## ME-Objective-Paper-II

1. Consider the following statements in connection with thermoplastics:
   (i) They are long-chain molecules held together by van der Waals' forces.
   (ii) They cannot be resoftened once they have set and hardened.
   (iii) They are highly plastic and are easy for shaping.
   (iv) Some commercial thermoplastics are polyethylene, polystyrene and PVC.
   Which of the above statements are correct?
   (A) 1, 2 and 3 only (B) 1, 3 and 4 only (C) 2, 3 and 4 only (D) 1, 2, 3 and 4

Key: (B)

Exp: Thermoplastics can be resoftened and recycled multiple times

2. Consider the following statements:
   Machine tool beds are made using grey cast iron due to
   (i) high tensile strength and ductility
   (ii) high compressive strength and damping property
   (iii) castability and low cost of production
   (iv) machinability and low material cost
   Which of the above statements are correct?
   (A) 1,2 and 3 only (B) 1,3 and 4 only (C) 2,3 and 4only (D) 1,2,3 and 4

Key: (C)

Exp: cast iron – low ductility, low tensile strength
- damping, compressive strength, castability, high machinebility

3. In hot die forging, thin layer of material all around the forging is
   (A) gutter space, which fills up hot gases
   (B) flash, the width of it is an indicator of the pressure developed in the cavity
   (C) coining, which indicates the quality of the forging
   (D) cavity, which is filled with hot impurities in the material

Key: (B)

Exp: In hot die forging, thin layer of material all around the forging is flash

4. Which drill is good for inverted drilling operation?
   (A) Oil-hole drill (B) Straight-flute drill
   (C) Taper-shank drill (D) High-helix drill

Key: (A)

Exp: Oil hole drill is suitable for good inverted operation

5. In wire-drawing operation, the maximum reduction per pass for perfectly plastic material in ideal condition is

(A) 68% (B) 63% (C) 58% (D) 50%

Key: (B)

Exp: In ideal condition

$$\sigma_\alpha = y.\ln\left(\frac{A_o}{A_y}\right)$$

$$\sigma_\epsilon = .1$$

$$\sigma_\alpha = \sigma_\epsilon \Rightarrow \ln\left(\frac{A_O}{A_y}\right) = 1 \Rightarrow \frac{A_o}{A_f} = e$$

$$\text{maximum reduction per pass} = \frac{A_0 - A_f}{A_o} = 1 - \frac{1}{C} = 0.63 = 63\%$$

6. In the process of metal rolling operation, along the arc of contact in the roll gap there is a point called the neutral point, because

(A) on one side of this point, the work material is in tension and on the other side, the work material is in compression

(B) on one side of this point, the work material has velocity greater than that of the roll and on the other side, it has velocity lesser than that of the roll

(C) on one side of this point, the work material has rough surface finish and on the other side, the work material has very fine finish

(D) at this point there is no increase in material width, but on either side of neutral point, the material width increases

Key: (B)

Exp: In the process of metal rolling operation, along the arc of contact in the roll gap there is a point called the neutral point, because on one side of this point, the work material has velocity greater than that of the roll and on the other side, it has velocity lesser than that of the roll

7. The process of impregnation in powder metallurgy technique is best described by which of the following?

(A) After sintering operation of powder metallurgy, rapid cooling is performed to avoid thermal stresses

(B) Low melting point metal is filled in the pores of a sintered powder metallurgy product

(C) Liquid oil or grease is filled in the pores of a sintered powder metallurgy product

(D) During sintering operation of powder metallurgy, rapid heating is performed to avoid sudden produce of high internal pressure due to volatilization of lubricant

Key: (C)

Exp: Impregnation is the filling of the due poxes in a metal with a fluid a common application of this is the production of self lubricating components such as bearings and gears. In This cases, power processed part is usually soaked in hot oil.

8. Consider the following statements for an induction furnace:
   (i) High-frequency current is generally used for the furnace working.
   (ii) There is less loss of alloying elements due to oxidation.
   (iii) Pronounced stirring action of molten metal occurs inside the furnace.
   (iv) Slag cover is essential for the efficient working of the furnace.
   Which of the above statements are correct?
   (A) 1, 3 and 4 only (B) 2, 3 and 4 only
   (C) 1, 2 and 3 only (D) 1, 2,3 and 4

Key: (D)

Exp: In an induction furnace
High-frequency current is generally used for the furnace working.
There is less loss of alloying elements due to oxidation.
Pronounced stirring action of molten metal occurs inside the furnace.
Slag cover is essential for the efficient working of the furnace.

9. The proportion of acetylene and oxygen used in gas welding is
   (A) 2 : 1 (B) 1 : 1 (C) 1 : 2 (D) 3 : 4

Key: (B)

10. In liquid-state welding process, the zones formed are
   (A) gas-shielded zone, fusion zone and unaffected original base metal zone
   (B) liquid zone, fusion zone and heat-affected unmelted zone
   (C) liquid-shielded zone, gas-shielded zone and flux-metal reactive zone
   (D) fusion zone, heat-affected unmelted zone and unaffected original base metal zone

Key: (D)

Exp: In liquid-state welding process, the zones formed are fusion zone, heat-affected unmelted zone and unaffected original base metal zone

11. A Simple turning operation is carried out on a lathe machine at constant spindle speed. What will happen after a few turning passes?
   (A) Cutting velocity will increase and surface finish improves
   (B) Cutting velocity will decrease and surface finish deteriorates
   (C) Cutting velocity will increase and chattering occurs
   (D) Cutting velocity will decrease and chattering reduces

Key: (D)

Exp: Chattering means formulation of black spots due to induced stresses

12. A milling cutter having 8 teeth is rotating at 150 r.p.m. If the feed per tooth is 0.1mm, the table speed in mm per minute is

(A) 70 (B) 120 (C) 125 (D) 187

Key: (B)

Exp: $\text{Time/cut} = \dfrac{L}{f_t \times z_n}$

$f_t z_n = \dfrac{L}{\text{Time/cut}}$

$0.1 \times 8 \times 150 = \dfrac{L}{\text{Time/cut}}$

$\dfrac{L}{\text{Time/cut}} = 120 \text{mm/min}$

13. Consider the following statements regarding milling machine:

(i) In the vertical milling machine, it is possible to machine dovetail recesses.

(ii) In universal milling machine, the worktable can be swivelled.

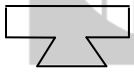
(iii) In rotary milling machine, motion imparted to work is rotary.

(iv) Planer milling machine is provided with several horizontal and vertical heads.

Which of the above statements are correct?

(A) 1,2 and 3 (B) 1,3 and 4 (C) 1,2 and 4 (D) 2,3 and 4

Key: (D)

Exp:  This shape cannot produced in vertical milling machine



14. In a plunge grinding operation, the workpiece is 10mm wide, the wheel is of 20cm diameter and 2 cm wide. The wheel speed is 3000 r.p.m and the table speed is 2.5m/min. If the depth of cut is 0.02mm, grain density is 250/cm$^2$ and the grinding forces are 20N tangential and 38 N thrust, the specific energy is

(A) $75.4 \times 10^4 \text{ N/mm}^2$ (B) $7.54 \times 10^4 \text{ N/mm}^2$

(C) $75.4 \times 10^6 \text{ N/mm}^2$ (D) $7.54 \times 10^6 \text{ N/mm}^2$

Key: (B)

Exp: Specific Energy = $\dfrac{\text{power}}{\text{MRR}}$

Power = Fg × velocity

$= 20 \times \dfrac{\pi DN}{60} = \dfrac{20 \times \pi \times 20 \times 10^{-2} \times 3000}{60}$

$= 200\pi \dfrac{\text{N} - \text{m}}{\text{sec}} - (1)$

MRR = Velocity Of table × width of Job × depth of cut

$$= \frac{2.5}{60}\times 10\times 10^{-3}\times 0.02\times 10^{-3} = \frac{0.5}{60}\times 10^{-6}\ \frac{m^3}{sec}$$

$$\therefore \text{Specific energy} = \frac{\text{power}}{\text{MRR}}$$

$$= \frac{200\pi\times 60}{0.5\times 10^{-6}}\ \frac{N}{m^2}$$

$$= \frac{200\pi\times 60}{0.5\times 10^{-6}}\times\frac{1}{10^{-16}}\ \frac{N}{mm^2}$$

$$= 75360\ \frac{N}{mm^2}$$

$$= 7.54\times 10^4\ \frac{N}{mm^2}$$

15. Consider the following statements with reference to grinding wheel characteristics:
(i) Aluminum oxide and silicon carbide are used for making the grinding wheels.
(ii) Rubber bonds are used for making flexible wheels.
(iii) The grade of a wheel is determined by the strength of the bonding materials.
(iv) Negative rake angles are used for grinding of high-strength materials.
Which of the above statements are correct?
(A) 1, 2 and 3 (B) 1, 2 and 4 (C) 1, 3 and 4 (D) 2, 3 and 4

