MADE EASY

Leading Institute for IES, GATE & PSUs

Delhi | Bhopal | Hyderabad | Jaipur | Pune

Web: www.madeeasy.in | **E-mail:** info@madeeasy.in | **Ph:** 011-45124612

CASTING+WELDING+FORMING

MECHANICAL ENGINEERING

Date of Test : 28/02/2026

ANSWER KEY ➤

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

DETAILED EXPLANATIONS

1.   (d)
All of the above statements, P, Q, R are function of riser.

2.   (b)
In Braze welding a molten filler metal is used to join two different metal, here molten metal do not flow due to capillary action, like in brazing and also melting of parent metal is not required.

3.   (a)
Solid phase welding is autogeneous welding processes.
Arc, gas, resistance and thermite welding processes are homogeneous welding processes as filler and parent material are same soldering and brazing processes are heterogenous as filler material is different from parent material.

4.   (b)
Given: Weld per minute = 600, Diameter of electrode = 22 cm, Weld required = 4 per cm
Now, welding speed required

$$= \frac{\text{weld per minute}}{\text{weld reuired per cm}} = \frac{600 \text{ weld/min}}{4 \text{ weld/cm}}$$
$$= 150 \text{ cm/min}$$

$$\text{RPM of electrode} = \frac{\text{welding speed required}}{\pi \times \text{electrode diameter}} = \frac{150}{\pi \times 22} = \text{rpm}$$
$$= 2.17 \text{ rpm}$$

5.   (a)
Due to high moisture content in sand, blow holes, fine holes are generated

6.   (b)
Excess material is called flash and grooves along the die that accommodate this excess material is called gutter.

7.   (a)
Given: Initial thickness, t_1 = 20 mm
Final thickness, t_2 = 16 mm
Radius of rolls, R = 200 mm
$$t_1 - t_2 = 2R(1 - \cos \alpha)$$
$$20 - 16 = 2 \times 20 (1 - \cos \alpha)$$
$$\alpha = 25.84$$
$$\alpha = 25.84 \times \frac{\pi}{180} \text{ radius} = 0.451 \text{ radians}$$

8.   (c)
Shrinkage allowance is always added to a linear dimension.

$$\text{Final inner diameter} = 10 + \frac{10 \times 0.2}{10} = 10.2 \text{ cm}$$

$$\text{Final outer diameter} = 20 + \frac{20 \times 0.2}{10} = 20.4 \text{ cm}$$

9. **(d)**

$$\text{Extrusion ratio} = \frac{A_0}{A_f} = \frac{\frac{\pi}{4}D_0^2}{\frac{\pi}{4}D_f^2} = \left(\frac{100}{50}\right)^2 = 4$$

10. **(c)**

In general, AC is preferred for aluminium and magnesium, because the cleaning action of AC removes oxides and improves weld quality.

11. **(c)**

From volume consistency,

$$\pi(30)^2 \times 30 = \pi r_f^2 \times 15$$

$$\therefore \qquad r_f = 42.42 \text{ mm}$$

True strain at the end of of the stroke

$$\varepsilon = \ln\left(\frac{30}{15}\right) = 0.69$$

$$\sigma_f = 800 \times (0.69)^{0.2} = 742.78 \text{ MPa}$$

Force at the end of the stroke,

$$F = \sigma_f \pi r_f^2 \left(1 + \frac{2\mu r_f}{3h_f}\right)$$

$$= 742.78 \times \pi \times (42.42)^2 \left(1 + \frac{2 \times 0.2 \times 42.42}{3 \times 15}\right) \times 10^{-6}$$

$$= 5.78 \text{ MN}$$

12. **(a)**

$$\text{Contact strip length, } L = \sqrt{R\Delta h} = \sqrt{500 \times (1 - 0.8) \times 25} = 50 \text{ mm}$$

$$\text{True strain, } \varepsilon = \ln\left(\frac{25}{20}\right) = 0.223$$

$$\text{Average flow stress, } \sigma_f = \frac{250 \times (0.223)^{0.2}}{1.2} = 154.32 \text{ MPa} \qquad \left[\sigma_f = \frac{k\varepsilon^n}{n+1}\right]$$

