Metal Casting, Forming and Joining Test 4

Number of Questions: 25 **Time:60 min.**

Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. In metal–casting process, risers are provided to account for:
(A) Solid shrinkage (B) Shake allowance
(C) Liquid shrinkage (D) Distortion allowance

2. A metal casting of a block with ϕ 80 mm hole is to be made. The machining allowance of the metal is 2 mm for bore. What should be the diameter of the pattern to cast the hole?
(A) 76 mm (B) 84 mm
(C) 78 mm (D) 82 mm

3. How does the recrystallization temperature (T_g°C) depend on the amount of cold work already received by the material?
(A) T_g increases with increasing the amount of cold work
(B) T_g decreases with increasing the amount of cold work
(C) T_g does not depend on the amount of cold work
(D) T_g increases first and then decreases with increasing the amount of cold work

4. In which of these arc–welding processes the arc is completely covered with granulated flux?
(A) Submerged arc-welding
(B) Gas Metal arc-welding
(C) Reverse polarity arc-welding
(D) Tungsten Inert-Gas welding

5. The hydrogen present in the weld pool causes which type of defect in welding?
(A) Lamellar tearing (B) Undercut
(C) Incomplete fusion (D) Porosity

6. In centrifugal casting, the slag, oxides and other impurities are
(A) Collected at the outer surface
(B) Collected at the mean radius
(C) Collected at the centre
(D) Distributed non–uniformly along the casting

7. Which of these process is used to give a fine surface finish to holes?
(A) Lapping (B) Honing
(C) Buffing (D) Deburring

8. The reflectivity of the work piece surface is one of the physical parameters in which of the machining processes?
(A) Electro chemical grinding
(B) Laser beam machining
(C) Water jet machining
(D) Abrasive jet machining

9. In which of these machining processes the tool wear is practically nil?
(A) Electric discharge machining
(B) Wire EDM
(C) Electro chemical machining
(D) Broaching

10. Which of these are used to produce cavities and hollow projections in metal casting?
(A) Chaplets (B) Cores
(C) Sprue (D) Chills

11. The gating ratio of a mould is given as 2 : 4 : 3. What is the area of the runner if the in–gate area is 450 mm^2?
(A) 600 mm^2 (B) 300 mm^2
(C) 150 mm^2 (D) 450 mm^2

12. The freezing ratio of a mould with mould constant 3969 s/m^2 is 0.03. What is the solidification time of the casting if the surface area to volume ratio of the riser is 42 m^{-1}?
(A) 125 mins 20 secs (B) 41 mins 40 secs
(C) 41 mins 20 secs (D) 1125 mins 40 secs

13. Match LIST–I with LIST–II

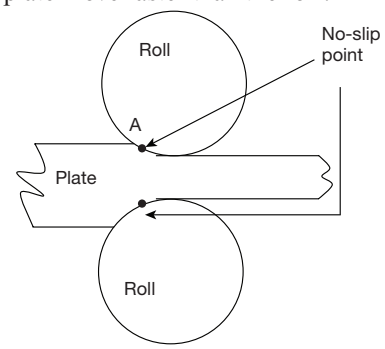
	LIST–I		LIST–II
P	Inoculation	1	Small lines
Q	Rat tails	2	Incomplete filling of mould cavity
R	Degassing	3	Addition of slicon alloy
S	Cold shut	4	Injection of Pure Argon

	P	Q	R	S		P	Q	R	S
(A)	4	1	3	2	(B)	4	2	3	1
(C)	3	2	4	1	(D)	3	1	4	2

14. In a single pass rolling process, a 25 mm thick plate is reduced to 20 mm. What is the roller diameter if the coefficient of friction at the work–roll interface is 0.15?
(A) 223 mm (B) 112 mm
(C) 445 mm (D) 890 mm

15. In a backward extrusion process, a billet of diameter 50 mm and length 150 mm is reduced to a diameter of 30 mm. What is the true strain produced?
(A) 1.778 (B) 0.5625
(C) 0.4375 (D) 2.286

16. In a rolling operation as shown in the figure, where does the plate move faster than the roll?



(A) At point A
(B) To the right of point A
(C) To the left of point A
(D) It is always faster than the roll

17. Two thick sheets are to be welded. If the thermal conductivities of both the sheets are same then which type of polarity is preferred for the process?
(A) DCEP (B) DCEN
(C) AC (D) None of these

