RAILWAY RECRUITMENT BOARD

# RRB JE

# JUNIOR ENGINEER

# MECHANICAL

# CBT Stage-II

# SOLV APER

# PRAC BOOK


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# CONTENT

## SOLVED PAPERS



## PRACTICE SET

# SYLLABUS

## Government of India, Ministry of Railways,
## Railway Recruitment Boards
### CENTRALISED EMPLOYMENT NOTICE (CEN) No.03/2018
### Recruitment of Junior Engineer (JE), Junior Engineer (Information Technology) [JE(IT)], Depot Material Superintendent (DMS)

**2nd Stage CBT :** Short listing of Candidates for the 2nd Stage CBT exam shall be based on the normalized marks obtained by them in the 1st Stage CBT Exam. Total number of candidates to be shortlisted for 2nd Stage shall be 15 times the community wise total vacancy of Posts notified against the RRB as per their merit in 1st Stage CBT. However, Railways reserve the right to increase/decrease this limit in total or for any specific category(s) as required to ensure availability of adequate candidates for all the notified posts.

**Duration** : 120 minutes *(160 Minutes for eligible PwBD candidates accompanied with Scribe)*

**No of Questions** : 150

**Syllabus :** The Questions will be of objective type with multiple choices and are likely to include questions pertaining to General Awareness, Physics and Chemistry, Basics of Computers and Applications, Basics of Environment and Pollution Control and Technical abilities for the post. The syllabus for General Awareness, Physics and Chemistry, Basics of Computers and Applications, Basics of Environment and Pollution Control is common for all notified posts under this CEN as detailed below:-

a) **General Awareness :** Knowledge of Curre , culture and history of India including freedom struggle, Indian Polity and constitution, Indi l issues concerning India and the World, Sports, General scientific and technological developm

b) **Physics and Chemistry:** Up to 10th standard

c) **Basics of Computers and Applications:** s; input and Output devices; Storage devices, Networking, Operating System like Window Various data representation; Internet and Email; Websites & Web Browsers; Computer Virus.

d) **Basics of Environment and Pollution Con** t; Adverse effect of environmental pollution and control strategies; Air, water and Noise pollu Waste Management, Global warming; Acid rain; Ozone depletion.

e) **Technical Abilities:** The educational qualifications mentioned against each post shown in Annexure-A, have been grouped into different exam groups as below. Questions on the Technical abilities will be framed in the syllabus defined for various Exam Groups given at Annexure-VII-A, B, C, D, E, F & G.

The section wise Number of questions and marks are as below :

| Subjects | No. of Questions | Marks for each Section |
|---|---|---|
| | Stage-II | Stage-II |
| General Awareness | 15 | 15 |
| Physics & Chemistry | 15 | 15 |
| Basics of Computers and Applications | 10 | 10 |
| Basics of Environment and Pollution Control | 10 | 10 |
| Technical Abilities | 100 | 100 |
| Total | 150 | 150 |
| Time in Minutes | 120 | |

*The section wise distribution given in the above table is only indicative and there may be some variations in the actual question papers.*

**Minimum percentage of marks** for eligibility in various categories: UR -40%, OBC-30%, SC-30%, ST -25%. This percentage of marks for eligibility may be relaxed by 2% for PwBD candidates, in case of shortage of PwBD candidates against vacancies reserved for them.

Virtual calculator will be made available on the Computer Monitor during 2nd Stage CBT.

# 2nd Stage Syllabus for Mechanical & Allied Engineering Exam Group – JE

1. **Engineering Mechanics :** Resolution of forces, Equilibrium and Equilibrant, parallelogram law of forces, triangle law of forces, polygon law of forces and Lami's theorem, couple and moment of a couple, condition for equilibrium of rigid body subjected to number of coplanar non-concurrent forces, definition of static friction, dynamic friction, derivation of limiting angle of friction and angle of repose, resolution of forces considering friction when a body moves on horizontal plane and inclined plane, calculation of moment of inertia and radius of gyration of : (a) I-Section (b) channel section (c) T-Section (d) L-Section (Equal & unequal lengths) (e) Z-Section (f) Built up sections (simple cases only), Newton's laws of motion (without derivation), motion of projectile, D'Alembert's principle, definition law of conservation of energy, law of conservation of momentum.
2. **Material Science :** Mechanical properties of engineering materials – tensile strength, compressive strength, ductility, malleability, hardness, toughness, brittleness, impact strength, fatigue, creep resistance. Classification of steels, mild steel and alloy steels. Importance of heat treatment. Heat treatment processes – annealing, normalizing, hardening, tempering, carburizing, nitriding and cyaniding.
3. **Strength of Materials :** Stress, strain, stress strain diagram, factor of safety, thermal stresses, strain energy, proof resilience and modules of resilience. Shear force and bending moment diagram – cant leaver beam, simply supported beam, continuous beam, fixed beam. Torsion in shafts and springs, thin cylinder shells.
4. **Machining :** Working principle of lathe. Types of lathes – Engine lathe – construction details and specifications. Nomenclature of single point cutting tool, geometry, tool signature, functions of tool angles. General and special operations – (Turning, facing, taper turning thread cutting, knurling, forming, drilling, boring, reaming, key way cutting), cutting fluids, coolants and lubricants. Introduction to shaper, slotter, plainer, broaching, milling and manufacture of gears, heat treatment process applied to gears.
5. **Welding :** Welding – Introduction, classification of welding processes, advantages and limitations of welding, principles of arc welding, arc welding equipment, choice of electrodes for different metals, principle of gas (oxy-acetylene) welding, equipment of gas welding, welding proced nd brazing techniques, types and applications of solders and fluxes, various flame cutting pro ations of flame cutting, defects in welding, testing and inspection modern welding methods, (s ydrogen, ultrasonic welding), brief description of MIG & TIG welding.
6. **Grinding & Finishing Process :** Principle ding, abrasives, natural and artificial, bonds and binding processes, vitrified, silicate, shellac classification: cylindrical, surface, tool & cutter grinding machine, construction details, rel centreless grinding, advantages & limitations of centreless grinding work, holding devices, g of wheels, coolants used, finishing by grinding, honing, lapping, super finishing, electroplati metals, applications, hot dipping, galvanizing tin coating, parkerising, anodizing, metal sprayi ocess and applications, organic coatings, oil base paint, lacquer base enamels, bituminous paints, rubber base coating.
7. **Metrology :** Linear measurement – Slip gauges and dial indicators, angle measurements, bevel protractor, sine bar, angle slip gauges, comparators (a) mechanical (b) electrical (c) optical (d) pneumatic. Measurement of surface roughness; methods of measurements by comparison, tracer instruments and by interferometry, collimators, measuring microscope, interferometer, inspection of machine parts using the concepts of shadow projection and profile projection.
8. **Fluid Mechanics & Hydraulic Machinery :** Properties of fluid, density, specific weight, specific gravity, viscosity, surface tension, compressibility capillarity, Pascal's law, measurement of pressures, concept of buoyancy. Concept of Reynold's number, pressure, potential and kinetic energy of liquids, total energy, laws of conservation, mass, energy and momentum, velocity of liquids and discharge, Bernoulli's equation and assumptions, venturimeters, pitottube, current meters. Working principle & constructional details of centrifugal pump, efficiencies – manometric efficiency, volumetric efficiency, mechanical efficiency and overall efficiency, cavitation and its effect, working principle of jet & submersible pumps with line diagrams.
9. **Industrial Management :** Job analysis, motivation, different theories, satisfaction, performance reward systems, production, planning and control, relation with other departments, routing, scheduling, dispatching, PERT and CPM, simple problems. Materials in industry, inventory control model, ABC Analysis, Safety stock, re-order, level, economic ordering quantity, break even analysis, stores layout, stores equipment, stores records, purchasing procedures, purchase records, Bin card, Cardex, Material handling, Manual lifting, hoist, cranes, conveyors, trucks, fork trucks.
10. **Thermal Engineering :** Laws of thermo dynamics, conversion of heat into work vice versa , laws of perfect gases, thermo dynamic processes – isochoric, isobaric, isothermal hyperbolic, isentropic, polytrophic and throttling, modes of heat transfer, thermal conductivity, convective heat transfer coefficient, Stefan Boltzman law by radiation and overall heat transfer coefficient. Air standards cycles – Carnot cycle, Otto cycle, Diesel cycle, construction and working of internal combustion engines, comparison of diesel engine and petrol engine. Systems of internal combustion engine, performance of internal combustion engines. Air compressors their cycles refrigeration cycles, principle of a refrigeration plant.

# RAILWAY RECRUITMENT BOARD (RRB)
# JUNIOR ENGINEER MECHANICAL
# Re-EXAM-2025

**EXAM DATE : 04.06.2025** **EXAM TIME : 9.00AM-11.00AM**

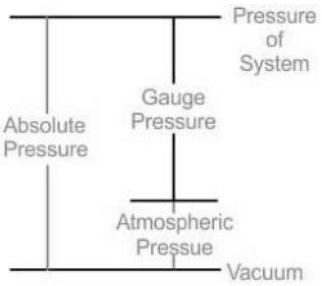
**1. Gauge pressure is measured as :**

(a) the pressure relative to a perfect vacuum
(b) the difference between absolute pressure and atmospheric pressure
(c) the pressure due solely to the fluid's density
(d) the pressure including atmospheric pressure

**Ans. (b) :** The gauge pressure is measured as the difference between absolute and atmospheric pressure.

Gauge pressure = Absolute pressure – atmospheric pressure.

- It is pressure measured relative to local atmospheric pressure.
- Gauge pressure is measured above the atmospheric pressure and the atmospheric pressure i datum i.e. atmospheric pressure is marked
- The absolute pressure measured with res pressure. It is measured by aneroid barom




**2. The moment of inertia of a circular area about a tangent to the circle is calculated as the moment of inertia of the circular area about its centroidal axis in the plane of the lamina _____ (where r is the circle radius).**

(a) $\times \pi r^2/2$ (b) $+\pi r^4$
(c) $\times 1.5$ (d) $-\pi r^4$

**Ans. (b) :** The moment of inertia of the circular area about its centroid axis in the plane of the lamina

$I = Ar^2$
$= \pi r^2 \times r^2$
$= \pi r^4$.

