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Web: [www.madeeasy.in](http://www.madeeasy.in) | E-mail: [info@madeeasy.in](mailto:info@madeeasy.in) | Ph: 011-45124612**MECHANICAL ENGINEERING****Manufacturing Engineering****Duration : 1:00 hr.****Maximum Marks : 50**

Read the following instructions carefully

1. This question paper contains **30** objective questions. **Q.1-10** carry one mark each and **Q.11-30** carry two marks each.
2. Answer all the questions.
3. Questions must be answered on Objective Response Sheet (**ORS**) by darkening the appropriate bubble (marked **A, B, C, D**) using HB pencil against the question number. Each question has only one correct answer. In case you wish to change an answer, erase the old answer completely using a good soft eraser.
4. There will be **NEGATIVE** marking. For each wrong answer **1/3rd** of the full marks of the question will be deducted. More than one answer marked against a question will be deemed as an incorrect response and will be negatively marked.
5. Write your name & Roll No. at the specified locations on the right half of the **ORS**.
6. No charts or tables will be provided in the examination hall.
7. Choose the **Closest** numerical answer among the choices given.
8. If a candidate gives more than one answer, it will be treated as a **wrong answer** even if one of the given answers happens to be correct and there will be same penalty as above to that questions.
9. If a question is left blank, i.e., no answer is given by the candidate, there will be **no penalty** for that question.

**DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE ASKED TO DO SO**

**Q. No. 1 to Q. No. 10 carry 1 mark each**

- Q.1** Which of the following is not correct for core design in casting?
- Dry strength of core should be enough to resist metal pressure
  - Core sand should have high refractoriness
  - Core sand should have lower strength than the moulding sand
  - Core sand should have high permeability
- Q.2** In an Orthogonal cutting, the cutting force is 850 N and thrust force is 300 N. If the chip shear angle is  $60^\circ$ , then chip shear force will be:
- 586.1 N
  - 259.8 N
  - 165.2 N
  - 476.3 N
- Q.3** A metallic disc of diameter 18 mm is to be punched from a sheet of 1.5 mm thickness. The punch and disc clearance is 4%. The required punch diameter is:
- 17.94 mm
  - 17.88 mm
  - 18.12 mm
  - 18.06 mm
- Q.4** The operation factor for an arc welding is 80%. What should be the length of job which can be welded with the given factor, if the welding is done at a speed of 20 m/hr and it takes 15 min to setup the welding machine?
- 1200 m
  - 20 m
  - 600 m
  - 40 m
- Q.5** The tendency of centre cracking in extrusion process increases with
- increasing die angle
  - decreasing die angle
  - increasing extrusion ratio
  - increasing friction
- Q.6** For increasing the material removal rate in turning, without any constraints, the right sequence to adjust the parameters?
- Speed
  - Feed
  - Depth of cut

Select the correct answer using the codes:

- 1-2-3
- 2-3-1
- 1-3-2
- 3-2-1

- Q.7** Forward slip in rolling is expressed as

- $\frac{v_f - v_r}{v_f}$

- $\frac{v_f - v_r}{v_r}$

- $\frac{v_r}{v_f - v_r}$

- $\frac{v_o - v_f}{v_r}$

where  $v_f$  = exit velocity of work ;  $v_o$  = entrance velocity of work ;  $v_r$  = surface velocity of rolls

- Q.8** Which of the following is most suitable for cellular manufacturing?

- Large variety of products in large volume
- Less variety of products in large volume
- Large variety products but less in volume
- None of these

- Q.9** The percent cold work when a cylindrical rod of 15.2 mm is reduced to 12.2 mm is

- 63%
- 82%
- 10%
- 36%

- Q.10 Statement (I):** Thread rolling is superior to other methods of manufacturing threads.

**Statement (II):** Rolling the threads leaves a grain flow pattern that improves the strength of the thread.

- Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I).
- Both Statement (I) and Statement (II) are individually true but Statement (II) is NOT the correct explanation of Statement (I).
- Statement (I) is true but Statement (II) is false.
- Statement (I) is false but Statement (II) is true.

**Q. No. 11 to Q. No. 30 carry 2 marks each**

**Q.11** Consider the following statements:

1. In precision die casting, the pattern is withdrawn by melting it.
2. Chills are used in moulds to reduce the freezing time.
3. Ceramic mould casting is used to produce complex cutting tools.
4. Electroslag welding employs a consumable electrode.

