ACE Engineering Academy

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ESE- 2020 (Prelims) - Offline Test Series Test - 11

MECHANICAL ENGINEERING

Subject: Engineering Mechanics and Strength of Materials + Engineering Materials — SOLUTIONS

01. Ans: (c)

Sol: Elastic limit is the point up to which the member can regain back to its original shape and size, if the load is removed.

02. Ans: (b)

03. Ans: (a)

Sol: Work done = Total area

$$= \frac{1}{2} \times [2F_o + F_o] \times 3x_o$$

$$= \frac{9F_o x_o}{2}$$

By work energy theorem,

$$\frac{9F_o x_o}{2} = \frac{1}{2} \times m \times V^2 - \frac{1}{2} \times m \times \frac{2F_o x_o}{m}$$

$$\therefore\ V = \sqrt{\frac{11F_o x_o}{m}}$$

04. Ans: (c)

Sol: The sequence of salient points in mild steel stress strain curves are

- Proportionality limit
- Yield point
- Yield plateau
- Ultimate point
- Breaking point

05. Ans: (c)

Sol: Young's modulus is the measure of stiffness of a material. More the Young's modulus, more the stiffness. The increasing order of stiffness is concrete, aluminium, cast iron, mild steel.

06. Ans: (b)

Sol: For substitutional solid solutions, the Hume-Rothery rules are as follows:

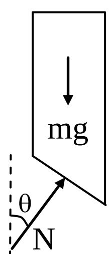
1. The atomic radius of the solute and solvent atoms must differ by no more than 15%:

$$\%\,\text{difference} = \left(\frac{r_{solute} - r_{solvent}}{r_{solvent}}\right) \times 100\% \le 15\%$$

2. The crystal structures of solute and solvent must be similar.
3. Complete solubility occurs when the solvent and solute have the same valency. A metal with lower valency is more likely to dissolve in a metal of higher valency.
4. The solute and solvent should have similar electronegativity. If the electronegativity difference is too great, the metals tend to form intermetallic compounds instead of solid solutions.

07. Ans: (b)

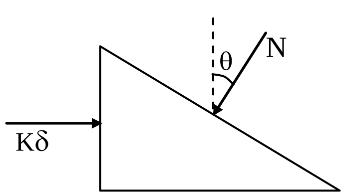
Sol: F.B.D of rod,



$N\cos\theta = mg$

$\Rightarrow N = \dfrac{mg}{\cos\theta}$

F.B.D of wedge,



$N\sin\theta = k\delta$

$\therefore \delta = \dfrac{mg\tan\theta}{k}$

Energy stored in spring

$$= \frac{1}{2}\times k\times\left(\frac{mg\tan\theta}{k}\right)^2 = \frac{m^2g^2\tan^2\theta}{2k}$$

08. Ans: (a)

Sol: Hook's law is applied to the materials having linear elastic behaviour.

09. Ans: (a)

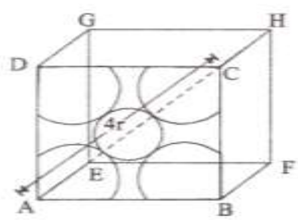
Sol: Consider the triangle ABC,

$AC^2 = AB^2 + BC^2$

$(4r)^2 = a^2 + a^2$

$16\,r^2 = 2a^2$

$r^2 = \dfrac{2a^2}{16}$



Taking square root on both sides, we have

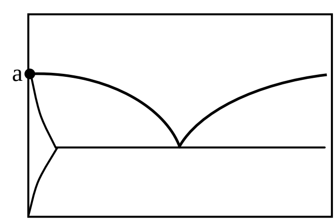
$\sqrt{r^2} = \dfrac{\sqrt{2a^2}}{\sqrt{16}}$

$\Rightarrow r = \dfrac{a\sqrt{2}}{4}$

10. Ans: (b)

11. Ans: (b)

Sol:



At point 'a' FCC iron and BCC iron coexist.