Key: (B)

Exp: Examples of abrasive bonds used in grinding wheel
1) Aluminum oxide and silicon carbide are used for making the grinding wheels
2) Rubber bonds are used for making flexible wheels
And Negative rake angles are used for grinding of high-strength materials

16. In NC machines, slides are positioned by hydraulic ram and are influenced by
(A) length of stroke and mass to be displaced
(B) feed and spindle speed
(C) length of stroke and feed
(D) spindle speed and mass to be displaced

Key: (C)

17. Which one of the following statements is correct about an oblique cutting?
(A) Direction of chip flow velocity is normal to the cutting edge of the tool
(B) Only two components of cutting forces act on the tool
(C) Cutting edge of the tool is inclined at an acute angle to the direction of tool feed
(D) Cutting edge clears the width of the workpiece

Key: (C)

Exp: Cutting edge is not normal to velocity vector these components of forces act, cutting edge does not affect width of work piece

18. A toothpaste tube can be produced by

(A) solid forward extrusion

(B) solid backward extrusion

(C) hollow backward extrusion

(D) hollow forward extrusion

Key: (B)

Exp: A toothpaste tube can be produced by solid backward extrusion

19. The fatigue failure of a tool is due to

(A) abrasive friction, cutting fluid and chip breakage

(B) variable thermal stresses, chip breakage and variable dimensions of cut

(C) abrasive friction, chip breakage and variable dimensions of cut

(D) chip breakage, variable thermal stresses and cutting fluid

Key: (B)

20. In accelerated tool life tests, the three main types of quick and less costly tool life testing are

(A) extrapolation on the basis of steady wear; conventional measurement of flank and crater wear; comparative performance against tool chipping

(B) measurement of abrasive wear; multi-pass turning; conventional measurement of diffusion wear

(C) extrapolation on the basis of steady wear; multi-pass turning; taper turning

(D) comparative performance against tool chipping; taper turning; measurement of abrasive wear

Key: (A)

Exp: In accelerated tool life tests, the three main types of quick and less costly tool life testing are extrapolation on the basis of steady wear; conventional measurement of flank and crater wear; comparative performance against tool chipping

21. The modulus of rigidity and the bulk modulus of a material are found as 70 GPa and 150 GPa respectively.

(i) elasticity modulus is 200 GPa

(ii) Poisson's ratio is 0.22

(iii) elasticity modulus is 182 GPa

(iv) Poisson's ratio is 0.3

Which of the above statements are correct?

(A) 1 and 2 (B) 1 and 4 (C) 2 and 3 (D) 3 and 4

Key: (D)

Exp: $E = 2G(1+\nu)$ or $\frac{3K}{2G} = \frac{1+\nu}{1-2\nu}$

$E = 3K(1-2\nu)$

$\therefore \frac{3\times150}{2\times70} = \frac{1+\nu}{1-2\nu} \quad \therefore \nu = 0.3$

$\therefore E = 2G(1+\nu) = 2\times70(1+0.3)$

$\therefore E = 182\,GPa$

22. Consider the following statements:

(i) Cross-section of a member of truss experiences uniform stress.

(ii) Cross-section of a beam experiences minimum stress.

(iii) Cross-section of a beam experiences linearly varying stress.

(iv) Cross-sections of truss members experience only compressive stress.

Which of the above statements are correct?

(A) 1 and 2 (B) 1 and 3 (C) 1 and 4 (D) 3 and 4

Key: (B)

Exp: Cross section of truss experiences both compressive and tensile stress which are uniform, Cross section of beam does not experience minimum stress.

23. A steel rod, 2m long, is held between two walls and heated from $20^{O}C$ to $60^{O}C$. Young's modulus and coefficient of linear expansion of the rod material are $200 \times 10^{3}$ MPa and $10\times10^{-6}/^{O}C$ respectively. The stress induced in the rod, if walls yield by 0.2mm, is

(A) 60 MPa tensile (B) 80 MPa tensile

(C) 80 MPa compressive (D) 60 MPa compressive

Key: (D)

Exp: $\sigma = \frac{(1\alpha t - \delta)\in}{l}$

$= \frac{(2000\times10^{-5}\times4^{O} - 0.2)\times200\times10^{3}}{2000}$

$=$ 60 compression

24. A tension member of square cross-section of side 10mm and young's modulus E is to be replaced by another member of square cross-section of same length but Young's modulus E/2. The side of the new square cross-section, required to maintain the same elongation under the same load, is nearly.

(A) 14mm (B) 17mm (C) 8mm (D) 5mm

Key: (A)

Exp: $\because \delta_1 = \delta_2$

$$\frac{P_1 L_1}{A_1 E_1} = \frac{P_2 L_L}{A_2 E_2} \qquad \text{as } P_1 = P_2 \text{ and } L_1 = L_2$$

$$\therefore \frac{E_1}{E_2} = \frac{A_2}{A_1}$$

$$\text{or } \frac{E}{E/2} = \frac{A_2}{10 \times 10} \Rightarrow 200 = A_2$$

$$\text{or } (l)^2 = 200 \therefore l = \sqrt{200} = 14.1\text{mm}$$

25. An aluminum bar of 8m length and a steel bar of 5mm longer in length are kept at $30^{O}$C. If the ambient temperature is raised gradually, at what temperature the aluminum bar will elongate 5mm longer than the steel bar (the linear expansion coefficients for steel and aluminum are $12\times10^{-6}/^{O}$C and $23\times10^{-6}/^{O}$C respectively)?

(A) $50.7^{O}$C (B) $69.0^{O}$C (C) $143.7^{O}$C (D) $33.7^{O}$C

Key: C

Exp: $x = \alpha_s . L_s . \Delta T$

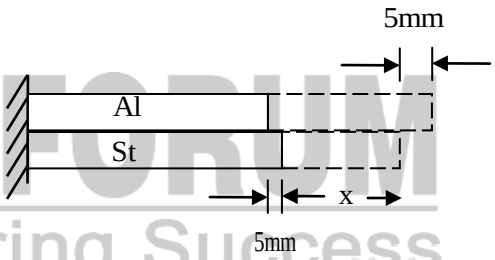
$$x = 12\times10^{-6}\times8.005\times\Delta T\times10^{3} = 0.09606\Delta T \quad \_\_\_(1)$$

$$\text{now } x + 5 + 5 = 23\times10^{-6}\times8\times10^{3}\times\Delta T \quad \_\_\_\_(2)$$

$$\text{or } 0.0960\Delta T + 10 = 23\times10^{-6}\times8\times10^{3}\Delta T$$

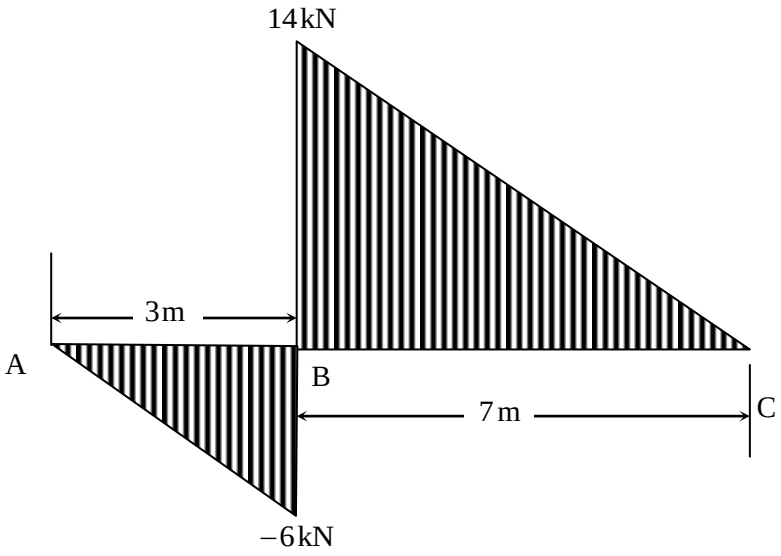
$$\therefore \Delta T = 113.7$$

$$T - 30 = 113.7 \ \therefore T = 143.7^{\circ}\text{C}$$






26. The part of the shear force diagram for a beam is shown in the figure

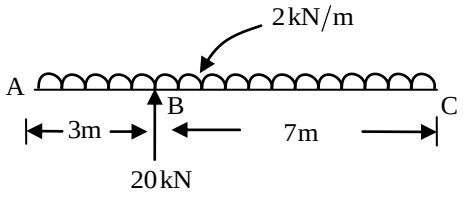



If the bending moment at B is -9kNm, then the bending moment at C is

(A) 40kN m (B) 58kN m (C) 116kN m (D) -80kN m

Key: (A)

