac{\text{Heat required}}{\text{volume}}$

Heat required

54. (B)
Mean arrival rate $(\lambda) = 4/hr$
Mean service time $= 10\min$

Mean service rate $(\mu) = \frac{1}{10} \times 60 = 6/hr$

$$\rho = \frac{\lambda}{\mu} = \frac{4}{6}$$

$$L_s = \frac{\rho}{1 - \rho} = \frac{4/6}{1 - 4/6} = \frac{4/6}{2/6} = 2$$

$$L_p = \rho \cdot L_s = \frac{4}{6} \times 2 = 1.33$$

55. (D)
$axy^2dx + e^x y\,dx - e^x dy = 0$

$$ax\,dx + \frac{e^x ydx - e^x dy}{y^2} = 0$$

$$\int axdx + \int d\left(\frac{e^x}{y}\right) = 0$$

$$\frac{ax^2}{2} + \frac{e^x}{y} = c$$

56. (D)
Suggestion is friendly / smooth
Demand is unfriendly / Rough
Take is smooth
Grab is rough

57. (B)
Number of non-negative integral solutions $= n + r - 1_{Cr-1}$

$= 21 + 3 - 1_{c_{3-1}}$

$= 23_{C_2} = 253$

58. (B)

59. (D)
The pattern is as follows

$S \xrightarrow{-1} R \xrightarrow{-1} Q \xrightarrow{-1} P \xrightarrow{-1} O$

$H \xrightarrow{-1} I \xrightarrow{-1} J \xrightarrow{-1} K \xrightarrow{-1} L$

$G \xrightarrow{-1} F \xrightarrow{-1} E \xrightarrow{-1} D \xrightarrow{-1} C$

Hence, in the above series OLC will come in place of question mark.

60. (D)

61. [120(120–120)]

Let the initial quantity of wine $= x$ litres

$\therefore$ wine left after 3 replacements

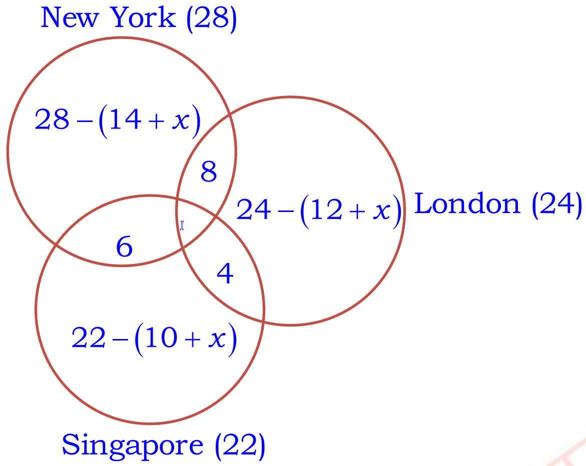
$$= \frac{343}{512} \times x = \left(\frac{x-15}{x}\right)^3 \times x$$

$$\left(\frac{7}{8}\right)^3 = \left(\frac{x-15}{x}\right)^3$$

$\therefore x = 120$ litres

62. (D)

Consider the diagram,



$\therefore$ Total business analysis = 42

$[28-(14+x)]+[22-(10+x)]+[24-(12+x)]+16(6+8+4)+x=42$

$\therefore x = 7$

$\therefore$ Number of analysts covering New York alone $= 28-(14+x)$

$= 28-(14+7) = 7$

63. (A)

80% of the total profit is divided in the ratio, $20000:24000:16000 = 5:6:4$

$\therefore$ 80% of the total profit $= 5x+6x+4x = 15x$

$\therefore$ Total profit $= \frac{15x}{80} \times 100 = 18.75x$

Share of C in profit $= 4x + 20\%$ of $18.75x = 7.75x$

Share of A and B in profit $= 6x+5x+11x$

$\therefore$ Given difference between A & B share and C share = 487.50

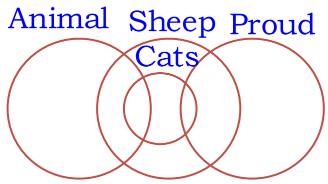
$\therefore 11x - 7.75x = 487.50$

$x = 150$

$\therefore$ Total profit $= 18.75 \times 150 = 2812.50$

64. (B)

Based on the given statements, one possible venn diagram is

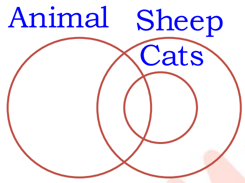


Fig(i)

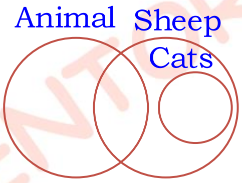
Fig. (i) indicates that conclusion (I) is wrong.

$\therefore$ Option (C) and (D) are wrong.

Based on last 2 statements, we are getting following venn diagrams.



Fig(ii)



Fig(iii)

Fig (iii) indicates that conclusion (II) is wrong and Fig (ii) indicates that conclusion (III) is wrong.

$\therefore$ Option (A) is wrong.

Based on both Fig (ii) and Fig (iii), either conclusion (II) or (III) follows.

$\therefore$ Option (B) is right.

65. (B)

Given,

edge of the cube $= 4cm$

$\therefore$ Volume of the cube $= (4)^3 = 64cm^3$

Weight of the cube of edge $4cm = 400kg$

Density of cube $= \frac{400}{64} kg/cm^3$ ...(1)

Now, weight of new cube of same metal $= 3200kg$

Let the edge of new cube be $x\,cm$

Density of cube $= \frac{3200}{x^3} kg/cm^3$ ...(2)

From equations (1) and (2), we get

$$\frac{400}{64} = \frac{3200}{x^3}$$

$$\Rightarrow x^3 = \frac{3200 \times 64}{400} \Rightarrow x^3 = 8 \times 64 = 8 \times 8 \times 8$$

$\therefore x = 8cm$

•••◈•••