CLASS TEST

S.No.: 01SKME_JKL_18072025

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MACHINE TOOLS

MECHANICAL ENGINEERING

Date of Test : 18/07/2025

ANSWER KEY

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

DETAILED EXPLANATIONS

1. (d)

Given,

$$Z = 10$$
$$N = 100 \text{ rpm}$$
$$f = 50 \text{ mm/min}$$

$$\text{Feed per revolution, } f_N = \frac{50}{100} = 0.5 \text{ mm/rev.}$$

$$\text{Feed per tooth, } f_Z = \frac{f_N}{Z} = \frac{0.5}{10} = 0.05 \text{ mm/tooth}$$

2. (a)

$$\text{Cone height} = \frac{D/2}{\tan\frac{\alpha}{2}} = \frac{5}{\tan 60^\circ} = 2.886 \text{ mm}$$

3. (b)

$$\text{cutting velocity, } (V) = \frac{\pi d N}{1000}$$

$$71.5 = \frac{\pi d \times 350}{1000}$$

$$\text{diameter } (d) = 65.026 \text{ mm}$$

4. (d)

As MRR (metal removal rate) = fdv

$$= (0.6 \times 2.5 \times 150 \times 10^3) \text{ mm}^3/\text{min}$$
$$= 225000 \text{ mm}^3/\text{min or } 22.5 \times 10^4 \text{ mm}^3/\text{min}$$

5. (d)

Time taken for cutting,

$$t = \frac{L}{V_c} = \frac{150 \times 60}{200} = 45 \text{ sec}$$

6. (c)

$$\text{Axial feed, } F = \frac{3000 \text{ mm}}{30s} = 100 \text{ mm/s} = 6000 \text{ mm/min}$$

We know, Axial feed, $F = \pi d N \sin\theta$

$$6000 = \pi \times 200 \times 500 \times \sin\theta$$
$$\theta = 1.094^\circ \simeq 1.09^\circ$$

7. (b)

As taper is on full length,

So, Offset, $S = \dfrac{(D-d)L}{2l}$

Where, L = full length of workpiece, l = portion of work piece

$$= \frac{(68-46)500}{2 \times 500} = 11 \text{ mm}$$

8. (b)

$$\text{Time/cut} = \frac{\text{Number of double strokes} \times \text{time}}{\text{double stroke}} = \frac{B}{f} \times \frac{1}{10} = \frac{300}{0.2} \times \frac{1}{10} = 150 \text{ min}$$

9. (c)

Glazing is the phenomenon in which the grinding wheel becomes dull due to wearing out of sharp edges of grit on continuous machining.

10. (b)

$$V = \frac{NL(1+m)}{1000} = \frac{20 \times 300\left(1+\frac{3}{4}\right)}{1000} = 10.5 \text{ m/min}$$

11. (a)

Given : Depth (d) = 5 mm, f_m = 2 mm/s

$$\text{Width of cut} = \text{Diameter of the tool}$$

$$\Rightarrow \quad w = 40 \text{ mm}$$

$$\text{Material removal rate (MRR)} = wdf_m$$

$$= 40 \times 5 \times 2 = 400 \text{ mm}^3/\text{s}$$

$$\text{Power required} = \frac{(\text{Specific energy}) \times MRR}{\eta} = \frac{8.5 \times 400}{0.5} = 6.8 \text{ kW}$$

12. (d)

$$\text{Machining time} = \frac{L}{f_t \times Z \times N}$$

$$\text{Approach distance, } A = \sqrt{d(D-d)} = \sqrt{2(100-2)} = 14 \text{ mm}$$

$$L = 150 + 2 \times 14 = 178 \text{ mm}$$

$$T = \frac{178}{0.15 \times 8 \times 65} = 2.28 \text{ min} = 2.28 \times 60 = 136.92 \text{ sec}$$

13. (b)