Exp:




$m_c = 20\times 7 - 2\times 10\times 5 = 40\,kN-m$

27. A beam of length L and flexural rigidity EI is simply supported at the ends and carries a concentrated load W at the middle of the span. Another beam of identical length L and flexural rigidity EI is fixed horizontally at both ends and carries an identical concentrated load W at the mid-span. The ratio of central deflection of the first beam to that of the second beam is

(A) 1 (B) 2 (C) 0.25 (D) 4

Key: (D)

28. A bar of rectangular cross-section (b × 2b) and another bar of circular cross-section (diameter = d) with the same length, are made of same material, and are subjected to same bending moment and have the same maximum bending stress developed. The ratio of weights of rectangular bar and circular bar will be

(A) $\frac{(2\pi)^{1/3}}{3\pi}$ (B) $\sqrt{\pi}$ (C) $\sqrt{3\pi}$ (D) $\frac{(3)^{2/3}}{2(\pi)^{1/3}}$

Key: (D)

Exp: $\frac{M}{I}=\frac{\sigma}{y}$

$$\frac{I_1}{I_2}=\frac{y_1}{y_2}\Rightarrow\frac{\frac{bd^3}{12}}{\frac{\pi}{64}d^4}=\frac{b}{\frac{d}{2}}\Rightarrow\frac{d}{b}=\left(\frac{64}{3\pi}\right)^{\frac{1}{3}}$$

$$W\alpha\frac{1}{V}$$

$$\frac{W_1}{W_2}=\frac{V_2}{V_1}=\frac{\frac{\pi}{4}d^2L}{2b^2L}=\frac{\pi}{8}\left(\frac{64}{3\pi}\right)^{\frac{2}{3}}$$

29. A shaft of diameter 8cm is subjected to a bending moment of 3000 N m and a twisting moment of 4000 Nm. The maximum normal stress induced in the shaft is equal to

(A) $\frac{250}{\pi}$ MPa (B) $\frac{500}{\pi}$ MPa (C) $\frac{157.5}{\pi}$ MPa (D) $\frac{315}{\pi}$ MPa

Key: (A)

Exp: $f = \frac{32M}{\pi d^3} = 59.7\,MPa$

$T = \frac{16T}{\pi d^3} = 39.7MPa$

$\sigma = \frac{f}{2} + \sqrt{\left(\frac{f}{2}\right)^2 + 2T^2}$

$= 79.57\,mm$

$= \frac{250}{\pi} MPa$

30. A close-coiled helical spring of 10 active turns is made of 8mm diameter steel wire. The mean coil diameter is 10cm. If G = 80GPa for the material of spring, the extension of spring under a tensile load of 200 N will be nearly

(A) 40mm (B) 45mm (C) 49mm (D) 53mm

Key: (C)

Exp: $\delta = \frac{64wR^3n}{cd^4} = \frac{64 \times 200 \times 50^3 \times w}{80 \times 10^3 \times 8^4}$

$= 48.83 = 49\,mm$

31. Two concentric springs, having same number of turns and free axial length, are made of same material. One spring has mean coil diameter of 12cm and its wire diameter is 1.0cm. The other one has mean coil diameter of 8cm and wire diameter of 0.6cm. If the set of springs is compressed by an axial load of 2000 N, the loads shared by the springs will be

(A) 1245.5 N and 754.5 N (B) 1391.4 N and 608.6 N

(C) 1100.0 N and 900.0 N (D) 1472.8 N and 527.2N

Key: (B)

Exp: As $\delta_1 = \delta_2$

$\therefore \frac{64w_1R_1^3n_1}{G_1d_1^4} = \frac{64w_2R_2^3n_2}{G_2d_2^4}$

$\therefore n_1 = n_2, G_1 = G_2$

$\frac{w_1}{w_2} = \left(\frac{R_2}{R_1}\right)^3 \left(\frac{d_1}{d_2}\right)^4$

$= \left(\frac{8}{12}\right)^3 \left(\frac{1}{0.6}\right)^4$

$\therefore \frac{w_1}{w_2} = 2.286 \quad \ldots (1)$

$or\ w_1 + w_2 = 2000 \quad \ldots (2)$

$\therefore w_1 = 1791.257N$

$w_2 = 628.598N$

32. A rod of length *l* tapers uniformly from a diameter D at one end to a diameter D/2 at the other end and is subjected to an axial load P. A second rod of length *l* and of uniform diameter D is subjected to the same axial load P. Both the rods are of same material with Young's modulus of elasticity E. The ratio of extension of the first rod to that of the second rod is

(A) 4 (B) 3 (C) 2 (D) 1

Key: (C)

Exp: Taper bar $\delta = \dfrac{4pl}{\pi E d_1 d_2}$

$$\delta = \frac{4pl}{\pi E d \frac{d}{2}} = \frac{8d}{\pi E d^2}$$

For bar $\delta = \dfrac{pl}{\frac{\pi}{4} d^2 E} = \dfrac{4pl}{\pi E d^2}$

$$\frac{\text{Taper bar}}{\text{bar}} = \frac{8}{4} = 2$$

33. If a thin-walled cylinder with closed hemispherical ends with thickness 12mm and inside diameter of 1250 mm is to withstand a pressure of 1.5MPa, then the maximum shear stress induced is

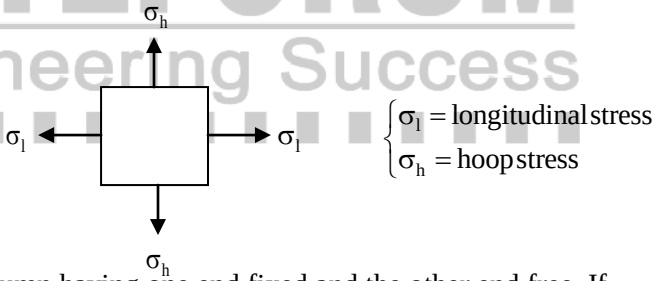
(A) 19.5 MPa (B) 39.05 MPa (C) 78.12 MPa (D) 90.5 MPa

Key: (A)

Exp: $\tau_{max} = \dfrac{\sigma_1 - \sigma_2}{2}$

$$= \frac{\sigma_l - \sigma_h}{2} = \frac{pd/2t - pd/4t}{2} = \frac{pd}{8t}$$

$$\therefore \tau_{max} = \frac{1.5 \times 1.25}{8 \times 12 \times 10^{-3}} = 19.5\,MPa$$




34. A 4m long solid round bar is used as a column having one end fixed and the other end free. If Euler's critical load on this column is found as 10kN and E=210 GPa for the material of the bar, the diameter of the bar is

(A) 50mm (B) 40mm (C) 60mm (D) 45mm

Key: (A)

Exp: $P = \dfrac{\pi^2 EI}{4l^2}$

$$10^4 = \frac{\pi^2 \times 210 \times 10^9 \times I}{4 \times 4^2}$$

$$I = 3.1 \times 10^{-7}$$

$$\frac{\pi}{64} d^4 = 3.1 \times 10^{-7}$$

$$d = 50\,mm$$

35. What is the slenderness ratio of a 4m column with fixed ends if its cross-section is square of side 40mm?

(A) 100 (B) 50 (C) 160 (D) 173

Key: (D)

