Manufacturing Technology Test 2

Number of Questions 35 **Time:60 min.**

Directions for questions 1 to 35: Select the correct alternative from the given choices.

1. A steel with 0.8% carbon is called
(A) Hypo – eutectoid steel
(B) Hyper – eutectoid steel
(C) Eutectoid steel
(D) Eutectic steel

2. Pearlite consists of
(A) 88% ferrite and 12% cementite
(B) 88% cementite and 12% ferrite
(C) 6.67% carbon and 93.33% iron
(D) 4.3% carbon and 95.7% iron

3. Heating the hypo eutectoid steels 30°C above upper critical temperature line, soaking at that temperature and then cooling slowly to room temperature to form a pearlite and ferrite structure is known as
(A) Hardening (B) Normalizing
(C) Tempering (D) Annealing

4. Light impurities in the molten metal are prevented from reaching the mould cavity by providing
(A) Strainer (B) Bottom well
(C) Skim bob (D) Choke

5. Methods that can be used for producing short length metallic seamless tubes are
(Select using the codes)
1: Drawing 2: Extrusion
3: Rolling 4: Spinning
(A) 1 and 3 (B) 2 and 3
(C) 1, 3 and 4 (D) 2, 3 and 4

6. For resistance welding
(A) Voltage is high and current is low
(B) Voltage is low and current high
(C) Both voltage and current are low
(D) Both voltage and current are high

7. In metal cutting shear angle is the angle made by shear plane with
(A) Direction of tool travel
(B) Direction of tool axis
(C) Central plane of work piece
(D) Perpendicular tool axis

8. Material used for lathe bed is
(A) Mild steel (B) Tool steel
(C) Cast iron (D) Cast steel

9. Machinability depends on
(A) Physical and mechanical properties of work piece
(B) Cutting force
(C) Type of chip
(D) Tool life

10. Best accuracy in a hole on a metal is obtained from
(A) Drilling (B) Reaming
(C) Broaching (D) Boring

11. In Electro discharge machining (*EDM*), tool is made of
(A) Copper (B) High speed steel
(C) Cast iron (D) Plain carbon steel

12. In electro chemical machining process, the electrolyte used is
(A) Kerosene (B) Water
(C) Air (D) Brine solution

13. A reflector combined with an auto collimater can be used for checking
(A) Parallelism (B) Alignment
(C) Surface finish (D) Circularity

14. The dimension of a shaft is $\varphi\ 40^{-0.008}_{-0.020}$ Fundamental deviation and tolerance are
(A) – 0.008, 0.012 (B) – 0.020, 0.012
(C) – 0.010, 0.030 (D) – 0.010, 0.030

15. Consider the following statements regarding *NC* machine tools
1: They reduce non – productive time
2: They reduce fixturing
3: They reduce maintenance cost
The correct statements are
(A) 1 and 2 (B) 1 and 3
(C) 2 and 3 (D) 1, 2 and 3

16. One cylindrical riser (*A*) of 25 cm diameter has 50 cm height. Another cylindrical riser (*B*) has 50 cm diameter and 25 cm height. Ratio of solidification times of riser A is
(A) 1.25 (B) 1.5
(C) 1.625 (D) 1.675

17. A down sprue of length 200 mm has a diameter of 30 mm at the top end. In the pouring cup the liquid metal is maintained at a height of 60 mm from the down sprue top. For smooth flow of liquid metal, bottom diameter of the down sprue is
(A) 18.7 mm (B) 19.3 mm
(C) 20.8 mm (D) 21.2 mm

18. A metal strip is to be rolled in a single pass rolling mill from a thickness of 4 mm to 3 mm. If roll diameter is 300 mm, angle of bite and roll contact length are
(A) 3.22°, 11.5 mm (B) 4.68°, 12.25 mm
(C) 4.93°, 12.75 mm (D) 5.14°, 13.25 mm

19. 12 mm diameter holes are to be punched in a steel sheet of 4 mm thickness. Shear strength of the material is 400 N/mm^2. If 2 mm shear is provided on the punch, force required to punch the hole is (Assume 40% penetration).

