CLASS TEST

S.No. : 05SPME_H_05062024

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MACHINE TOOLS

MECHANICAL ENGINEERING

Date of Test : 05/06/2024

ANSWER KEY

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

DETAILED EXPLANATIONS

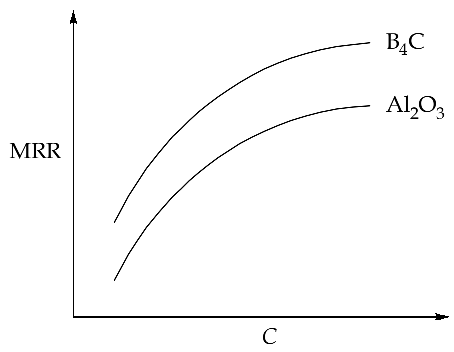
1. (a)

$$\text{Cone height} = \frac{D/2}{\tan\frac{\alpha}{2}} = \frac{5}{\tan 60^\circ} = 2.886 \text{ mm} \simeq 2.89 \text{ mm}$$

2. (a)

In USM the variation of material removal rate (MRR) with respect to the volume concentration of abrasive in water slurry is governed by:

$$\text{MRR} \propto \frac{c^{1/4} A^{1/4} F^{3/4} a_0^{3/4} d_g f}{\sigma_w^{3/4}(1+\lambda)^{3/4}} \mu^{3/4}$$



Volume concentration of abrasive slurry, C

3. (b)

It does not cause any thermal damage to the part.

4. (c)

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

5. (d)

As MRR (metal removal rate) = *fdv*

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

6. (b)

$$\text{Speed range} = \frac{N_{max}}{N_{min}} = \frac{1120}{100} = 11.2$$

$$r = \sqrt[(n-1)]{\frac{N_{max}}{N_{min}}} = (11.2)^{\frac{1}{5}} = 1.62 \qquad (n = \text{no. of speeds})$$

$$N_3 = N_1 r^2 = 100(1.62)^2 = 262.84 \text{ rpm}$$

7. (a)

The size of shaper is given by maximum length of stroke or ram movement. Size varies from 175 to 900 mm stroke.

The length of stroke can be increased by increasing the centre distance of bull gear and crank pin.

8. (b)

Soft material cannot be economically grinded because of its ductile nature, small chips produced and get clogged in between randomly oriented teeth.

9. (b)

$$\frac{\text{Pitch to be cut}}{\text{Pitch of lead screw}} = \frac{\text{rpm of lead screw}(N_1)}{\text{rpm of spindle}}$$

$$\frac{2}{6} = \frac{N_1}{60}$$

$$N_1 = 20 \text{ rpm}$$

10. (a)

Conical locator: These are used to locate a work piece which is cylindrical and with or without a hole.

Cylindrical locator: In these, the locating diameter of the pin is made a push fit with the hole in the workpiece.

Diamond pin locator: These are used to constrain the pivoting of the workpiece around the principal location

V-locator: These are used in circular and semicircular profile.

11. (d)

Time taken for cutting,

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

12. (d)

Reaming: It is operation of sizing and finishing a hole.

Counter-boring : The hole is enlarged with a flat bottom to provide a proper seating for bolt head or nut.

Countersinking: Similar to counter boring additional machining done on a hole is conical to accommodate the counter sink machine screw head.

Spot facing: Similar to counter boring but removes only very small portion of material.

13. (a)

We know, MRR is given by,

$$\text{MRR} = \frac{AI}{\rho VF}$$

So,

$$I = \frac{(MRR) \times \rho VF}{A}$$

$$\therefore \quad I = \frac{(2.5/60)\times 8\times 2\times 96500}{56} = 1148.81 \text{ A}$$

14. (c)

V : Vitrifield
B : Resinoid
C : Rubber
E : Shellac

15. (a)

Saw has 12 teeth per meter

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

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

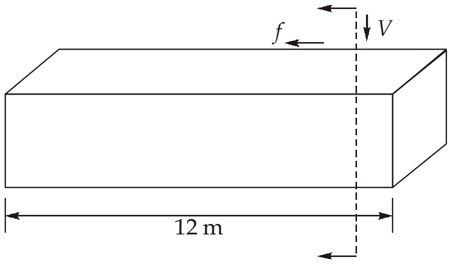
$$= 1800 \text{ Teeth/minute}$$

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

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

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

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



16. (c)

Power required in turning is given by

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

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

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

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

17. (b)

Maximum uncut chip thickness

$$t_{max.} = \frac{2f}{NZ}\sqrt{\frac{d}{D}}$$

where, N = rpm of cutter = 30
d = depth of cut = 2 mm
f = feed = 20 mm/min
Z = number of teeth = 30
D = cutter diameter = 80 mm

$$t_{max.} = \frac{2\times 20}{30\times 30}\sqrt{\frac{2}{80}} = 7.027\ \mu\text{m}$$