Exp: $\text{Slenderness Ratio} = \frac{L_e}{K} = \frac{L}{2.K}$

$\text{here } k = \sqrt{\frac{I_{min}}{A}} = \sqrt{\frac{b^4}{12 \times b^2}} = \frac{b}{\sqrt{12}}$

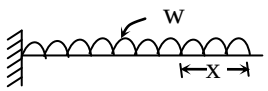
$\therefore S.R = \frac{L \times \sqrt{12}}{2 \times b} = \frac{4 \times \sqrt{12}}{2 \times 0.04} = 173.2$

36. A cantilever beam, 2m in length, is subjected to a uniformly distributed load of 5kN/m. If E = 200GPa and I = 1000 $cm^4$, the strain energy stored in the beam will be

(A) 7 Nm (C) 12 Nm (C) 8Nm (D) 10Nm

Key: (D)

Exp: $S.E = \int_0^L \frac{\left(\frac{wx^2}{2}\right)^2 .dx}{2.E.2}$




$m = \frac{wx^1}{2}$

$\left(\because E = \int_0^L \frac{m^2 .dx}{2EI}\right)$

$\therefore S.E = \frac{w^2 \times L^5}{40.E.I}$

$\therefore S.E = \frac{5 \times 5 \times 10^6 \times (2)^5}{40 \times 200 \times 10^9 \times 10^3 \times 10^{-8}}$

$\therefore S.E = \frac{25 \times 10^6 \times 32}{40 \times 2 \times 10^6}$

$\therefore S.E = \frac{800}{80} = 10 \text{ N.m}$

[where in for cantilever with U.d.L = $\frac{wxL}{2}$.

37. Consider the following statements in connection with the phase diagrams:

(i) Phase diagrams of binary alloys change by the presence of other alloying elements.

(ii) Tie-line construction and lever rule are used to determine the phase compositions.

(iii) Time-temperature transformations can be studied with the help of phase diagrams.

Which of the above statements are correct?

(A) 1 and 2 only (B) 1 and 3 only

(C) 2 and 3 only (D) 1, 2 and 3

Key: (A)

38. Eutectoid reaction occurring at $727^OC$ with 0.77%C is

(A) austenite $\rightarrow$ ferrite + pearlite

(B) austenite $\rightarrow$ ferrite + martensite

(C) austenite $\rightarrow$ ferrite + cementite

(D) austenite → martensite + bainite

Key: (A)

Exp: From iron – iron carbide diagram

Eutectoid reaction occurring at $727^{O}C$ with 0.77%C is

austenite → ferrite + pearlite

39. Cast iron possessing which one of the following metallographic structures is best suited for damping capacity in engineering applications?

(A) Excess cementite (B) Carbon in temper form

(C) Silicon carbide in flake structure (D) Spheroidal form of graphite

Key: (D)

Exp: Graphite in the form of flakes is best suited for damping capacity

40. Jominy end-quench test is carried out to determine

(A) recrystallization temperature of steel

(B) glass transition temperature of a material

(C) hardenability of steel

(D) hardness of steel

Key: (C)

Exp: Jominy end-quench test is carried out to determine hardenability of steel



41. In an orthogonal turning process, the chip thickness = 0.32 mm, feed = 0.2mm/rev. Then the cutting ratio will be

(A) 2.6 (B) 3.2 (C) 1.6 (D) 1.8

Key: (C)

Exp: $r = \frac{t_1}{t_2} = \frac{0.32}{0.2} = 1.6$

42. In an orthogonal cutting operation, shear angle = $11.31^{O}$, cutting force = 900 N and thrust force = 810N. Then the shear force will be approximately (given $\sin 11.31^{O} = 0.2$).

(A) 650 N (B) 720 N (C) 620 N (D) 680 N

Key: (B)

Exp: $\frac{F_C}{\cos(\beta-\alpha)} = \frac{F_S}{\cos(\phi+\beta-\alpha)} \Rightarrow \frac{900}{\cos 42} = \frac{F_S}{\cos(11.31+42)}$

$F_S = 720\,N$

43. The stick-slip motion is found to occur in machine tool slides under certain conditions which are

(A) at very high feed rates and / or when there is small difference between the coefficients of static and dynamic friction at the slider and guideway interfaces

(B) at very high feed rates and when there is small difference between the coefficients of static and dynamic friction at the headstock spindle and bed of machine tool

(C) at very low feed rates and/ or when there is large difference between the coefficients of static and dynamic friction at the slider and guideway interfaces

(D) at very low feed rates and large difference in coefficient of only dynamic friction at head stock spindle and bed of machine tool

Key: (C)

Exp: As feed rate is less stick-slip motion occurs in slides.

44. Consider the following reasons for using non-conventional machining processes:

(i) High-strength alloys

(ii) Complex surfaces

(iii) High accuracies and surface finish

Which of the above are correct?

(A) 1 and 2 only (B) 1 and 3 only

(C) 2 and 3 only (D) 1,2 and 3

Key: (D)

Un-conventional machining (UCM) needs These 3 reasons

(i) High-strength alloys

(ii) Complex surfaces

(iii) High accuracies and surface finish

45. Exponential smoothening methods are best suited under conditions when

(A) forecasting horizon is relatively large

(B) forecasting for large number of items

(C) available outside information is more

(D) All of the above

Key: (A)

46. The correct sequence of increasing production volume is

(A) batch, job, flow and mass

(B) mass, flow, batch and job

(C) job, flow, mass and batch

(D) job, batch, mass and flow

Key: (D)

Exp: sequence of production value is job, batch, mass and flow type of production

47. The data for break-even analysis of a product are given as - fixed cost is Rs.10,000; variable cost is Rs.10/unit; selling price is Rs.15/unit. The break-even volume is

(A) 2000 (B) 2500 (C) 3500 (D) 4000

Key: (A)

Exp: $BEV = \frac{F}{S-V} = 2000$

48. Bushes are generally provided in a jig to

(A) locate the job (B) guide the tool

(C) hold the job (D) All of the above

Key: (B)

Exp: Bushes are generally provided in a jig to guide the tool

49. In ABC inventory control of spare parts, the items A, B and C respectively refer to

(A) high stock-out cost, moderate stock-out cost and low stock-out cost

(B) low stock-out cost, moderate stock-out cost and high stock-out cost

(C) moderate stock-out cost, high stock-out cost and low stock-out cost

(C) stock-out costs whose sequence depends on other factors also

Key: (A)

Exp:

| 2tem | Quantity | Value/cost (stock out cost) |
|---|---|---|
| A | Less | High |
| B | Moderate | Moderate |
| C | High | Low |

50. Materials requirement planning is driven by

(A) master production schedule

(B) total quality measurement

(C) overall production planning

(D) overall inventory planning

Key: (A)

Exp: Material required planning is based on master production schedule

51. A micro programmed control unit

(A) is faster than hardwired control unit

(B) facilitates easy implementation of new instructions

(C) is useful when very small programs are to be run

(D) usually refers to the control unit of microprocessor

Key: (B)

Exp: A micro programmed control unit facilitates easy implementation of new instructions

52. Preparing a magnetic disk for data storage is called

(A) booting (B) formatting (C) debuffing (D) buffing

Key: (B)

Exp: Preparing a magnetic disk for data storage is called formatting

53. The time for which a piece of equipment operates is called

(A) seek time (B) effective time (C) access time (D) real time

Key: (B)

54. The addressing mode used in the instruction PUSH B is

(A) direct (B) register

(C) register indirect (D) immediate

Key: (B)

Exp: There are four types of instruction: -

PUSH A, PUSH B, add α popc

Wherein addressing mode used are as follows: -

PUSH A - Direct

PUSH B - Register

Add - Register indirect

Pop.C - Immediate



55. Index register in a microprocessor is used for

(A) direct addressing

(B) address modification

(C) pointing to the stack

(D) loop execution

Key: (C)

Exp: Index Register is also called special purpose Register, which is used as stack pointer to programme stack i.e., is used to hold the address of the top of stack.