P = 2 (α - Fe, γ-Fe)

C = 2 (Fe, C)

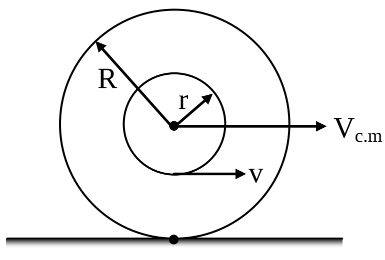
F + P = C + 1

F + 2 = 2 + 1

$\Rightarrow$ F = 1

12. Ans: (c)

Sol:



Point P is at instantaneous rest ∴ point P is I.C.R.

$$\omega = \frac{v_{c.m}}{R} = \frac{V}{R-r}$$

$$\Rightarrow V_{c.m} = \frac{VR}{R-r}$$

13. Ans: (d)

Sol: Given,

Young's modulus, E = 144 GPa,

Bulk modulus, K = 80 GPa

$$E = \frac{9KG}{3K+G}$$

$$144 = \frac{9\times 80\times G}{3\times 80+G}$$

144 × 3 × 80 + 144 G = 9×80 G

$$G = \frac{144\times 3\times 80}{(9\times 80-144)} = 60 \text{ GPa}$$

14. Ans: (a)

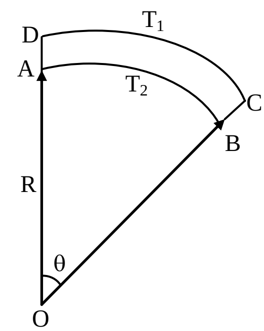
Sol: A eutectoid reaction is a three-phase reaction by which, on cooling a solid transforms into two other solid phases at the same time. If the bottom of a single-phase solid field closes (and provided the adjacent two-phase fields are solid also), it does so with an eutectoid point.

15. Ans: (b)

Sol: Maximum deflection due to temperature difference

$$\delta_{max} = \frac{\ell^2}{2R}$$

where R is radius of curvature of beam due to temperature difference.



$$AB = \ell(1+\alpha\Delta T_2)$$

$$CD = \ell(1+\alpha\Delta T_1)$$

But AB = R θ

CD = (R + d) θ

where d is depth of beam,

$$R\theta = \ell(1+\alpha\Delta T_2)$$

$$R\theta + d\theta = \ell(1+\alpha\Delta T_1)$$

$$\ell + \ell\alpha\Delta T_2 + d\theta = \ell + \ell\alpha\Delta T_1$$

$$\theta = \frac{\ell}{d}(\alpha(\Delta T_1 - \Delta T_2))$$

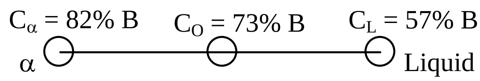
$$R\theta = \ell(1+\alpha\Delta T_2)$$

$$\frac{1}{R} = \frac{\ell\alpha(\Delta T_1-\Delta T_2)}{d(\ell+\ell\alpha\Delta T_2)} \cong \frac{\alpha(\Delta T_1-\Delta T_2)}{d}$$

$$\therefore \delta_{max} = \frac{\ell^2}{2d}\alpha(T_1 - T_2)$$

16. Ans: (a)

Sol:



$$m_L = \frac{C_o - C_\alpha}{C_L - C_\alpha}$$

$$= \frac{73-82}{57-82} = \frac{-9}{-25} = 0.36$$

17. Ans: (d)

Sol: Strain varies linearly along the depth

$$\frac{(\sigma_{max})_{wood}}{100\ \text{mm}} = \frac{\sigma_{wood}}{\frac{d}{2}\text{mm}}$$

where, σ_{wood} = bending stress in wood at a distance of d/2 mm from neutral axis.

$$\sigma_{wood} = \frac{(\sigma_{max})_{wood}}{100} \times \frac{d}{2}$$

$$= \frac{10}{100} \times \frac{d}{2} = \frac{d}{20}\text{MPa}$$

σ_{steel} = maximum stress in steel at a distance d/2 from neutral axis

σ_{steel} = Modular ratio × σ_{wood}

[∵ Strain in steel and wood is same at a distance $\frac{d}{2}$ from neutral axis]

$$200 = 25 \times \frac{d}{20}$$

∴ d = 160 mm

18. Ans: (b)

Sol: One standard procedure that is widely utilized to determine hardenability is the Jominy end-quench test.

19. Ans: (a)

Sol: $\vec{r}\Big|_{\text{at } t=2} = 4\hat{i} - 12\hat{j}$

$$\vec{V} = \frac{d\vec{r}}{dt} = 2\hat{i} - 6t\hat{j}$$

$$\vec{V}\Big|_{\text{at } t=2} = 2\hat{i} - 12\hat{j}$$

Angular momentum $= m(\vec{r} \times \vec{V})$

$$= 2[4\hat{i} - 12\hat{j}] \times [2\hat{i} - 12\hat{j}]$$

$$= -48\hat{k}$$

20. Ans: (b)

Sol: M_B = total area of shear force diagram upto section-B

$$= 40 \times 0.5 + \frac{40 \times 0.5}{2} = 30\ \text{N.m}$$

21. Ans: (a)

Sol: The presence of alloying elements (other than carbon) causes a much more gradual decrease in hardness with position from the quenched end for a hardenability curve. The reason for this effect is that alloying elements retard the formation of pearlitic and bainitic structures which are not as hard as martensite.