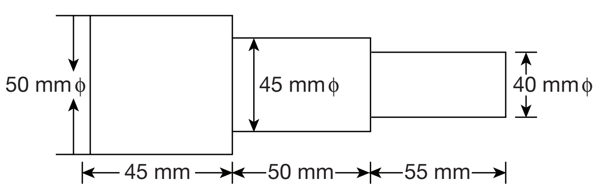
(A) 20.92 kN (B) 22.62 kN
(C) 24.24 kN (D) 26.81 kN

20. Diameter of a steel wire is reduced from 9 mm to 7 mm by wiredrawing process. If mean flow stress of the material is 400 N/m^2, the ideal drawing force required is
(A) 7.74 kN (B) 7.98 kN
(C) 8.15 kN (D) 8.36 kN

21. A shell of 100 mm diameter and height 120 mm with corner radius 6 mm is to be produced by cup drawing process. The minimum blank diameter required is
(A) 218.74 mm (B) 236.22 mm
(C) 240.83 mm (D) 248.24 mm

22. In arc welding of a butt joint, area of weld cross section is 6 mm^2 and energy required to melt metal is 12 J/mm^3. If power consumed is 2.2 kW, melting efficiency and heat transfer efficiency are 0.6 and 0.7 respectively, welding speed in mm/s is
(A) 12.83 (B) 14.12
(C) 14.92 (D) 15.05

23.



A stepped shaft is to be turned from a shaft from a shaft of 50 mm ϕ in a lathe. Feed and depth of cut used are 0.3 mm/rev and 2.5 mm respectively. If the cutting speed is 20 m/min, the machining time required is
(A) 3.24 min (B) 3.63 min
(C) 3.86 min (D) 4.46 min

24. In a turning operation the cutting tool used has a rake angle of 10°. Coefficient of friction between tool and chip can be taken as 0.6. For minimum cutting force, the value of shear plane angle is
(A) 24.04° (B) 29.86°
(C) 32.15° (D) 34.52°

25. In a turning operation tool life of 85 minutes is obtained at a cutting speed of 25 m/min and 10 minutes at a cutting speed of 55 m/min. Cutting speed corresponding to a tool life of 5 minutes will be
(A) 71 m/min (B) 75 m/min
(C) 82 m/min (D) 88 m/min

26. In an orthogonal machining operation, the following data is given
rake angle – 6°
cutting speed – 5 m/s
width of cut – 3 mm
chip thickness – 1.5 mm
uncut chip thickness – 1 mm
If shearing takes place under minimum energy conditions, area of the shear plane is
(A) 4.26 mm^2 (B) 4.84 mm^2
(C) 5.15 mm^2 (D) 5.92 mm^2

27. In electro chemical machining, material is removed from an iron surface of 25 mm × 25 mm. The data given is,
Inter electrodes gap – 0.3 mm
Supply voltage – 3.5 V
Specific resistance of electrolyte – 4 Ω cm
Atomic weight – 56
Valency – 2
Faradays constant = 96500 C
Mass material removed in 25 seconds is
(A) 4.14 gms (B) 4.53 gms
(C) 4.96 gms (D) 5.28 gms

28. Lower limit dimension of a 20 f_8 shaft is [The following data may be used
Diameter step of 20 mm is 1 to 30 mm
i = 0.45 $(D)^{1/3}$ + 0.001 D
Upper deviation of f shaft = – 5.5 $D^{0.41}$
*IT*8 = 25 *i*]
(A) 12.624 mm (B) 14.372 mm
(C) 16.826 mm (D) 19.947 mm

