

AE/JE Foundation

Mechanical Engineering

Manufacturing & Engineering
Materials

▶ Top 100
Most Expected Questions

1. A 100 mm long, 15 mm diameter stainless steel rod is being turned to 12 mm diameter. The spindle rotation at 350 rpm with the tool traversing at an axial speed of 150 mm/min, then the metal removal rate is ____mm³/min.



- A. 356.43
B. 159.04
C. 212.33
D. 9542.58

Ans. D

Sol. Velocity: $V = 150 \text{ mm/min}$

$$\text{MRR} = x/s \times \text{Axial velocity}$$

$$= \frac{\pi}{4} (D_1^2 - D_f^2) \times V$$

$$= \frac{\pi}{4} (15^2 - 12^2) \times 150$$

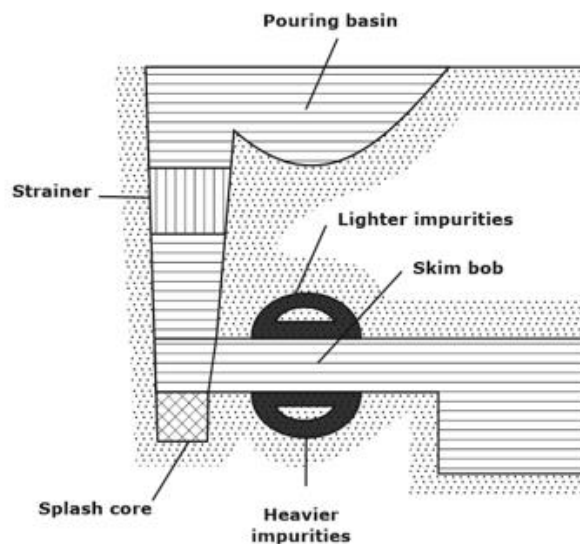
$$\text{MRR} = 9542.58 \text{ mm}^3/\text{min}$$

2. Which of the following has correct sequence in gating design _____.
- A. Sprue → Runner → splash core → skim bob
B. Sprue → sprue base well → gate → strainer
C. Splash core → Runner → skim bob → strainer
D. Pouring Basin → strainer → sprue → splash core

Ans. D

Sol. Correct sequence of the Gating design is:

Pouring Basin → strainer → Sprue → splash core → runner → skim bob → gate → cavity



3. Match list – 1 (Defects) with list – 2 (causes) and select the correct answer using the codes given below

Sol. **Non pressurized gating system:**

— A non-pressurised gating system has choke area (minimum area) at the bottom of the sprue base and have total runner area and in-gate areas higher than the sprue area.

— In this system, there is no pressure existing in the metal-flow system and thus it helps to reduce turbulence. Due to low turbulence oxides formation will not takes place thus we can **cast Non-Ferrous alloys such as aluminium and magnesium alloys.**

— The gating ratio of a typical example are Sprue: Runner: In-gate:: 1:4:4, 1:2:2, 1:2:4, 0.5:1.5:1

7. A 5 mm thick metal sheet is to be bent at an angle of 120° with a bend radius of 100 mm. If the stretch factor is 0.6, the bend allowance is (take $n = 3$ radians).

- A. 100mm
- B. 103 mm
- C. 200 mm
- D. 206 mm

Ans. D

Sol. The bend allowance is given by:

$$L_b = \alpha(R + kt)$$

Where,

α = angle made of bend

R= Bend radius

k = stretch factor

t = plate Thickness

As the angle traversed is $2\pi/3=2$ radian

k = 0.6 , R=100 mm and t=5 mm

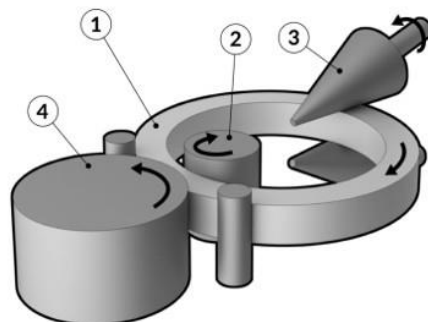
Thus, $L_b = 2 \times (100 + 0.6 \times 5) = 206\text{mm}$

8. Ring Rolling is used _____.

- A. To decrease the thickness and increase diameter
- B. To increase the thickness of a ring.
- C. For producing a seamless tube
- D. For producing large cylinder

Ans. A

Sol. Ring rolling is a particular category of metal rolling, in which a ring of smaller diameter is rolled into a precise ring of larger diameter and a reduced cross section.



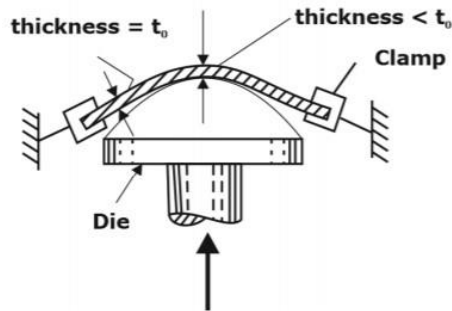
Ring gauge: For gauging external dimensions.

Gap gauge: For gauging the gaps and grooves.

12. Stretch forming is a process in which _____.
- A. All deformations occur in the direction of stretch
 - B. All forces are applied in the direction of stretch
 - C. Advantage is taken of plastic state indicated due to stretch
 - D. no dies are used

Ans. A

Sol. — Stretch forming is a metal forming process in which a piece of sheet metal is stretched and bent simultaneously over a die in order to form large contoured parts.



— As the form die is driven into the sheet, which is gripped tightly at its edges, the tensile forces increase and the sheet plastically deforms into a new shape. The method can only create surfaces with radii in one direction.

13. Solidification of casting with complex details is not uniform but it is accompanied by warping distortions. This factor is compensated in pattern as _____.
- A. solidification allowance
 - B. camber allowance
 - C. draft
 - D. shake allowance

Ans. B

Sol. Distortion allowances, also called camber allowance, takes into account this warping or distortion.

14. The point $(\sqrt{2}, \sqrt{2}, 0)$ when rotated 45° anti-clockwise about z-axis becomes _____.
- A. $(0, \sqrt{2}, 0)$
 - B. $(0, 0, \sqrt{2})$
 - C. $(\sqrt{2}, 0, 0)$
 - D. $(0, 2, 0)$

Ans. D

Sol. Given:

Point: $[x, y, z] = [\sqrt{2}, \sqrt{2}, 0]$

Pre multiplication matrix for rotation about z-axis counterclockwise by angle ' θ ' is:

$$[R_{z,\theta}] = \begin{bmatrix} \cos \theta & -\sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Calculating new point after rotation by angle: $\theta = 45^\circ$

$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} \frac{1}{\sqrt{2}} & \frac{-1}{\sqrt{2}} & 0 \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \sqrt{2} \\ \sqrt{2} \\ 0 \end{bmatrix} = \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix}$$

15. Match list 1 with list 2 and select the correct answer using the codes given below

List 1	List 2
a) annealing	1) refined grain structure
b) nitriding	2) improve the hardness of the whole mass
c) martempering	3) increase surface hardness
d) normalizing	4) improve ductility

- A. A-4 B-3 C-2 D-1
- B. A-1 B-3 C-4 D-2
- C. A-4 B-2 C-1 D-3
- D. A-2 B-3 C-4 D-1

Ans. A

Sol. Annealing improves ductility

Nitriding is used to increase surface hardness

Martempering increase the hardness of the whole mass

Normalizing is used to refine the grain structure

16. In gas welding , oxidizing flame is define as the welding process in which the ratio of oxygen is more than acetylene that comes out from torch of the welding machine and is generally use to weld which material _____.

- A. Steel
- B. Iron
- C. Copper alloy
- D. Aluminium alloy

Ans. C

Sol. — Oxidizing welding flames are produced when slightly more than one volume of oxygen is mixed with one volume of acetylene.

— An oxidizing flame can be recognised by its hissing sound.

— The temperature of this flame is approximately 3482°C at the inner cone tip.

— **Materials application:** Zinc (Zn), Copper (Cu), Manganese steel, cast iron, Brass, Cu-Sn.