**3. If any part is immersed in a heated 'magnesium dihydrogen phosphate' solution, then what could be the coating process?**

(a) Cladding (b) Anodising
(c) Calorising (d) Parkerizing

**Ans. (d) :** If any part is immersed in a heated 'magnesium dihydrogen phosphate' solution, then parkerizing could be the coating process.

- Parkerizing is a method of protecting steel surfaces from corrosion and increasing their wear resistance by creating a layer of phosphate crystals on the surface.
- It is a process of applying an anti-corrosion and lubricating phosphatized surface treatment.
- It is also used extensively on automobiles to protect unfinished metal parts from corrosion.
- Anodising is an oxidising process used for aluminium and magnesium articles.

**rding to Herzberg's Two-Factor Theory, 'hygiene factor' that leads to job tisfaction is :**

chievement (b) salary
esponsibility (d) recognition

According to Herzberg's two-factor theory, e factor' that leads to job dis-satisfaction is

factors are those job factors that are essential for the existence of motivation in the workplace.

- These do not load to positive satisfaction long term.
- Hygiene factors are also called as dissatisfiers or maintenance factors as they are required to avoid dis-satisfaction.

**Hygiene factors include–**

(i) Salary and benefits
(ii) Job security
(iii) Work environment
(iv) Job policies
(v) Supervisory practices
(vi) Company policies and administration
(vii) Company reputation.

**5. A material exhibits a large amount of plastic deformation before fracture and can absorb significant energy. This material is said to have:**

(a) high hardness
(b) high strength
(c) high modulus of elasticity
(d) high toughness

**Ans. (d) :** A material exhibits a large amount of plastic deformation before fracture and can absorb significant energy. This material is said to have high toughness.

**Hardness–** It is the ability of a material to resist identation or surface abrasion.

- Brinell hardness test is used to check hardness.

**Strength–** This property enables material to resist fracture under load. It is very important property from design point of view.

**Modulus of elasticity–** It is also known as young modulus. It is defined as the ratio of stress to strain in the linearly elastic region of the stress-strain curve.

**6. The influence of forecasting in volume decision-making with regards to production is that it:**

(a) ensures that all products meet international standards
(b) determines the specific design of the product
(c) reduces manufacturing costs
(d) determines whether production is for stock or for immediate orders

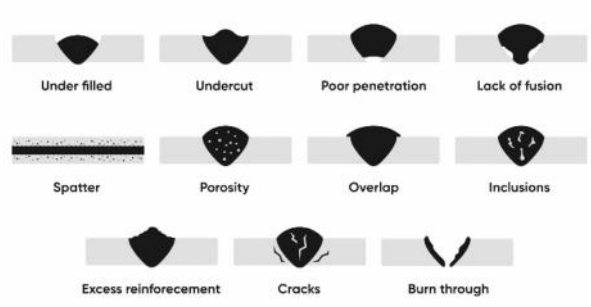
**Ans. (d) :** The influence of forecasting in volume decision making with regards to production is that is determines whether production is for stock or for immediate orders.

- It ensures that all products meet i standards.
- It determines the specific design of the pr
- It reduces manufacturing cast.

**7. What is lack of penetration in weldi**

(a) Small holes throughout the weld
(b) Failure of the filler metal to fu parent metal
(c) Cracks either in the weld meta parent metal
(d) Failure of the filler metal to penetrate into the root of the joint

**Ans. (d) :** Lack of penetration in welding defects is defined as the failure of the filler metal to penetrate into the root of the joint.




- The small holes throughout the weld metal is called weld porosity failure of the filler metal to fuse with the parent metal is called lack of fusion.
- Cracks either in the weld metal or in the parent metal is called weld crack.
- All of these defects are comes in the category of welding defect.

**8. In the _____ method, a large amount of solder is melted in a tank that is closed.**

(a) dip soldering (b) flame soldering
(c) infrared soldering (d) soldering iron

**Ans. (a) :** In the dip soldering method, a large amount of solder is melted in a tank that is closed.

- Dip soldering is a method of joining two or more objects, typically metals, using a solder that is heated until it melts and them applied to objects to be joined.
- The process involves dipping the objects to be soldered into a molten solder bath.

**9. The disadvantage of the early shadow projector was that the:**

(a) magnification was insufficient
(b) screen was too far from the operator
(c) image was too small
(d) image was distorted

**Ans. (a) :** The disadvantage of the early shadow projector are :

(i) Magnification was insufficient.
(ii) Limited to inspecting surface profiles.
(iii) Requires proper calibration and alignment for te results.
be not suitable for analyzing material sition.
mary purpose of a shadow projector is to an undistorted magnified reflected image of t.

**h of the following is generally used for ing metal in the metallic gun type of metal ying process?**

(a) Compressed air (b) Plasma torch
(c) Oxy acetylene flame (d) Electric arc

**Ans. (c) :** Oxy-acetylene flame is generally used for melting metal in the metallic gun type of metal spraying process due to their ability to generate high temperatures needed to melt the metal.

- An oxy-acetylene flame is sometimes called oxidizing flame.
- In this, the ratio of oxygen to acetylene is 1.5 : 1.
- A plasma torch is a versatile tool used in various industries for cutting, welding and coating applications.

**11. The _____ concept is derived from the Pareto's 80/20 rule curve.**

(a) XYZ (b) FSN
(c) ABC (d) VED

**Ans. (c) :** The ABC concept is derived from the Pareto's 80/20 rule curve.

- It is used for identifying and prioritizing the most impactful factors that contribute to a significant outcome.
- It suggests that roughly 80% of results come from 20% of the causes of efforts.

- This principle is widely applied in business project management and personal productivity to optimize resource allocation.
- ABC, VED, HML are some selective inventory control techniques.

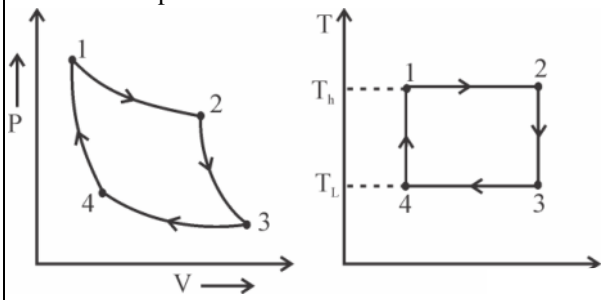
**12. The efficiency of the Carnot cycle is defined as:**

(a) $\frac{\text{Heat rejected}}{\text{Heat supplied}}$ (b) $\frac{\text{Work done}}{\text{Heat supplied}}$

(c) $\frac{\text{Heat supplied}}{\text{Work done}}$ (d) $\frac{\text{Work done}}{\text{Heat rejected}}$

**Ans. (b) :** The efficiency of the carnot cycle is defined as the ratio of work done and heat supplied.

- The carnot cycle consist two isentropic and two isothermal process.




**Process–**

(1-2) : Reversible isothermal expansion addition.

(2-3) : Reversible adiabatic or isentropic ex

(3-4) : Reversible isothermal compressio rejection.

(4-1) : Reversible adiabatic or isentropic co

- The efficiency of carnot cycle $(\eta_c) = \frac{\text{Wo}}{\text{Heat supplied}}$

$$(\eta_c) = 1 - \frac{Q_R}{Q_A}$$

$Q_A$ = Heat added during process (1-2)

$Q_R$ = Heat rejected during process (3-4)

$$Q_A = (\partial Q)_{1-2} = T_H(S_2 - S_1)$$

$$Q_R = (\partial Q)s_{3-4} = T_H(S_3 - S_4)$$

$$\left[\because (2-3)\,\&\,(4-1)\text{ are isentropic}, \therefore S_3 = S_2\ \&\ S_4 = S_1\right]$$

$$\eta_c = 1 - \frac{Q_R}{Q_A} = 1 - \frac{T_H(S_3 - S_4)}{T_H(S_2 - S_1)}$$

$$\boxed{\eta_c = 1 - \frac{T_L}{T_H}}$$

**13. Which of the following is true about the weldability of mild steel and alloy steel?**

(a) Alloy steel is easier to weld than mild steel.

(b) Weldability depends only on the thickness of the steel.

(c) Mild steel is easier to weld than alloy steel.

(d) Both mild and alloy steel have the same weldability.

**Ans. (c) :** Mild steel is easier to weld than alloy steel.

**Weldability–**To ease with which welding of a given material can be done without producing any defect under the fabrication condition is called weldability.

Iron > mild steel > low alloy steel > stainless steel > aluminium > copper.

$$\boxed{\%\text{ weldability} = \frac{\text{Resistivity}\times 100}{K_{\text{relative constant}} \times T_{\text{melting point}}}}$$

**14. How does indicated power differ from brake power in an internal combustion engine?**

(a) Indicated power is measured at the engine's output shaft, while brake power is measured in the cylinders.

(b) Indicated power is derived from combustion chamber pressures, whereas brake power is the net output at the crankshaft after mechanical losses.

(c) Both indicated and brake power represent the same value under ideal conditions.

ndicated power accounts for frictional losses, hereas brake power does not.

Indicated power is measured at the engine's side the engine cylinder. While brake power d on the crank shaft of the engine that is ut of the engine.

$\frac{NK}{0}$ $\boxed{B.P = \frac{2\pi NT}{60}}$

wer is always less than indicated power.

**Friction power–** It is the difference of indicated power and brake power.

$\boxed{F.P = I.P - B.P}$

- It is called power loss in overcoming the friction between piston and cylinder walls, between the crankshaft and camshaft and their bearing etc.