22. Ans: (b)

Sol: Strain energy,

$$U = \frac{1}{2} P\delta$$

$$= \frac{1}{2} P \frac{P\ell}{EA_{eq}}$$

$$= \frac{P^2\ell}{2EA_{eq}}$$

For linearly tapering bar,

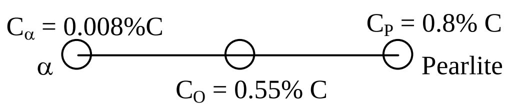
$$A_{eq} = \sqrt{A_1 A_2}$$

$$= \sqrt{4A_2\ A_2} = 2A_2$$

$$U = \frac{P^2\ell}{4EA_2}$$

23. Ans: (c)

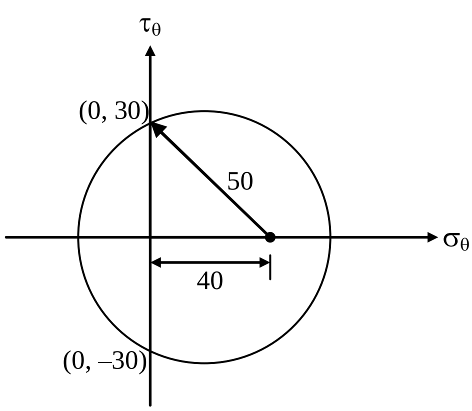
Sol:



$$m_{Pearlite} = \frac{C_o - C_\alpha}{C_p - C_\alpha} = \frac{0.55 - 0.008}{0.8 - 0.008} = 0.634$$

24. Ans: (b)

Sol:



$\sigma_1 = 40 + 50 = 90$

$\sigma_2 = 40 - 50 = -10$

25. Ans: (b)

Sol: $$\omega_{PQ} = \frac{6\sin 30 + 8\sin 30}{5}$$

$$= \frac{3+4}{5} = \frac{7}{5} \text{rad/s}$$

26. Ans: (c)

Sol: Annealing is a widely used heat-treatment process which involves heating the material to the *austenitic* temperature and subsequently cooling it very slowly in a way similar to that of the cooling line A in figure below.

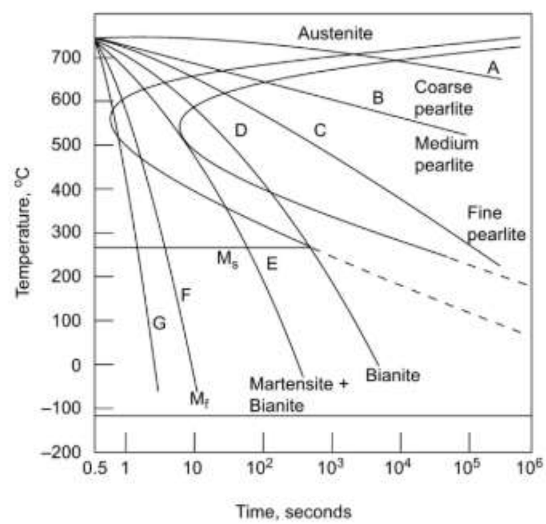


Fig: Effect of cooling rates on the final structure of eutectoid steel

27. Ans: (b)

Sol: Given data,

$\sigma_\theta = 80$ MPa, $\theta = 45°$

$\tau_\theta = -30$ MPa, $\tau_{xy} = -40$ MPa

$$\tau_\theta = \frac{\sigma_x - \sigma_y}{2}\sin 2\theta - \tau_{xy}\cos 2\theta$$

when $\theta = 45° \Rightarrow 30 = \frac{\sigma_x - \sigma_y}{2}$

$\sigma_x - \sigma_y = 60$ -----(1)

$$\tau_\theta = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos 2\theta + \tau_{xy}\sin 2\theta$$

Here, $\theta = 45°$ and $\tau_{xy} = -40$

$\sigma_x + \sigma_y = 240$ -----(2)

Solving (1) and (2)

$\sigma_x = 150$ MPa

$\sigma_y = 90$ MPa

28. Ans: (d)

Sol:

- Speed will remain constant because tension force will be always perpendicular to velocity.
- $T = \frac{mv^2}{r}$

As $r\downarrow \;\; \therefore T\uparrow$

29. Ans: (d)

Sol: Alloying elements in steels such as *aluminum, chromium, vanadium and molybdenum* would from very hard nitrides when they come in contact with nitrogen. This is made use of in the process of nitriding where alloy steels are case hardened without any quenching process.