18. (a)

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

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

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

19. (d)

Given,

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

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

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

20. (d)

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

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

21. (c)

$$\text{Semi-drill point angle, } \alpha = 60°$$

$$\text{Breakthrough distance, } d = \frac{D}{2\tan\alpha} = \frac{12}{2\tan 60} = 3.464 \text{ mm}$$

$$\text{Total length of travel} = 24 + 3.464 + 3 = 30.464 \text{ mm}$$

$$\text{Time required to drill a hole} = \frac{L}{fN} = \frac{30.464}{0.3 \times 350} \text{ min} = 17.408 \text{ sec.}$$

22. (c)

23. (a)

Jig Boring Machines: These are precision boring machines having precision spindles and slides. These are used for machining drilling, boring of precision components as well as for making tools and dies for press work and machining of components for jigs and fixtures etc. The machines are generally equipped with high precision optical scales for motion measurement of every slide. For high accuracy the machines should be kept in a clean and temperature controlled (air- conditioned) environment.

Vertical precision boring are used to machine inside and outside diameters of large pipes and pressure vessels. Since boring machines are very heavy and big i.e., Standard vertical boring machine is largest of machine tool so boring machine are kept at job shops.

24. (b)

Grinding process is a very inefficient one compared to the conventional metal cutting process.

Specific energy of grinding = 50 J/mm^3

Specific energy of other = 2 to 5 J/mm^3

A large number of cutting edges are involved in cutting this result in large contact area between wheel and work.

25. (b)

$$\text{Length of approach } (L_1) = \sqrt{d(D-d)}$$

$$= \sqrt{4(50-4)} = 13.56 \text{ mm}$$

$$\text{Time of one cut} = \frac{L+L_1}{fN} = \frac{230+13.56}{(0.25\times 20\times 100)/60}$$

$$= 29.227 \text{ sec} \simeq 29.23 \text{ sec}$$

26. (b)

$$V = \frac{NL(1+m)}{1000} = \frac{25\times 200\times(1+0.6)}{1000} = 8 \text{ m/min}$$

27. (b)

Given:

$$D = 20 \text{ mm}$$
$$V = 25 \text{ m/min}$$
$$f = 0.3 \text{ mm/rev}$$
$$T = 120 \text{ min}$$
$$l = 40 \text{ mm}$$

$$N = \frac{1000V}{\pi D} = \frac{1000\times 25}{\pi\times 20} = 397.88 \text{ rpm}$$

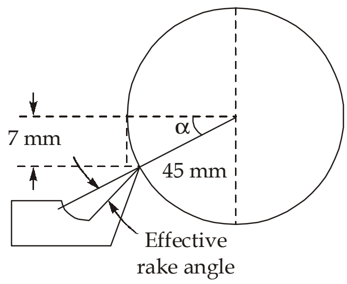
$$\text{Total length } (L) = 40 \text{ mm}$$

∴ Time to produced one hole (T)

$$= \frac{L}{fN} = \frac{40}{0.3\times 397.88} = 0.335 \text{ min}$$

$$\therefore \text{Number of holes/ drill} = \frac{120}{0.335} = 358.2 \simeq 358 \text{ holes}$$

28. (c)



$$\sin\alpha = \left(\frac{7}{45}\right)$$

$$\alpha = \frac{7}{45} \text{ rad}$$

$$\alpha = \frac{7}{45}\times\frac{180}{\pi} = \frac{7\times 4}{\frac{22}{7}} = \frac{98}{11}$$

$$\alpha = 8.909°$$

$$\text{Effective rake angle} = 10° - \alpha°$$

$$= 10° - 8.909° = 1.091°$$

$$\text{Effective clearance angle} = 5° + 8.909° = 13.909°$$

29. (a)

Given, $D = 80$ mm, $z = 8$

$$N = \frac{1000V}{\pi D} = \frac{1000\times 20}{\pi\times 80} = 79.58 \text{ rpm}$$

$V = 20$ m/min, $f = 160$ mm/min

$d = 2$ mm

Maximum chip thickness,

$$t_{max} = \frac{2f_m}{Nz}\sqrt{\frac{d}{D}} = \frac{2\times 160}{79.58\times 8}\sqrt{\frac{2}{80}} = 0.079 \text{ mm}$$

Minimum chip thickness,

$$t_{min} = 0$$

$$t_{avg} = \frac{t_{max}+t_{min}}{2} = 0.0395 \text{ mm}$$

30. (b)

Given: 0.4 thread $\rightarrow$ 1 mm

then, pitch of lead screw $(P) = \frac{1}{0.4} = 2.5$ mm

Ratehet has 30 teeth,

$\therefore$ Pawl indexes $\frac{1}{30}$ revolution during each stroke

$$\therefore \quad \text{feed} = \frac{1}{30}\times 2.5 = 0.083 \text{ mm}$$

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