**15. Which of the following interactions is expected to produce chip during a grinding process?**

(a) Grit-workpiece (b) Bond-workpiece

(c) Chip-workpiece (d) Chip-bond

**Ans. (a) :** Grit-workpiece interactions is expected to produce chip during a grinding workpiece.

**The grain sizes are used in grinding–**

Coarse grain : 8-24

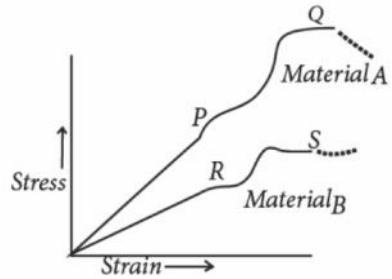
Medium grain : 30-60

Fine grain : 80-180

Very fine grain : 220-600

**16. The diagram below shows the stress-strain curves of two materials, Material A and Material B. Material A has a finer grain structure, while Material B has a coarser grain structure. Based on the diagram, which of the**

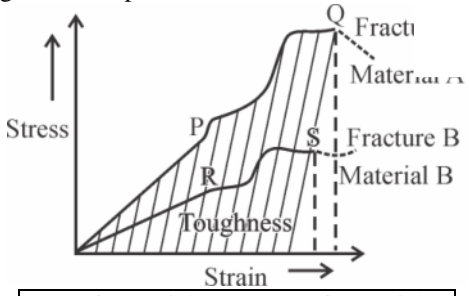
**following statements is correct regarding their toughness?**




(a) Material A (finer grain size) has lower toughness than Material B (coarser grain size).
(b) Both materials have the same toughness, as indicated by their identical total strain values.
(c) Material A (finer grain size) has higher toughness than Material B (coarser grain size).
(d) Toughness can be determined directly by comparing the slopes of the stress-strain curves.

**Ans. (c) :** The stress-strain curve of two materials A and B.

- Material A has a finer grain structure and has coarse grain structure.
- Toughness is represented by the area stress-strain curve up to the fracture point
- Material A curve encompasses a large material B. Therefore, material A toughness compared to material B.



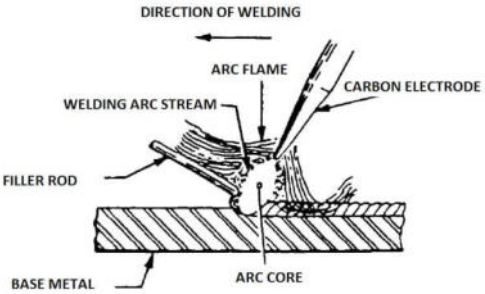

Area of material A > Area of material B.

**17. In the Carbon Arc Welding (CAW) process, _____ is used to create an electric arc.**

(a) pure graphite electrode
(b) stainless steel electrode
(c) cellulosic electrode
(d) rutile electrode

**Ans. (a) :** In the carbon arc welding (CAW) process, pure graphite electrode is used to create an electric arc.

- In this, arc is produced between a carbon electrode and the workpiece . This arc generates the heat required to melt the metals at the welding point.
- Shielding is not used in CAW.
- No pressure applied in it.
- It may be used in twin arc method that is between two carbon (graphite) electrodes.




**18. What bond is commonly employed in super abrasive grinding wheels?**

(a) Metal bond (b) Oxychloride bond
(c) Brazed bond (d) Shellac bond

**Ans. (a) :** Metal bond is commonly employed in super abrasive grinding wheels.

- Metallic bond is used for diamond wheels only.
- Shellac bond (E) is used for thin but strong wheels possessing some elasticity. It produce high polish thus used for grinding such parts as camshaft and mill rolls.
- Brazed bond is a joint created using a process called where metals are joined by melting a filler

loride bond, the abrasive grains are mixed gnesium chloride and magnesium oxide. This sed for making disc-shaped wheels.

**h of the following CANNOT be generally ed as an abrasive material in the grinding ess?**

(a) Super alloy (b) Silicon carbide
(c) Aluminium oxide (d) Diamond

**Ans. (a) :** Super alloy cannot be generally utilised as an abrasive material in the grinding.

**Silicon carbide–** It is less hard than diamond and less tough than aluminium oxide. It is used for grinding of the material of low tensile strength.

**e.g.** Cemented carbide, stone and ceramic, grey cast iron, brass, bronze.

**Aluminium oxide–** It is tough and fracture-resistant. It is preferred for grinding of materials of higher tensile strength like steel, high carbon and high speed steel and tough bronze.

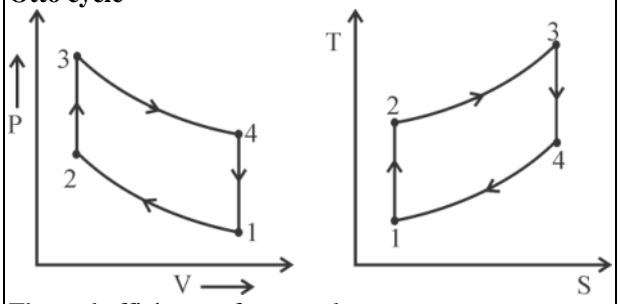
- Diamond is used for glass, tungsten carbide and ceramics.

**20. The thermal efficiency of the Otto cycle is a function of:**

(a) engine size and speed
(b) heat supplied and pressure ratio
(c) temperature and mass flow rate
(d) compression ratio and the ratio of specific heats

**Ans. (d) :** The thermal efficiency of the otto cycle is a function of compression ratio and the ratio of specific heats. Its consists two reversible isentropic and two isochoric i.e. constant volume process.

**Otto cycle–**




Thermal efficiency of otto cycle–

$$\eta_{otto} = 1 - \frac{1}{(r)^{\gamma-1}}$$

Compression ratio (r) = $\frac{V_1}{V_2}$, $\boxed{\gamma = \frac{C_p}{C_v}}$

$$\frac{T_2}{T_1} = \left(\frac{P_2}{P_1}\right)^{\frac{\gamma-1}{r}} = \left(\frac{V_1}{V_2}\right)^{\gamma-1}$$

$$\frac{T_2}{T_1} = (r)^{\gamma-1}$$

$$\frac{V_1}{V_2} = r$$

$$\eta_{otto} = 1 - \frac{1}{(r)^{\gamma-1}} = 1 - \frac{1}{\left(\frac{T_2}{T_1}\right)} = 1 - \frac{T_1}{T_2}$$

$$\boxed{\eta_{otto} = 1 - \frac{T_1}{T_2}}$$

**21. Which of the following statements accurately describes vacuum pressure?**

(a) It is the pressure due to the weight of a fluid column.
(b) It is the pressure below atmospheric pressure in a system.
(c) It is the absolute pressure at any point in a fluid.
(d) It is the pressure exerted by the atmospheric air.

**Ans. (b) :** Vacuum pressure is the pressure below atmospheric pressure in a system.

$$\boxed{P_{vacuum} = P_{atm} - P}$$

- Gauge pressure ($P_{gauge}$) measured with respect to atmospheric pressure is taken as datum.
- Absolute pressure is defined as the pressure which is measured with zero pressure. It is measured by aneroid barometer.

$$P_{abs} = P_{atm} + P_{gauge}$$

**22. Which of the following statements best describes a special-purpose lathe used for heavy duty applications?**

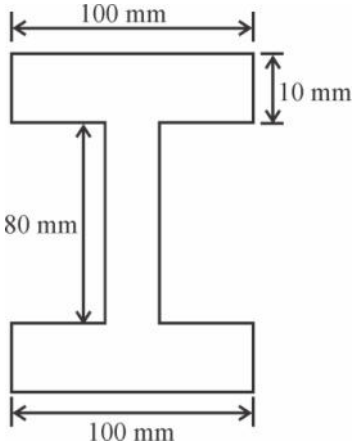
(a) A T-lathe is used for machining flat plates and sheet metal components.
(b) A missile lathe is designed for lightweight parts with small diameters.
(c) A wheel lathe is designed for machining railway wheels, including journals and treads.
(d) A gap bed lathe is mainly used for cutting small, high-precision components.

**Ans. (c) : Special-purpose lathe–**

A special-purpose lathe is designed for specific machining applications that cannot be efficiently performed using standard lathes. These machines are tailored for specialized tasks, offering enhanced precision, productivity, and functionality in handling unique or heavy-duty machining requirements. Among the various types of special-purpose lathes, a wheel lathe stands out for heavy-duty applications, particularly in machining railway components like wheels, journals and treads.

**23. A symmetrical channel section has width of its top and bottom flanges as 100 mm and ness 10 mm. The web is 80 mm high een flanges and 10 mm thick. Its moment ertia about a centroidal axis in its plane llel to the flanges is 449.3 X $10^4$ $mm^4$. ulate its moment of inertia about a parallel at the top face of the upper flange.**

$149.3 \times 10^4$ (b) $20.3 \times 10^4$
$415 \times 10^3$ (d) 43,000




Width of top and bottom flanges = 100 mm
Thickness of flanges = 10 mm
Height of the web = 80 mm

$$Y = \frac{80}{2} + 10 = 50$$

Thickness of the web = 10 mm

$A = 2 \times b \times t_f + h_w \cdot t_w = 2 \times 100 \times 10 + 80 \times 10$
$= 2800\ mm^2$

Moment of inertia about the centroidal axis

$= 449.3 \times 10^4$

$I = I_C + AY^2$

$= 449.3 \times 10^4 + 2800 \times (50)^2$

$I = 4493000 + 70,00000$

$I = 11493000$

$I = 1149.3 \times 10^4 \text{ mm}^4$

**24. What does mean effective pressure (MEP) indicate in engine performance analysis?**

(a) The pressure of the fuel injected into the cylinder

(b) The average pressure acting on the piston during the complete engine cycle that would produce the measured work output

(c) The maximum pressure reached in the combustion chamber

(d) The difference between intake and exhaust pressures

**Ans. (b) :** The engine performance analysis the mean effective pressure (MEP) indicates the average pressure acting on the piston during the complete engine cycle that would produce the measured work output.

- Mean effective pressure is defined as ratio of workdone per cycle to the swept volume.

$$MEP = \frac{\text{Work done per cycle}}{\text{Swept volume}}$$

- Mean effective pressure increases with c ratio because of an increase in efficiency.