56. In the Fortran program

```
M = 0
DO 100I = 1,2
DO  200J = 1,2
M = M + I + J
200 CONTINUE
100 CONTINUE
STOP
END
```

the value of M in the end will be

(A) 10 (B) 11 (C) 12 (B) 14

Key: (C)

Exp: $m = 0, I = 1, J = 1$

$\therefore m = m + I + J = 0 + 1 + 1 = 2$

$m = 2, I = 1, J = 2$

$m = 2 + 1 + 2 = 5$

$m = 5, I = 2, I = 1$

$m = 5 + 2 + 1 = 8$

$m = 8, I = 2, J = 2$

$m = 8 + 2 + 2 = 12$



57. In a FORTRAN program

(A) all statements must be numbered

(B) the numbered statements must be referred

(C) the statements referred must be numbered

(D) all statements must be referred

Key: (C)

Exp: In Fortran programming the statements referred must be numbered

58. In C language, $i^{++}$ means

(A) i = i + 1 (B) i = i - 1 (C) i = i + 2 (D) i = i - 2

Key: (A)

59. Which header file should be included to use functions like malloc ( ) and calloc ( )?

(A) dos.h (B) stdlib.h (C) memory.h (D) string.h

Key: (C)

Exp: # include <memory.h> , includes mollo () and colloc () functions from 'C' database.

60. Program status word (PSW) contains various status of

(A) Program (B) CPU (C) ALU (D) register

Key: (D)

Exp: PSW is a collection of data 8 bytes or (64 bits) long maintained by the o.s and it keeps track of current status of system registers. It describes: -

1. Interrupt masks
2. Privillage states
3. condition code
4. Instruction address

61. In a crank and slotted lever quick-return motion, the distance between the fixed centres is 150 mm and the length of the driving crank is 75mm. the ratio of the time taken on the cutting and return strokes is

(A) 1.5 (B) 2.0 (C) 2.2 (D) 2.93

Key: (B)

Exp: OA = 150mm

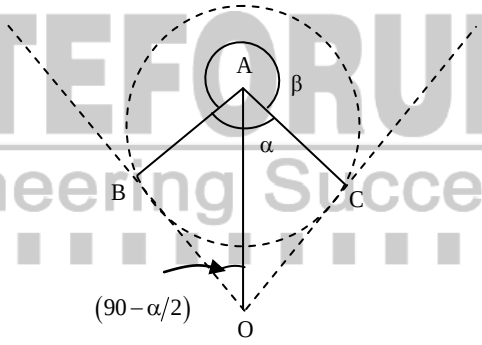
AB = 75 mm

$$\sin(90-\alpha/2)=\frac{AB}{OA}$$

$$\cos\alpha/2=\frac{1}{2} \qquad \therefore \alpha=120°$$

$$\beta=360-120°=240°$$

$$\text{Quick return ratio}(QRR)=\frac{\beta}{\alpha}=\frac{240}{120}=2$$

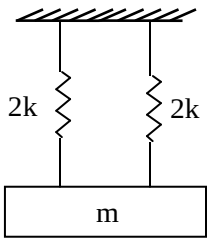



62. A helical coil spring of stiffness k is cut to two equal halves and then these are connected in parallel to support a vibrating mass m. The angular frequency of vibration, $\omega_n$ is

(A) $\sqrt{\frac{k}{m}}$ (B) $\sqrt{\frac{2k}{m}}$ (C) $\sqrt{\frac{4k}{m}}$ (D) $\sqrt{\frac{k}{4m}}$

Key: (C)

Exp: $\text{Stiffness} \propto \frac{1}{\text{length}}$




$$k_{eq}=2k+2k=4k$$

$$\therefore \omega = \sqrt{\frac{4k}{m}}$$

63. Consider the following statements:

In a slider-crank mechanism, the slider is at its dead centre position when the

(i) slider velocity is zero

(ii) slider velocity is maximum

(iii) slider acceleration is zero

(iv) slider acceleration is maximum

Which of the above statements are correct?

(A) 1 and 4 (B) 1 and 3 (C) 2 and 3 (D) 2 and 4

Key: (A)

Exp: At dead centre velocity is zero, because instantaneous acceleration is maximum

64. Which one of the following mechanisms is an inversion of double slider-crank chain?

(A) Elliptic trammels (B) Beam engine

(C) Oscillating cylinder engine (D) Coupling rod of a locomotive

Key: (A)

Exp: Elliptic trammels

65. The number of instantaneous centres of rotation for a 10-link kinematic chain is

(A) 36 (B) 90 (C) 120 (D) 45

Key: (D)

Exp: Instantaneous centre = $\frac{n(n-1)}{2} = 45$

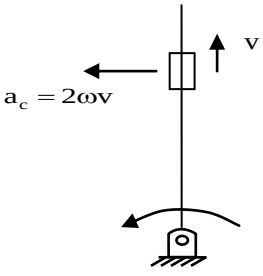
66. A slider moves with uniform velocity $\upsilon$ on a revolving link of length r with angular velocity $\omega$. The Coriolis acceleration component of a point on the slider relative to a coincident point on the link is equal to

(A) $\omega\upsilon$ parallel to the link (B) $2\omega\upsilon$ perpendicular to the link

(C) $\omega\upsilon$ perpendicular to the link (D) $2\omega\upsilon$ parallel to the link

Key: (B)

Exp: coriolis components of acceleration for slider is perpendicular to the link



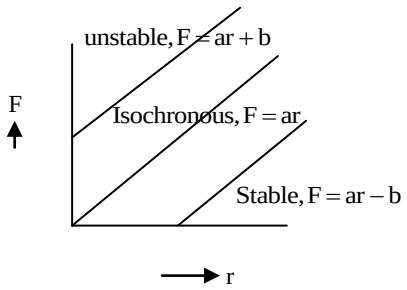
67. The governor becomes isochronous, when

(A) $F = ar + b$ (B) $F = ar - b$ (C) $F = ar^2 + b$ (D) $F = ar$

where F is controlling force, r is radius of rotation for governing balls and a, b are constants.

Key: (D)

Exp:




68. The sensitiveness of a governor is defined as

(A) $\frac{N_1 - N_2}{N_1 + N_2}$ (B) $\frac{N_1 + N_2}{N_1 - N_2}$ (C) $2\left(\frac{N_1 + N_2}{N_1 - N_2}\right)$ (D) $2\left(\frac{N_1 - N_2}{N_1 + N_2}\right)$

where $N_1$ and $N_2$ are the maximum and the minimum equilibrium speeds of the governor respectively.

Key: (D)

Exp: Sensitiveness of governor = $\frac{2(N_1 - N_2)}{N_1 + N_2}$

69. Which of the following statements are correct for mating gears with involute profiles?

(i) The pressure angle, from the start of the engagement to the end of the engagement, remains constant.

(ii) The pressure angle is maximum at the beginning of the engagement, reduces to zero at pitch point, starts decreasing and again becomes maximum at the end of the engagement.

(iii) The face and flank of the teeth are generated by a single curve and the normal to this curve at any point is tangent to the base circle of the gear.

(iv) The centre distance for a pair of mating gears can be varied within limits without altering the velocity ratio.

Select the correct answer using the code given below.

(A) 1, 3 and 4 (B) 1 and 3 only (C) 2 and 4 only (D) 2,3 and 4

Key: (A)

Exp: The pressure angle varies only for cycloidal gears.

70. Two involute gears are designed to mesh for a given centre distance and a given angular velocity ratio (other than 1). During assembly, the centre distance has increased slightly. Then which of the following changes occur?

(i) Velocity ratio changes

(ii) Pressure angle changes

(iii) Pitch circle diameter changes

(iv) Working depth changes

(v) Base circle radius changes

Select the correct answer using the code given below.

(A) 1, 2 and 3 (B) 2, 3 and 4 (C) 2 and 5 (D) 3 and 5

Key: (B)

Exp: When Centre to centre distance increases then pressure angle, depth, pitch circle diameter changes. Velocity ratio and base circle radius will remain same.