Which of the above statements are correct?

- (a) 1, 2 and 3                      (b) 2, 3 and 4  
(c) 1, 3 and 4                      (d) 1, 2 and 4

**Q.12** A part programme for an arbitrary object is given as follows:

```
N001 G91 G71 M03 S600 EOB
N002 G00 X10.00 Y10.00 Z10.00 EOB
N003 G00 Z-10.00 EOB
N004 G83 Z-60.00 Q-20.00 R-10.00 F100 EOB
N005 G80 EOB
N006 M02 EOB
```

The above programming format will be used as canned cycle for

- (a) Drilling - Spot boring
- (b) Topping
- (c) Boring
- (d) Deep hole peck drilling

**Q.13** Which of the following is/are the characteristic of the product made through powder metallurgy?

1. They have poor ductility.
2. It does not cause any waste product during processing thus being economical.
3. They can produce wide range of parts of different sizes as compared to casting process.

Select the correct answer using codes given below:

- (a) 1 and 2                      (b) 1 and 3  
(c) 2 and 3                      (d) 1, 2 and 3

**Q.14** Match **List-I** (Welding) with **List-II** (Application) and select the correct answer using the codes given below the lists:

**List-I**                      **List-II**

- A. Explosive      1. Joining thick sheets

- B. Ultrasonic      2. Manufacturing of heat exchanger  
C. Thermit      3. Joining thin sheets or wires of similar/dissimilar metals  
D. Projection      4. Joining hydraulic piston rods for agricultural machinery  
5. Joining rails, pipes or thick steel sections

**Codes:**

- |     | A | B | C | D |
|-----|---|---|---|---|
| (a) | 2 | 5 | 1 | 3 |
| (b) | 4 | 5 | 1 | 3 |
| (c) | 2 | 3 | 5 | 1 |
| (d) | 4 | 3 | 5 | 1 |

**Q.15** Consider the following statements about defects in drawing:

1. Earing in a drawn cup can be due to non-uniform speed of the press.
2. Stretcher strains are caused by plastic deformation due to inhomogeneous yielding.
3. Wrinkles on flange are developed due to insufficient blank holder pressure.
4. Earing defect is caused by too much blank holder pressure.

Which of the above statements are correct?

- (a) 1, 2, 3 and 4  
(b) 2 and 3  
(c) 1 and 4  
(d) 3 and 4

**Q.16** Select the correct statements in respect of a grinding wheel of specification, 51-A-36-L-7-R-23, using the standard alphanumeric codification:

1. Abrasive used in the wheel is aluminium oxide.
2. The grain size of abrasive is medium.
3. The wheel grade is medium hard.
4. It has an open structure.
5. It has resinoid as bonding agent.

- (a) 1, 2 and 3                      (b) 1, 3 and 5  
(c) 2, 3 and 5                      (d) 1, 4 and 5

**Q.17** Select the correct statements regarding comparator:

1. A comparator with higher magnification has small range.
2. Brooke's level comparator is a mechanical comparator.
3. Sigma comparator is an optical comparator.
4. Johnson Mikrokator is a pneumatic comparator.

- (a) 1 only
- (b) 1 and 2
- (c) 2 and 3
- (d) 3 and 4

**Q.18** For a metal machining process, following information is given:

Tool change time = 7 min

Tool regrind time = 4 min

Machine running cost = ₹ 5 per hour

Tool depreciation cost per re-grind = 40 paise

Taylor's tool life constants,

$$n = 0.24, c = 160$$

The optimum cutting speed is

- (a) 62.6 m/min
- (b) 56.4 m/min
- (c) 44.4 m/min
- (d) 76.2 m/min

**Q.19** During ultrasonic machining, the metal removal rate is affected by the

- (a) Hammering action of abrasive particles
- (b) Rubbing action between tool and workpiece
- (c) Low frequency of sound waves
- (d) High frequency of eddy currents

**Q.20** Electrochemical machining is to be performed on iron block to remove a surface of 30 mm × 10 mm.

Following informations are given below:

Valency of Iron = 2

Atomic weight of Iron = 55.845

Faraday's constant = 96485

Density of Iron = 7.86 g/cm<sup>3</sup>

If the desired material removal rate is 20 g/min, the current and electrode feed rate required to achieve this MRR respectively are

- (a) 9053 A, 6.67 cm/min
- (b) 1152 A, 6.67 cm/min
- (c) 9053 A, 0.848 cm/min
- (d) 1152 A, 0.848 cm/min

**Q.21** Consider the following statements:

1. Plasma arc welding (PAW) closely resembles the TIG process, the main difference is in construction of torch.
2. Due to squeezing action of the constraining nozzle, the arc in PAW is concentrated and straight.
3. In the transferred arc method in PAW, the arc is between the electrode and nozzle.

Which of the above statements are correct?

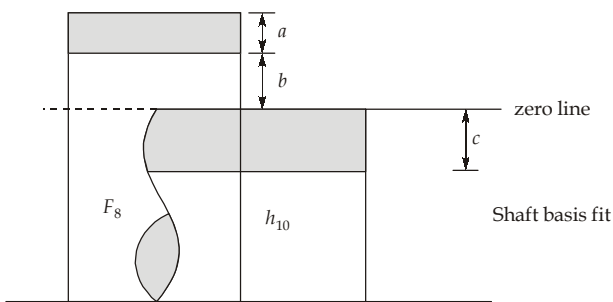
- (a) 1 and 2
- (b) 2 and 3
- (c) 1 and 3
- (d) all of the above

**Q.22** The size effect refers to the increase in specific cutting energy at low values of under formed chip thickness. It is due to which of the following?

- (a) Existence of ploughing force
- (b) Work hardening
- (c) High strain rate
- (d) Presence of high friction at chip-tool interface

**Q.23** A 110 mm diameter shaft hole pair is to be designed for a batch of vehicle manufacturing. The hole-shaft pair is designed by  $F_8h_{10}$ . The fundamental deviation for the shaft designation is  $-5.5D^{0.41}$ . Shaft diameter lies in the diameter step range of 80 - 120 mm.

Tolerance grade	Tolerance value
IT8	$25i^\circ$
IT10	$64i^\circ$



The dimensions  $a$ ,  $b$  and  $c$  are respectively

- (a)  $54\ \mu\text{m}$ ,  $139\ \mu\text{m}$ ,  $36\ \mu\text{m}$
- (b)  $54\ \mu\text{m}$ ,  $36\ \mu\text{m}$ ,  $139\ \mu\text{m}$
- (c)  $36\ \mu\text{m}$ ,  $54\ \mu\text{m}$ ,  $139\ \mu\text{m}$
- (d)  $139\ \mu\text{m}$ ,  $54\ \mu\text{m}$ ,  $39\ \mu\text{m}$

**Q.24** In a single pass rolling process using 400 mm diameter steel rollers, a strip of width 140 mm and thickness 8 mm undergoes 10% reduction of thickness. Under similar conditions if thickness of strip is increased to 10 mm. What is the percentage increase in angle of bite for 10% reduction.

- (a) 11.82
- (b) - 11.82
- (c) 88.18
- (d) - 88.18

**Q.25** In an open-die forging, a disc of 150 mm diameter and 75 mm height is forged without any barreling effect. If the final diameter of the disc is 450 mm, then the true strain is:

- (a) 0.693
- (b) 1.1
- (c) 1.386
- (d) 2.2

**Q.26** A hole of 42 mm diameter and 50 mm depth is to be drilled in mild steel component. If the cutting speed is 70 m/min, feed is 0.25 mm/rev and the sum of approach and overtravel length is 2.82 mm, then the machining time is: (Use point angle of drill =  $120^\circ$ )

- (a) 0.49 min
- (b) 0.84 min
- (c) 0.51 min
- (d) 0.39 min

**Q.27** While turning a diameter 90 mm the turning tool is set below center line by an amount equal to 7 mm. The actual back rake angle is  $10^\circ$  and clearance angle is  $5^\circ$ . What will be the effective rake angle and effective clearance angle respectively?