17. The braze welding offers the strength _____.

- A. Greater than base metal.
- B. Lower than solder joint.
- C. Greater than braze joint.
- D. Same as fusion weld joint.

Ans. C

Sol. — Braze welding is similar in which the joint is formed by means of a filler metal, whose liquidus temperature is above 450° C and below solidus temperature of base metal.

Sol. Given:

Extrusion Constant (K) or $\sigma_0 = 400 \text{ MPa}$,

Initial diameter: $d_0 = 100 \text{ mm}$

Final diameter: $d_f = 50 \text{ mm}$

$$\text{Extrusion force (F)} = 2A_0\sigma_0 \ln\left(\frac{d_0}{d_f}\right)$$

$$\text{Since: } A_0 = \frac{\pi}{4}(d_0^2) = \frac{\pi}{4}(100^2) = 7853.981 \text{ mm}^2$$

$$F = 2 \times 7853.981 \times 400 \times \ln\left(\frac{100}{50}\right)$$

$$F = 4.35 \text{ MN}$$

22. For obtaining a cup of diameter 25 mm and height 15 mm by drawing, the size of the round blank should be approximately _____.

- A. 42 mm
- B. 44 mm
- C. 46 mm
- D. 48 mm

Ans. C

Sol. Given,

Cup diameter: $d = 25 \text{ mm}$

Cup height: $h = 15 \text{ mm}$

The blank diameter is obtained by:

$$D = \sqrt{d^2 + 4dh} = \sqrt{(25)^2 + 4(25)(15)} = 46 \text{ mm}$$

23. Which of the following element has FCC crystal structure _____.

- A. Mg
- B. Co
- C. Pt
- D. Cr.

Ans. C

Sol.

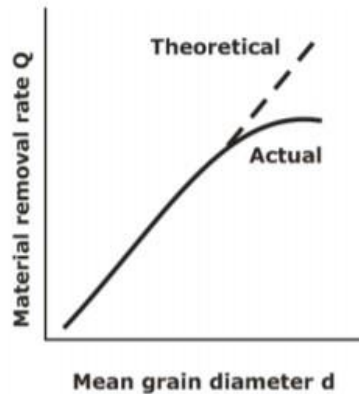
Structure	Examples
Simple cubic (SC)	Polonium (Po), α -Mo
Body-centred Cubic (BCC)	Fe, W, Nb, Ta, K, Na, V, Cr
FCC	Cu, Au, Pt, Ag, Pb, Ni
HCP	Ti, Mg, Zn, Co, Zr, Cd

24. In USM process, then material removal rate (MRR) variation with increasing grain size _____?

- A. Increasing
- B. Decreasing
- C. First increasing & then decreasing
- D. Constant

Ans. C

Sol. MRR rises proportionately with the mean grain diameter. However, when d becomes too large and approaches the magnitude of amplitude A , it's crushing tendency increases, resulting in a fall in the MRR.



25. The time required (t_m) for the surface to reach the melting temperature (θ_m) is given by the expression _____. Where k = thermal conductivity, α = thermal diffusivity of material.

A. $\frac{1}{\alpha} \left(\frac{\theta_m k}{2H} \right)^2$

B. $\frac{\pi}{\alpha} \left(\frac{\theta_m k}{2H} \right)^2$

C. $\frac{\pi}{\alpha} \left(\frac{\theta_m k}{2H} \right)^{1/2}$

D. $\frac{1}{\alpha} \left(\frac{\theta_m k}{2H} \right)^{1/2}$

Ans. B

Sol. The time required (t_m) for the surface to reach the melting temperature (θ_m) is given by the expression:

$$t_m = \frac{\pi}{\alpha} \left(\frac{\theta_m k}{2H} \right)^2$$

Where:

k = thermal conductivity

α = thermal diffusivity of material.

H = heat flux

26. Arc blow is _____.

A. A casting defect

B. A welding defect

C. A forging defect

D. A fitting defect

Ans. B

Sol. — Arc blow is the undesirable effect of arc stream wandering from the shortest path between the electrode and the workpiece and is deflected forward or backward from the direction of travel.

— It is due to both the magnetic and thermal effects.

27. When alloys solidify over a short range of temperatures, they form _____.

A. a wholly columnar structure

B. a wholly dendritic structure

- C. partially columnar and partially dendritic structure
- D. none of the above

Ans. A

Sol. When alloys solidifies over a short range of temperature, it results into a wholly columnar structure. But over a wide range of temperature, they form a dendritic structure.

28. Which one of the following methods are used for obtaining directional solidification for riser design:

- 1. Suitable placement of chills
- 2. Suitable placement of chaplets
- 3. Employing padding

Select the correct answer?

- A. 1 and 2
- B. 1 and 3
- C. 2 and 3
- D. 1, 2 and 3

Ans. B

Sol. — Chaplets are used to support cores inside the mold cavity to take care of its own weight and overcome the metallic forces.

— Directional solidification can be achieved by using chills in the molds and exothermic materials in the risers or in facing sand and also by increasing thickness of certain sections by using exothermic padding.

29. During monotectic solidification, one liquid _____.

- A. combines with one solid to form a second new solid
- B. solidified into two different solids
- C. forms one solid
- D. forms one solid and another liquid of different Composition

Ans. D

Sol. — In monotectic reaction, a liquid transforms into another liquid of different composition and a solid phase precipitates out on cooling.

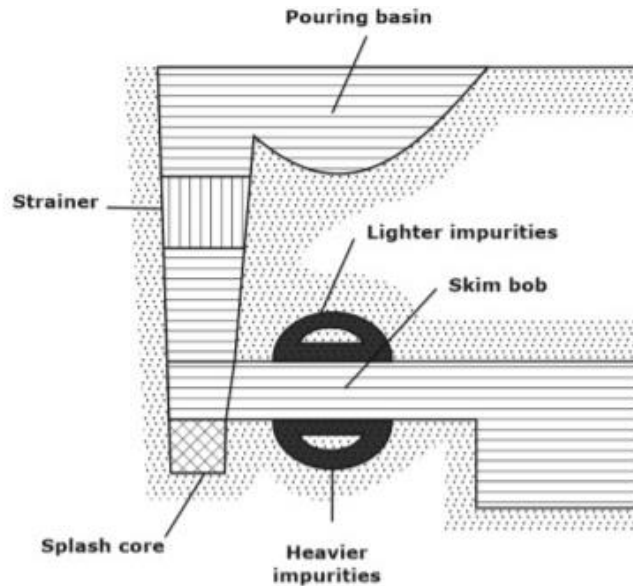
— On heating, reversible process takes place.

30. In metal casting "Skim Bob" is used for which of the following purposes _____.

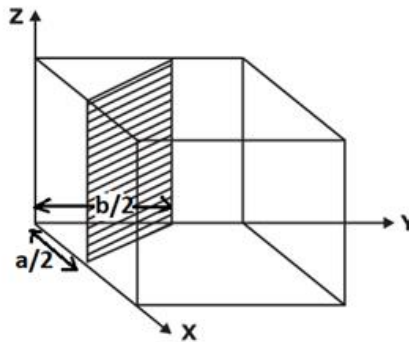
- A. Removing heavier impurities
- B. Removing lighter impurities
- C. Both a & b
- D. None of the above

Ans. C

Sol. — Skim bob is a trap placed in a horizontal gate to prevent heavier and lighter impurities from entering the mould.



31. Choose the miller indices of the plane shown in figure.



- A. [110]
- B. [2 1 0]
- C. [1 2 0]
- D. [2 2 0]

Ans. D

Sol. Intercept of parameters = $\frac{a}{2}, \frac{b}{2}, \infty$

$$\text{Reciprocal of Intercepts} = a \times \frac{2}{a}, b \times \frac{2}{b}, \frac{1}{\infty} = 2, 2, 0$$

Miller indices $\Rightarrow [2 2 0]$

32. The process of making hollow casting of desired thickness by permanent mould without the use of cores is known as _____.