29. Size of a hole is $30^{+0.03}_{-0.02}$ mm. A shaft is to be machined to obtain a clearance fit in the hole such that minimum clearance is 0.01 mm and maximum clearance is 0.08 mm. Tolerance on the shaft will be
(A) 0.01 mm (B) 0.02 mm
(C) 0.03 mm (D) 0.04 mm

30. For inspecting holes of size $30^{+0.050}_{+0.010}$ mm, GO and NO GO plug gauges are to be designed for the use in a workshop. Gauge tolerance is taken as 10% of hole tolerance, Size of NO GO gauge will be
(A) $30^{+0.015}_{+0.010}$ mm (B) $30^{+0.010}_{+0.005}$ mm
(C) $30^{+0.065}_{+0.060}$ mm (D) $30^{+0.060}_{+0.055}$ mm

31. Match list I with list II and select correct answer

	List – I		List – II
P	Welding of aluminum alloy	1.	Submerged arc welding
Q	Ship building	2.	Electron beam welding
R	Joining HSS drill bit to carbon steel shank	3.	TIG welding
S	Deep penetration and precision welding	4.	Gas welding

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

Common data for linked answer questions 32 and 33: In orthogonal machining of a shaft on lathe the following data is available.
Axial feed rate: 0.3 mm/rev
Depth of cut: 0.4 mm
Rake angle: 8°
Shear plane angle: 25°

32. Thickness of the chip produced is
(A) 0.5 mm (B) 0.6 mm
(C) 0.7 mm (D) 0.8 mm

33. Using Earnst and Merchant theory, coefficient of friction at the chip is
(A) 0.25 (B) 0.8
(C) 0.85 (D) 0.9

Statement for linked answer questions 34 and 35: In an orthogonal turning operation the following conditions are used. Feed 0.25 mm/rev, depth of cut 3 mm, chip thickness ratio 0.6, orthogonal rake angle 6°

34. If shear strength of the work piece is 240 N/mm^2, shear force is
(Merchants theory can be used)
(A) 268 N (B) 286 N
(C) 335 N (D) 392 N

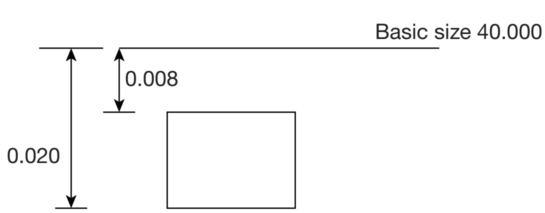
35. The cutting force is
(A) 522 N (B) 565 N
(C) 614 N (D) 636 N

Answer Keys

1. C	**2.** A	**3.** D	**4.** C	**5.** B	**6.** B	**7.** A	**8.** C	**9.** A	**10.** D
11. A	**12.** D	**13.** B	**14.** A	**15.** D	**16.** A	**17.** C	**18.** B	**19.** D	**20.** A
21. C	**22.** A	**23.** B	**24.** D	**25.** A	**26.** C	**27.** B	**28.** D	**29.** B	**30.** D
31. C	**32.** B	**33.** D	**34.** C	**35.** B					

Hints and Explanations

1. Choice (C)
2. Choice (A)
3. Choice (D)
4. Choice (C)
5. Choice (B)
6. Choice (B)
7. Choice (A)
8. Choice (C)
9. Choice (A)
10. Choice (D)
11. Choice (A)
12. Choice (D)
13. Choice (B)
14.