- (a)  $13.95^\circ$ ,  $1.05^\circ$
- (b)  $18.95^\circ$ ,  $3.95^\circ$
- (c)  $1.05^\circ$ ,  $13.95^\circ$
- (d)  $3.95^\circ$ ,  $18.95^\circ$

**Q.28** Machining centre is a

- (a) numerical control
- (b) machine tool
- (c) transfer machine tool group of automatic machine tools
- (d) next logical step beyond NC machine

**Direction (Q.29 to Q.30):** The following items consists of two statements, one labelled as **Statement-I** and the other labelled as **Statement-II**. You are to examine these two statements carefully and select your answers to these items using the codes given below:

**Codes:**

- (a) Both **Statement-I** and **Statement-II** are true and **Statement-II** is the correct explanation of **Statement-I**.
- (b) Both **Statement-I** and **Statement-II** are true but **Statement-II** is not a correct explanation of **Statement-I**.
- (c) **Statement-I** is true but **Statement-II** is false
- (d) **Statement-I** is false but **Statement-II** is true

**Q.29 Statement-I:** In an interference fit, the inner diameter of inner cylinder will be more than the outer diameter of the hollow outer cylinder.

**Statement-II:** These fits are recommended for two parts frequently dismantled and assembled.

**Q.30 Statement-I:** Brittle materials can be extruded successfully by hydrostatic extrusion process.

**Statement-II:** In hydrostatic extrusion, the pressure required for extrusion is supplied through a compressible fluid medium surrounding the billet.





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# MANUFACTURING ENGINEERING

## MECHANICAL ENGINEERING

Date of Test : 10/08/2023

### ANSWER KEY >

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

## DETAILED EXPLANATIONS

1. (c)

Cores are surrounded on all sides by the molten metal and are therefore subjected to much more severe thermal and mechanical conditions. As a result, it should be of higher strength than the moulding sand.

2. (c)

$$\begin{aligned} \text{Chip shear force, } F_s &= F_c \cos \phi - F_t \sin \phi \\ &= 850 \cos 60^\circ - 300 \sin 60^\circ \\ &= 850 \times \frac{1}{2} - 300 \times \frac{\sqrt{3}}{2} = 425 - 150 \times 1.732 = 165.2 \text{ N} \end{aligned}$$

3. (b)

$$\begin{aligned} \text{Product} &= \text{Disc in blanking operation} \\ \text{So, size of punch} &= \text{Die size} - 2C \\ &= 18 - 2(0.04 \times 1.5) = 17.88 \text{ mm} \end{aligned}$$

4. (b)

Operating factor is the percentage of a welder's working day that is actually spent in welding. It is the arc time in hours divided by the total hours worked.

$$\text{Operation factor} = \frac{\text{Actual welding time } (t_w)}{\text{Actual welding time } (t_w) + \text{Setup time } (t_s)} \times 100$$

$$\Rightarrow 80 = \frac{t_w}{t_w + 15} \times 100$$

$$\Rightarrow t_w = 60 \text{ min}$$

$$\text{Welding speed, } V = 20 \text{ m/hr}$$

$$\text{Length of weld, } L_w = t_w \times V = 60 \times \frac{20}{60} = 20 \text{ m}$$

5. (a)

**Centre Burst or Centre Cracking or Chevron defect** are attributed to a state of hydrostatic tensile stress at the centreline in the deformation zone in the die. The tendency of centre cracking increases with increasing die angle and amount of impurities. This tendency decreases with increasing extrusion ratio and friction.

6. (d)

**Sensitivity towards tool life is in the order:** Speed > Feed > Depth of cut

As these parameter are increased, tool life decreases.

∴ First depth of cut is to be increased, then feed and at last speed is to be increased.

7. (b)

Forward slip is the slip that is caused due to difference between exit velocity of the work material ( $v_f$ ) and the roller velocity ( $v_r$ ).