30. Ans: (a)

Sol: $\varepsilon_{max} = \frac{\sigma_{max}}{E}$

$$= \frac{6 \times m}{E \times b \times d^2}$$

$$= \frac{6 \times 85 \times 10^3}{200 \times 10^3 \times 30 \times 50^2} = 34\mu$$

31. Ans: (d)

Sol: Fore = Rate of change of linear momentum.

Mass of any time t = M + σt

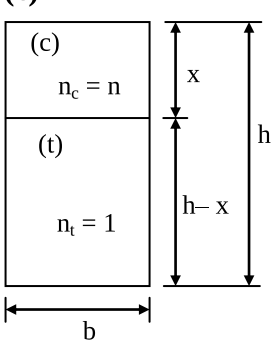
$$\text{Force} = \frac{d}{dt}[(M + \sigma t)v] = \sigma v$$

32. Ans: (a)

Sol: Higher carbon content in steel, increases strength and decreases percentage elongation.

33. Ans: (c)

Sol:



Use E_t as the reference modulus.

Then $E_c = n\,E_t$

Locate neutral axis

$$nb\times\frac{x}{2}-b(h-x)\frac{h-x}{2}=0$$

$$nx^2-(h-x)^2=0$$

$$\sqrt{n}x=(h-x)$$

$$x=\frac{h}{\sqrt{n}+1}$$

$$h-x=\frac{\sqrt{n}\,h}{\sqrt{n}+1}$$

$$I_{trans}=\frac{n}{3}bx^3+\frac{1}{3}b(h-x)^3$$

$$=\left[\frac{n}{3}\left(\frac{1}{\sqrt{n}+1}\right)^3+\left(\frac{\sqrt{n}}{\sqrt{n}+1}\right)^3\right]bh^3$$

$$=\frac{1}{3}\frac{n+n^{3/2}}{\left(\sqrt{n}+1\right)^3}bh^3$$

$$=\frac{1}{3}\frac{n\left(1+\sqrt{n}\right)}{\left(\sqrt{n}+1\right)^3}bh^3\quad=\frac{1}{3}\frac{n}{\left(\sqrt{n}+1\right)^3}bh^3$$

$$\frac{1}{\rho}=\frac{M}{E_t\,I_{trans}}=\frac{M}{E_rI}\qquad[\text{where, } I=\frac{1}{12}bh^3]$$

$E_r\,I = E_t\,I_{trans}$

$$E_r=\frac{E_t\;I_{trans}}{I}$$

$$=\frac{12}{bh^3}\times E_t\times\frac{n}{3\left(\sqrt{n}+1\right)^2}bh^3$$

$$=\frac{4E_t\;E_c/E_t}{\left(\sqrt{E_c/E_t}+1\right)^2}\quad=\frac{4E_tE_c}{\left(\sqrt{E_c}+\sqrt{E_t}\right)^2}$$

34. Ans: (c)

Sol: In steels, manganese enhances strength, stiffness, hardness, toughness, hardenability, wear resistance as well as forging and rolling qualities.