18. What is the amount of heat generated during the resistance welding of mild steel at 2 Volts? The current passed and the time period are 16,000 A and 0.25 s.
(A) 16 kJ (B) 8 kJ
(C) 0.5 J (D) 2 J

19. The arc voltage characteristic is given by $V = 20 + 5L$ (L in the arc length in mm). The V-I characteristic of the power source can be approximated by a straight line with the open circuit voltage as 100 V and short circuit current as 800 A. What is the arc length of maximum power?
(A) 6 mm (B) 4 mm
(C) 8 mm (D) 4.5 mm

20. Match LIST–I with LIST–II

	LIST–I		LIST–II
1	Aluminium + Iron oxide	P	Brazing
2	Lead and tin alloy	Q	Friction welding
3	High rotation speeds	R	Soldering
4	Alloys	S	Thermit welding

	1	2	3	4
(A)	Q	R	S	P
(B)	Q	P	S	R
(C)	S	R	Q	P
(D)	S	P	Q	R

21. A extrusion process uses a round copper alloy billet of 300 mm diameters at 1200°C. If the final diameter of the extruded part is 200 mm and the extrusion constant is 180 MPa then what is amount of extrusion force required in MN?
(A) 5.159 (B) 4.586
(C) 7.068 (D) 10.318

22. Match the following in LIST–I with the most appropriate process in LIST–II

	LIST–I		LIST–II
P	Die sinking	1	Electro chemical grinding
Q	Drilling composite materials	2	Water jet machining
R	Sharpening of tools	3	Electric discharge machining
S	Slicing food products	4	Laser beam machining

	P	Q	R	S
(A)	4	3	1	2
(B)	3	4	2	1
(C)	4	2	3	1
(D)	3	4	1	2

23. In turning of mild steel, the depth of cut is 0.25 mm, feed is 0.5 mm/rev and the speed is 300 rpm. What is the material removal rate if the average diameter of the workpiece is 50 mm.
(A) 5.89 mm^3/s (B) 98.175 mm^3/s
(C) 9.817 mm^3/s (D) 58.9 mm^3/s

24. The material removal rate in a turning process is found to be M mm^3/min. What is the material removal rate when the cutting speed is doubled and the feed and depth of cut are halved?
(A) M mm^3/min (B) $2M$ mm^3/min
(C) $\frac{M}{2}$ mm^3/min (D) $4M$ mm^3/min

25. What is the power required for turning of an aluminium alloy of specific energy 0.9 $W.s/mm^3$ when the turning parameters are set at feed = 0.7 mm/rev, depth of cut = 1 mm and cutting velocity = 30 m/min?
(A) 315 W (B) 18.9 kW
(C) 18900 W (D) 31.5 kW

Answer Keys

1. C	**2.** A	**3.** B	**4.** A	**5.** D	**6.** C	**7.** B	**8.** B	**9.** C	**10.** B
11. A	**12.** B	**13.** D	**14.** C	**15.** A	**16.** B	**17.** B	**18.** B	**19.** A	**20.** C
21. D	**22.** D	**23.** B	**24.** C	**25.** A					

Hints and Explanations

1. Choice (C)

2. Machining allowance for bore = 2 mm
The dimension of the pattern = $80 - (2 \times 2) = 76$ mm
Ans (A)

3. As the amount of cold work (plastic deformation in %) increases the recrystallization temperature decreases.
Ans (B)

4. Choice (A)

5. Choice (D)

6. Choice (C)

7. Choice (B)

8. Choice (B)

9. The principle of *ECM* is electrolysis. The reaction at the cathode is

$H_2O + 2e^- \rightarrow H_2 + 2OH^-$

The cathode being the tool, where only hydrogen gas is evolved and no other reaction takes place, so the shape of the cathode in unaffected. Ans (C)

10. Choice (B)

11. Gating ratio = Sprue : Runner : In–gate = 2 : 4 : 3

In–gate area = 450 mm^2

i.e., 3K = 450 mm^2

$\Rightarrow$ $K = 150$ mm^2

$\therefore$ area of runner = 4K = 4 × 150 = 600 mm^2 Ans (A)

12. $\left(\frac{SA}{V}\right)_{rises} = 42\ m^{-1}$

$$\text{Freezing ratio} = \frac{\left(\frac{SA}{V}\right)_{cast}}{\left(\frac{SA}{V}\right)_{riser}} = 0.03$$