$$\text{Forward slip} = \frac{v_f - v_r}{v_r}$$

8. (b)  
Cellular manufacturing is an approach of manufacturing that seeks to maximize production efficiencies by grouping similar and recurring problems or tasks.
9. (d)
- $$\begin{aligned} \% \text{ cold work} &= \frac{A_0 - A_f}{A_0} \times 100 = \left[ 1 - \left( \frac{d_f}{d_0} \right)^2 \right] \times 100 \\ &= \left[ 1 - \left( \frac{12.2}{15.2} \right)^2 \right] \times 100 = 35.578\% \end{aligned}$$
10. (a)  
In machining the threads cuts through the grain flow lines of the material, which weakens the thread strength but thread rolling leaves a grain flow pattern that improves the strength of the thread.
11. (c)  
Chills are used in moulds to achieve directional solidification.
12. (d)  
G91 : Specified incremental input dimensions  
G83 : Deep hole peck canned drilling cycle  
G80 : Canned cycle cancelled
13. (a)  
The size of products producing using powder metallurgy process as compared to casting is limited because of the requirement of large presses and expensive tools which would be required for compacting.
14. (c)
- (i) Explosive welding can be used to repair of plug tubes in heat exchangers on-site, where conventional welding methods are difficult to use.
  - (ii) Ultrasonic welding is an industrial technique whereby high-frequency ultrasonic acoustic vibrations are locally applied to workpieces being held together under pressure to create a solid-state weld. It is commonly used for plastics, and especially for joining dissimilar materials.
  - (iii) Mainly thermit welding technique is used in the repair works of rails in railways.
15. (b)  
Earing tends to occur because of the anisotropy induced by rolling operation. It may also be caused due to non-uniform clearance between tools.
16. (a)
- A(Abrasive type) :  $Al_2O_3$   
 36(Grit size) : medium  
 L(Grade) : medium  
 7(Structure) : dense  
 R(Type of bond) : rubber
17. (b)  
Both Sigma and Johnson Mikrokator are mechanical comparator.



18. (a)

Given: Tool changing time,  $T_C = 7$  min; Tool regrind time = 4 min; Machine running cost,  $C_m = \text{Rs. } 5/\text{hour}$ ;  $n = 0.24$  and  $C = 160$

Tooling cost,  $C_t = \text{Tool regrind cost} + \text{Tool depreciation cost}$

$$= \left( \frac{5}{60} \times 4 \right) + 0.4 = \text{Rs. } 0.733$$

Optimum tool life for minimum cost,

$$T_o = \left( T_C + \frac{C_t}{C_m} \right) \left( \frac{1-n}{n} \right)$$

$$T_o = \left( 7 + \frac{0.733}{5/60} \right) \left( \frac{1-0.24}{0.24} \right) = 50.03 \text{ min}$$

$$V_o T_o^n = C$$

$$V_o = \frac{C}{T_o^n} = \frac{160}{(50.03)^{0.24}} = 62.56 \approx 62.6 \text{ m/min}$$

19. (a)

The material removal rate in USM is affected by the:

- (i) property of the work material,
- (ii) size of the abrasive,
- (iii) amplitude of vibration,
- (iv) the frequency of vibrating tool,
- (v) slurry concentration, etc.

20. (d)

$$\text{MRR} = \frac{eI}{F} = \frac{20}{60} = \frac{\left( \frac{55.845}{2} \right) I}{96485}$$

$$\Rightarrow I = 1151.82$$

$$\approx 1152 \text{ A}$$

$$\text{Electrode feed rate, } f = \frac{\text{MRR} \times v}{A} = \frac{\left( \frac{\text{MRR}}{\rho} \right)}{A} = \frac{\left( \frac{20}{7.86} \right)}{\frac{30}{10} \times \frac{10}{10}} \text{ cm/min}$$

$$= 0.848 \text{ cm/min}$$

21. (a)

In the transferred arc method, the metal being welded is part of the electrical circuit. The arc thus transfers from the electrode to the workpiece, hence the term transferred.

22. (a)

The grit having negative rake angle or rounded cutting edge do not form chip but may rub or make a groove by ploughing leading lateral flow of workpiece material and increase in specific cutting energy.

23. (b)

$$\text{Basic size} = 110 \text{ mm}$$

$$D = \sqrt{120 \times 80} = 97.98 \text{ mm}$$

$$\text{Fundamental deviation of shaft} = -5.5D^{0.41} = -36 \mu\text{m}$$

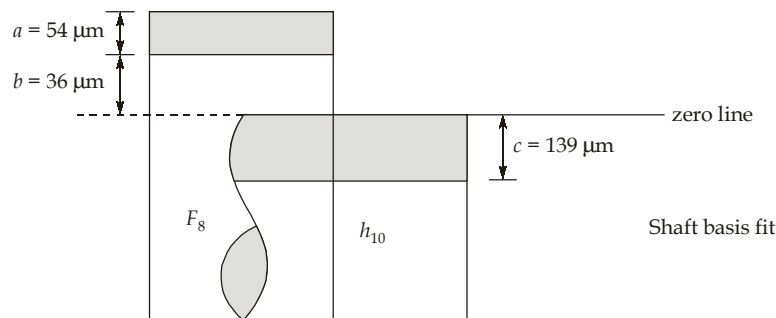
$$\therefore \text{Fundamental deviation of hole} = +36 \mu\text{m} \Rightarrow b = 36 \mu\text{m}$$

