CLASS TEST

S.No.:09SPME_ABCD_19092023

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METAL CUTTING + METROLOGY + AUTOMATION

MECHANICAL ENGINEERING

Date of Test : 19/09/2023

ANSWER KEY

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

DETAILED EXPLANATIONS

1. (d)

Sensitivity towards tool life is in the order,

Speed > Feed > Depth of cut

As these parameter are increased, tool life decreases.

$\therefore$ First depth of cut is to be increased, then feed followed by speed.

2. (a)

Optimum tool life for maximum production rate is

$$T_{opt} = \frac{t_c(1-n)}{n} = \frac{2\times(1-0.25)}{0.25} = 6 \text{ minutes}$$

3. (c)

As the chip-tool contact length is reduced, it results in excessive stress concentration and greater heat generation. However, cutting force is less due to lesser contact area. Thus cutting force is reduced and interface temperature would increase. Thus (c) is the correct choice.

4. (c)

Effects of increasing positive rake angle:

- increase in tool life
- reduction in tool strength
- reduction in cutting force
- less heat generation

5. (c)

The line generated by the cutting motion is called generatrix and line generated by the feed motion is termed as directrix. During taper turning on a lathe machine, directrix is a straight line whereas generatrix is a circle.

6. (c)

Given: $\alpha_s = 10°$, $\alpha_b = 5°$, $\psi_s = 10°$, $\psi_e = 20°$

$$\tan\alpha = \tan\alpha_s \sin\lambda + \tan\alpha_b \cos\lambda$$

$$\text{Approach angle } (\lambda) = 90° - \psi_s = 90° - 10° = 80°$$

$$\tan\alpha = \tan 10° \sin 80° + \tan 5° \cos 80°$$

$$\alpha = 10.693° \simeq 10.7°$$

7. (d)

Groove depth is given by

$$d = \frac{B}{2}\times\frac{\lambda}{2}$$

Here, $B = 4$, $\lambda = 0.6$ microns

$$d = \frac{4}{2}\times\frac{0.6}{2} = 2\times 0.3 = 0.6\,\mu\text{m}$$

8. (d)

Roughness R_a (μm)	Roughness symbol
12.5 to 25	∇
1.6 to 6.3	∇∇
0.2 to 0.8	∇∇∇
0.025 to 0.1	∇∇∇∇

9. (c)

IC engine cylinder and piston form clearance fit with very small clearance.

10. (c)

G21 is used for dimensioning in metric unit.

11. (d)

$$\text{Least count of micrometer} = \frac{\text{Screw pitch}}{\text{Division on thimble}}$$

$$= \frac{0.5}{50} = 0.01 \text{ mm}$$

$$\Rightarrow \quad \text{Reading} = 10 \times 0.5 + 25 \times 0.01 = 5.25 \text{ mm}$$

12. (b)

$$\text{Maximum clearance} = \text{HLH} - \text{LLS} = 50.02 - (50 - 0.08) = 0.10 \text{ mm}$$

$$\text{Minimum clearance} = \text{LLH} - \text{HLS} = 50.00 - (50.00 - 0.05) = 0.05 \text{ mm}$$

$$\text{Tolerance on hole} = \text{HLH} - \text{LLH} = 50.02 - 50.00 = 0.02 \text{ mm}$$

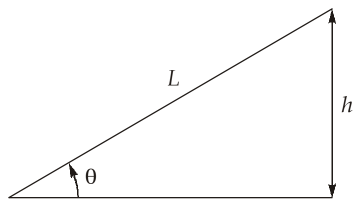
$$\text{Tolerance on shaft} = \text{HLS} - \text{LLS} = (50 - 0.05) - (50 - 0.08) = 0.03 \text{ mm}$$

Since maximum and minimum clearance are positive so, it is a clearance fit.

$$\text{Allowance} = \text{LLH} - \text{HLS} = 50 - (50 - 0.05) = 0.05 \text{ mm}$$

13. (b)

$$\sin\theta = \frac{h}{L}$$



Differentiating,

$$\cos\theta d\theta = \frac{dh}{L} - \frac{h}{L^2}dL$$

As length L is constant So, $dL = 0$

$$\cos\theta d\theta = \frac{dh}{L}$$

So,

$$d\theta = \frac{dh}{L\cos\theta} = \frac{0.005}{125 \times \cos 30^\circ} = 4.618 \times 10^{-5} \text{ radian}$$

$$= 2.65 \times 10^{-3} \text{ degree} = 2.65 \times 10^{-3} \times 60 \times 60 = 9.525''$$