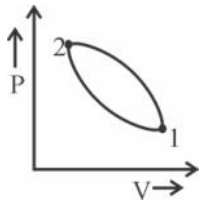
**25. For a closed system undergoing a pr cycle), the first law is expressed as:**

(a) $Q = W$ (b) $\Delta S \geq 0$

(c) $\Delta U = Q - W$ (d) $PV = n$

**Ans. (c) :** For a closed system undergoing a process, the first law is expressed as-

$$\Delta U = Q - W$$




Where,

$\Delta U$ = Change in internal energy of the system.

Q = Heat added to the system

W = Work done by the system.

- For a closed system, undergoing a thermodynamic cycle, the first law of thermodynamics states that the net work done by the system over one complete cycle is equal to the net heat added to the system over the cycle.
- During a complete cycle, the system returns to its initial state, which means the change in internal energy ($\Delta U$) is zero.

$$\Delta U = 0$$

**26. When is the lead screw engaged in a lathe?**

(a) Only for turning and facing operations

(b) Only during thread-cutting operations

(c) Continuously for all machining processes

(d) During both knurling and continuous feed motion

**Ans. (b) :** The lead screw engaged in the lathe only during thread-cutting operations.

- Turning, facing and knurling operation also performed on the lathe machine but it does not required any lead screw.
- Knurling is operation of embossing a diamond shape pattern on the workpiece.
- Thread cutting operation of cutting helical grooves on the external cylindrical surface of the workpiece.

**27. Which of the following end conditions could characterise a cantilever beam?**

(a) A fixed support at one end and free at the other

(b) A roller support at one end and hinged at the other

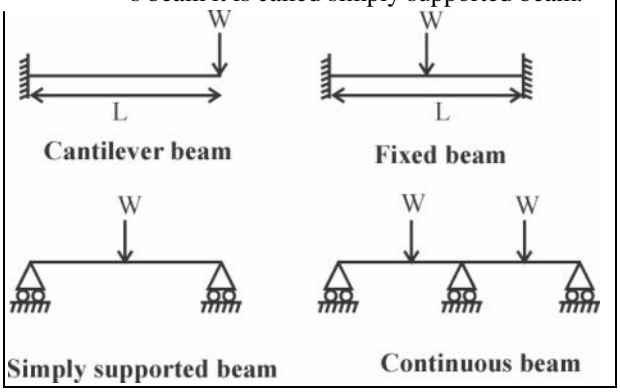
(c) A hinged support at one end and free at the other

fixed support at one end and pin support at he other

A fixed support at one end and free at other d cantilever beam.

am is fixed at both end, it is called fixed

ends of a beam are made to rest freely on s beam it is called simply supported beam.




**28. When using a Venturimeter, a decrease in the cross-sectional area causes:**

(a) a decrease in static pressure

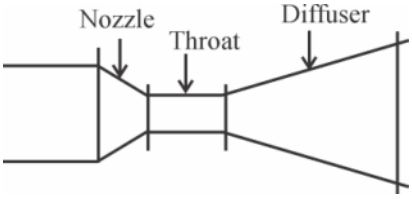
(b) no change in velocity

(c) an increase in fluid density

(d) an increase in static pressure

**Ans. (a) :** When using a venturimeter, a decrease in the cross-sectional area causes a decrease in static pressure and increase velocity.

- Venturimeter is used for measuring the flow rate or discharge of the fluid.




- It is a gradually converging and gradually diverging device used for the measurement of flow in a pipeline.
- It is based on the principle of Bernoulli's theorem.

**It have three parts–**

- Converging cone → ($20^o$ - $22^o$)
- Throat (Area is minimum)
- Diverging cone → ($5^o$ - $7^o$)

**29. The manometric efficiency in a pump is the ratio of:**

(a) the actual pressure head produced to the theoretical pressure head
(b) the theoretical head to the actual head
(c) the temperature difference between inlet and outlet
(d) the fluid density to the pump speed

**Ans. (a) :** The manometric efficiency in a pump is the ratio of the actual pressure head produ theoretical pressure head.

- Manometric efficiency is also called efficiency.

$$\eta_m = \frac{\text{rotor or impeller power}}{\text{shaft power}}$$

- Volumetric efficiency is defined as the ra discharge to theoretical discharge.

$$\eta_v = \frac{\text{Actual discharge}}{\text{theoretical discharge}}$$

- Overall efficiency ($\eta_o$)= $\eta_{mech} \times \eta_v \times \eta_{mano}$

**30. What happens to the mechanical properties of mild steel when carbon content increases?**

(a) Strength decreases and ductility increases
(b) Both strength and hardness decrease
(c) Strength increases and ductility decreases
(d) Both strength and ductility increase

**Ans. (c) : As the carbon content increase in mild steel–**

- The ultimate strength of steel increases.
- The ductility of the metal decreases.
- The elongation before fracture decreases.
- Increasing carbon also reduces the weldability.
- Especially above 0.25% carbon
- Increasing carbon content increases hardness and strength and improve hardenability.

**31. Which of the following elements is NOT a primary alloying element in stainless steel?**

(a) Carbon (b) Nickel
(c) Chromium (d) Lead

**Ans. (d) :** Lead is not a primary alloying element in stainless steel.

**Stainless composition–**

- Nickel (Ni) → 18
- Chromium (Cr) → 8
- Carbon (C) → 0.12% to 0.35%
- Rest iron present in the stainless steel.
- Stainless steel can be easily welded and machined. It have better corrosion resistance property.

**32. The purpose of scheduling in Production Planning and Control is to:**

(a) determine the cost of materials
(b) hire old personnel
(c) hire new personnel
(d) ensure products are completed on time

**Ans. (d) :** The purpose of scheduling in production planning and control is to ensure products are completed on time.

- It is the function of management which plans, directs and controls the material supply and processing activities of an enterprise.
- Scheduling is that steps in production planning and (PPC), it determines sequence of each n, its starting and finishing time so that material and machines are kept ready as per table in order to avoid delay in processing.

duling may be defined as the fixing of time for each operation as well as determining ence of operation.

**design of a semi-open impeller makes it ble for:**

(a) only low flow rate applications
(b) applications requiring the highest efficiency regardless of clogging
(c) fluids with moderate amounts of suspended solids while providing better efficiency than open impellers
(d) liquids with very high solid content

**Ans. (c) :** The design of a semi-open impeller makes it suitable for fluids with moderate amounts of suspended solids while providing better efficiency.

- Semi-open impellers have a back shroud but no front shroud.
- They are less prone to clogging and can handle larger solids compared to closed impellers.
- It is suitable for liquids with some suspended solids and for applications requiring frequent cleaning and maintenance.

**34. If the degree of the shear force diagram is x, then the:**

(a) degree of the loading curve is x + 1
(b) degree of the bending moment diagram is x − 1
(c) degree of the bending moment diagram is x + 1
(d) degree of the loading curve is x

**Ans. (c) : Relationship between shear force and bending moment diagram–** If the degree of the shear force diagram is x, then the bending moment diagram is x + 1.

**Relationship between loading and shear force–** If the degree of the loading curve is x, then the degree of the shear force diagram is x + 1. Conversely, if the degree of shear force diagram is x, then the degree of the loading curve is x – 1.

**35. If the area under the shear force diagram between two specified points is equal to P, then the difference in the bending moments at those points will be :**

(a) $\frac{P}{2}$ (b) Zero

(c) 2P (d) P

**Ans. (d):** If the area under the shear force diagram between two specified point is equal to P, then the difference in the bending moments at those points will be P.

$$\boxed{\sum M_A - \sum M_B = P}$$

**36. If 30 m is the height difference between the two rollers and 60 m is the distance centres of the rollers, what is the a between the upper surface of a sine surface plate (datum)?**

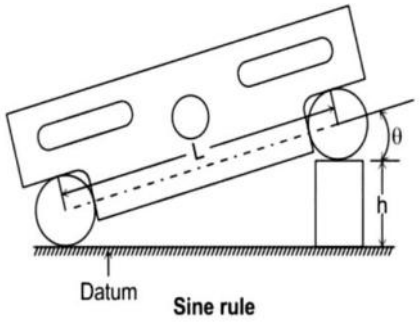
(a) 45° (b) 90°

(c) 60° (d) $30^o$

**Ans. (d) :** Give,

Height difference between the two roller (H)

Distance between the centres of roller (L) =




Sine rule

The angle formed between the upper surface of a sine bar and the surface plate (datum) = $\sin\theta = \frac{H}{L}$

$$\sin\theta = \frac{30}{60} = \frac{1}{2}$$

$\sin\theta = \sin 30^o$

$\boxed{\theta = 30^o}$

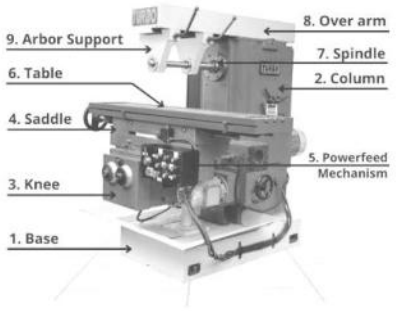
**37. Name the part of a milling machine on which milling cutters are securely mounted and rotated.**

(a) Arbor (b) Front brace

(c) Overhanging arm (d) Saddle

**Ans. (a) :** Arbor is the part of a milling machine on which milling cutters are securely mounted and rotated.

- Its one end is attached to the column and other end is supported by on overam. Its holds and drive different types of milling cutters.
- Milling is defined as the process of cutting, shaping and finishing a piece of metal.
- Milling is used when more complex metal shapes are desired.
- It involves cutting away pieces of metal to create dovetails, thread, bevels, slot and ridges.




