RIB RANK IMPROVEMENT BATCH
MECHANICAL ENGINEERING

RIB-R | T12

Session 2019-20 | S.No. : 170919_GH1A

ANSWER KEY ➤ Manufacturing

1.	(d)	7.	(a)	13.	(c)	19.	(d)	25.	(a)
2.	(b)	8.	(c)	14.	(a)	20.	(a)	26.	(a)
3.	(c)	9.	(d)	15.	(a)	21.	(c)	27.	(d)
4.	(d)	10.	(a)	16.	(c)	22.	(a)	28.	(b)
5.	(b)	11.	(b)	17.	(d)	23.	(b)	29.	(a)
6.	(d)	12.	(d)	18.	(b)	24.	(b)	30.	(b)

DETAILED EXPLANATIONS

1. (d)

Gating : Gating design is related to casting.

Fettling : Trim or clean the rough edges of a metal casting.

Stack moulding : Stack molding is a high production sand casting or green sand molding process. It is popular method for producing piston ring etc.

Calendaring : It is a finishing process used on cloth and fabrics. Also used during plastic processing etc.

3. (c)

$$\text{Maximum draft} = \mu^2 R$$
$$= (0.1)^2 \times 100 = 1 \text{ mm}$$

6. (d)

Melting of base material is not involved in friction welding process as heat is generated due to rubbing and external pressure.

7. (a)

G02 : CW Interpolation

G03 : CCW Interpolation

We have to remember some basic and standard G-codes to solve such.

9. (d)

Gear shaping: finishing process of an external spur and helical gear as well as internal gear.

10. (a)

BLU, $$\Delta x = \frac{P_x}{2\pi}\Delta\theta = \frac{3}{2\pi}\times\frac{1.5\pi}{180}\times 10^3\ \mu\text{m} = 12.5\ \mu\text{m}$$

11. (b)

Buoyant force, $F = V(\rho - d)g\ N$

Volume of core material, $V = \frac{\pi}{4}\times 0.15^2 \times 0.2$

$= 3.5343 \times 10^{-3}\ m^3$

Density of liquid metal, $\rho = 11,300\ kg/m^3$

Density of core material, $d = 1600\ kg/m^3$

$F = 3.5343 \times 10^{-3} \times (11300 - 1600) \times 9.81$

$= 336.3\ N$

12. (d)

$$\text{Heat} = I^2Rt = (6000)^2 \times 75 \times 10^{-6} \times 0.15 = 405\ J$$

$$\text{Weld nugget volume} = \frac{\pi}{4}\times d^2 \times t$$

$$= \frac{\pi}{4}\times 5^2 \times 2.5 = 49.0874 = 142.35\ J$$

Remaining heat to the surrounding = 405 – 142.35 = 262.65 J

13. (c)

Clearance, $C = 0.06 \times 3 = 0.18$ mm

For blanking operation:

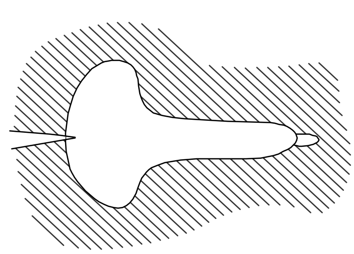
Die size = blank size = 60 mm

Punch size = blank size – 2C

= 60 – 2 × 0.18 = 59.64 m

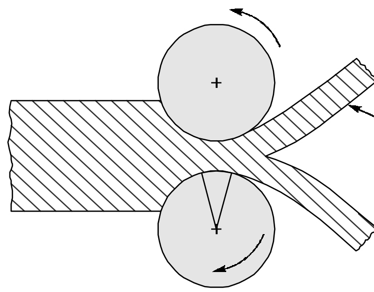
15. (a)

Fir-tree cracking in extrusion: Too high extrusion speed, too large a friction and too high a temperature may result in formation of surface cracks. Fir-tree cracks are transverse cracks which often occur in aluminium or magnesium due to hot shortness.



Cracking at the flash

Alligatoring: It is a complex phenomena that results from inhomogeneous deformation of the material during rolling.



16. (c)

Extrusion force, $$F = A_0 k \ln\left(\frac{A_0}{A_f}\right)$$

Pressure, $$\frac{F}{A_0} = k \ln\left(\frac{A_0}{A_f}\right)$$

A_0 = Original area of billet, $R = \dfrac{A_0}{A_f}$, extrusion ratio

k (extrusion constant) - measure of the strength of the material being extruded and the frictional conditions and depends on extrusion temperature.

Therefore, pressure ↑ if R↑

Pressure is independent of length of billet.