- A. die casting
- B. slush casting
- C. pressed casting
- D. centrifugal casting

Ans. B

Sol. — Slush casting is a variant of permanent mold casting to **create a hollow casting or hollow cast**. It is used widely for production of hollow casting without the use of core.

— True centrifugal casting—the standard centrifugal casting method—is used **to create symmetrical round hollow parts, such pipes and tubes**. The process does not require

— This is the ability of the steel to partially or to completely transform from austenite to some fraction of martensite at a given depth below the surface, when cooled under a given condition from high temperature.

36. In a CNC machine tool, the function of an interpolator is to generate _____.
- NC code from the part drawing during post processing.
 - error signal for tool radius compensation during machining.
 - signal for the lubrication pump during machining
 - reference signal prescribing the shape of the part of the machined.

Ans. D

Sol. — The interpolator coordinates the motion along the machine axes, which are separately driven, by providing reference positions instant by instant for the position-and velocity-control loops, to generate the required machining path.

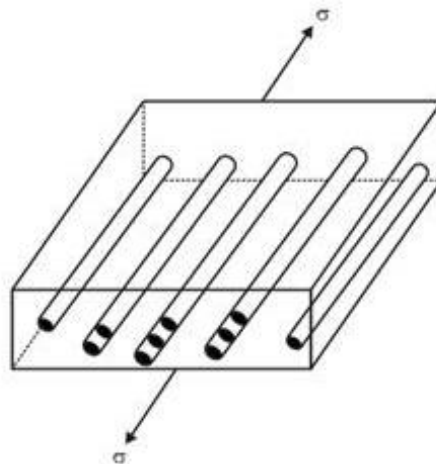
— Typical interpolators are capable of generating linear and circular paths.

37. A continuous, aligned carbon fibre (CF) reinforced polymer composite with 25 vol% of CF and rest resin was designed for a specific application. The modulus of elasticity of CF is 180 GPa and that of resin is 4.0 GPa. The modulus of elasticity for this composite in the direction of fibre alignment is _____ GPa.

- | | |
|-----------|-------------|
| A. 15 GPa | B. 5.29 GPa |
| C. 48 GPa | D. 136 GPa |

Ans. C

Sol.



In the direction of loading, Young's modulus of composite is given by:

$$E_c = \alpha_{CF} E_{CF} + \alpha_R E_R$$

Where:

α_{CF} = volume fraction of carbon fibre

α_R = Volume fraction of Resin

$$\alpha_{CF} = 0.25$$

$$\alpha_R = 1 - 0.25 = 0.75$$

Thus, $E_c = 0.25 \times 180 + 0.75 \times 4$

$E_c = 45 + 3$

$E_c = 48 \text{ GPa}$

38. Which of the following is used as flux material in soldering _____?

- A. Borax
- B. Zinc chloride
- C. Lead and tin.
- D. Copper and zinc

Ans. B

Sol. — To remove the oxides from joint surfaces and to prevent the filler material from oxidising, fluxes are used in soldering.

— The organic fluxes such as zinc chloride are quick acting produce efficient Joint. But because of their corrosive nature, the joint should be thoroughly cleaned of entire flux residue from joint.

39. Two 8 mm thick steel plates are placed 5 mm apart and welded by a butt joint. Welding is carried out at 20 V. Heat transfer efficiency is 0.80. If the heat required to melt steel is 10 J/mm³ and melting efficiency is 0.625. The weld current is 200 A. The welding speed (in mm/s) is _____.

- A. 5
- B. 10
- C. 15
- D. 20

Ans. A

Sol. Given,

Heat required to melt steel: $H_m = 10 \text{ J/mm}^3$

Energy utilized as heat:

Heat transferred to steel:

$H_t = 0.8 \times V I = 0.8 \times 20 \times 200$

$H_t = 3200 \text{ J}$

Melting efficiency is given by:

$$\eta_m = \frac{H_m}{\frac{H_t}{Av}} = \frac{H_m}{\frac{VI}{Av}} \times \eta_t$$

$$v = \frac{H_t \times \eta_m}{A \times H_m} = \frac{3200 \times 0.625}{8 \times 5 \times 10}$$

$v = 5 \text{ mm/sec}$

40. Two abrasive particles have diameter 2 mm and 4 mm respectively. What will be the ratio of their respective Material removal rates in the ultrasonic machining _____?

- A. 1:2
- B. 2:1
- C. 8:1
- D. 1:8

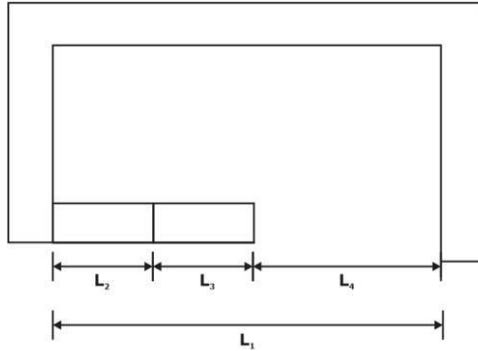
Ans. D

Sol. As the material removal rate is directly proportional to the cube of diameter of the abrasive grains.

$$Q \propto d^3$$

$$\frac{Q_1}{Q_2} = \left(\frac{d_1}{d_2}\right)^3 \Rightarrow \frac{Q_1}{Q_2} = \left(\frac{1}{2}\right)^3 \Rightarrow \frac{Q_1}{Q_2} = \frac{1}{8}$$

41. In the assemble shown below, the part dimensions are: $L_1 = 24.0^{\pm 0.002}$ mm, $L_2 = 11^{\pm 0.006}$ mm, and $L_3 = x^{\pm 0.004}$ mm,



Assuming the normal distributions of part dimension, the maximum dimension L_4 is 5.012 mm, then minimum dimension L_4 (in mm) is _____.

- A. 5.988
B. 5.024
C. 4.988
D. 7.998

Ans. C

Sol. Given $L_1 = 24^{\pm 0.002}$ mm

$$L_2 = 10^{\pm 0.006}$$
 mm

$$L_3 = x^{\pm 0.004}$$
 mm

And maximum $L_4 = 5.012$ mm

$$\text{Now: } (L_4)_{\max} = (L_1)_{\max} - (L_2)_{\min} - (L_3)_{\min}$$

$$5.012 = 24.002 - (10 - 0.006) - (x - 0.004)$$

$$5.012 = 14.02 - x$$

$$x = 14.012 - 5.012$$

$$x = 9 \text{ mm}$$

$$\text{Thus, } L_{\min} = (L_1)_{\min} - (L_2)_{\max} - (L_3)_{\max}$$

$$L_{\min} = (23.998) - (10.006) - (9 + 0.004)$$

$$L_{\min} = 4.988$$

42. In a rolling operation using rolls of diameter of 480 mm, if a thick plate cannot be reduced to less than 18 mm when coefficient of friction is 0.16 between the plate and rolls. Now, if friction is increased by 15% after continuous operation then the final thickness (in mm) that can be achieved in a single pass is _____.

- A. 23.81 mm
B. 14.65 mm
C. 8.13 mm
D. 16.02 mm

Ans. D

Sol. Given,

$$h_f = 18 \text{ mm}$$

Ans. C

Sol. The codes for corresponding option are M00, M01, M02

G-code	Description	M-Code	Description
G00	Rapid traverse	M00	Program Stop
G01	Linear Interpolation	M01	Optional Program stop
G02	Circular Interpolation (CW)	M02	End of Program
G03	Circular Interpolation (CCW)	M03	Spindle start forward CW
G04	Dwell	M04	Spindle start reverse CCW
G40	Tool cutter compensation off	M05	Spindle stop
G41	Tool cutter compensation left	M06	Too change
G42	Tool cutter compensation right	M07	Coolant ON – Mist coolant
G90	Absolute programming of XYZ	M08	Coolant ON – Flood coolant
G91	Incremental programming of XYZ	M09	Coolant OFF

46. Match the following:

List-I		List-II	
P.	Quick return mechanism	1.	Lathe
Q.	Apron mechanism	2.	Milling machine
R.	Indexing mechanism	3.	Shaper
S.	Regulating wheel	4.	Centerless grinding

A. P-3, Q-2, R-1, S-4

B. P-2, Q-3, R-4, S-1

C. P-3, Q-1, R-2, S-4

D. P-4, Q-2, R-3, S-1

Ans. C

Sol. — Quick return mechanism is used where there is a need to convert rotary motion into reciprocating motion. It is used in Shaper.