35. Ans: (c)

Sol: Maximum eccentricity = $\dfrac{I}{A\times y_{max}}$

$$I=\frac{a^4}{12}$$

$$A=a^2$$

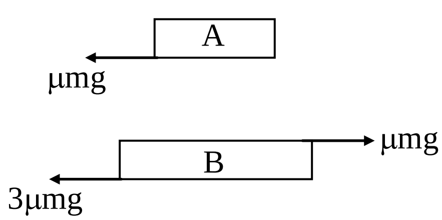
$$y_{max}=\frac{a}{\sqrt{2}}$$

$$e_{max}=\frac{a^4/12}{a^2\times\dfrac{a}{\sqrt{2}}}$$

$$=\frac{a}{6\sqrt{2}}$$

36. Ans: (c)

Sol: F.B.D of A & B are shown below



$$\vec{a}_A=-\mu g\hat{i}$$

$$\vec{a}_B=-2\mu g\hat{i}$$

$$\vec{a}_{AB}=\vec{a}_A-\vec{a}_B$$

$$=-\mu g\hat{i}+2\mu g\hat{i}=\mu g\hat{i}$$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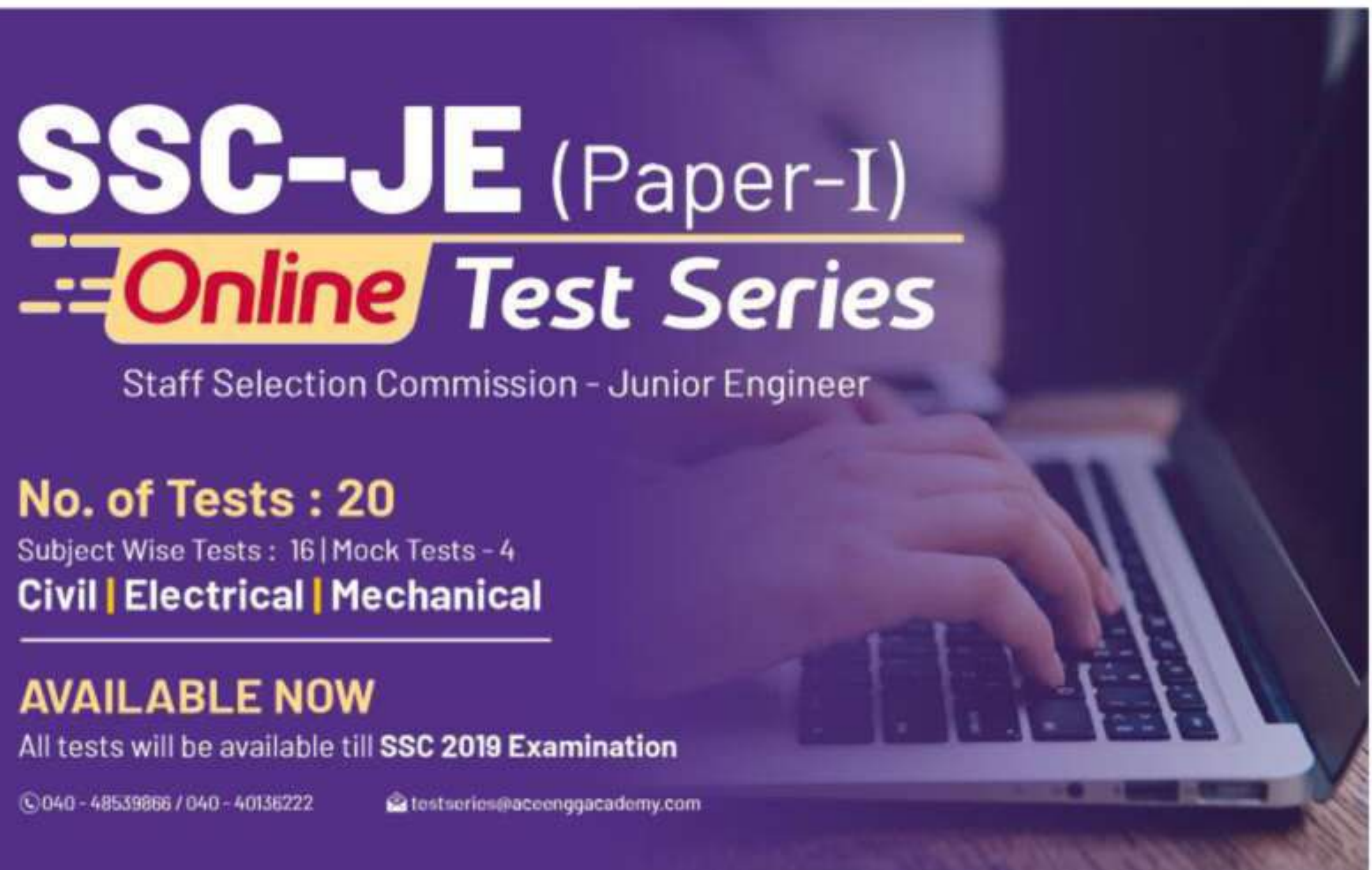
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37. Ans: (c)

Sol: High carbon steel has higher hardness, ultimate strength and yield strength but it has less ductility.