**38. In the analytical method, how is the resultant force determined when all forces act in the same direction?**

y adding all the forces together

y subtracting the smallest force from the argest

y dividing the total force by the number of orces

y multiplying all the forces together

n the analytical method, the resultant force is by adding all the forces act in the same

$$\boxed{\sum R = F_1 + F_2 + F_3}$$

**39. What is the primary mechanism by which thermal radiation transfers energy?**

(a) Convection due to fluid motion

(b) Direct transfer via physical contact

(c) Conduction through molecular collisions

(d) Electromagnetic waves

**Ans. (d) :** The primary mechanism by thermal radiation transfer energy is electromagnetic waves.

- Radiation does not require the presence of any medium.
- It is the fastest mode of energy transfer.
- Thermal radiation is the radiation because of its temperature.
- Radiation is volumetric phenomenon and all solids, liquids and gases emit, absorbs or transmit radiation, treated as surface phenomenon.

**40. The Stefan-Boltzmann law is derived from:**

(a) Wien's Displacement Law

(b) Kirchhoff's Law

(c) Fourier's Law

(d) Planck's Law

**Ans. (d) :** The Stefan-Boltzman law is derived from Planck's law.

- Planck's law describes the spectrum of electromagnetic radiation emitted by a black body in thermal equilibrium at a given temperature.

Planck's constant is –

$$h = \frac{E}{\nu} = \frac{\text{Joule}}{1/\text{sec}} = \text{Joule-sec.}$$

$h = 6.67 \times 10^{-34}$ J-s

Where, E = Energy

$\nu$ = Frequency

h = Plank's constant.

Stefan Boltzman law– $\boxed{Q_{\text{max radiation}} = \sigma A T^4}$

$$\boxed{\sigma = 5.67 \times 10^{-8}\ W/m^2K^4}$$

**41. In a two-stroke petrol engine, the inlet port is opened by the piston:**

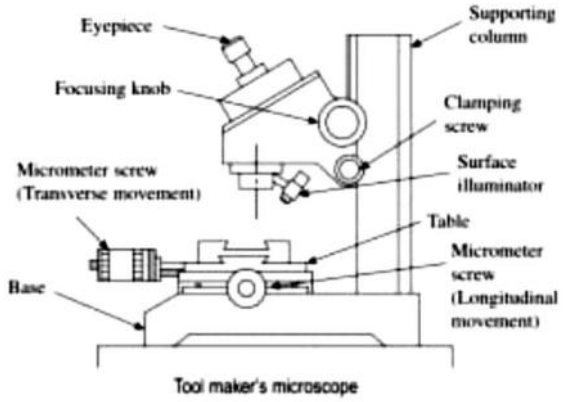
(a) 30° to 40° before BDC
(b) 40° to 55° before BDC
(c) 30° to 40° after BDC
(d) 45° to 55° before TDC

**Ans. (a) :** In a two-stroke petrol engine, the inlet port is opened by the piston $30^o$ to $40^o$ before BDC.

**42. The function of the supporting c Tool Maker's Microscope is to ____**

(a) provide vertical working distance
(b) magnify the image
(c) illuminate the workpiece
(d) hold the specimen in place

**Ans. (d) :** The function of the supporting tool maker's microscope is to hold the s place.



Tool maker's microscope

- A tool maker's microscope (also known as a measuring microscope) is a versatile, high precision instrument used in metrology and quality control.

**43. What is the effect of compression ratio (CR) on the air standard efficiency of otto and diesel cycles?**

(a) CR has no effect on efficiency.
(b) Efficiency increases with CR in SI engines and decreases in CI engines.
(c) Higher CR always leads to higher efficiency.
(d) Lower CR always leads to higher efficiency.

**Ans. (c) :** The effect of compression ratio (CR) on the air standard efficiency of otto and diesel cycles that higher CR always leads to higher efficiency.

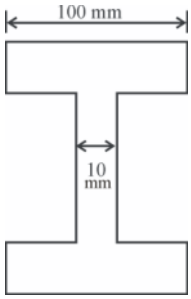
- The compression ratio of otto cycle 6 to 12 and diesel cycle is 16 to 20.
- The efficiency of otto cycle is higher than diesel cycle at the same compression ratio.

$$\boxed{\eta_{\text{otto}} = 1 - \frac{1}{r^{\gamma-1}}} \qquad \boxed{\eta_{\text{diesel}} = 1 - \frac{1}{r^{\gamma-1}}\left[\frac{\alpha^{\gamma}-1}{\gamma(\alpha-1)}\right]}$$

**44. The flange of an I-section is 100 mm wide and 10 mm thick, and has moment of inertia $I_f$ about its own centroidal axis parallel to flange length, in the plane of the flange. Its centroidal axis is 50 mm from the centroidal axis X-X of the I-section normal to the web in the plane of the I-section. Area moment of inertia of the flange about axis X-X is :**

(a) 8333 $mm^4$ (b) $I_f + 25X10^5$ $mm^4$
(c) $I_f - 25X10^5$ $mm^4$ (d) $I_f + 50{,}000$ $mm^4$

**Ans. (b) :** Given,
Width = 100 mm
Thickness = 10 mm
d = 50 mm




A = Width × thickness
A = 100 mm × 10 mm = 1000 $mm^2$
$I_{xx} = I_f + Ad^2$
$I_{xx} = I_f + 1000 \times (50)^2$
$I_{xx} = I_f + 2500000$
$I_{xx} = I_f + 25 \times 10^5$ $mm^4$

**45. Broaching is a _____ that uses a toothed tool to remove the material from the workpiece.**

(a) grinding process (b) boring process
(c) machining process (d) casting process

**Ans. (c) :** Broaching is a machining process that uses a toothed tool to remove the material from the workpiece.

- The grinding process is used to produce a high surface finish with a close tolerance and for machining hard materials.
- The boring process is an accurate internal cylindrical surface is produced by enlarging an existing opening in the workpiece. The workpiece move parallel to the axis of rotation of the cutting tool.
- Casting is a manufacturing process in which a liquid material is usually poured into a mold which contains a hollow cavity of the desired shape and then allowed to solidify.

**46. Which of the following is NOT a type of nitriding process?**

(a) Vacuum nitriding (b) Gas nitriding
(c) Liquid nitriding (d) Plasma nitriding

**Ans. (a) :** Vacuum nitriding is not a type of nitriding process.

- Nitriding is a process used to harden the surface of metal parts by introducing nitrogen into the surface. This process can improve wear resistance, fatigue resistance and corrosion resistance.
- Gas nitriding process uses ammonia gas to introduce nitrogen to the surface of the metal.
- Liquid nitriding process involves imersing the metal part in the molten salt bath contains nitrogen.
- Plasma nitriding uses a plasma to introduces nitrogen to the surface of the metal.

All these are the type of nitriding process.

**47. Which of the following best describes the primary function of a simple carburetor in a petrol engine?**

(a) To electronically control the fuel injection timing
(b) To compress the air-fuel mixture before combustion
(c) To atomise and mix fuel with air i ratio
(d) To regulate exhaust emissions conversion

**Ans. (c) :** The primary function of a simpl in petrol engine to atomise and mix fuel proper ratio.

- The process of formation of a combusti mixture by mixing the proper amount of fuel with air before a mixture to the engine cylinder is called carburetion and the device which does this job is called a carburetor.
- In CI engines, only air is compressed and then fuel is injected into the cylinder by an injector. So, the CI engine does not require the carburetor.

**48. Blowholes are welding defects caused by _____.**

(a) unsuitable parent metals used in the weld
(b) gas being trapped and due to moisture
(c) poor edge preparation
(d) too great a heat concentration

**Ans. (b) :** Blowholes are welding defects caused by gas being trapped and due to moisture contains.

- Under cut is a welding defects where a groove or depression is formed along the edge of the weld bead. It occurs when the base metal is melted away and not filled with weld metal.
- Burn through is a defects that occurs when the weld metal penetrates through the base metal, creating a hole. This defects is typically caused by excessive heat input or incorrect welding parameters.

**49. A centrifugal pump has a hydraulic power output of 10 kW and consumes 15 kW of mechanical power. Calculate its overall efficiency.**

(a) 66.7% (b) 75%
(c) 50% (d) 80%

**Ans. (a) :** Given,
Hydraulic power output = 10 kW
Mechanical power output = 15 kW

$$\text{Overall efficiency } (\eta_o) = \frac{\text{Hydraulic power output}}{\text{Mechanical power input}}$$

$$= \frac{10}{15} \times 100$$
$$= 0.6667 \times 100$$
$$= 66.67\%$$

**50. Forced convection is primarily characterised by:**

(a) the absence of any temperature gradients in the fluid
(b) heat transfer occurring solely through radiation
he natural buoyancy-driven flow of the fluid
he use of external devices such as fans or umps to move the fluid

Force convection is primarily characterised of external devices such as fans or pumps to uid.
ernal force enhances heat transfer compared l convection.

**function of fluxes in soldering is _____.**

(a) to heat metal over a range of temperature up to fusion and then allow to cool
(b) to remove oxides and other surface compounds from the surfaces to be soldered
(c) to use consumable bare electrode in combination with a flux feeder tube
(d) to remove dirt particles and other surface compounds from the surfaces to be soldered

**Ans. (b) :** The function of fluxes is soldering is to remove oxide and other surface compounds from the surfaces to be soldered.

- By definition, soldering is a brazing type of operation where the filler metal has a melting temperature below 450°C.
- Most solders are alloys of lead and tin.
- In this, strength of the filler metal is low.
- Soldering is used for a leak-proof joint or a low resistance electrical joint.

**52. _____ is used for mixing oxygen and acetylene in gas welding processes.**

(a) Goggles (b) Earth clamp
(c) Welding torch (d) Spark-lighter

**Ans. (c) :** Welding torch is used for mixing oxygen and acetylene in gas welding processes.

- The mixture of oxygen and acetylene produces a high temperature flame suitable for welding, cutting and brazing metals.
- Goggles are used for eye protection.
- An earth clamp is used to provide a return path for the welding current.
- Spark lighter is used to ignite the gas mixture.