Fundamental deviation = – 0.008
Tolerance = 0.020 – 0.008 = 0.012. Choice (A)

15. Choice (D)

16. According to Chvorinov's rule, solidification time µ $\left(\frac{V}{A}\right)^2$

$$\frac{V}{A} = \frac{\frac{\pi}{4}d^2 \times h}{\pi dh + 2\times\frac{\pi d^2}{4}}$$

$$= \frac{dh}{4h+2d}$$

For riser A,

$$\frac{V}{A} = \frac{25\times 50}{4\times 50+2\times 25} = 5$$

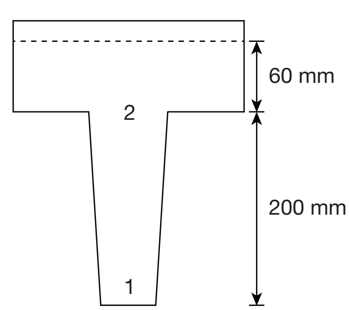
For riser B,

$$\frac{V}{A} = \frac{50\times 25}{4\times 25+2\times 50} = 6.25$$

Ratio of solidification times B to A

$$= \frac{6.25}{5} = 1.25.$$ Choice (A)

17.



Let 1 and 2 represent sprue bottom and top
d_2= 30 mm

Liquid head at sprue top $h_2 = 60$ mm
Liquid head at sprue bottom $h_1 = 200 + 60$
= 260 mm
For smooth flow,
$A_1V_1 = A_2V_2$
$$\frac{A_1}{A_2} = \frac{V_2}{V_1}$$
but $V = \sqrt{2gh}$
and $A = \frac{\pi d^2}{4}$
$$\therefore \quad \frac{d_1^2}{d_2^2} = \sqrt{\frac{h_2}{h_1}}$$
$$\frac{d_1^2}{(30)^2} = \sqrt{\frac{60}{260}}$$
$d_1 = 20.8$ mm. Choice (C)

18. $R = \frac{D}{2} = \frac{300}{2} = 150$ mm
$h_i = 4$ mm
$h_f = 3$ mm
$\Delta h = h_i - h_f = 1$ mm
$$\tan \alpha = \sqrt{\frac{\Delta h}{R}}$$
$$= \sqrt{\frac{1}{150}}$$
$\alpha = 0.082$ radian
$= 4.68°$
Roll contact length
$L = \sqrt{R\Delta h}$
$= \sqrt{150 \times 1}$
= 12.25 mm Choice (B)

19. Force required when shear is provided
$$= F_{max} \times \frac{tp}{tp + s}$$
$$= \pi\, d\, t\, \tau \times \frac{tp}{tp + s}$$
where d = hole diameter
t = sheet thickness
= percentage penetration
s = shear provided
$$= \pi \times 12 \times 4 \times 400 \times \frac{(4 \times 0.4)}{(4 \times 0.4 + 2)}$$
= 26808 N
= 26.81 kN. Choice (D)

20. $r_i = \frac{9}{2} = 4.5$ mm
$r_f = \frac{7}{2} = 3.5$ mm
$\sigma_0 = 400$ N/mm²
$$\sigma = 2\,\sigma_0\, I_n\left(\frac{r_i}{r_f}\right)$$
$$= 2 \times 400 \times I_n\left(\frac{4.5}{3.5}\right)$$
= 201.05 N/mm²
Ideal force = $\sigma \times \pi\,(r_f)^2$
$= 201.05 \times \pi \times (3.5)^2$
= 7737.4 N
= 7.74 kN. Choice (A)

21. Cup diameter d = 100 mm
corner radius r = 6 mm
cup height h = 120 mm
$$\frac{d}{r} = \frac{100}{6} = 16.67$$
when $15 \geq \frac{d}{r} \geq 20$
blank diameter
$$D = \sqrt{d^2 + 4dh - 0.5r}$$
$$= \sqrt{100^2 + 4 \times 100 \times 120 - 0.5 \times 6}$$
= 240.83 mm. Choice (C)

22. Power consumed P = 2.2 kW
melting efficiency $\eta_m = 0.6$
Heat transfer efficiency $\eta_t = 0.7$
Area of cross section A = 6 mm²
Energy required to melt E = 12 J/mm³
Power required to melt = $E \times A \times f$
Where f = feed rate
Power applied = $P \times \eta_m \times \eta_t$
$E \times A \times f = P \times \eta_m \times n_t$
$12 \times 6 \times f = 2.2 \times 10^3 \times 0.6 \times 0.7$
f = 12.83 mm/s. Choice (A)