— Apron Mechanism is used in Lathe in which Apron is attached to the carriage and hangs over the front side of the lathe bed. It is useful in providing power and hand-feed to both carriage and cross-slide. It is also used to provide power feed to the carriage during thread cutting through two half nuts.

— Indexing mechanisms generally converts a rotating or oscillatory motion to a series of step movements of the output link or shaft. It is used in milling machine.

— Regulating wheel is used in centerless grinding.

47. Match the following List-I and List-II

List-I		List-II	
A.	LVDT	1.	Small angular deviation on long flat surface
B.	McLeod Gauge	2.	Displacement
C.	Auto Collimators	3.	Vacuum
D.	Diffraction grating	4.	Area
E.	Planimeter	5.	Measurement of very small displacement

A. A-2,B-3,C-1,D-5,E-4

B. A-1,B-2,C-3,D-5,E-4

C. A-3,B-1,C-2,D-5,E-5

D. A-4, B-1,C-3,D-2,E-5

Ans. A

Sol. — **A planimeter**, also known as a platometer, is a measuring instrument used to determine the area of an arbitrary two-dimensional shape.

— **An autocollimator** is an optical instrument that is used to measure small angles with very high sensitivity. It also measures the straightness of a beam and detection of angular movement.

— **The McLeod Gauge** is used to measure vacuum pressure. It is also used mainly for calibrating other inferential type of gauges.

— Linear variable differential transformers (**LVDT**) are used to measure displacement.

48. What is the optimum tool life for maximum production (in min), if the Taylor's tool life exponent is 0.4 and tool changing time is 1.2 min _____.

- A. 1.2
- B. 1.4
- C. 1.8
- D. 1

Ans. C

Sol. For max. production, Optimum tool life is given by:

$$T_o = T_c \left(\frac{1-n}{n} \right)$$

$$T_o = 1.2 \times \left(\frac{1-0.4}{0.4} \right)$$

$$T_o = 1.8 \text{ min}$$

49. Match **List-I** with **List-II** and select the correct answer using the codes given below the Lists:

List-I		List-II	
A.	Lathe	1.	Flute
B.	Shaper	2.	Universal indexing
C.	Drilling machine	3.	Leadscrew
D.	Milling machine	4.	Rocker arm

- A. A-2, B-4, C-1, D-3
- B. A-3, B-4, C-1, D-2
- C. A-2, B-1, C-4, D-3
- D. A-3, B-1, C-4, D-2

Ans. B

Sol. **Machine Process**

Lathe : Leadscrew

Shaper : Rocker arm

Drilling machine : Flute

Milling machine : Universal indexing

50. For a welding operation, the area of penetration and the area of reinforcement is 100 mm² and 60 mm² respectively. Find the % dilution for the welding operation_____.

- A. 80
- B. 12.5
- C. 55
- D. 62.5

Ans. D

Sol. Given,

Area of penetration (A_p) = 100 mm²

and Area of reinforcement (A_r) = 60 mm²

$$\% \text{Dilution} = \frac{A_p}{A_p + A_R} \times 100$$

$$\% \text{Dilution} = \left(\frac{100}{100 + 160} \right) \times 100 = 62.5\%$$

51. Fluidity of melt increases with increase of which parameter _____.

- A. freezing range
- B. surface tension
- C. degree of superheat
- D. viscosity

Ans. C

Sol. **Fluidity:** It is an ability of metals and alloys to flow through the gating system filling the cavity of the casting mold and conforming its shape.

Affecting parameters:

- (a) **Viscosity:** As viscosity and its sensitivity to temperature (viscosity index) increase, fluidity decreases.
- (b) **Surface tension:** A high surface tension of the liquid metal reduces fluidity.
- (c) **Inclusions:** As insoluble particles, inclusions can have a significant adverse effect on fluidity.
- (d) **Solidification pattern of the alloy:** Fluidity is inversely proportional to the freezing range. Thus, the shorter the range (as in pure metals and eutectic), the higher the fluidity becomes.
- (e) **Degree of super heat:** Higher the degree of superheat, higher will be fluidity.

52. For straight line VI characteristics for DC welding, if short circuit current is 500 A and open circuit voltage is 500 V. Then the value of maximum power is _____ kW.

- A. 6.25
- B. 2.50
- C. 62.5
- D. 25

Ans. C

Sol. Since VI characteristic is linear. Thus:

$$\frac{V}{V_{oc}} + \frac{I}{I_{sc}} = 1$$

OC = open circuit voltage

SC = short circuit current

$$V = 500 \times \left(1 - \frac{I}{500} \right) = 500 - I$$

$$\text{Power} = VI = (500 - I)I$$

$$\therefore P = 500I - I^2$$

For maximum power:

$$\frac{dP}{dI} = 0 = 500 - 2I$$

$$\therefore I = 250A \text{ and } V = 250V$$

$$\therefore P_{\max} = 250 \times 250W = 62.5kW$$

53. Match **List-I** (Machining Process) with **List-II** (Application) and select the correct answer using the code give below the lists:

List-I		List-II	
A.	EDM	1.	Holes and cavities in hard and brittle materials
B.	LBM	2.	Micro-drilling and micro-welding of materials
C.	USM	3.	Shaping of hard metals or reshaping of cemented carbide tools
D.	ECM	4.	Shaping of cemented carbide dies and punches

A. A-4, B-1, C-2, D-3

B. A-3, B-2, C-1, D-4

C. A-4, B-2, C-1, D-3

D. A-3, B-1, C-2, D-4

Ans. C

Sol. — **EDM** : Shaping of hard metal or alloy steel reshaping of cemented carbide dies, used for moulding, forging, extrusion, wire drawing.

— **LBM** : Micro-drilling and micro welding of material.

— **USM** : Ultrasonic machining is best process for making hole in glass. It can be used for drilling precise hole and ductility in hand and brittle material.

— **ECM** : Shaping of hard metal or reshaping of cemented combine tools.

54. A casting of size 100 x 50 x 50 cm was filled by top gates with manometric height in pouring basin to be 25 cm. find the time (in sec) to fill the casting. The area of gate is 5 square cm.

A. 225.76

B. 451.7

C. 332.8

D. 250

Ans. A

Sol. In the top gating system, Filling time is given by:

$$t_f = \frac{V_m}{v_g A_g}$$

Where:

V_m : Volume of mold

A_g : Gate area

Velocity at gate (v_t) = $\sqrt{2gh_t}$

$$\text{Thus: } t_f = \frac{100 \times 50 \times 50}{5 \times \sqrt{2 \times 981 \times 25}} = 225.76\text{sec}$$

55. Consider a solid cylinder of diameter 100 mm and height 200 mm. The shape factor for this cylinder is _____.

- A. 1
- B. 2
- C. 3
- D. 4

Ans. C

Sol. Shape factor is given as:

$$SF = \frac{L + W}{T}$$

Where: Length (L) = Height of the cylinder (H)

Width (W) = diameter of the cylinder (D)

Thickness (T) = D

$$\text{Shape factor} = \frac{D + H}{D} = \frac{100 + 200}{100} = 3$$

56. A shaft of 50 mm diameter and 80 cm long is turned in 50 cm length for making the tapered shaft using the tailstock offset. If the diameter at the smaller end be 30 mm then offset required will be _____.

- A. 4 mm
- B. 8 mm
- C. 16 mm
- D. 24 mm

Ans. C

Sol. The tailstock offset is given by:

$$S = \left(\frac{D - d}{2} \right) \times \frac{L_w/p}{1}$$

Where d is diameter at smaller end.

l = taper length

$$S = \left(\frac{50 - 30}{2} \right) \times \frac{80}{50} = \frac{20}{2} \times \frac{80}{50} = 16\text{mm}$$

57. A GTAW of steel is carried with welding current of 200A, 20V and weld speed of 10 mm/min. What will be heat input per unit length _____ (in kJ/mm)?