38. Ans: (c)

Sol: $M_{max} = \frac{1}{2} w_o L \times \frac{L}{3} = \frac{w_o \ell^2}{6}$

$$\sigma_{max} = \frac{6\,M_{max}}{b\,h_o^2} = \frac{w_o \ell^2}{b \times h_o^2}$$

$$\sigma_x = \frac{6M_x}{b \times h^2} = \frac{w(x)x^2}{b \times h^2}$$

$$= \frac{w_o \frac{x}{\ell} \times x^2}{b \times h^2} = \frac{w_o\,x^3}{\ell \times b \times h^2}$$

For a beam of uniform strength,

$$\sigma_{max} = \sigma_x$$

$$\frac{w_o \ell^2}{b h_o^2} = \frac{w_o\,x^3}{\ell \times b \times h^2}$$

$$h^2 = h_o^2 \times \frac{x^3}{\ell^3}$$

$$h = h_o \left(\frac{x}{\ell}\right)^{3/2}$$

39. Ans: (b)

Sol: Extrusion can be used to process most thermoplastics such as polyethylene, polypropylene, polyurethane, polystyrene, polymide, polyester and flexible poly vinyl chloride.

40. Ans: (d)

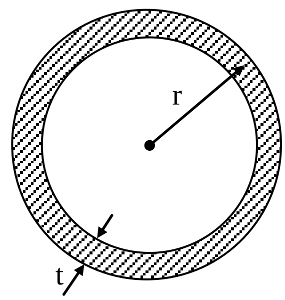
Sol: $A = 2\pi rt$

$J = 2\pi\, r^3\, t$

$I = \pi\, r^3\, t$

$b = 2\,t$

$$\tau_{max} = \frac{VQ}{I\,b}$$



$$= \frac{V\left(\frac{2\pi rt}{2} \times \frac{2r}{\pi}\right)}{\pi\, r^3\, t \times 2t}$$

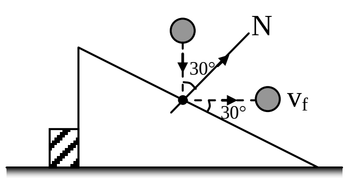
$$= 2\frac{V}{2\pi rt}$$

$$= 2\frac{V}{A}$$

$\therefore$ k = 2

41. Ans: (b)

Sol:



Linear momentum of body will remain conserved along the incline.

$\therefore$ 3sin30 = $v_f$cos30

v_f = 3tan30 = $\sqrt{3}$ m/s

$$v_f = \sqrt{3}\,m/s$$

42. Ans: (d)

Sol: *Glass Fiber–Reinforced Polymer (GFRP) Composites: Fiberglass is simply a* *composite consisting of glass fibers, either continuous or discontinuous,* contained within a polymer matrix; this type of composite is produced in the largest quantities. The composition of the glass that is most commonly drawn into fibers (sometimes referred to as E-glass); fiber diameters normally range between 3 and 20μm. Glass is popular as a fiber reinforcement material for several reasons:

- It is easily drawn into high-strength fibers from the molten state.
- It is readily available and may be fabricated into a glass-reinforced plastic economically using a wide variety of composite-manufacturing techniques.
- As a fiber it is relatively strong, and when embedded in a plastic matrix, it produces a composite having a very high specific strength.
- When coupled with the various plastics, it possesses a chemical inertness that renders the composite useful in a variety of corrosive environments.

43. Ans: (d)

Sol: Stress comes into play only when the component experiences deformation in the direction of load.

Here, as the cylinder is in vertical position, total load is acting on one end only ($\because$ partially filled)

Deformation is experienced only when the equal and opposite loads are acting on the member.

As there is no deformation in longitudinal direction,

$$\sigma_{\text{longitudinal}} = 0$$

$$\therefore \quad \frac{\sigma_{\text{longitudinal}}}{\tau_{\max}} = 0$$

44. Ans: (c)

Sol: $\omega = \frac{v}{r}$

$$\alpha = \frac{d\omega}{dt} = -\frac{v}{r^2}\frac{dr}{dt} \text{ -------------(1)}$$

Now, $\frac{dr}{dt}$ is rate of change of radius w.r.t time.

$$\text{Time for one revolution} = \frac{\theta}{\omega} = \frac{2\pi}{\frac{v}{r}} = \frac{2\pi r}{v}$$

In one revolution radius reduces by b

$$\therefore \frac{dr}{dt} = \frac{b}{\frac{2\pi r}{v}} = \frac{bv}{2\pi r}$$

Putting this in equation (1), we get

$$\alpha = -\frac{v}{r^2}\frac{bv}{2\pi r} = -\frac{v^2 b}{2\pi r^3}$$

45. Ans: (a)

Sol: It is a *terpolymer* (consisting of three polymers) of Acrylonitrile, Butadiene and Styrene called ABS. The butadiene chain in this terpolymer is grafted to the side of the acrylonitrile-styrene chain. This is a very important engineering thermoplastic and finds wide use in industry. It has *excellent toughness and very good formability*. This material is suitable because of this reason to most of the plastic-processing methods such as thermoforming and moulding.