17. (d)

$$F = A \,.\, k \ln R = \frac{\pi}{4} \times (60)^2 \times 300 \times \ln(4) = 1.176 \text{ MN}$$

18. (b)

Blanking force, $$F = (\pi\, d\, t)\tau_s = \pi \times 250 \times 2.5 \times 150 \times 10^{-3} = 294.5 \text{ kN}$$

20. (a)

Taylor's tool life equation, $VT^n = C$

We have

$$V_1 T_1^{\,n} = V_2 T_2^{\,n}$$

$$120 \times (12)^n = 90 \times (36)^n$$

$$\frac{120}{90} = \left(\frac{36}{12}\right)^n$$

$$1.33 = (3)^n$$

Taking logarithm: $$n \ln(3) = \ln(1.33)$$

$$n = 0.26186 \approx 0.262$$

23. (b)

From volume constancy,

$$\pi r_1^2 h_1 = \pi r_2^2 h_2$$

$$r = r_2 = r_1\left(\frac{h_1}{h_2}\right)^{1/2} = 100\times\left(\frac{150}{75}\right)^{1/2} = 141.42 \text{ mm}$$

Forging force,
$$F = Y_f \pi r^2\left(1+\frac{2\mu r}{3h}\right)$$

$$= 1100\times\pi\times(141.42)^2\left[1+\frac{2\times0.2\times141.42}{3\times75}\right] = 86.5 \text{ MN}$$

24. (b)

From Taylor's tool life equation

$$50(45)^n = 100\,(10)^n$$

$$(4.5)^n = 2$$

$$n = \frac{\log(2)}{\log(4.5)} = 0.46$$

Tool life constant,
$$C = 50(45)^{0.46} = 100(10)^{0.46} = 288.4$$

Cutting speed for maximum production rate is given as

$$V_{opt} = \frac{C}{\left[\left(\frac{1}{n}-1\right)T_{tot}\right]^n} = \frac{288.4}{\left[\left(\frac{1}{0.46}-1\right)\times 2\right]^{0.46}} = \frac{288.4}{(2.34)^{0.46}} = 195.054 \text{ m/min}$$

25. (a)

Length of uncut chip,
$$l = \frac{\pi(80+78)}{2} = 248.186 \text{ mm}$$

Cutting ratio,
$$r = \frac{l_c}{l} = \frac{78.5}{248.186} = 0.3163$$

Shear angle,
$$\phi = \tan^{-1}\left[\frac{r\cos\alpha}{1-r\sin\alpha}\right]$$

$$= \tan^{-1}\left[\frac{0.3163\cos15^\circ}{1-0.3163\sin15^\circ}\right] = \tan^{-1}(0.33276)$$

$$\phi = 18.4^\circ$$

26. (a)

(i) The purpose of providing relief holes in sine bars is to reduce weight.

(ii) The maximum angle that can be set using a sine bar is limited to 45°.

27. (d)

$$\text{Maximum clearance} = \text{HLH} - \text{LLS}$$
$$= 30 - 0.03 - 30 + x = x - 0.03$$
$$\text{Minimum clearance} = \text{LLH} - \text{HLS}$$
$$= 30 - y - 30 - x$$
$$= -(x + y)$$

For interference fit, Maximum clearance < 0

Minimum clearance < 0

Values	Maximum clearance	Minimum clearance
$x = 0.06,\ y = 0.050$	$x - 0.03 = 0.03 > 0$	$-(x + y) = -0.11 < 0$
$x = 0.05,\ y = 0.045$	$x - 0.03 = 0.02 > 0$	$-(x + y) = -0.095 < 0$
$x = 0.05,\ y = 0.042$	$x - 0.03 = 0.02 > 0$	$-(x + y) = -0.092 < 0$
$x = 0.025,\ y = 0.045$	$x - 0.03 = -0.005 < 0$	$-(x + y) = -0.07 < 0$

28. (b)

$$\text{MMR} = \frac{AI}{ZF\rho}\ \text{cm}^3/\text{s}$$

$A = 27$ gm, $Z = 3$, $F = 96500$ coulombs, $\rho = \dfrac{2700 \times 1000}{(100)^3}$ gm/cm^3

$$\text{MMR} = \frac{27 \times 70 \times 3 \times 0.8 \times 1000 \times 60}{3 \times 96500 \times 2700}\ \text{cm}^3/\text{min}$$
$$= 0.348186\ \text{cm}^3/\text{min} = 348.186\ \text{mm}^3/\text{min}$$

30. (b)

For ISO metric thread, $2\theta = 60°$ (included angle)

$$\theta = 30°$$

For best size of rollers, $d = \dfrac{P}{2}\sec\theta$

$$= \frac{2}{2} \times \frac{1}{\cos 30°} = 1.155\ \text{mm}$$

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