- A. 16
- B. 20
- C. 24
- D. 28

Ans. C

Sol. Heat per unit length is given by:

$$P = \frac{VI}{\text{speed}} = \frac{200 \times 20}{\frac{10}{60}} = 24\text{kJ / mm}$$

58. Consider the following statements:

1. Porosity in the metal is largely eliminated.
2. Strength is decreased.
3. Close tolerances cannot be maintained.

Which of the above characteristics of hot working is/are correct _____?

- A. 1 only
- B. 3 only
- C. 2 and 3
- D. 1 and 3

Ans. D

Sol. **Hot Working:**

Hot Working is done at temperatures above the recrystallization temperature of the metal, hence deformation of metal and recovery takes place simultaneously.

Hot working properties:

- (i). Greater ductility of material is available, and therefore more deformation is possible.
- (ii). Defects in the metal such as blowholes, internal porosity and cracks get removed or welded up during hot working.
- (iii). Poor accuracy and dimensional control of parts, hence close dimensional tolerances cannot be maintained.

59. Match the list I with List II and select the correct answer from the codes given in the lists below

List-I (Measuring instruments)		List-II (Applications)	
a.	Talysurf	1.	T slots
b.	Telescopic gauge	2.	Flatness
c.	Transfer Calipers	3.	Internal Diameter
d.	Autocollimator	4.	Roughness

- A. a-1 b-2 c-3 d-4
- B. a-4 b-3 c-1 d-2
- C. a-4 b-3 c-2 d-1
- D. a-3 b-4 c-1 d-2

Ans. B

Sol. — Talysurf is a simple to operate high accuracy instrument capable of roughness and waviness measurement.

- Telescopic gauge is used to measure internal diameter of hole.
- Transfer Calipers is used to measure used to measure inside recesses or over projections in T slots.
- Autocollimator is used to measure flatness of surface.

60. Internal gears can be made by _____.

- A. Hobbing
- B. Gear shaping with rack cutter
- C. Gear shaping with pinion cutter
- D. Gang milling

Ans. C

Sol. — Internal gears will be made by gear shaping with pinion cutter.
 — Straight or helical teeth of both external and internal spur gears can be produced by gear shaping with high accuracy and finish.
 — It also provides productivity is also higher.

61. Power source for welding rated at 500A and 60% duty cycle. Then maximum output current that can be drawn at 100% duty cycle from same power source is _____A.
- A. 464.7
 - B. 833.3
 - C. 387.3
 - D. 300.0

Ans. C

Sol. Given,

D_R = rated duty cycle = 60%

D_D = desired duty cycle = 100%

I_R = rated current form source = 500A

I_D = desired current form source

Now, $D \propto \frac{1}{I^2}$

$$\therefore D_R I_R^2 = D_D I_D^2$$

Solving we get, $I_D = 387.298 \text{ A}$

62. The statement that best describes the function of a GO gauge in the context of Taylor's principle of gauging is,
- A. GO gauge checks the maximum material condition and is designed to check as many dimensions as possible.
 - B. GO gauge checks the Least material condition and is designed to check as many dimensions as possible.
 - C. GO gauge checks the maximum material condition and is designed to check only one dimension.
 - D. GO gauge checks the Least material condition and is designed to check only one dimension.

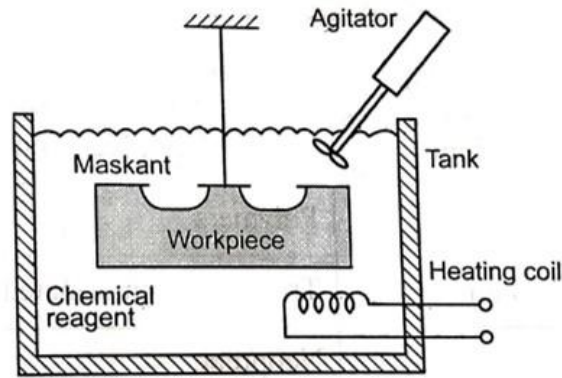
Ans. A

Sol. — According to Taylor's principle, GO gauge is designed for Maximum Material Condition and can check as many dimensions as possible while a NOGO gauge is for least material condition and for only one dimension.

63. In chemical machining is material removal takes by _____?
- A. Chemical reaction
 - B. Erosion
 - C. Electron removal
 - D. None of the mentioned

Ans. A

Sol. Chemical Machining is the process of removal of material from the workpiece using chemical reactions by immersing the workpiece into a chemical solution (called Etchant) and surface not to be machined are protected using the Maskant (chemical resistant coatings).



64. The ratio of solidification time of a cube to that of sphere made up of same material is 1:2. Find the ratio of their surface areas _____.

- A. 1.053
- B. 0.950
- C. 0.850
- D. 1.176

Ans. B

Sol. Solidification time is given by: $t_s = x \left(\frac{V}{A} \right)^2$

Where x is the material constant.

For Cube: $t_c = x \left(\frac{a^3}{6a^2} \right)^2$ (1)

Sphere: $t_s = x \left(\frac{\frac{4}{3} \pi r^3}{4\pi r^2} \right)^2$ (2)

Now by equation (1) and (2):

$$\frac{t_c}{t_s} = \frac{1}{2} = \frac{a^2}{36} \times \frac{9}{r^2} \Rightarrow r^2 = \frac{a^2}{2}$$

$$\therefore \text{Surface area ratio} = \frac{6a^2}{4\pi r^2}$$

$$\frac{A_{s,c}}{A_{s,sp}} = \frac{6}{4\pi} \times 2 = \frac{3}{\pi} = 0.95$$

65. The shear strength of a sheet metal is 350 MPa. The blanking force required to produce a blank of 120 mm diameter from a 2 mm thick sheet is close to _____.

- A. 26.4 kN
- B. 264 kN
- C. 84 kN
- D. 12 kN

Ans. B

Sol. Given,
 Shear strength: $\tau = 350 \text{ MPa}$
 Blank diameter: $d = 120 \text{ mm}$

Blank thickness: $t = 2 \text{ mm}$

Blanking force (F) is given by:

$$F = \pi d t r$$

$$F = \pi \times 120 \times 2 \times 10^{-6} \times 350 \times 10^6$$

$$F = 264 \text{ kN}$$

66. The mechanism on which servo meter works _____.

- A. Open loop
- B. Closed loop
- C. Both Open loop and Closed loop
- D. None of the above

Ans. B

Sol. — Servo motor works on the Pulse Width Modulation (PWM) principle i.e., its angle of rotation is controlled by the duration of pulse applied to its control PIN.

— A servo motor is a closed-loop servomechanism that uses position feedback to control its motion and final position.

67. Coefficient of friction in rolling operation is given as μ . What is its relation with the draft?

- A. Directly proportional to absolute draft
- B. Directly proportional to square root of absolute draft
- C. Inversely proportional to absolute draft
- D. Inversely proportional to square root of absolute draft

Ans. B

Sol. — Absolute draft is the difference between the initial and final heights of work-piece undergoing rolling operation.

— The relation with coefficient of friction is: $\Delta h = \mu^2 R$. Where, Δh is the draft, μ = coefficient of friction between rolls and work-piece and R is roll radius.

— Thus, $\mu = \sqrt{\frac{\Delta h}{R}}$

68. In an RC generator of EDM, the maximum charging voltage is 60 kV and the charging capacitor is 80 μF . Determine the spark energy (in MJ) _____ (correct to 3 decimal places).

- A. 0.72
- B. 1.44
- C. 0.144
- D. 144

Ans. C

Sol. Given,

Voltage (V) = $60 \times 10^3 \text{ V}$

Capacitance (C) = 80×10^{-6}

Power required: $P = \frac{1}{2} \times C \times V^2$

$$P = \frac{1}{2} \times 80 \times 10^{-6} \times [60 \times 10^3]^2 = 0.144 \text{ MJ}$$

69. The tumbler gear in the feed mechanism of lathe is provided _____.

- A. to change the tool post.
- B. to change the direction of the lead screw.
- C. to change the direction of the chuck.
- D. to change the spindle speed.