23. Feed f = 0.3 mm/rev, depth of cut = 2.5 mm.
Reducing 45 mm ϕ to 40 mm ϕ
Length $L_1 = 50 + 55 = 105$ mm
Cutting speed $V = \pi\, D_1 N_1$
$$20 = \pi \times \frac{45}{1000} \times N_1$$
N_1 = 141.47 rpm
$$\text{Time } T_1 = \frac{L_1}{fN_1}$$
$$= \frac{105}{0.3 \times 141.47}$$
= 2.474 min

Reducing 45 mm ϕ to 40 mm ϕ

$L_2 = 55$ mm

$20 = \pi \times \frac{40}{1000} \times N_2$

$N_2 = 159.15$ rpm

$T_2 = \frac{L_2}{fN_2}$

$= \frac{55}{0.3 \times 159.15}$

$= 1.152$ min

Total time $= T_1 + T_2$

$= 2.474 + 1.152$

$= 3.63$ min. Choice (B)

24. Coefficient of friction

$\mu = \tan\beta$

where β = friction angle

$\therefore \tan\beta = 0.6$

$\beta = 30.96°$

For minimum cutting force,

$2\phi + \beta - \alpha = 90°$

where ϕ = shear plane angle and

α = rake angle

$\therefore 2\phi + 30.96 - 10° = 90°$

$\phi = 34.52°$. Choice (D)

25. Let V be cutting speed and T be the tool life As per Taylor's equations

$VT^n = C$

Or

$V_1T_1^n = V_2T_2^n$

$\frac{V_1}{V_2} = \left(\frac{T_2}{T_1}\right)^n$

$\left(\frac{85}{10}\right)^n = \frac{55}{25}$

$8.5^n = 2.2$

$n = 0.3684$

$V_1T_1^n = V_3T_3^n$

$V_3 = V_1\left(\frac{T_1}{T_3}\right)^n$

$= 25\left(\frac{85}{5}\right)^n$

$= 25 \times \left(\frac{85}{5}\right)^{0.3684}$

$= 71$ m/min. Choice (A)

26. $\alpha = 6°$

$V = 0.5$ m/s

$w = 3$ mm

$t_1 = 1$ mm

$t_2 = 1.5$ mm

$r = \frac{t_1}{t_2} = \frac{1}{1.5} = 0.67$

$\tan\phi = \frac{r\cos\alpha}{1 - r\sin\alpha}$

$= \frac{0.67\cos 6}{1 - 0.67\sin 6}$

$= 0.7165$

$\phi = 35.62°$

Area of shear plane $= \frac{t_1 w}{\sin\varphi}$

$= \frac{1 \times 3}{\sin 35.62^\circ}$

$= 5.15$ mm^2. Choice (C)

27. Material removed in time t

$m = Z\,I\,t$

where $Z = \frac{E}{F}$

$E = \frac{Atomic\ weight}{Valency}$

$= \frac{56}{2}$

$= 28$

F = Faraday's constant

$I = \frac{V}{R}$

$R = \frac{\rho \times \ell}{A}$

$\rho = 4\ \Omega$ cm

ℓ = inter electrode gap = 0.3 mm

A = surface area = 25 × 25

= 625 mm^2

$R = \frac{4 \times 0.3 \times 10^{-1}}{625 \times 10^{-2}}$

$= \frac{4 \times 3}{625}$

$= 0.0192\ \Omega$

$I = \frac{12}{0.0192}$

$= 625$ A

$m = \frac{28}{96500} \times 625 \times 25$

$= 4.53$ gms. Choice (B)