$$\text{Rolling torque, } T = Fa = \sigma_f bL \times \frac{L}{2} = 154.32 \times 250 \times 50 \times \frac{50}{2000} \times 10^{-3}$$

$$= 48.225 \text{ kN-m}$$

$$\text{Power} = 2T \times \frac{V}{r} = 2 \times 48.225 \times \frac{0.5}{0.5}$$

$$= 96.45 \text{ kW}$$

13. **(a)**

$$\text{Heat for melting, } H_m = UV$$

$$V = \frac{\pi}{4}d^2 t = \frac{\pi}{4}(5)^2 \times 2.5 = 49.087 \text{ mm}^3$$

$$\text{Heat supplied, } H_s = 4H_m = 4 \times 9 \times 49.087 = 1767.132 \text{ J}$$

$$H_s = \int_0^t I^2 R dt = \left(10^5\right)^2 \times 100 \times 10^{-6} \int_0^t t^2 dt = \frac{10^6 t^3}{3}$$

$$t = \left(\frac{3 \times 1767.132}{10^6}\right)^{1/3} = 0.174 \text{ seconds}$$

14.   (d)

P and R are correct statements.

15.   (c)

16.   (a)

Time taken for filling mold, $t_f = \dfrac{V}{A_g v_g}$

$A_g v_g$ = Volumetric flow rate = 25 cm³/min

$$V = \text{Volume} = \frac{40 \times 10 \times 10}{1000} = 4 \text{ cm}^3$$

$$t_f = \frac{4}{25} \text{ min} = 0.16 \text{ min}$$

17.   (b)

Here, $\in_y = \ln\left(\dfrac{75}{80}\right) = -0.0645$

$\sigma = 400(0.0645)^{0.2} = 231.21$ MPa

Now, $\dfrac{\sigma}{\in_{el}} = E$ (where, ε_{el}: Elastic strain)

$\Rightarrow$ $\in_{el} = \dfrac{231.21}{100 \times 10^3} = 2.3121 \times 10^{-3}$

Length recovered $= L \times \in_{el}$

$= 80 \times 2.3121 \times 10^{-3} = 0.185$

Final dimension $(L') = 75 + 0.185 = 75.185$ mm

18.   (a)

$$t = k\left(1.41 + \frac{T}{14.59}\right)\sqrt{w} \text{ sec}$$

$T = 1.1525$ cm $= 11.525$ mm

$$t = \frac{28}{40}\left[1.41 + \frac{11.525}{14.59}\right] \times \sqrt{20} \text{ sec} = 6.8868 \text{ sec}$$

$$= \frac{6.8868}{60} \text{ minutes} = 0.11478 \text{ minutes}$$

19. (b)

$$\text{Mean flow stress } \left(\overline{\sigma}_0\right) = \frac{k \in^n}{1+n}$$

$$k = 600 \text{ MPa}$$
$$n = 0.15$$

$$200 = \frac{600 \times \in^{0.15}}{1+0.15}$$

$$\in = 1.67 \times 10^{-3}$$
$$\sigma = 600 \, (1.67 \times 10^{-3})^{0.15}$$

$$\text{True stress, } \sigma = 230 \text{ MPa}$$

20. (a)

$$\text{Length of contact, } L_P = R\sin\alpha = \sqrt{R\Delta h}$$

$$\Delta h = 2R(1 - \cos\alpha)$$

$$5 = 2 \times 150 \, (1 - \cos\alpha)$$

$$\frac{5}{300} = 1 - \cos\alpha$$

$$\Rightarrow \qquad \alpha = 10.4753°$$

$$L_P = 150 \times \sin 10.4753° = 27.27 \text{ mm}$$

$$\text{Roll separating force, } F = \sigma_0 \, L_P \times b = 195 \times 27.27 \times 100 = 0.531 \text{ MN}$$

Ans. 27.5 mm, 0.531 MN

21. (c)
- The main purpose of using chaplet is to support the cores. For directional solidification chills and paddings are primarily used, although chaplets can promote directional solidification but it is not their main purpose.
- If the unsupported load on core is less than or equal to zero, no chaplet is required. But if it is greater than zero than the chaplet area required is 29 mm^2 for every Newton of unsupported load.

22. (b)

A cold shut is caused when two metal streams, while meeting in the mould cavity, do not fuse together properly thus causing a discontinuity or weak spot. These defects are caused essentially by the lower fluidity of the molten metal or that the section thickness of the casting is too small.