$$i = 0.45D^{1/3} + 0.001D = 0.45 \times (97.98)^{1/3} + 0.001 \times 97.98$$

$$i = 2.17 \mu\text{m}$$

$$\text{IT8} = 25i = 25 \times 2.17 = 54.3 \mu\text{m} \Rightarrow a = 54.3 \mu\text{m}$$

$$\text{IT10} = 64i = 64 \times 2.17 = 139 \mu\text{m} \Rightarrow c = 139 \mu\text{m}$$



24. (a)

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

In first case for 10% reduction:

$$h_0 = 8 \text{ mm}, h_f = 8(1 - 0.1) = 7.2 \text{ mm}, D = 400 \text{ mm} = 2R$$

$$8 - 7.2 = 400(1 - \cos\theta)$$

$$\cos\theta_1 = 1 - \frac{0.8}{400}$$

$$\theta_1 = 3.624^\circ$$

In second case, for 10% reduction

$$h_0 = 10 \text{ mm}, h_f = 10(1 - 0.1) = 9 \text{ mm}, D = 400 \text{ mm} = 2R$$

$$1 = 400(1 - \cos\theta_2)$$

$$\cos\theta_2 = 1 - \frac{1}{400}$$

$$\theta_2 = 4.052^\circ$$

$$\% \text{ increase in bite angle} = \left( \frac{\theta_2}{\theta_1} - 1 \right) \times 100 = \left( \frac{4.052}{3.624} - 1 \right) \times 100 = 11.82\%$$

25. (d)

$$\text{True strain, } (\varepsilon_T) = \ln\left(\frac{A_0}{A}\right) = 2 \ln\left(\frac{d_0}{d}\right) = 2 \ln\left(\frac{450}{150}\right)$$

$$\Rightarrow \varepsilon_T = 2 \times \ln 3 = 2 \times 1.0986 \simeq 2.2$$

26. (a)  
As machining time in drilling,

$$T = \frac{\pi DL}{1000 fV}$$

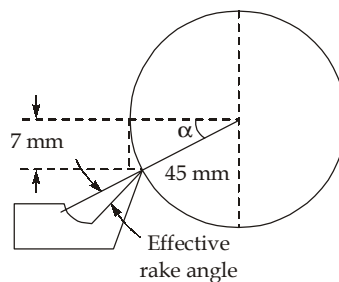
$$L = L_1 + (OT + A) + (D/2)(\cot 60)$$

As 
$$L = L_1 + (OT + A) + 21 \times 0.57735$$
  

$$= 50 + 2.82 + 12.124 = 64.94 \text{ mm}$$

$$\Rightarrow T = \frac{\frac{22}{7} \times 42 \times 64.94}{1000 \times 0.25 \times 70} = 0.489547 \text{ min}$$

27. (c)



$$\sin \alpha = \left( \frac{7}{45} \right) \Rightarrow \alpha = \sin^{-1} \left( \frac{7}{45} \right) = 8.95^\circ$$

$$\text{Effective rake angle} = 10^\circ - \alpha = 10^\circ - 8.5^\circ = 1.05^\circ$$

$$\text{Effective clearance angle} = 5^\circ + \alpha = 5^\circ + 8.95^\circ = 13.95^\circ$$

28. (d)  
Machining centre or work centre consists of a single but sometimes, two machine tools with the specific features of an automatic tool changer and capable of performing a number of operations on a workpiece. It is next logical step beyond NC machine.
29. (c)  
An interference fit may be shrink fit, heavy drive fit and light drive fit. It is rarely dismantled.
30. (c)  
The fluid through which pressure is applied to billet in hydrostatic extrusion process should be incompressible fluid.