71. In a governor, if the equilibrium speed is constant for all radii of rotation of balls, the governor is said to be

(A) Stable (B) unstable (C) inertial (D) isochronous

Key: (D)

Exp: the governor is said to be Isochronous if the equilibrium speed is constant for all radii of rotation of balls

72. Critical speed is expressed as

(A) rotation of shaft in degrees

(B) rotation of shaft in radians

(C) rotation of shaft in minutes

(D) natural frequency of the shaft

Key: (D)

Exp: Critical speed is expressed as natural frequency of the shaft



73. In a locomotive, the ratio of the connecting rod length to the crank radius is kept very large in order to

(A) minimize the effect of primary forces

(B) minimize the effect of secondary forces

(C) have perfect balancing

(D) start the locomotive conveniently

Key: (B)

Exp: $F_S = \text{secondary force} = \frac{m\omega^2 r\cos 2\theta}{n}$ , where $n = \frac{l}{r}$

So as 'l' increases $F_S$ decreases

Hence the ratio is kept large to avoid secondary forces for each balancing

74. In balancing of single-cylinder engine, the rotating unbalance is

(A) completely made zero and so also the reciprocating unbalance

(B) completely made zero and the reciprocating unbalance is partially reduced

(C) partially reduced and the reciprocating unbalance is completely made zero

(D) partially reduced and so also the reciprocating unbalance

Key: (B)

Exp: In balancing of single-cylinder engine, the rotating unbalance is completely made zero and the reciprocating unbalance is partially reduced

75. The first critical speed of an automobile running on a sinusoidal road is calculated by (modeling it as a single degree of freedom system)

(A) resonance (B) approximation

(C) Superposition (D) Rayleigh quotient

Key: (A)

Exp: frequency of automobile and road are same.

76. The equation of free vibration of a system is $\frac{d^2x}{dt^2} + 64\pi^2 x = 0$. Its natural frequency would be

(A) $4\pi$ Hz (B) $8\pi$ Hz (C) $64\pi^2$ Hz (D) 4 Hz

Key: (D)

Exp: $\omega^2 = 64\pi^2 \Rightarrow \omega = 8\pi \Rightarrow f = \frac{\omega}{2\pi} = \frac{8\pi}{2\pi} = 4\text{Hz}$

77. Linear vibration analysis has the greatest advantage because of

(A) Newton's laws of motion (B) eigenvalue analysis

(C) Rayleigh quotient (D) principle of superposition

Key: (A)

Exp: Linear vibration analysis has the greatest advantage because of Newton's laws of motion which is basic analysis used.

78. Which of the following are responsible for occurrence of critical or whirling speed of shaft?

(i) Eccentric mounting of the rotor

(ii) Non-uniform distribution of rotor material

(iii) Bending of shaft due to the weight of the rotor and the shaft itself

(iv) Environmental effect such as effect of moisture and temperature

Select the correct answer using the code given below.

(A) 1,2,3 and4 (B) 1,2, and 3only

(C) 1,2,and 4 only (D) 1, and 3only

Key: (B)

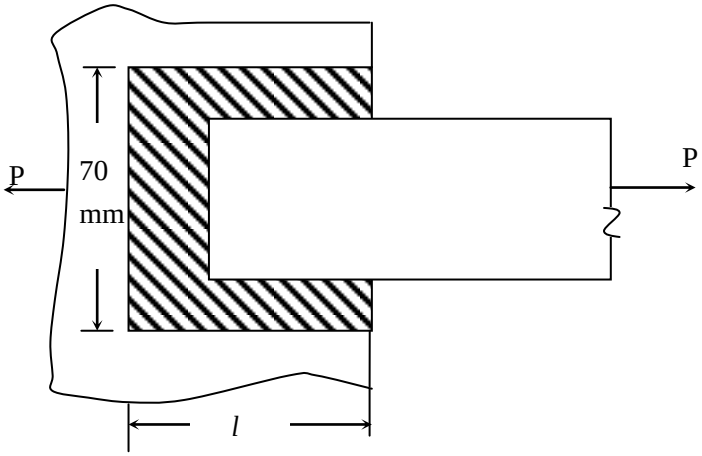
Exp: Whirling speed of shaft occurs due to

(i) Eccentric mounting of the rotor

(ii) Non-uniform distribution of rotor material

(iii) Bending of shaft due to the weight of the rotor and the shaft itself

79. Two plates are jointed as shown in the figure




The maximum tensile and shear stresses are 70 N/mm$^2$ and 56N/mm$^2$ respectively. The plate is 70m wide and 12.5 mm thick. What will be the value of $l$ if the total load carried by the joint is 85 kN?

(A) 126.39mm (B) 84.25mm (C) 70.00mm (D) 42.125mm

Key: (D)

Exp: $w = 0.707\, s \times l_1 \sigma_t + 1.414 \times 5 \times l_2 \times \tau$

$85 \times 10^3 = 0.707 \times 12.5 \times 70 \times 70 + 1.4 \times 14 \times 12.5 \times l_2 \times 56$

$l_2 = 42.126$

80. If a rectangular key of 8 mm width and 6mm height and a shaft of diameter 32 mm are made of same material, then the necessary length of the key for equal shear strength of shaft and key will be (neglecting stress concentration on the shaft)

(A) 50.24mm (B) 55 mm (C) 45mm (D) 60.24 mm

Key: (A)

Exp: $T = \tau_{key} \times l \times w \times \frac{d}{2} \qquad \{as\ \tau_{key} = \tau_{shaft}\}$

$T = \frac{16T}{\pi d^3} \times l \times w \times \frac{d}{2}$

$\therefore l = \frac{2\pi d^2}{16w} = \frac{\pi \times 32 \times 32 \times 2}{16 \times 8}$

$\therefore l = 50.24\,mm$

**Directions:**

Each of the following **twenty (20)** items consists of two statements, one labeled as 'Statement (I)' and the other as 'Statement (II)', You are to examine these two statements carefully and select the answers to these items using the code given below.

Code:

(A) Both statement (I) and statement (II) are individually true and statement (II) is the correct explanation of statement (I)

(B) Both statement (I) and statement (II) are individually true but statement (II) is not the correct explanation of statement (I)

(C) Statement (I) is true but statement (II) is false

(D) Statement (I) is false but statement (II) is true

81 **Statement (I):**

When a flat-faced follower is used, it would be preferable to provide an offset in the plane perpendicular to the plane of rotation of the cam.

**Statement (II):**

Because of the offset, the follower is made to rotate continuously about its axis which in turn avoids jamming of the follower in its guide while moving up or down reduces the wear of the follower flat surface and distributes the wear uniformly.

Key: (A)

Exp: The offset is given for an easy operation of cam

82. **Statement (I):**

In case of partial balancing of locomotives, the maximum magnitude of the unbalanced force perpendicular to the line of stroke is called hammer blow and this has to be limited by proper choice of the balancing mass and its radial position.

**Statement (II):**

The effect of hammer blow is to cause variation in pressure between the wheel and the rail, and it may sometimes cause the lifting of wheels from the rails.

Key: (A)

Exp: Both the statements are true and second statement is correct explanation of statement I

83. **Statement (I):**

In interference fit, the outer diameter of the inner cylinder will be more than the inner diameter of the hollow outer cylinder.

**Statement (II):**

These fits are recommended for two parts frequently dismantled and assembled.

Key: (C)

Exp: Interference fits are used for long run component these fits are not frequently dismantled and assembled.

84. **Statement (I):**

In short open-belt drives, an idler pulley is used in order to increase the angle of contact on the smaller pulley for higher power transmission:

**Statement (II):**

The idler pulley facilitates changing the speed of the driven shaft, while the main or driving shaft runs at constant speed.

Key: (C)

85. **Statement (I):**

Worm and worm wheel drive can be reversible.

**Statement (II):**

If the friction angle is more than the lead angle, the drive will be reversible.

Key: (C)

Exp: If friction angle > lead angle we cannot determine whether drive is reversible or not

86. **Statement (I):**

In die casting process, molten metal is injected at high pressure into a metallic die.

**Statement (II):**

In this die casting process, some excess metal as required than filling the mold is also forced into the parting plane.

Key: (A)

Exp: The high pressure is required to force the metal into intricate shapes

87. **Statement (I):**

I – sections are best suited for carrying bending load in one lateral direction.

**Statement (II):**

In the zone, in the vicinity of neutral axis of I-beams, I-section has the least material.

Key: (D)

Exp: I – section is best suited for transverse loads

Statement '2' is false : - 2 section can take ending as well as shear load, since approx, 80% of bending load is resisted by flanges and 90 % of shear load is resisted by web.

88. **Statement (I):**

Cast iron is good in compression.

**Statement (II):**

It is extensively used in members of the truss.

Key: (C)

Exp: Cast iron is not used in truss

89. **Statement (I):**

Cobalt exhibits hexagonal close-packed structure below $420^{O}C$

**Statement (II):**

Structure of cobalt changes to face-centered cubic structure above $420^{O}C$.