23. (d)
- Metals and alloys with high melting temperatures are difficult to cast by hot chamber process, because gooseneck of the hot chamber machine is continuously in contact with the molten metal.
- The main difference between hot and cold chamber die casting is that in hot chamber, the holding furnace for the liquid metal is integral with the die casting machine, whereas in the cold chamber machine, the metal is melted in a separate furnace and then poured into the machine with a ladle for each casting cycle which is also called "shot".
- Since the metal is ladled into the cold chamber machine from the separate furnace, it may lose the superheat and sometimes may cause defects like cold shuts.

24. **(a)**

Applying continuity equation,

$$h_o b_o v_o = h_f b_f v_f$$
$$\Rightarrow \quad 5 \times 100 \times 10 = 3 \times 100 \times v_f$$
$$v_f = 16.67 = 16.7 \text{ cm/sec}$$

25. **(a)**

Friction force favours the rolling operation at entry and opposes the rolling operation at exit. Magnitude of friction force at point P is greater than that at Q, that's why the rolling operation is possible.

26. **(c)**

Given: $L = 1000$ mm, $d = 750$ mm, $k = 2$ s/mm^2,

$$\text{Solidification time (t)} = k\left(\frac{V}{A}\right)^2$$

$$\left(\frac{V}{A}\right)_{\text{cylinder}} = \frac{\frac{\pi}{4}D^2 L}{2 \times \frac{\pi}{4}D^2 + \pi DL} = \frac{D^2 L}{2D^2 + 4DL}$$

$$= \frac{(750)^2 \times 1000}{2(750)^2 + 4 \times 750 \times 1000} = 37190.08\,s = 619.83 \text{ minutes}$$

27. **(c)**

Given: $V = 20 + 40L$

Power source characteristic equation can be written as,

$$\frac{V}{V_o} + \frac{I}{I_s} = 1$$

$$\Rightarrow \quad \frac{V}{80} + \frac{I}{1000} = 1$$

$$I = 1000\left(1 - \frac{V}{80}\right) = 1000 - 12.5V$$

$$= 1000 - 12.5(20 + 40L) = 1000 - 250 - 500L = 750 - 500L$$

$$\text{Power, } P = VI$$
$$= (20 + 40L)(750 - 500L)$$
$$= 20(1 + 2L) \times 250(3 - 2L)$$
$$P = 5000(1 + 2L)(3 - 2L) \text{ W}$$

28. **(c)**

$$V = OCV - \frac{OCV}{SSC}I$$

$$V = 62 - \frac{62}{130}I$$

$$V = 20 + 1.5\,L = 20 + 1.5 \times 4 = 26 \text{ V}$$

$$26 = 62 - \frac{62}{130}I$$

$\Rightarrow$ $\qquad\qquad\qquad\qquad\qquad$ $I = 75.5$ A

$\qquad\qquad$ Power consumed $= V \times I$

$\qquad\qquad\qquad\qquad$ $P = 75.5 \times 26 = 1963$ W

$\qquad$ Heat input into work-piece $= 0.85 \times 1963 = 1668.25$ W $\simeq 1.7$ kW

29. (a)

Given: $\qquad\qquad\qquad$ $d = 0.13$ m $\qquad\qquad\qquad$ $h = 0.2$ m

$\qquad\qquad\qquad\qquad$ $\rho_c = 1500$ kg/m^3, $\qquad\qquad$ $\rho_z = 12000$ kg/m^3

$\qquad$ Net force $= g.V(\rho_z - \rho_c) = 9.81 \times \dfrac{\pi}{4} \times (0.13)^2 \times 0.2(10500)$

$\qquad\qquad\qquad$ $= 273.442$ N

30. (b)

$$\varepsilon = \ln\left(\frac{A_i}{A_f}\right) = 2\ln\left(\frac{d_i}{d_f}\right) = 2\ln\left(\frac{30}{6}\right) = 2\ln 5 = 3.22$$

Average flow stress, $\bar{\sigma} = \dfrac{\sigma_o \times \varepsilon^n}{1+n} = \dfrac{315 \times 3.22^{0.44}}{1+0.44} = 365.93$ MPa

■■■■