Ans. A

Sol. — The tumbler Gear Mechanism can be described as an arrangement of gear wheels which is used to reverse the direction of rotation of any machinery.

— Usually, to change the direction of feed rod and lead screw tumbler gear mechanism is used.

70. Which among the following is NOT the characteristics of non-traditional machine process _____?

A. The cutting tool needed to cut workpiece should be harder than workpiece.

B. Material removal takes place with chip formation.

C. It requires no physical tool.

D. The process uses mechanical energy to provide material removal.

Ans. A

Sol. — In non-traditional machining process, material removal occur with chip formation as in AJM, chips are of microscopic size are used.

— In this, there may not be physical tool present. The tools need not be harder than the work piece material as copper is used as tool material to machine hardened steels.

— The non-traditional machining process can utilize mechanical energy, thermal energy and chemical to provide material removal.

71. Jig bushes are _____.

A. the parts of a drill jig through which the cutting tools are operated and located

B. the locating devices used in jigs along with the fixture

C. the operating bushes in a jig

D. the locating and damping parts of a jig and fixture arrangement

Ans. A

Sol. — Jig bushes (generally referred as drill bushes) are used to locate and guide the tools like drills, reamer, and counterboring cutters.

— Mild steel is the common material for Drill bush and it is usually case hardened.

72. In drawing operation the initial diameter of the blank is given as 100 mm and the final diameter is 50 mm. if $\sigma_0 = 500$ MPa, then load required for operation will be _____.

A. 1360.74 kN

B. 1231.89 kN

C. 547.34 kN

D. 425.88 kN

Ans. A

Sol. Given,

$d_i = 100$ mm, $d_f = 50$ mm, $\sigma_0 = 500$ MPa

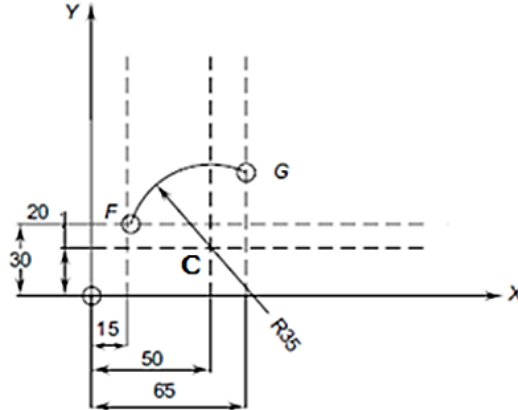
The drawing force is given by:

$$F_d = A_f \times \sigma_d = \frac{\pi}{4} d_f^2 \times \sigma_0 \times \ln\left(\frac{A_0}{A_f}\right)$$

$$F_d = \frac{\pi}{4} \times (0.05)^2 \times 500 \times 10^6 \times \ln \left(\frac{\frac{\pi}{4} \times 0.1^2}{\frac{\pi}{4} \times 0.05^2} \right)$$

$$F_d = 1.36099 \times 10^6 \text{ N} = 1360.99 \text{ kN}$$

73. Consider the following motion from F to G as shown in the figure:

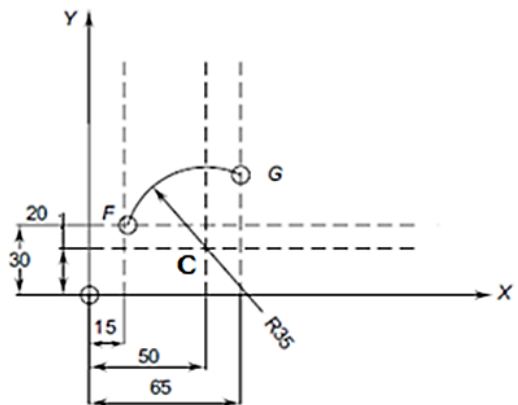


What is the correct Program block if the tool traverses with feed rate of 250 mm/min _____?

- A. N125 G02 X65.0 Y60.0 I 35.0 J-10.0 F250
- B. N125 G03 X65.0 Y60.0 I 35.0 J-10.0 F250
- C. N130 G03 X15.0 Y30.0 I 50.0 J 150.0 F250
- D. N130 G02 X15.0 Y30.0 I 50.0 J 15.0 F250

Ans. A

Sol.



when the motion is from F to G in XY plane, the program block would be:

$$N125 G02 X65.0 Y60.0 I35.0 J-10.0 F250$$

Here, (X, Y) are the co-ordinates of the destination and (I, J) the distances, along the reference axes of the centre of the arc from the starting point of the arc.

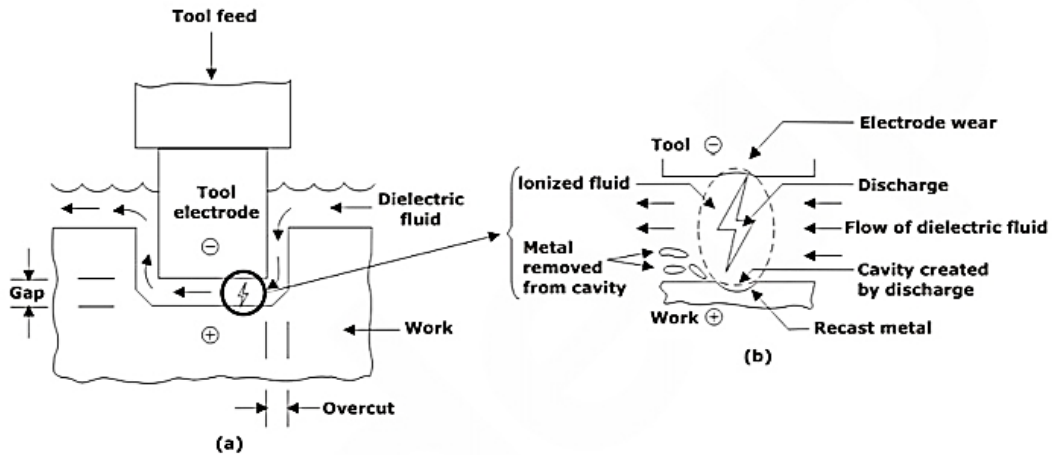
74. Which of the following pulses contribute to the desired material removal in EDM _____?

- A. Open circuit pulses
- B. Short circuits
- C. Arcs
- D. Sparks

Ans. D

Sol. — The sparks are the one which contribute to the desired material removal in Electro discharge machining.

— The sparks occur across a small gap between tool and work surface. The EDM process must take place in the presence of a dielectric fluid, which creates a path for each discharge as the fluid becomes ionized in the gap

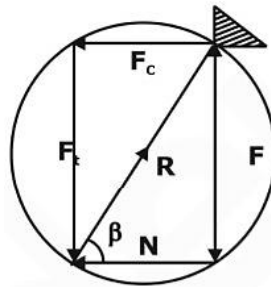


75. In an Orthogonal machining if rake angle is zero then in a merchant circle Frictional force, normal force, cutting force, and thrust force together forms a _____.

- A. Circle
- B. Rectangle
- C. Ellipse
- D. Square

Ans. B

Sol. — In an orthogonal machining if rake angle is zero then in a merchant circle Frictional force, normal force, cutting force, and thrust force together forms a rectangle.

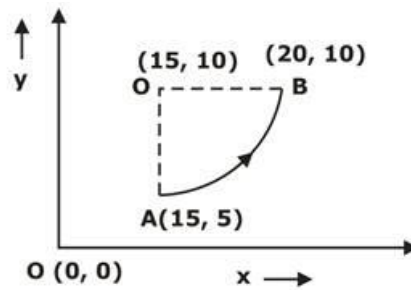


76. The tool of an NC machine has to move along a circular arc from (15, 5) to (20, 10) while performing an operation. The center of Arc is at (15, 10) and the machine has absolute mode of defining position co-ordinates, the correct tool path command is _____.

- A. N010 G91 G02 X5 Y5 R5
- B. N010 G91 G03 X5 Y5 R5
- C. N010 G02 X15 Y5 X20 Y10 R5
- D. N010 G03 X15 Y5 X20 Y10 R5

Ans. D

Sol.