**53. Which of the following is NOT a feature of pneumatic comparators?**

(a) No wearing of parts
(b) High range of amplification
(c) Non-contact inspection of work parts
(d) Presence of hysteresis

**Ans. (d) :** Presence of hysteresis is not a feature of pneumatic comparators.

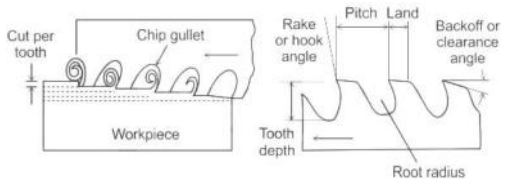
- In pneumatic comparators, either air flow or air pressure is measured to give measurement deviation from a standard.
- The response of the comparators working on air flow is quicker than those working on air press latter is more versatile than the former.

**54. The _____ in a broaching tooth is prevent rubbing of the tool with the**

(a) front rake angle
(b) back-off angle
(c) face angle
(d) hook angle

**Ans. (b) :** The back-off angle in a broaching tooth is provided to prevent rubbing of the tool with the workpiece. The back-off angle is also known as relief angle.

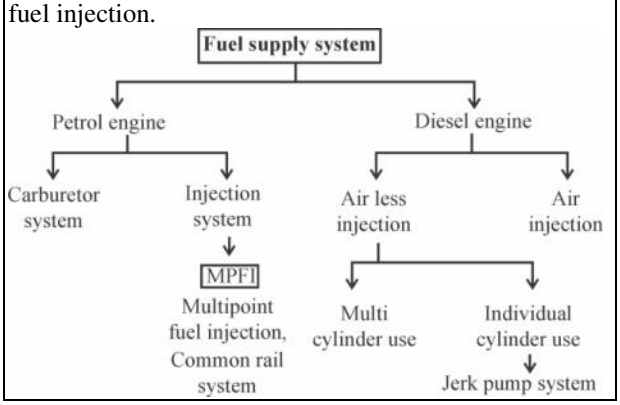
- This angle allows the cutting edge to engage the material efficiency.
- The front rake angle affects the ability of the tool to shear the work form a chip. After plastic deformation chips flow over the rake face and heavy drag exists between chip and rake face.




**55. IC engines are classified into carburetor engine and air injection engine based on the:**

(a) speed of the engine
(b) cooling system used
(c) number of cylinders
(d) method of fuel injection

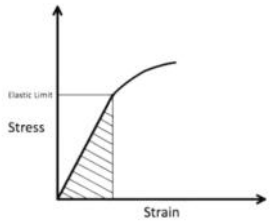
**Ans. (d) :** IC engines are classified into carburetor engine and air injection engine based on the method of fuel injection.




**56. The modulus of resilience is characterised by the area located under the stress-strain curve upto the:**

(a) ultimate point
(b) proportional limit
(c) point where strain hardening starts
(d) fracture point

**Ans. (b) :** The modulus of resilience is characterised by the area located under the stress-strain curve up to the l limit.




the curve/Strain energy per unit volume

$$= \frac{1}{2} \times \sigma \times \delta$$

- It is the strain energy per unit volume.

**Modulus of toughness–** It is the strain energy per unit volume which can be stored in metal without fracture. It is equal to the total area under the stress-strain curve up to the fraction point.

**Proof resilience–** It represent strain energy per unit volume of metal. It is defined for those ductile metals which don't show clear yield point.

**57. In a four-stroke diesel engine, the exhaust valve opens before the piston reaches the Bottom Dead Center to:**

(a) improve fuel atomization
(b) reduce pumping losses
(c) enhance air-fuel mixing
(d) increase the compression ratio

**Ans. (a) :** In a four-stroke diesel engine, the exhaust valve opens before the piston reaches the bottom dead center to improve fuel atomization.

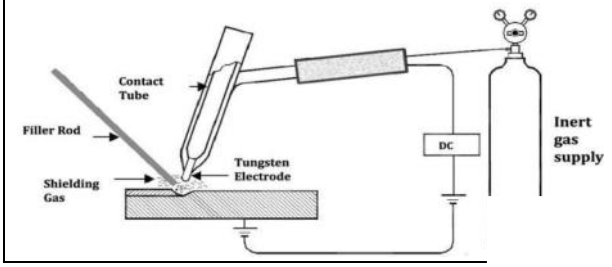
- This is because opening the valve early helps to reduce the pressure in the cylinder, which can lead to better fuel atomization during the injection process.

**58. Identify the gas used in Tungsten Inert Gas Welding (TIG).**

(a) Hydrogen-nitrogen mixtures
(b) Oxygen-hydrogen mixtures
(c) Oxygen-nitrogen mixtures
(d) Argon-helium mixtures

**Ans. (d) :** The gas used in tungsten inert gas welding is argon-helium mixtures.

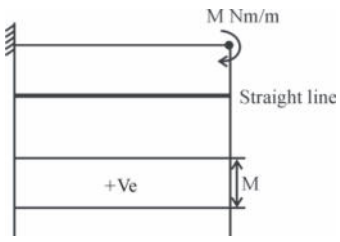
- TIG welding utilizes a non-consumable tungsten electrode to produce the weld.
- Tungsten inert gas (TIG) welding process also known as gas tungsten arc welding (GTAW).
- The heat-affected zone, the molten metal and the tungsten electrode all shielded from atmospheric contamination by a blanket of inert gas fed through the GTAW torch.




**59. A cantilever beam with a span len carries a uniform moment of in Nm/m. Which of the following st correct?**

(a) Shear force throughout the length w
(b) Shear force throughout the length w
(c) Shear force throughout the length will be zero.
(d) Shear force throughout the length will be ML.

**Ans. (c) :** A cantilever beam with a span length L m carries a uniform moment of intensity 'M' Nm/m.




- The shear force throughout the length will be zero and bending moment is rectangular.

**60. What is the purpose of introducing two equal and opposite forces at a different point on a rigid body?**

(a) To transfer the original force to a new location
(b) To change the direction of the applied force
(c) To balance the rotational motion of the body
(d) To increase the force acting on the body

**Ans. (a) :** The purpose of introducing two equal and opposite forces at a different point on a rigid body is to transfer the original force to a new location.

- When two equal and opposite forces are applied at a point on a rigid body, they are known as balanced forces.
- Balanced forces are forces that are equal in magnitude but opposite in direction. They act along the same line of action and as a result they cancel each other out.

**61. In production engineering, gear hobbing is a _____.**

(a) surface finishing process
(b) primary shaping process
(c) joining process
(d) machining process

**Ans. (d) :** In production engineering, gear hobbing is a machining process.

- Gear hobbing is a continuous generating process in which the tooth flanks of the constantly moving workpiece are formed by equally spaced cutting edges of the hob.
- It produce a variety of gears including spur, helical, heels, serration, splines etc.

in advantage of the method is higher on rate of the gear due to continuously .

**h test is commonly used to measure the eability of a material?**

orsion test (b) Compression test
ardness test (d) Impact test

Compression test is commonly used to measure the malleability of a material.

- Malleability is the ability of a material to deform under compressive stress without facturing.
- Compression tests assess how much a material can be flattened or shaped into a sheet before it breaks.
- Impact test is done to test toughness.
- Toughness is measured by Izod and Charpy impact testing machines.

**63. What is lack of fusion in welding defects?**

(a) It is the entrapment of slag or other impurities in the weld.
(b) It is the failure of the filler metal to fuse with the parent metal.
(c) It is the failure of the filler metal to penetrate into the welding joint.
(d) It is a group of small holes throughout the weld metal.

**Ans. (b) : Lack of fusion–** It is the failure of the filler metal to fuse with the parent metal.

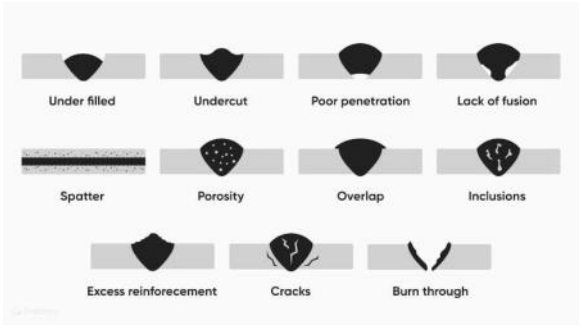
- It is occurs due to lack of current, high welding speed and incorrect electrode and torch angle.

**Incomplete penetration–** It is the failure of the filler metal to penetrate into the welding joint.

- It is occurs due to excessive welding speed and due to the inedequate cleaning before depositing sealing run.

**Porosity or blow hole–** It is the entrapment of slag or other impurities in the weld.

- It causes presence of contaminants on the job or electrode surface.
- Due to moisture trapped between joining surfaces.
- Freezing of weld at a faster rate.




**64. In the resolution of a force, along which of the following directions is a force generally resolved?**

(a) Two mutually perpendicular direc
(b) Any three random directions
(c) A single fixed direction
(d) Two parallel directions

**Ans. (a) :** A force is generally resolved i mutually perpendicular directions.

- This is because any force can be respe vector sum of its components along the two perpendicular axes.

**65. Which of the following components generally evaporate in the organic coating?**

(a) Additives (b) Pigments
(c) Binder (d) Solvents

**Ans. (d) : Solvents-** These are volatile liquids used to dissolve binders and adjust viscosity for easy application. After the coating is applied, solvents evaporate leaving behind a solid film of binder, pigment, and additives.

**Example-** When you apply paint, the smell comes from evaporating solvents. As these evaporate, the paint dries and hardens into a protective layer.