46. Ans: (c)

Sol:

- Thin cylinders are designed to carry internal pressures.
- Due to hoop stresses crack propagation takes place among longitudinal direction.
- Variation of stresses in thickness of cylinders is hyperbolic.

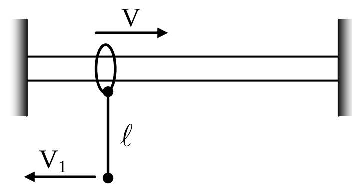
47. Ans: (b)

Sol: Top - down techniques like Ball - milling (Reducing a bulk material to nano - size) is a slow process and is not conducive to large scale production.

Bottom - up techniques like Chemical Vapour Deposition (CVD), PVD process are fast.

48. Ans: (c)

Sol:



From conservation of linear momentum,

$mV = 2\,mV_1$

$\therefore\; V = 2\,V_1$ -------(i)

By conservation of mechanical energy,

$$\frac{1}{2}mV^2 + \frac{1}{2}2mV_1^2 = 2mg\ell$$

$V^2 + 2V_1^2 = 4g\ell$ ------(ii)

From (i) and (ii)

$$V_1 = \sqrt{\frac{2g\ell}{3}}$$

49. Ans: (b)

Sol: Properties of polytetrafluoroethylene are :

- High chemical resistances
- Low and high temperature capability
- Resistance to weathering, low friction
- Electrical and thermal insulator
- It is non-hygroscopic

50. Ans: (d)

Sol: $\frac{\tau}{r} = \frac{T}{J} = \frac{G\theta}{L}$

$\tau = \left(\frac{G\theta}{L}\right)r$ ------(1)

$$\gamma = \frac{\tau}{G} = \left(\frac{\theta}{L}\right).r \text{ ----(2)}$$

The angle of twist for hollow and solid shaft remains same.

Hence, from equation (2) shear strain varies linearly and slope must be same for both materials. However, from equation (1) it can be concluded that as at interface G value is suddenly decreasing, τ should decrease suddenly.

51. Ans: (c)

Sol: Let the cart recoil backward with velocity = v.

$\therefore$ Velocity of bullet in horizontal direction $= u\cos\theta - v$

$\therefore$ By using linear momentum conservation in horizontal direction,

$$m(u\cos\theta - v) = Mv$$

$$\therefore\ v = \frac{mu\cos\theta}{m+M}$$

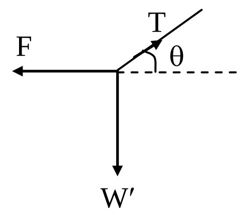
52. Ans: (a)

Sol: The properties of carbon nanotubes are

- High electrical conductivity
- Very high tensile strength
- High thermal conductivity
- Low thermal expansion coefficient

53. Ans: (b)

Sol:



Let the weight of block A is W′

$$\frac{W'}{\sin(180-\theta)} = \frac{F_{max}}{\sin(90+\theta)}$$

$F_{max} = \mu W$

$$\frac{W'}{\sin\theta} = \frac{\mu W}{\cos\theta}$$

$W' = \mu W \tan\theta$

54. Ans: (c)

Sol: Low electrical conductivity and continuous oxide film on surface increase oxidation resistance.

55. Ans: (c)

Sol:

- Angular momentum = $m(\vec{r}\times\vec{V})$. If the point is on the straight line then, $(\vec{r}\times\vec{V})$ = 0.
- If the point is not on the same straight line then, $(\vec{r}\times\vec{V}) \neq 0$.
- Since, no external torque is applied, So angular momentum about any given point remains constant.

56. Ans: (b)

Sol: Chromium, nickel, silicon and aluminium alloying elements are added to iron to improve its oxidation resistance.

57. Ans: (b)

Sol: By using equation of motion during two second before it reaches the maximum height

$v = u + at$

$v = 0$

$a = -g$

$t = 2$ sec

$\Rightarrow 0 = u - gt$

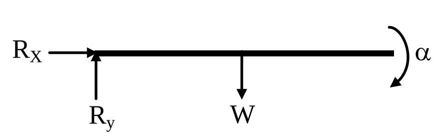
$\Rightarrow u = g \times 2 = 20$ m/s

58. Ans: (a)

Sol: In shore scleroscope the hardness is measured based on the amount rebounding of the ball when it is dropped on the material. This is generally used for measurement of hardness of very soft materials like rubber.