14. (a)

$$D = \sqrt{30 \times 50} = 38.73 \text{ mm}$$

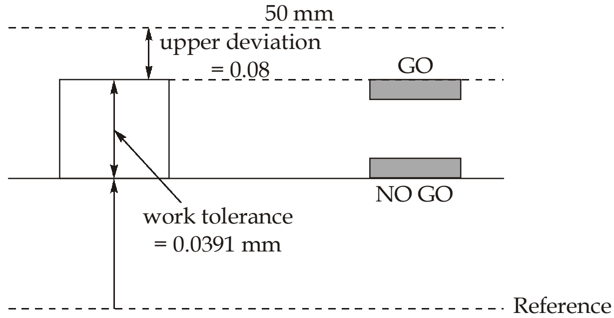
For shaft ⇒

Fundamental deviation of 'd' shaft $= -16D^{0.44}$

$$= -79.95 \text{ microns}$$

$$\approx -0.08 \text{ mm}$$

For ring gauges:



$$\text{Gauge tolerance} = \frac{1}{10}(\text{work tolerance})$$

$$= \frac{1}{10} \times 0.0391 = 3.91 \times 10^{-3} \text{ mm}$$

Dimensions of GO gauge are:

$$50 - 0.08 = 49.92 \text{ mm}$$

and $49.92 - 3.91 \times 10^{-3} = 49.916$ mm

Dimensions of NO GO gauge are:

$$50 - 0.08 - 0.0391 = 49.8809 \text{ mm}$$

and $49.8809 + 3.91 \times 10^{-3} = 49.8848$ mm

Ring gauge:

GO gauge = 49.92 mm
49.916 mm

NO GO gauge = 49.8848 mm
49.8809 mm

15. (c)

$$t_1 = 0.25 \text{ mm}$$

$$t_2 = 0.75 \text{ mm}$$

$$r = \frac{t_1}{t_2} = \frac{0.25}{0.75} = 0.33$$

$$\tan\phi = \frac{r\cos\alpha}{1 - r\sin\alpha} = \frac{0.33\cos 30°}{1 - 0.33\sin 30°}$$

$$\tan\phi = 0.346$$

18. (d)

The energy consumption per unit volume of material removal is commonly known as specific energy.

$$\text{Cutting force} = 2 \times 1000 \times 0.2 \times 2 = 800 \text{ N}$$

20. (d)

Given, $\alpha = 10°$, $r = 0.4$

$$\tan\phi = \frac{r\cos\alpha}{1 - r\sin\alpha} = \frac{0.4\cos 10°}{(1 - 0.4\sin 10°)}$$

$$\phi = 22.94°$$

Now applying Merchant theory,

$$\phi = 45° + \frac{\alpha}{2} - \frac{\beta}{2}$$

$$22.94° = 45° + \frac{10°}{2} - \frac{\beta}{2}$$

$$\beta = 54.12°$$

$$\mu = \tan\beta = \tan 54.12° = 1.38$$

21. (b)

Friction force, $F = F_C \sin\alpha + F_T \cos\alpha$

$= 1000 \sin(-5) + 500 \cos(-5) = 410.94 \text{ N} \simeq 411 \text{ N}$

22. (d)

$$V_2 T_2^{0.25} = V_1 T_1^{0.25}$$

$$\left(\frac{V_1}{2}\right) T_2^{0.25} = V_1 T_1^{0.25}$$

or $$\left(\frac{T_2}{T_1}\right)^{0.25} = 2$$

or $$\left(\frac{T_2}{T_1}\right) = 2^4 = 16$$

23. (c)

Given that clearance fit is required between shaft and bearing

Thus, (i) the lower limit of hole > upper limit of shaft

Also, hole basis system is followed

Thus, (ii) lower limit of hole = Basic size = 25 mm

Only option satisfying conditions (i) and (ii) and the given values of tolerance is option (c).

24. (c)

Let frequency of pulse $= x$ Hz

Distance travelled per pulse $= \frac{10}{120}$

Speed of table $= \frac{10}{120} \times x = 60$

$\therefore \quad x = \frac{60 \times 120}{10} = 720$ pulses/sec $= 720$ Hz

25. (c)

Part programming codes	Functions
G43	Tool length compensation plus
G81	Canned drilling cycle
M09	Coolant off
M30	Program stop

27. (d)

$$d_p = \frac{p}{2}\sec\theta = \frac{2}{2}\sec 30° = 1.154 \text{ mm}$$

28. (b)

G 98 - Specify feed per minute

G 99 - Specify feed per revolution

M 08 - Turn cutting fluid on

M 03 - Spindle start forward CW

29. (b)

$$\text{CLA} = \frac{\Sigma A}{L} \times \frac{1}{\text{Vertical scale}} \times \frac{1}{\text{Horizontal scale}}$$

$$= \frac{(240+180+90+100)+(65+125+270+350)}{0.8 \times 10000 \times 100} = \frac{1420}{0.8 \times 10000 \times 100}$$

$$= 1.775 \times 10^{-3} \text{ mm}$$

$$= 1.775 \ \mu\text{m}$$

30. (b)

Given pitch of lead screw = 5 mm

Thus, linear movement of table in one revolution = 5 mm

Since, sensitivity is 500 pulses per revolution.

Linear movement corresponding to 500 pulses = 5 mm

$\therefore$ Linear movement corresponding to 1 pulse = BLU = $\frac{5}{500}$ mm = 0.01 mm

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