- In absolute mode, machine measures Co-ordinates from origin.
- This is counter – clockwise operation with arc radius of 5 units.

Thus, NC code: N010 G03 X15 Y5 X20 Y10 R5

77. Match the following

List-I		List-II	
A.	Coarse cementite in ferrite phase	1.	Sorbite
B.	Alternate layers of ferrite and cementite	2.	Martensite
C.	Needle like shape of grains	3.	Pearlite
D.	Fine cementite in ferrite	4.	Troosite

A. A-1,B-3,C-2,D-4

B. A-2,B-3,C-4,D-1

C. A-4,B-3,C-2,D-1

D. A-2,B-4,C-1,D-3

Ans. A

Sol. – **Martensite** is finely acicular, very hard and brittle structure. It is formed during quenching of austenite at such high cooling rates that the carbon does not have time for diffusion from the lattice.

– **Sorbite** is one of the constituents of steel which is the transition between the Troostite and pearlite state.

– **Pearlite** is a two-phased, lamellar structure composed of alternating layers of ferrite (87.5 wt%) and cementite (12.5 wt%) that occurs in some steels and cast irons.

– **Troosite:** When martensite is heated to about 400°C then Troosite is formed. It is low in hardness and brittleness than martensite.

78. Under certain cutting conditions, doubling the cutting speed reduces the tool life to $(1/16)^{\text{th}}$ of tile original. Taylor’s tool life index (n) for this tool-work piece combination will be_____.

A. 0.56

B. 0.35

C. 0.25

D. 0.65

Ans. C

Sol. $VT^n = C$

$$V_1 T_1^n = 2V_1 \times \left(\frac{T_1}{16}\right)^n$$

Solving this equation

We get $n = 0.25$.

cutting speed: $V = 3 \text{ m/s}$

chip thickness: $t_c = 0.75 \text{ mm}$

For Orthogonal cutting: $t = d = 0.5 \text{ mm}$

$$\text{Cutting ratio: } r = \frac{t}{t_c} = \frac{V_c}{V}$$

$$V_c = \frac{0.50}{0.75} \times 3 = 2 \text{ m/s}$$

83. In a grinding wheel designation given by A 50 G 8 B 23, 'B' stands for _____.

- A. Rubber bond
- B. Shellac bond
- C. Resinoid bond
- D. Silicate bond

Ans. C

Sol. Grinding wheel specification is given by:

Example: 51 - A - 36 - L - 5 - V - 23									
	Prefix	Abrasive type	Abrasive grain size		Grade	Structure	Bond type	Manufacturer's record	
Manufacturer's symbol (Indicating exact kind of abrasive) (use optional) A Aluminium oxide C Silicon carbide oxide			Coarse 8 10 12 14 16 20 24	Medlume 30 46 54 60	Fine 70 80 90 100 120 150 180	Very fine 200 240 280 320 400 500 600	Dense 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 etc. Open (Use optional)	B Resinoid BF Resinoid reinforced E Shellac O Oxychloride R Rubber RF Silicate S Silicate V Vitrified	Manufacturer's private marking (to identify wheel) (use optional)
			Soft ABCDEFGHIJKL		Medium MNOPQRSTUVWXYZ				
			Hard ABCDEFGHIJKL		Grade scale				

84. A side and face cutter 125 mm diameter having 10 teeth. If operates at a cutting speed of 10 m/min with a table transverse 100 mm/min. The feed per tooth of the cutter is.

- A. .288 mm
- B. 3.93 mm
- C. 0.393 mm
- D. 0.8 mm

Ans. C

Sol. Given,

diameter, $D = 125 \text{ mm}$

no of teeth = 10 teeth

cutting speed, $V = 10 \text{ m/min}$

table speed = 100 mm/min.

$$V = \pi DN \Rightarrow 10 = \pi \times 0.125 \times N$$

$$N = 80/\pi \text{ RPM}$$

$$\text{So, in } \frac{80}{\pi} \text{ revolution} = 100 \text{ mm}$$

$$\text{So, in 1 revolution} = \frac{5\pi}{4} \text{ mm}$$

$$\text{Feed per 10 teeth} = \frac{5\pi}{4} \text{ mm}$$

$$\text{Feed per teeth} = \frac{5\pi}{4 \times 10} = \frac{\pi}{8} \text{ mm}$$

$$\text{Feed per teeth} = 0.392 \text{ mm}$$

85. Predominant surface patterns are produced by feed marks. This happens in process ____.
- | | |
|--------------|-------------|
| A. Roughness | B. Waviness |
| C. Lay | D. Flaw |

Ans. C

Sol. Flaw \Rightarrow Surface irregularities

Roughness \Rightarrow Small wavelength fluctuations

Waviness \Rightarrow Large wavelength fluctuations

Lay \Rightarrow Surface patterns are produced by feed marks

86. Vacuum is the machining medium for _____?
- | | |
|--------|--------------------------|
| A. LBM | B. WJM |
| C. EBM | D. None of the mentioned |

Ans. C

Sol. — Electron beam machining (EBM) is one of several industrial processes that use electron beams.

— Electron beam machining uses a high velocity stream of electrons focused on the workpiece surface to remove material by **melting and vaporization**.

— EBM must be **carried out in a vacuum chamber** to eliminate collision of the electrons with gas molecules.

87. Current range in Sub-merged arc welding _____?
- | | |
|---------------|------------------|
| A. 50-1000Amp | B. 200-2000Amp |
| C. 50-500Amp | D. 1000-10000Amp |

Ans. B

Sol. — In submerged-arc welding (SAW) process, the arc is formed between a continuously fed wire electrode and the workpiece, and the weld is formed by the arc melting the workpiece and the wire.

— In SAW a shielding gas is not required as the layer of flux generates the gases and slag to protect the weld pool and hot weld metal from contamination.

— As SAW is a high current welding process, the equipment is designed to produce high deposition rates. Current for SAW ranges from as low as 200 A to as high as 2000 A.

88. Which one of the following mediums is used for the fastest cooling rate of steel quenching _____?
- | | |
|----------|----------|
| A. Air | B. Oil |
| C. Water | D. Brine |

Ans. D

Sol. — The severity of a quench refers to how quickly heat can be drawn out of a part. Different quenching media have different degrees of severity. Severity order is as follows:

Brine > Water > Oil > Air

89. Which of the following the correct option for the speed exponent (n) for carbides in the tool life equation:

- A. 0.08 to 0.20
- B. 0.10 to 0.25
- C. 0.20 to 0.49
- D. 0.35 to 0.65

Ans. C

Sol.

Tool material	Speed Exponent, n
HSS	0.08 to 0.20
Carbides	0.20 to 0.49
Oxides	0.50 to 0.70

90. For higher weld deposition rate which of the current is used _____.

- A. Direct current straight polarity
- B. Alternating current.
- C. Direct current Reverse polarity
- D. none of the above

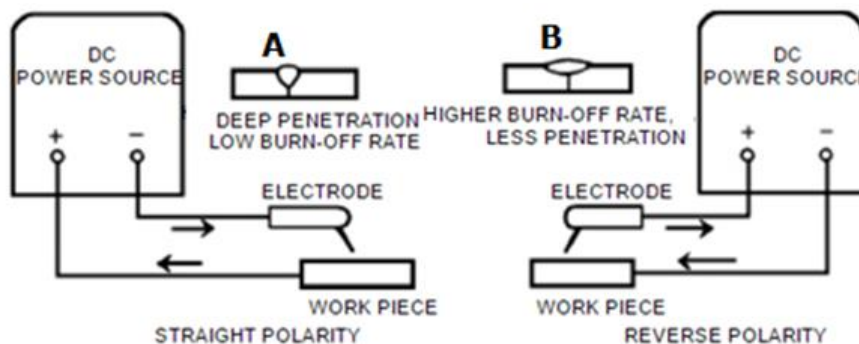
Ans. C

Sol. **Direct Current Reverse Polarity (DCRP) or Direct Current Electrode Positive (DCEP):**

— In DCRP base metals are connected with the negative terminal of the power source and electrode is connected with the positive terminal.