59. Ans: (A)

Sol: When the force 'F' is removed, then the F.B.D of rod is shown below:



We know that,

Force along any direction = Mass × Component of acceleration of centre of mass along that direction

$\therefore \quad R_x = m \times \frac{\omega^2 L}{2} = 0$ [since, just after removal of force F the angular velocity of rod is zero]

60. Ans: (c)

Sol: Yield strength of material depends on crystal defects.

61. Ans: (a)

Sol: Instantaneous axis of rotation lies above the centre of mass where $v - \omega r = 0$

$$\Rightarrow r = \frac{v}{\omega} = \frac{6v_o}{\frac{2v_o}{R}} = 3R$$

62. Ans: (b)

Sol: The density of Carbon fiber reinforced plastics (CFRP) is less than the glass fiber reinforced plastics (GFRP), hence the CFRP is most common.

63. Ans: (a)

Sol: Work done = $\frac{1}{2} K x_f^2 - \frac{1}{2} K x_i^2$

$$= \frac{1}{2} \times 100 \times (0.2^2 - 0.1^2)$$

$$= \frac{1}{2} \times 100 \times 0.3 \times 0.1$$

$$= 1.5 \text{ Nm}$$

64. Ans: (d)

Sol: Cubic structured metals will have high ductility hence they can be plastically deformed easily.

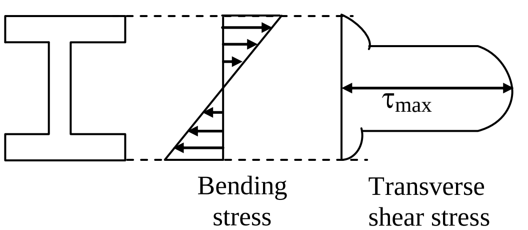
65. Ans: (d)

66. Ans: (d)

Sol: An Isotropic material need not be homogeneous but, an Isotropic material has same properties in all the directions.

67. Ans: (d)

Sol:



For 'I' section beam flanges carry maximum bending load where as web carries maximum shear load. The distribution of bending stress and transverse shear stress is shown above.

68. Ans: (d)

Sol: In an inelastic collision :

- Linear momentum is conserved.
- Initial kinetic energy is not equal to final kinetic energy.

69. Ans: (a)

70. Ans: (d)

Sol:

- Cermet [ceramic (cer) and metal (met)] has properties of both ceramic and metal.
- Ceramic: which can resist high temperature and possess higher hardness.
- Metal: Which has ability to undergo plastic deformation and possesses ductility
- In cermet clay (80%) is mixed with metals like nickel, molybdenum, and cobalt. (usually less than 20%), which can be stable at around 600°C.
- Cermet is used to resist high temperature, and used to resist shocking (impact) loads.
- Aluminum can not take temperature beyond 600°C

∴ Statement – I is false

71. Ans: (d)

Sol: If two beams are made of different materials, it is not necessary that a beam of more section modulus will have more strength. Hence, statement (I) is incorrect.

72. Ans: (d)

Sol: Poly vinyl chloride is a thermo plastic material. So, given statement(I) is incorrect, while statement (II) is Correct.

73. Ans: (a)

Sol: For a thin spherical vessel,

$$\sigma_h = \sigma_\ell = \frac{Pr}{2t}$$

- Since the principal stresses σ_1 , σ_2 are equal, Mohr's circle for transformations of stress within the plane tangent to the surface of the vessel reduces to a point. The in - plane normal stress is constant, and the in-plane maximum shearing stress is zero.

74. Ans: (b)

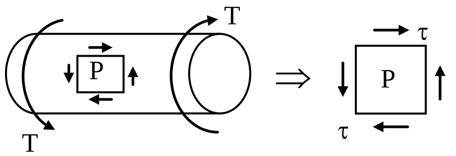
Sol: Nano-optic elements consisting of numerous nano scale structure created by replicating nano pattern masters, with spatial integration method are established.

In hybrid integration method, discreate nono-optic devices are produced by adding a nano-optic layer or layers.

Statement (I) and Statement (II) are correct but Statement (II) is not the correct explanation of Statement (I).

75. Ans: (a)

Sol: Mild steel is a ductile material. Ductile material fails in shear. In pure torsion, maximum shear stress occurs at angle 90° to the axis of the rod.



Thus, both the statements are correct and statement (II) is the correct explanation of statement (I).