Total material removal rate,

$$\text{MRR} = \frac{\pi}{4} D_1^2 f_m + \frac{\pi}{4} D_2^2 f_m = \frac{\pi}{4} f_m \left(D_1^2 + D_2^2\right)$$

$$\Rightarrow \quad \frac{\pi}{4} \times \left(13^2 + 19^2\right) \times f_m = 24580$$

$$f_m = 59.049 \text{ mm/min}$$

$$\text{Compulsory approach for drill 1, } x_1 = \frac{D_1/2}{\tan\frac{\alpha}{2}} = \frac{13/2}{\tan 59^\circ} = 3.905 \text{ mm}$$

$$\text{Compulsory approach for drill 2, } x_2 = \frac{D_2/2}{\tan\frac{\alpha}{2}} = \frac{19/2}{\tan 59^\circ} = 5.708 \text{ mm}$$

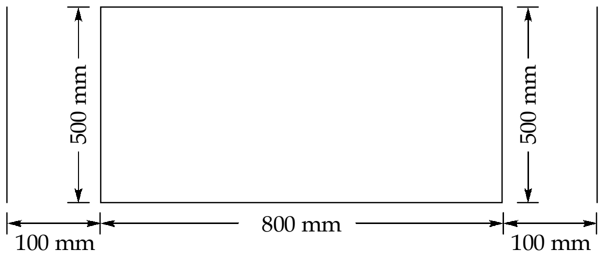
$$\text{Time required to drill hole 1} = \frac{L + x_1}{f_m} = \frac{40 + 3.905}{59.049} \times 60 = 44.612 \text{ seconds}$$

$$\text{Time required to drill hole 2} = \frac{L + x_2}{f_m} = \frac{40 + 5.708}{59.049} \times 60 = 46.44 \text{ seconds}$$

$$= 46.44 \text{ seconds}$$

As both the drills are working simultaneously, so the time for the complete operation is 46.44 seconds.

14. (b)



$$L = 100 + 800 + 100 = 1000 \text{ mm}$$

$$\text{Cutting time per stroke} = \frac{1000 \text{ mm}}{6000 \text{ mm/min}} = \frac{1}{6} \text{min}$$

$$\text{Return time} = \frac{1}{2} \text{ of cutter time} = \frac{1}{12} \text{min per stroke}$$

$$\text{Total time per stroke} = \frac{1}{6} + \frac{1}{12} = \frac{1}{4} \text{min}$$

$$\text{Number of stroke} = \frac{500}{2} = 250$$

$$\therefore \quad \text{Total time} = \frac{1}{4} \times 250 = 62.5 \text{ min}$$

15. (a)

$$\text{Length of uncut chip, } l = \frac{\pi}{2}(D_i + D_f)$$

$$\text{Length of uncut chip, } l = \frac{\pi(75 + 73)}{2} = 232.48 \text{ mm}$$

$$\phi = 0.3328 \text{ radian} = 19.068°$$

$$\tan 19.068° = \frac{r \cos 15°}{1 - r \sin 15°}$$

$$r = \frac{l_c}{l}$$

$$0.3275 = \frac{l_c}{232.48}$$

$$l_c = 76.137 \text{ mm}$$

16. (b)

$$L = 1.5 \text{ m} = 1500 \text{ mm}$$

$$AL = OL = 20 \text{ mm}$$

$$L_{total} = 20 + 1500 + 20 = 1540 \text{ mm}$$

$$W = 5.5 + 600 + 5.5 = 611 \text{ mm}$$

Number of required stroke= $\dfrac{W}{f} = \dfrac{611\,\text{mm}}{2\,\text{mm/stroke}} = 305.5 \simeq 306$

$$\text{Planning time} = \frac{W}{f}\left[\frac{L_{\text{total}}}{V_{\text{forward}}} + \frac{L_{\text{total}}}{V_{\text{return}}} + T_{\text{reversing table}}\right]$$

$$= 306\left[\frac{1540}{21\times1000} + \frac{1540}{42\times1000} + 0.02\right]$$

$$= 39.78 \text{ min} \simeq 2386.8 \text{ sec}$$

17. (d)

$$V_c = \frac{\pi DN}{1000}$$

$\Rightarrow$ $$N = \frac{1000\times5}{\pi\times50} = 31.83 \text{ rpm}$$

Now, $$T_c = \frac{L_c}{fN}\times\text{Number of passes}$$

$$= \frac{150}{1\times31.83}\times3 = 14.14 \text{ minutes}$$

18. (c)

$$V \times (5\times60)^{0.16} = 100\times(45)^{0.16}$$

$$V = 73.82 \text{ m/min}$$

$$\text{Spindle speed} = \frac{73.82\times1000}{\pi\times25} = 939.90543 \text{ rev/min}$$

$$\text{Cutting time per piece} = \frac{50\times60}{939.90543\times0.25} = 12.7672 \text{ sec}$$