**66. The reversed carnot cycle is used as a basis for which of the following?**

(a) Heat engines
(b) Internal combustion engines
(c) Refrigerators and heat pumps
(d) Steam turbines

**Ans. (c) :** The reversed carnot cycle is used as a basis for refrigerators and heat pumps.

- In refrigerator, refrigerating effect is always created in the low temperature region.
- Refrigerator works on the Bell-Coleman cycle.
- In heat pump, heating effect is always created in the high temperature region.

$$(COP)_R = \frac{RE}{W} \qquad (COP)_{HP} = \frac{HE}{W}$$

Where, RE = Refrigerating effect
HE = Heating effect,

$$(COP)_{HP} = (COP)_R + 1$$

**67. Which factor does NOT directly affect the power required to drive a centrifugal pump?**

(a) Fluid viscosity (b) Flow rate
(c) Fluid density (d) Atmospheric pressure

**Ans. (d) :** Atmospheric pressure does NOT directly affect the power required to drive a centrifugal pump.

**68. Fatigue failure in materials occurs due to:**

onstant stress (b) high temperature
yclic loading (d) low temperature

Fatigue failure in materials occurs due to ng.

ither the magnitude or the direction of the hanged frequently with time, it is termed as ng loading or fatigue loading.

ue failure occurs due to fatigue loading and it is sudden and total.

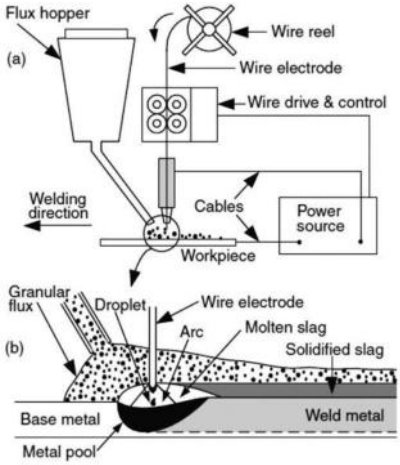
- Fatigue is the progressive and localized structural damage that occurs when a material is subjected to cyclic loading.

**69. ____ is used in Submerged Arc Welding process.**

(a) Tungsten electrode
(b) Carbon electrode
(c) Graphite electrode
(d) Consumable bare electrode

**Ans. (d) :** Consumable bare electrode is used in submerged arc welding process.

- A thick layer of granular flux is deposited just a head of a bare-wire consumable electrode and an arc is maintained beneath the blanket of flux with only a few small flames being visible.
- A portion of the flux melts molten flux and flux provides thermal insulation, slow cooling rate and produce soft, ductile welds.
- SAW is most suitable for flat butt or fillet weld in low carbon steel.




**70. The value of density of water at room temperature is _____.**

(a) 10 gm/cm$^3$ or 10000 kg/m$^3$
(b) 1 gm/cm$^3$ or 1000 kg/m$^3$
(c) 3 gm/cm$^3$ or 3000 kg/m$^3$
(d) 2 gm/cm$^3$ or 2000 kg/m$^3$

**Ans. (b) :** The value of density of water at room temperature is 1 gm/cm$^3$ or 1000 kg/m$^3$ and 4°C and 1 atmospheric pressure.

- It is the standard density of water and it i density of water also.

**71. To measure surface finish, the t stylus instruments used are:**

(a) Digital and Analog
(b) Manual and Automated
(c) True Datum and Surface Datum
(d) Contact and Non-contact

**Ans. (d) :** The measure surface finish, the two types of stylus instruments used are contact and non-contact.

**Contact stylus instruments–** These instruments use a physical stylus that makes direct contact with the surface to trace it profile and measure roughness parameters.

**Non-contact instruments–** These instruments utilize optical or other non-contact methods (like laser or light interferometry) to measure the surface profile without physical contact.

**72. Three collinear horizontal forces of magnitudes 250 N, 150 N and 350 N are acting on a rigid body. If the 150 N force acts in the opposite direction, determine the resultant force.**

(a) 350 N (b) 250 N
(c) 450 N (d) 550 N

**Ans. (c) :** Three collinear horizontal forces are 250 N, 150 N and 350 N.

In this 150 N is acts in the opposite direction.

250 N → 150 N ← 350 N →

$$\sum H = 250N - 150N + 350N$$

$$\boxed{\sum H = 450N}$$

**73. The type of surfaces best suited for measuring surface roughness using a light interference microscope are _____.**

(a) liquid surfaces
(b) surfaces requiring high-precision 3D mapping
(c) soft or thin surfaces
(d) very large surface areas

**Ans. (c) :** The type of surfaces best suited for measuring surface roughness using a light interference microscope are soft or thin surfaces.

**74. What is a coplanar force system?**

(a) A system where all forces lie in the same plane
(b) A system where forces act only in one direction
(c) A system where forces do not intersect at a point
(d) A system where all forces lie in different planes

**Ans. (a) :** Coplanar force system is a system where all forces lie in the same plane.

- All forces are parallel to each other and lie in a single plane is called coplanar parallel forces.

action of all the forces act along the same lled collinear forces.

action of all forces pass through a single d forces lie in same plane is called coplanar nt forces.

forces do not meet at a point but lie in a ane is called coplanar non concurrent forces.

**h of the following statements is correct regarding electroplating?**

(a) The rate of anodic dissolution is found greater to the rate of deposition of metal onto the substrate.
(b) The dissolution of metal starts at the cathode.
(c) The rate of anodic dissolution is found equal to the rate of deposition of metal onto the substrate.
(d) The metal is deposited on the anode.

**Ans. (c) :** In electroplating, the rate of anodic dissolution is found equal to the rate of deposition of metal onto the substrate.

- Electroplating is also known as electro-deposition.
- It involves the deposition of material by using an electric current.
- This process result in a thin layer of metal being deposited onto the surface of a workpiece called the substrate.
- Electroplating is primarily used to change the physical property of an object.
- This process can be used to give objects increased wear resistance, corrosion protection or aesthetic appeal as well as increased thickness.

**76. Which of the following back pressure gauges is NOT used in Pneumatic Comparators?**

(a) Differential back pressure gauge
(b) Venturi back pressure gauge
(c) Water column back pressure gauge
(d) Absolute back pressure gauge

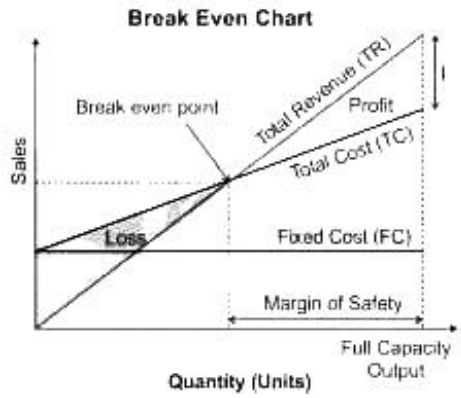
**Ans. (d) :** Absolute back pressure gauge is not used in pneumatic comparators.
Differential back pressure gauge, venturi-back pressure gauge and water-column back pressure gauge are parts of pneumatic comparators.

**77. In graphical representation of the cost–volume relationship, the point where the 'Total revenue' line intersects the 'Total costs' line represents the :**

(a) variable costs (b) break-even point
(c) maximum profit (d) margin of safety

**Ans. (b) :** In graphical representation of the cost-volume relationship, the point where the 'total revenue' line intersects the 'total cost' line represent the break-even point.

- At this point, total revenue equals to th
that means no profit no loss.

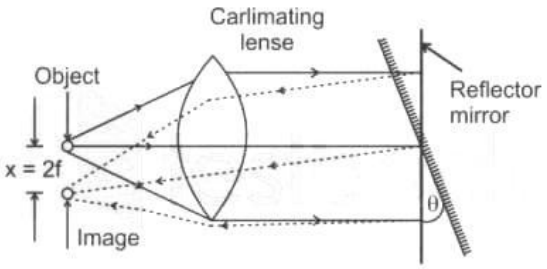



**78. Which of the following can be used for angular measurements?**

(a) Slip Gauge (b) Micrometer
(c) Autocollimator (d) Depth Gauge

**Ans. (c) :** Auto-collimator can be used for angular measurement.

- An auto-collimator is an optical instrument that is used to measure small angles with very high sensitivity.
- The auto-collimator has a wide variety of applications including precision alignment, detection of angular movement, verification of angle standards and angular monitoring over long periods.
- An auto-collimator is essentially an infinity telescope and a collimator combined into one instrument.



Principle of auto-collimator

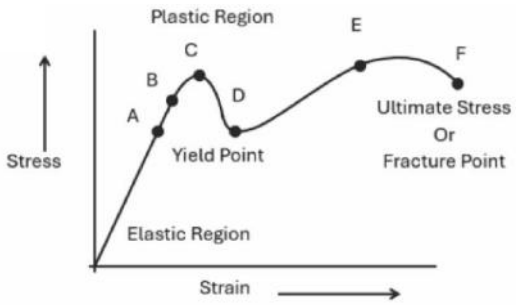
**79. Compared to a single volute casing, a double volute casing with a vaned diffuser generally provides:**

(a) lower pressure generation capability
(b) increased wear on pump components
(c) lower efficiency due to complex flow paths
(d) better hydraulic performance and efficiency

**Ans. (d) :** Compared to a single volute casing, a double volute casing with a vaned diffuser generally provides better hydraulic performance and efficiency.

- Double volute casings help to balance radial forces on the impeller, reducing vibration and wear, while iffuser convert kinetic energy into pressure more efficiently, leading to improved c performance and higher overall efficiency d to single volute casing designs.

**h region of the stress-strain curve as n below represents work hardening in ile materials?**




(a) D-E (b) E-F
(c) C-D (d) A-C

**Ans. (c) :**

- Elastic region (A-C)
- Plastic region (C-F)
- Work hardening region (C-D)
- Necking region (E-F)

**81. Thermal stress in a composite bar DOES NOT depend on which of the following factors?**

(a) Coefficient of thermal expansion
(b) Temperature change
(c) Modulus of elasticity
(d) Area of cross-section

**Ans. (d) :** Thermal stress in a composite bar does not depend on the area of cross-section.

Thermal stress ($\sigma_T$) = $E\alpha\Delta T$

Where, E = Young's modulus of material

$\sigma_T$ = Thermal stress

$\Delta T$ = Change in temperature

$\alpha$ = Coefficient of thermal expansion.

**82. The area between the 'Total revenue' line and the 'Total costs' line to the right of the breakeven point represents :**

(a) fixed costs (b) loss zone

(c) profit zone (d) variable costs

**Ans. (c) :** The area between the "Total revenue" line and the total cost line to the right of the break even point represents the profit zone.