28. $D = \sqrt{18 \times 30}$

$= 23.2379$ mm

$i = 0.45\,(23.2379)^{1/3} + 0.001 \times 23.2379$

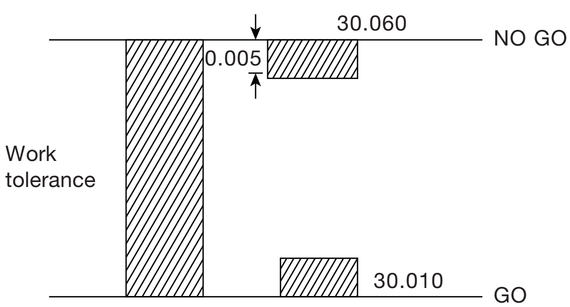
$= 1.3074$ microns

$IT\,8 = 25\,i$

= 25 × 1.3074
= 33 microns
= 0.033 mm
Upper deviation of shaft = −5.5 $D^{0.41}$
= −5.5 × $(23.7379)^{0.41}$
= – 20 microns
= – 0.02 mm
HL of shaft = 20 – 0.02
LL of shaft = *HL* – Tolerance
= 20 – 0.02 – 0.033
= 19.947 mm. Choice (D)

29. *HL* of hole = 30.03 mm
HL of hole = 30 – 0.02
= 29.98 mm
Minimum clearance =
LL of hole – *HL* of shaft
∴ 0.01 = 29.98 – *HL* of shaft
HL of shaft = 29.98 – 0.01
= 29.97 mm
Maximum clearance =
HL of hole – *LL* of shaft
∴ 0.08 = 30.03 – *LL* of shaft
LL of shaft = 29.95 mm
Tolerance on shaft = *HL* – *LL*
= 29.97 – 29.95
= 0.02 mm. Choice (B)

30. Tolerance on workshop gauges are arranged to fall inside the work tolerance.



Hole tolerance = 30.060 – 30.010
= 0.050 mm
Gauge tolerance = 0.050 × 0.1 = 0.005 mm
HL of NO GO plug gauge
= *HL* of hole = 30.060
LL of NO GO plug gauge
= *HL* – Tolerance = 30.060 – 0.005
= 30.055 mm
∴ Size of NO GO plug gauge
= $30^{+0.060}_{+0.055}$ mm. Choice (D)

31. Choice (C)

32. Depth of cut = 0.4 mm
Feed (t_1) = 0.3 mm/rev
Rake angle α = 8°
Shear plane angle ϕ = 28°
Chip thickness ratio $r = \frac{t_1}{t_2} = \frac{\sin\varphi}{\cos(\varphi-\alpha)}$
$= \frac{\sin 28}{\cos(28-8)}$
= 0.4996
i.e., $\frac{0.3}{t_2} = 0.4996$
t_2 = 0.6 mm. Choice (B)

33. Using Earnst and Merchant's theory
2ϕ + β – α = 90°
where β = friction angle
∴ 2 × 28+ β – 8 = 90°
β = 42°
Coefficient of friction
μ = tan β
= 0.9. Choice (D)

34. Feed *f* = 0.25 mm/rev
Depth of cut *d* = 3 mm
Chip thickness ratio r = 0.6
Rake angle α = 6°
Tan $\phi = \frac{r\cos\alpha}{1-r\sin\alpha}$
$= \frac{0.6\times\cos 6}{1-0.6\sin 6}$
= 0.63664
ϕ = 32.48°
Shear force $F_s = \frac{\tau df}{\sin\varphi}$
$= \frac{240\times 3\times 0.25}{\sin 32.48}$
= 335 N. Choice (C)

35. Applying Merchant's rule,
2 ϕ + β – α = 90°
2 × 32.48 + β – 6 = 90°
β = 31°
Cutting force $F_c = \frac{F_s\cos(\beta-\alpha)}{\cos(\varphi+\beta-\alpha)}$
$= \frac{335\cos(31-6)}{\cos(32.48+31-6)}$
= 564.76 N or 565 N. Choice (B)