No. of components per tool change

$$= \frac{5\times60\times60}{12.7672} = 1409.858 = 1410$$

19. (b)

$$\text{MRR} = \frac{\pi}{4}D^2 fN$$

D = 25 mm $\qquad$ f = 0.25 mm/rev

$$V = \frac{\pi DN}{1000}$$

$\Rightarrow$ $$30 = \frac{\pi\times25\times N}{1000}$$

$$N = 381.972 \text{ rpm}$$

$$\text{MRR} = \frac{\pi}{4}\times25^2\times0.25\times381.972 \text{ mm}^3/\text{min}$$

$$= 46874.9 \text{ mm}^3/\text{min} = 0.78 \text{ cm}^3/\text{sec}$$

20. (a)

Saw has 12 teeth per meter

$$\text{Saw speed} = 150\ \text{m/min}$$

So, Number of teeth engaging per minute $= \frac{12}{(\text{metre})} \times 150 \times \left(\frac{\text{metre}}{\text{min}}\right)$

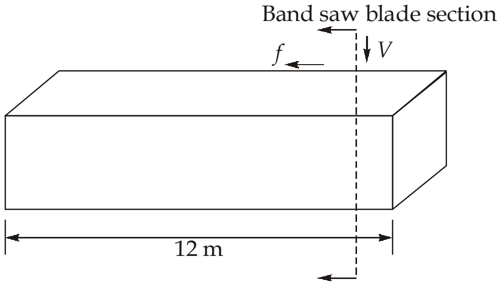
$$= 1800\ \text{Teeth/minute}$$

$$\text{Feed per tooth} = 0.003\ \text{meter}$$

$$\text{Feed per minute} = 1800 \times 0.003$$

$$= 5.4\ \text{m/min}$$

Time taken to cut 12 m $= \frac{12}{5.4} = 2.223$ min



21. (c)

$$V = 70\ \text{m/min}$$
$$D = 50\ \text{mm}$$
$$f = 0.25\ \text{mm/rev}$$
$$L = 60\ \text{mm}$$

Spindle speed, $N = \frac{1000V}{\pi D} = \frac{1000 \times 70}{\pi \times 50} = 445.633$ rev/min

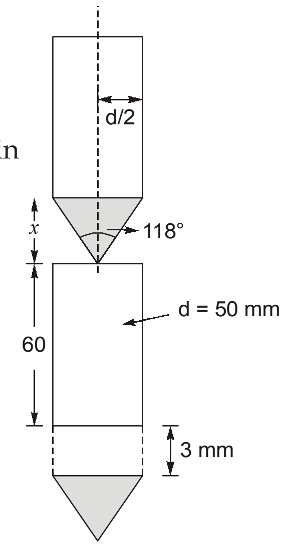
Breakthrough distance,

$$A = \frac{50}{2\tan 59°}$$
$$A = 15.02\ \text{mm}$$

Total length of drill travel, $L = 60 + 15.02 + 3$

$$L = 78.02\ \text{mm}$$

Time for drilling the hole $= \frac{78.02}{0.25 \times 445.633} = 0.7$ min



22. (c)

Power required in turning is given by

$$P = K.d.f.V$$

$$V = \frac{\pi DN}{1000} = \frac{\pi \times 50 \times 140}{1000} = 21.99\ \text{m/min}$$

$$P = \frac{1600 \times 3 \times 1 \times 21.99}{60}$$

$$P = 1.76\ \text{kW}$$

23. (c)

As per given data,

length = 120 mm; initial diameter, D = 60 mm; cutting speed, V = 90 m/min

$$\pi DN_1 = 90$$

$$N_1 = \frac{90 \times 1000}{\pi \times 60}$$

$$N_1 = 477.464 \text{ rpm}$$

1st conversion (60 mm to 40 mm) machining Length, $L_1 = 76 + 38 = 114$ mm

$$D_1 = 40 \text{ mm}$$

$$T_{m1} = \frac{L_1}{f \times N_1} = \frac{114}{0.8 \times 477.464} = 0.2984 \text{ min}$$