Key: (C)

Exp: Cobalt changes to B.C.C, if $T > 420^{O}C$

90. **Statement (I):**

Melting point of alloy containing 62% tin and 38% lead is $327^{O}C$.

**Statement (II):**

Low melting point of this alloy enables delicate parts of metal to be soldered.

Key: (B)

91. **Statement (I):**

Salts like sodium chloride, sodium hydroxide when added to water to use as quenching media, cooling rate of quenching media will be increased.

**Statement (II):**

When salts are added to water, during quenching, distortion and crack appearance in the quenched steel components reduces.

Key: (C)

Exp: The salts added doesn't affect properties of metals

92. **Statement (I):**

In drawing process, cross-section of round wire is reduced by pulling it through a die.

**Statement (II):**

Bundle drawing produces wires that are polygonal in cross-section rather than round.

Key: (B)

Exp: A is round wire, B is polygonal and statement II is not an explanation for statement I

93. **Statement (I):**

For high extrusion pressure, the initial temperature of billet should be high.

**Statement (II):**

As the speed of hot extrusion is increased, it may lead to melting of alloy constituents.

Key: (D)

Exp: For high extrusion pressure, the billets need not to be heated to high temperature

94. **Statement (I):**

For casting of metal like magnesium, top gating is not used.

**Statement (II):**

The gases will escape resulting in early cooling of metal.

Key: (C)

95. **Statement (I):**

Cupola is used in cast iron foundry.

**Statement (II):**

Basic furnaces are used for melting low-grade steel.

Key: (C)

Exp: Basic furnaces can be used for any grade of steel

96. **Statement (I):**

In powder cutting process, iron powder is injected into the oxygen jet while the cutting is proceeding

**Statement (II):**

In this process of powder cutting, iron gets oxidized by the oxygen jet and produces additional heat for preheating of metal.

Key: (A)

Exp: The process is powder cutting

97. **Statement (I):**

In sand molding process, pouring time depends on materials being cast, complexity of casting, section thickness and size.

**Statement (II)**

In order to maintain optimum pouring time, thickness of casting is the important factor.

Key: (B)



98. **Statement (I):**

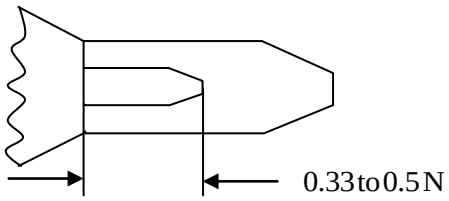
The length of the oxidizing flame is smallest compared to neutral or reducing flame.

**Statement (II):**

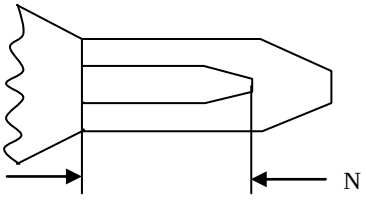
Due to extra oxygen available, the combustion is faster producing smaller length of flame.

Key: (A)

Exp: Oxidizing flame




Neutral flame



99. **Statement (I):**

Lead screw is used instead of the feed rod to produce sufficiently accurate threads.

**Statement (II):**

Lead screw provides more accurate movement to the carriage.

Key: (A)

Exp: Both the statements are true and second statement is correct explanation of statement I

100. **Statement (I):**

In the manufacture of gears by extrusion, the outside surface of the material is hard and smooth.

**Statement (II):**

The material in this process passes through one hot and smooth die.

Key: (C)

101. Rivets undergo single shear in

(A) lap joint and single-cover butt joint

(B) single-cover butt joint and double-cover butt joint

(C) lap joint and double-cover butt joint

(D) lap joint only

Key: (A)

Exp: Only one side of the rivet is covered – single shear



102. A multi-disc clutch employs 3 steel and 2 bronze discs having outer diameter of 300mm and inner diameter of 175 mm. If the coefficient of friction is 0.25 and axial force on each pair of surfaces is 5kN, then the torque transmitted (assuming uniform wear) is

(A) 416.6 N m (B) 887.5 N m

(C) 1093.75 Nm (D) 593.75 N m

Key: (D)

Exp: $T = n\mu wR$

$$= 4 \times 0.25 \times 5000 \times \left( \frac{0.3 + 0.175}{2 \times 2} \right)$$

$$= 593.75\,\text{Nm}$$

103. A truncated conical pivot bearing has semi-cone angle $\alpha$ and the two radii are $r_1$ and $r_2$ respectively with $r_1 > r_2$. The coefficient of friction between the sliding surfaces is $\mu$. For an axial thrust load of W kN, the reduction in torque due to friction (assuming uniform rate of wear) is

(A) $\mu W(r_1 + r_2)\cos ec\ \alpha$ (B) $\frac{1}{2}\mu W(r_1 + r_2)\cos ec\alpha$

(C) $\frac{3}{2}\mu W\left[\frac{(r_1)^3 - (r_2)^3}{3}\right]\cos ec\ \alpha$ (D) $\frac{2}{3}\mu W\left[\frac{(r_1)^3 - (r_2)^3}{3}\right]\cos ec\alpha$

Key: (B)

Exp: Torque(T) = $\frac{1}{2}\mu W(r_1 + r_2)\cos ec\alpha$

104. Which of the following statements are correct regarding power transmission through V-belts?

(i) V-belts are used at the high-speed end.

(ii) V-belts are used at the low-speed end.

(iii) V-belts are of standard lengths.

(iv) V-angles of pulleys and belts are standardized.

Select the correct answer using the code given below.

(A) 1 and 3 only (B) 2 and 4 only

(C) 2, 3 and 4 (D) 1, 3 and 4

Key: (D)

Exp: Advantages of V -belts

V-belts are used at the high-speed end.

(i) V-belts are used at the high-speed end.

(ii) V-belts are of standard lengths.

(iii) V-angles of pulleys and belts are standardized

105. Pressure angle of involute gears does not exceed $25^O$, since

(A) this will lead to unwanted radial force

(B) the number of teeth to avoid undercutting will be very high

(C) no cutters are available

(D) gear will become too small

Key: (A)

Exp: Pressure angle of involute gears does not exceed $25^O$, since Gear is curved

106. Consider the following statements:

In the case of involute gears in contact

(i) the motion is one of pure rolling

(ii) pressure angle does not change during contact

(iii) velocity ratio does not change

(iv) output torque of the driven gear changes

Which of the above statements are correct?

(A) 1 and 2 (B) 2 and 4 (C) 2 and 3 (D) 3 and 4

Key: (C)

107. If the centre distance between a pair of spur gears in mesh is 240 mm and the pinion moves five times faster than the gear, then the pitch circle diameters of pinion and gear respectively are

(A) 40mm and 200 mm (B) 80mm and 400 mm

(C) 60mm and 300 mm (D) 50mm and 250 mm

Key: (B)

Exp: $r_p + r_g = 240$

$\frac{r_g}{r_p} = 5$

$r_g = 200\,mm \; d_g = 400$

$r_p = 40\,mm \quad d_p = 80mm$

108. The diameter of a solid shaft made of mild steel, rotating at 250 r.p.m. is 45mm. The shaft is designed to transmit 50 kW. What will be the factor of safety if the ultimate shear stress at yield is 427 $N/mm^2$?

(A) 6 (B) 5 (C) 4 (D) 3

Key: (C)

Exp: $T = \frac{60P}{2\pi N} = \frac{\pi}{16} d^3 \tau$

$\tau = 106.75$

$FOS = \frac{\tau_{ult}}{\tau} = 4$

109. The bending moment (M) and twisting moment (T) at four particular sections P, Q, R and S along the length of shaft are as follows:

| Section | P | Q | R | S |
|---|---|---|---|---|
| M (N m) | 10 | 40 | 20 | 15 |
| T (N m) | 45 | 30 | 50 | 40 |

Which section is to be considered for designing the shaft?

(A) p (Q) Q (C) R (D) S

Key: (B)

Exp:

| Option | Section | Eq. moment $M+\sqrt{M^2+T^2}$ |
|---|---|---|
| (A) | P | $10+\sqrt{10^2+45^2}=56.1$ |
| (B) | Q | $40+\sqrt{40^2+30^2}=90$ |
| (C) | R | $20+\sqrt{20^2+50^2}=73.85$ |
| (D) | S | $15+\sqrt{15^2+40^2}=57.72$ |

Hence section 'Q' is the most critical, as the equivalent moment is highest on it.