— As 2/3rd heat is generated at electrode thus it has high deposition rates and shallow penetration.

— Arc cleaning action is good.



91. A GO – NOGO plug gauges is to be designed for measuring of hole of nominal diameter 20 mm with a hole tolerance of ± 0.02 mm. Gauge tolerance can be considered as 10% of work tolerance the dimension of NOGO gauge would be as per unilateral system.

A. $20.02_{+0.000}^{+0.004}$ mm

B. $20.02_{-0.004}^{+0.000}$ mm

C. $19.98_{-0.004}^{+0.000}$ mm

D. $19.98_{+0.000}^{+0.004}$ mm

Ans. B

Sol. Given,

hole of nominal diameter = 20 mm,

hole tolerance = ± 0.02 mm,

Higher limit of hole = $20 + 0.02 = 20.02$ mm

Lower limit of hole = 19.98 mm,

Work tolerance = 0.04 mm

Gauge tolerance = 10% of work tolerance = 0.004 mm

Dimension of NOGO plug gauge = $20.02_{-0.004}^{+0.000}$ mm

92. Which of the following is correct about progressive dies _____.

A. Cutting and forming operation are combined and carried out in single operation.

B. Two or more cutting operations can be performed in progressive dies.

C. Work-piece moves from one station to other with separate operation performed at each operation.

D. All of these

Ans. C

Sol. — Progressive die performs two or more operations in sheet metal forming at two or more station for each press stroke and the part is made progressively.

— The sheet is fed from one station to next where different operations are performed on different stations.

93. What maximum output current can be drawn at 100% duty cycle from a welding power source rated at 500A at 60% duty cycle _____?

A. 330.9 A

B. 300 A

C. 183.8 A

D. 387.3 A

Ans. D

Sol. Given,

Current rated: 500A @ duty cycle: $D_1 = 60\%$

I_2 _____? @ duty cycle: $D_2 = 100\%$

For a given power source,

$$I^2D = \text{Constant}$$

where D is duty cycle

$$I_1^2 D_1 = I_2^2 D_2^2$$

$$500^2 \times 0.6 = I_2^2 \times 1$$

$$I_2 = 387.29 \text{ Amp}$$

94. **Assertion (A):** Greater force on the plunger is required in case of direct extrusion than indirect one.

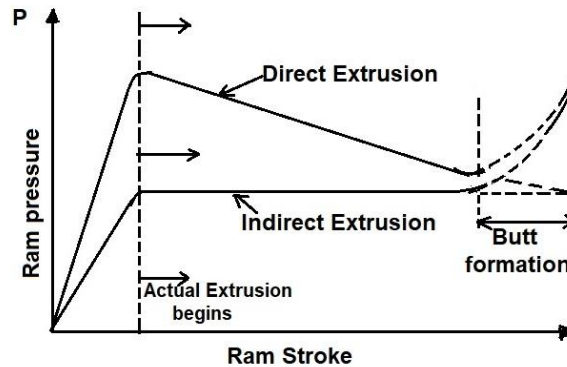
Reason (R): In case of direct extrusion, the direction of the force applied on the plunger and the direction of the movement of the extruded metal are the same.

- A. both A and R are true and R is the correct explanation of A
- B. both A and R are true but R is not a correct explanation of A
- C. A is true but R is false
- D. A is false but R is true

Ans. B

Sol. — Direct extrusion is also called forward extrusion (ram and billet move in the same direction) and it is the most general extrusion process.

— In direct extrusion, the effect of friction between the container walls and the billet causes the ram pressure to be greater than that of indirect extrusion.



95. Match the following, the % of carbon solubility in various form of iron is given below

1. δ ferrite	a.	0.025%
2. γ austenite	b.	2%
3. α ferrite	c.	0.008%
4. α ferrite at room temperature	d.	0.1%

- A. 1-c,2-b,3-a,4-d
- B. 1-a,2-c,3-b,4-d
- C. 1-d,2-b,3-a,4-c
- D. 1-a,2-b,3-c,4-d

Ans. C

Sol.

1. δ ferrite	a.	0.1%
2. γ austenite	b.	2%
3. α ferrite	c.	0.025%
4. α ferrite at room temperature	d.	0.008%

96. Match The following

Section-I		List-II	
1.	Soldering	P.	Below 450°
		Q.	Filler Cu and Zinc
2.	Brazing	R.	Filler Lead and Tin
		S.	Above 450°

- A. 1-P,S 2-Q,R
- B. 1-Q,R 2-P,S
- C. 1-P,R 2-Q,S
- D. 1-Q,S 2-P,R

Ans. C

Sol. **Soldering:**

- Soldering is a process in which two or more items (usually metal) are joined together by melting and putting a filler metal (solder) into the joint.
- The filler metal having a lower melting point than the adjoining metal (around 450°).
- Filler material is used of alloy of 63% tin and 37% lead.

Brazing:

- Brazing is the process of the joining of metals through the use of a heat and a filler metal.
- In this process the melting temperature of the brazing filler metal is **above 840° F (450°**

C).

- The more common types of filler metals used are Aluminum-silicon, Copper, Copper-silver, Copper-zinc (brass), Copper-tin (bronze), Gold-silver, Nickel alloy and Silver.

97. Which of the following factors affect the distribution of solder between sheets being joined?
- a. Melting points of the solder.
 - b. Cleanliness of contact surfaces
 - c. Clearance between the sheets.
 - d. Interaction between solder and base metal.

- | | |
|--------------------|--------------------|
| A. a, b and c only | B. b, c and d only |
| C. a, c and d only | D. a, b, c and d |

Ans. B

Sol. – The distribution of solder depend on following factors as follows:

- The surfaces are need to be cleaned to provide chemically clean surface to obtain proper bond. Hence a cleaner surface will have more solder alloy interaction.
- The clearance between sheets is a major factor in the distribution of solder.
- The gap between the parent bodies is filled by filler material. This is achieved by capillary action.Hence spreading and wetting between surface and solder plays a predominant role towards distribution.

98. What is the order of root mean square surface roughness for gear shafts and bores _____?
- | | |
|-----------------|-----------------|
| A. 0.20 microns | B. 0.30 microns |
| C. 0.75 microns | D. 1.5 microns |

Ans. D

Sol. Values of root mean square surface roughness for different machine components:

Component	Root mean square (rms) roughness [in microns]
Gear shafts and bores	1.5
Bronze bearings	0.75

Cylinder bores and pistons	0.30
Crankshafts, cams and connecting rod	0.20

99. A cast steel slab of dimension $40 \times 20 \times 10$ cm, is poured horizontally using side riser. The riser is cylindrical in shape with diameter and height both equal to 20 cm. Then the freezing ratio is _____.
- A. 1
B. 1.167
C. 1.2
D. 1.5

Ans. B

Sol. Modulus of a casting is given by:

$$\text{Modulus (M)} = \frac{V}{A_s}$$

Modulus of casting will be given by:

$$M_c = \frac{V}{A_s} = \frac{40 \times 20 \times 10}{2 \times (40 \times 20 + 20 \times 10 + 10 \times 40)} = \frac{20}{7}$$

Since riser is the side riser (for which $h = D$). Thus, modulus of riser:

$$M_R = \frac{\frac{\pi}{4} D^2 h}{2 \times \frac{\pi}{4} D^2 + \pi D h}$$

Now substitute: $h = D$

$$M_R = \frac{\frac{\pi}{4} D^3}{2 \times \frac{\pi}{4} D^2 + \pi D^2} = \frac{D}{6}$$

Now, freezing ratio is given by:

$$\text{Freezing ratio} = \frac{M_R}{M_c} = \frac{\frac{D}{6}}{\frac{20}{7}} = \frac{7 \times 20}{20 \times 6} = 1.1667$$

100. In casting shape factor is given by _____, (where L = length, W = width, T = thickness).
- A. $(L+T)/W$
B. $(L+W)/T$
C. $(T+W)/L$
D. none of these

Ans. B

Sol. Shape factor of a casting is given as:

$$SF = \frac{L+W}{T}$$

Where,

L = length

W = width

T = thickness