2nd conversion (40 mm to 20 mm) machining Length, $L_2 = 38$ mm, $D_2 = 20$ mm

$$\text{Cutting speed, } V = 90 \text{ m/min}$$

$$\pi D_1 N_2 = 90 \text{ m/min}$$

$$N_2 = \frac{90 \times 1000}{\pi \times 40}$$

$$N_2 = 716.197 \text{ rpm}$$

$$\text{Machining time, } T_{m2} = \frac{L_2}{f \times N_2} = \frac{38}{0.8 \times 716.197} = 0.06632 \text{ min}$$

$$\text{So total machining time} = T_{m1} + T_{m2}$$

$$= 0.2984 + 0.06632$$

$$= 0.3647 \text{ min}$$

24. (b)

$$\text{Cutting speed, } v = \frac{\pi DN}{1000}$$

$$95 = \frac{\pi \times 20 \times N}{1000}$$

$$N = 1511.9719 \text{ rpm}$$

$$\text{Feed per min} = \text{Feed per tooth} \times \text{No. of teeth} \times \text{rpm}$$

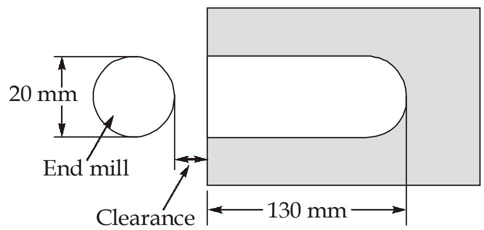
$$= 0.15 \times 5 \times 1511.9719 = 1133.97897 \text{ mm/min}$$

$$\text{Approach distance } A_D = \frac{D}{2} = \frac{20}{2} = 10 \text{ mm}$$

$$L = 130 + 10 = 140 \text{ mm}$$

$$\text{Cutting time} = \frac{140}{1133.97897} = 0.12345 \text{ min}$$

$$= 7.40 \text{ sec}$$



25. (a)

$$t_1 = \frac{2f}{Nz}\sqrt{\frac{d}{D}}$$

$$t_2 = \frac{2f}{Nz}\sqrt{\frac{3d}{3D}}$$

$$\therefore \quad \% \text{ change } t_2 - t_1 = 0$$

26. (a)

Given:

$$N_{min} = 35 \text{ rpm}$$
$$N_{max} = 300 \text{ rpm}$$
$$n = 6$$

$$\text{Sped, ratio, } r = \sqrt[(n-1)]{\frac{N_{max}}{N_{min}}} = \sqrt[5]{\frac{300}{35}} = 1.537$$

$$3^{rd} \text{ spindle speed, } N_3 = N_1 r^2$$
$$= 35(1.537)^2 = 82.66 \text{ rpm}$$

27. (a)

$$\pi DN = 18 \text{ m/min}$$
$$\pi D_{min} \times N_{max} = 18$$
$$N_{max} = \frac{18}{\pi \times 6.25 \times 10^{-3}} = 916.732 \text{ rpm}$$
$$\pi D_{max} \times N_{min} = 18$$
$$N_{min} = \frac{18}{\pi \times 25 \times 10^{-3}} = 229.183 \text{ rpm}$$
$$N_{min} = N_1$$
$$N_{max} = N_1 r^{8-1}$$
$$916.73 = 229.183\ r^7$$
$$r = \sqrt[7]{\frac{916.73}{229.183}}$$
$$r = 1.219 \simeq 1.22$$
$$\frac{N_1}{N_2} = 1.22$$

28. (c)

29. (d)

Given : $N_s = 200$ rpm, $D_s = 1$ mm, $Z_s = 2$, $p_L = 4$ mm

$$N_S \times p_S \times Z_S = N_L \times p_L \times Z_L \times 4$$
$$200 \times 1 \times 2 = N_L \times 4$$
$$N_L = 100 \text{ rpm}$$

30. (a)

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