$\therefore$ $(SA/V)_{cast} = 42 \times 0.03 = 1.26$

$$\text{Solidification time} = t_s = K\left(\frac{V}{SA}\right)^2$$

K = mould constant = 3969 s/m^2

$$\therefore \quad t_s = 3969 \times \left(\frac{1}{1.26}\right)^2 = 2500\ s$$

$$\therefore \quad t_s = \frac{2500}{60} = \frac{125}{3} = 41 + \frac{2}{3} = 41 \text{ mins } 40 \text{ secs}$$

Ans (B)

13. Choice (D)

14. $h_1 = 25$ mm , $h_2 = 20$ mm, $\mu = 0.15$

$h_1 - h_2 = \mu^2 R$

$$\therefore \quad R = \frac{25-20}{0.15^2} = 222.23 \text{ mm}$$

$\Rightarrow$ $D = 2R = 444.45$ mm ≈ 445 mm Ans (C)

15. $D_i = 50$ mm, $L_i = 150$ mm, $d_f = 30$ mm

$$\frac{\pi}{4} d_i^2 L_i = \frac{\pi}{4} d_f^2 L_f$$

$\therefore$ $(50)^2 \cdot 150 = (30)^2 \cdot L_f$

$\Rightarrow$ $L_f = 416.67$mm

$$\therefore \quad \text{True strain} = \frac{L_f - L_i}{L_i} = \frac{416.67 - 150}{150}$$

$= 1.778$ Ans (A)

16. The velocity of the plate increases from the entry to the exit. At the neutral point or no–slip point the velocity of the plate is equal to that of the roll. Towards the right of this point the plate moves faster than the roll.

Ans (B)

17. In DC arc welding, more heat is generated at the anode. Therefore, making the work–piece as anode results in a deeper penetration. This type is called straight polarity or DCEN (Direct Current Electrode Negative)

. Ans (B)

18. Heat generated = $H = L^2Rt$

$V = IR$

$$\Rightarrow \quad R = \frac{V}{I} = \frac{2}{16{,}000} = 1.25 \times 10^{-4}\ \Omega$$

$\therefore$ $H = (16{,}000)^2 \times 1.25 \times 10^{-4} \times 0.25$

$\Rightarrow$ $H = 8000$ J = 8 kJ Ans (B)

19. $V = 20 + 5L$

OCV = Open circuit voltage = 100 V

SCC = Short circuit current = 800 A

$$\frac{V}{OCV} + \frac{1}{SCC} = 1$$

$$\therefore \quad \frac{V}{100} + \frac{I}{800} = 1$$

$\Rightarrow$ $8V + I = 800$

$I = 800 - 8V$

Power $P = VI = V(800 - 8V)$

For maximum power $\frac{\partial P}{\partial V} = 0$

$\Rightarrow$ $800 - 16\ V = 0$

$\Rightarrow$ $V = 50$ V

$\therefore$ $50 = 20 + 5L$

$\Rightarrow$ $L = 6$ mm Ans (A)

20. Choice (C)

21. Extursion force $(F) = K A_0 \ell n\left(\frac{A_0}{A_f}\right)$

$K = 180 \times 10^6$ N/m^2,

$A_0 = \frac{\pi}{4} 0.3^2$, $A_f = \frac{\pi}{4} 0.2^2$

$$\therefore \quad F = 180 \times 10^6 \times \frac{\pi}{4} \times 0.3^2 \times \ell n\left(\frac{0.3^2}{0.2^2}\right)$$

$F = 10.318$ MN Ans (D)

22. Choice (D)

23. Material removal rate = $MRR = \pi D_{avg}\, d\, f.\, N$

$D_{avg} = 50$ mm, $d = 0.25$ mm, $f = 0.5$ mm/rev, $N = 300$ rpm

$MRR = \pi \times 50 \times 0.25 \times 0.5 \times 300$

$MRR = 5890.5$ mm^3/min = 98.175 mm^3/s Ans (B)

24. $V = \pi DN$ – (Cutting speed)

Material removal rate = $v\,d\,f$(d – depth of cut & f – feed)

$$\therefore \quad MRR = (2V).\left(\frac{d}{2}\right).\left(\frac{f}{2}\right) = \frac{vdf}{2} \text{ mm}^3/\text{min}$$

$$= \frac{M}{2} \text{ mm}^3/\text{min}$$ Ans (C)

25. M = Material removal rate = vdf

$M = 30 \times 10^3 \times 1 \times 0.7 = 21000$ m^3/min

$$\therefore \quad \text{Power required} = 0.9 \times M = 0.9 \times \frac{21000}{60} = 315 \text{ W}$$

Ans (A)