110. If $T_1$ and m represent the maximum tension and mass per unit length of a belt, then the maximum permissible speed of the belt is given by

(A) $\sqrt{\frac{T_1}{3m}}$ (B) $\sqrt{\frac{3T_1}{m}}$ (C) $\sqrt{\frac{2T_1}{3m}}$ (D) $\sqrt{\frac{T_1}{m}}$

Key: (A)

Exp: maximum permissible speed of the belt $=\sqrt{\frac{T_1}{3m}}$

111. The efficiency of a power screw is maximum, when the lead (helix) angle is

(A) $\frac{\pi}{2}-\frac{\Phi}{2}$ (B) $\frac{\pi}{2}-\Phi$ (C) $\frac{\pi}{4}-\frac{\Phi}{2}$ (D) $\frac{\pi}{4}-\Phi$

where $\Phi$ is friction angle.

Key: (C)

Exp: In power screws, lead angle $=\frac{\pi}{4}-\frac{\Phi}{2}$

112. Consider that a wire rope is subjected to the following stresses:

(i) Direct stress on account of axial force

(ii) Bending stress

(iii) Stress due to acceleration of the moving mass

Which of the above are correct?

(A) 1 and 2 only (B) 1 and 3 only

(C) 2 and 3 only (D) 1,2 and 3

Key: (D)

Exp: In case of wire rope, These 3 cases needed

(i) Direct stress on account of axial force

(ii) Bending stress

(iii) Stress due to acceleration of the moving mass

113. When a shaft rotates in anti-clockwise direction at high speed in a bearing, it will

(A) move towards right of the bearing making metal to metal contact

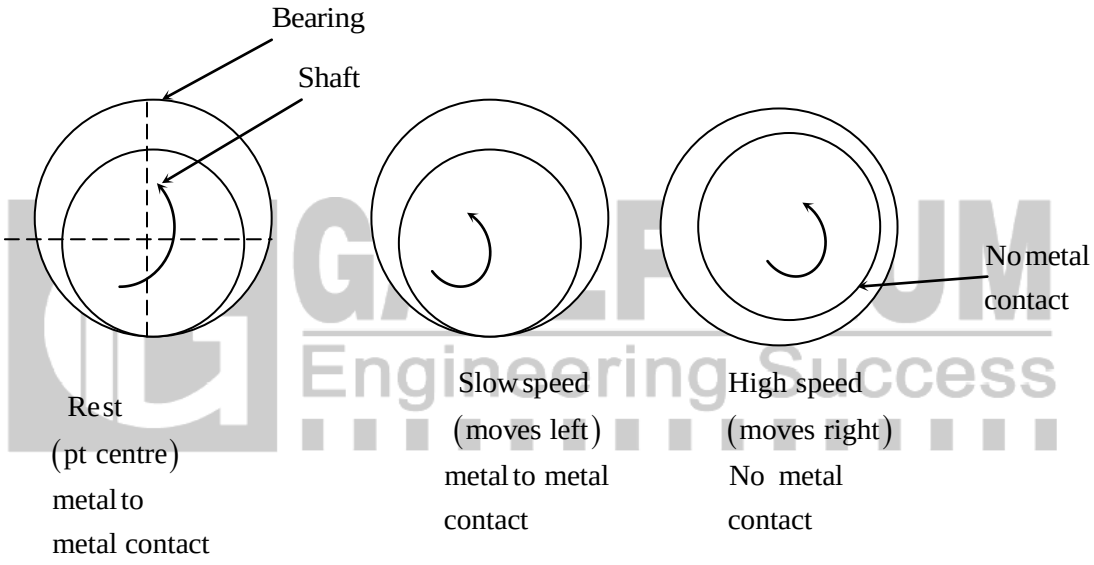
(B) have contact at the lowest point of the bearing

(C) move towards left of the bearing making metal to metal contact

(D) move towards left of the bearing making no metal to metal contact

Key: (D)

Exp:




Hence correct option should be: - "moves towards right with no metal contact"

But none of the option is that and hence closest option is 'D' which can be picked up.

114. The load on a gear tooth is 50 kN. If the gear is transmitting a torque of 6000 Nm, the diameter of the gear is approximately (consider pressure angle as $20^O$ and cos $20^O$ = 0.94)

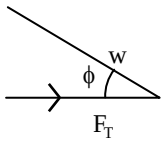
(A) 0.5m (B) 0.75m (C) 1 m (D) 0.25 m

Key: (D)

Exp: $T = w\cos\phi \times \frac{d}{2}$

$6000 = 50000 \times 0.94 \times \frac{d}{2}$

$d = 0.25\,m$



115. In a particular application the shaft is subjected to bending loads and also large axial loads. The bearing suitable for supporting such a shaft is

(A) thrust bearing

(B) tapered roller bearing

(C) ball bearing

(D) spherical roller bearing

Key: (B)

Exp: Bending loads and large axial loads are examples of tapered roller bearing

116. A hole of diameter 35mm is to be punched in a sheet metal of thickness t and ultimate shear strength 400 MPa, using puching force of 44kN. The maximum value of t is

(A) 0.5 mm (B) 10 mm (C) 1 mm (D) 2 mm

Key: (C)

Exp: $F = \tau_{max} \pi dt$

$44000 = 400 \times \pi \times 35 \times t$

$t = 1mm$

117. Two principal tensile stresses of magnitude 40 MPa and 20 MPa are acting at a point across two perpendicular planes. An oblique plane, makes an angle of $30^O$ with the major principal plane. The normal stress on the oblique plane is

(A) 8.66 MPa (B) 17.32 MPa (C) 35.0 MPa (D) 60.0MPa

Key: (C)

Exp: $\sigma_x = \left(\frac{\sigma_x + \sigma_y}{2}\right) + \left(\frac{\sigma_x - \sigma_y}{2}\right)\cos 2\theta$

$\therefore \sigma_n = \frac{40+20}{2} + \frac{40-20}{2}\cos 60°$

$\therefore \sigma_n = 35\,MPa$

118. The state of stress at a point under plane stress condition is

Okabe stress condition is

$\sigma_{xx} = 60\,MPa,\ \sigma_{yy} = 120\,MPa$ and $\tau_{xy} = 40\,MPa$

The radius of Mohr's circle representing the given state of stress in MPa is

(A) 40 (B) 50 (C) 60 (D) 120

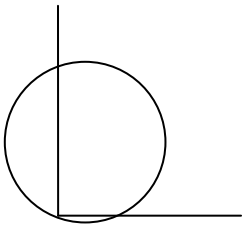
Key: (B)

Exp: $R = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau^2}$ $\therefore R = \sqrt{\left(\frac{60-120}{2}\right)^2 + 40^2}$

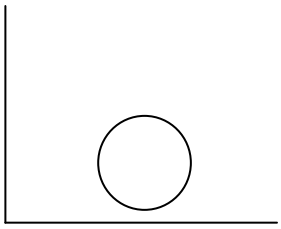
$\therefore R = 50$

119. Which of the following figure may represent Mohr's circle?

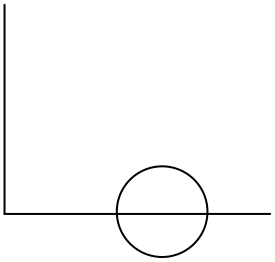
(A)



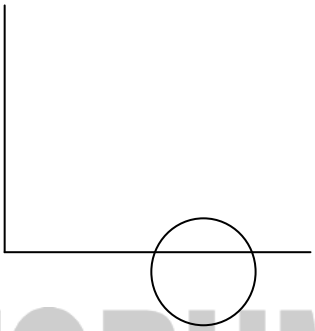
(B)



(C)



(D)



Key: (C)

120. If Mohr's circle is drawn for the shear stress developed because of torque applied over a shaft, then the maximum shear stress developed will be equal to

(A) diameter of the Mohr's circle

(B) radius of the Mohr's circle

(C) half of the radius of the Mohr's circle

(D) 1.414 times radius of the Mohr's circle

Key: (B)

Exp: Radius of mohr circle = maximum shear stress.