- To the right of the break-even point total revenue exceeds total costs, indicates profit.
- The break-even point is a point where total costs and total revenues are equal.
- No profit no loss.

**83. EOQ stands for :**

(a) Electrical Ordering Quantity

(b) Economic Ordering Quantity

(c) Electronic Ordering Quantity

(d) Ensemble Ordering Quantity

**Ans. (b) :** EOQ stands for 'economic orderin

- There are mainly two costs associated wit ordering cost and inventory carrying cost.
- Above two cost in opposite in nature quantity must be balanced quantity, minimum total cost. This quantity is economic order quantity.

At EOQ, total cost is minimum

At EOQ, ordering cost = holding cost.

**84. Parallel shank type and morse taper shank type drills belong to _____ type of drills.**

(a) straight-fluted (b) twist

(c) hexagonal (d) flat

**Ans. (b) :** Parallel shank type and morse taper shank type drills belong to twist type of drills.

- Twist drills are rotary cutting tools primarily used for drilling holes and feature flutes to aid in chip removal and coolant delivery.
- Parallel shank drills are typically held in drill chuck, while taper shank drill with a morse taper are held in sleeves or socket that match the taper for a secure fit.

**85. Which of the following pigments provide anti-corrosion characteristics in the organic coating?**

(a) Zinc phosphate (b) Barium metaborate

(c) Lithopone (d) Limestone

**Ans. (a) :** Zinc phosphate pigments provide anti-corrosion characteristic in the organic coating due to its ability to form a protective layer on metal surface, inhibiting the corrosion process.

- Barium metaborate and lithopone are not primarily known for their anti-corrosion properties.
- Limestone is a filler and not an anti-corrosive pigment.

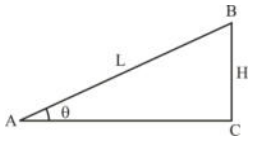
**86. What is the maximum angle that can be generally set using a sine bar?**

(a) 60° (b) 90°

(c) 75° (d) 45°

**Ans. (d) :** The maximum angle that can be generally set using a sine bar is 45°.

- A sine bar is used to measure angles based on the sine principle. Its upper surface forms the hypotenuse of a triangle formed by a steel bar terminating in a cylinder near each end.




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

- It is not recommended to use sine bars for angles greater than 45° because any error in the sine bar or f slip gauges gets accentuated.

**hich location on a beam section will the mum bending moment occur, concerning hear force?**

here shear force will be maximum

ending moment does not depend upon shear orce.

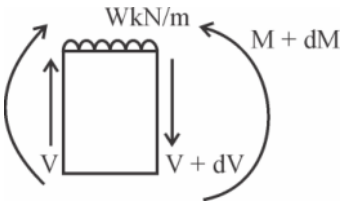
here shear force will be minimum

here shear force will change its sign

**Ans. (d) :** The maximum bending moment in a beam occurs at the location where the shear force is zero or changes its sign.

- Rate of change of shear force (V) is equal to load.

$$\frac{dV}{dx} = -W$$




W = Load per unit length

- Rate of change of bending moment along the length of beam is equal to shear force.

$$\frac{dM}{dx} = V$$

**88. Which of the following factors primarily influences the toughness of a material?**

(a) Elastic modulus (b) Grain size

(c) Surface finish (d) Yield strength

**Ans. (b) :** Grain size is a primarily factor influencing the toughness of a material.

- Toughness is the ability of a material to absorb energy and plastically deform up to fracturing.
- Fine grain sizes generally lead to increased toughness because they provide more grain boundaries, which act as barriers to check propagation, requiring more energy for fracture.

**89. In a parting-off operation, how is the cutting tool fed into the workpiece?**

(a) By rotating the cross-slide screw by hand
(b) By rotating the headstock spindle directly
(c) By adjusting the tailstock manually
(d) By moving the carriage along the lathe bed

**Ans. (a) :** In a parting-off operation, by rotating the cross-slide screw by hand.

- In a parting-off operation on a lathe, the cutting tool is fed radially into the workpiece to separate a section of material.
- The radial movement is achieved by rotating the cross slide screw, which moves the tool post perpendicular to the lathe axis.

**90. The reason for a company to strongly favour buying a component even if they co themselves is that the:**

(a) company has excess manufacturin
(b) vendor offers a lower cost and hig
(c) company wants to maintain desig
(d) company wants to improve its qua

**Ans. (b) :** The reason for a company to stro buying a component even if they coul themselves is that vendor offers a lower cos quality.

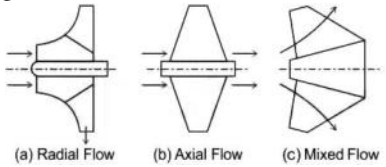
- Lower cost helps reduce expenses.
- Higher quality improves the end product and customer satisfaction.

**91. In a radial flow pump, the fluid primarily flows:**

(a) in a circular path around the pump shaft
(b) parallel to the pump shaft
(c) outward radially from the impeller centre
(d) inward radially toward the impeller centre

**Ans. (c) :** In a radial flow pump, the fluid primarily flows outward radially from the impeller centre.

- An axial flow pump, the fluid enters impeller axially and also leaves axially. These pumps have very large discharge but a low head.




**92. Which of the following is NOT a requirement of an ignition system in a spark-ignition engine?**

(a) Maintaining consistent spark duration across all RPMs
(b) Generating sufficient voltage to jump the spark plug gap
(c) Mixing air and fuel in the intake manifold
(d) Timing the spark to coincide with the compression stroke

**Ans. (c) :** Mixing air and fuel in the intake manifold is not a requirement of an ignition system in a spark ignition engine.

- The requirement of an ignition system in a spark-ignition engine are–
  (i) Maintaining consistent spark duration across all RPMs.
  (ii) Generating sufficient voltage to jump the spark plug gap.
  (iii) Timing the spark to coincide with the compression stroke.

**93. What is the basic function of a single volute casing in a centrifugal pump?**

(a) To increase the speed of the fluid
(b) To direct the fluid flow and convert kinetic energy into pressure
(c) To divide the fluid into multiple streams
o reduce the temperature of the fluid

The basic function of a single volute casing fugal pump is to direct the fluid flow and etic energy into pressure energy.

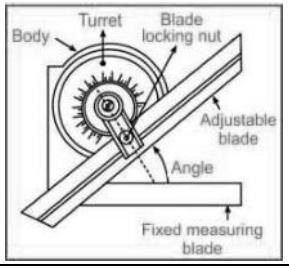
ntrifugal pump, the fluid enters the pump along or near to the rotating axis and is ted by the impeller, flowing radially outward ffuser or volute chamber, from where it exit downstream piping system.

**94. What is the accuracy of the universal bevel protractor?**

(a) 12-minute (12') (b) 15-minute (15')
(c) 8-minute (8') (d) 5-minute (5')

**Ans. (d) :** The accuracy of the universal bevel protractor is 5 minute (5') i.e. $\left(\frac{1}{12}\right)^{\circ}$

- Apart from being used for measuring angles, vernier bevel protractor is also used for setting work holding devices on machine tools, work tables etc.
- It is used to measure the acute as well as obtuse angle.
- For setting work-holding devices to angles on machine tools work tables.



**95. In Arc Welding process, welding cables are used for _____.**

(a) cleaning the surface to be welded
(b) conduction of current from the welding machine to the electrode holder
(c) connecting to the hand held electrode directly and conducting current to it
(d) frequently igniting the welding torch

**Ans. (b) :** In arc welding, welding cables are used for conduction of current from the welding machine to the electrode holder which then transfers the current to the electrode for creating the arc.

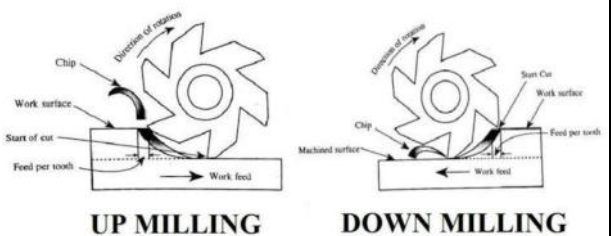
- In arc welding are specifically designed to carry the high electric current required from the welding power source to electrode holder and workpiece, forming the welding circuit.

**96. In the Up-milling process, the metal is removed in the form of small chips by a cutter rotating _____.**

(a) in the same direction of the feed of the workpiece
(b) Metal will not be removed in the milling process.
(c) against the direction of the tr workpiece
(d) perpendicular to the direction of the workpiece

**Ans. (c) :** In the Up-milling process, t removed in the form of small chips by a cu against the direction of the travel of the wor cutting force is minimum during the begin cut and maximum at the end of the cut.

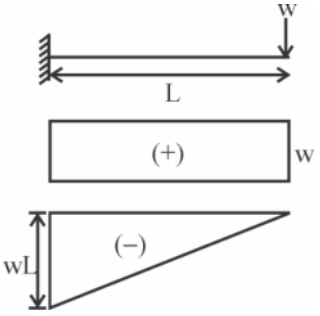
- In down milling, the metal is removed in the form of small chips by a cutter rotating same direction of the travel of the workpiece.
- The cutting force is maximum at the beginning and minimum at the end of the cut.




**97. A cantilever beam with span length L m carries a point load 'w' N at the free end. What will be the value of the resisting bending moment at the fixed end?**

(a) wL (b) 2wL
(c) Zero (d) $\frac{wL}{2}$

**Ans. (a) :** The cantilever beam with span length 'L m' carries a point load 'w' N at the free end.




- The value of the resisting bending moment at the fixed end is 'wL'.

**98. Given an annual usage value of 400 units, the procurement cost is ₹20 per order, cost per piece is ₹100 and cost of carrying inventory is 10%. Calculate the economic order quantity.**

(a) 40 (b) 30
(c) 60 (d) 50

**Ans. (a) :** Given,
Annual usage value (D) = 400 units
procurement cost order ($C_o$) = 20 Rs.
Cost per piece = 100 Rs.
ning inventory ($C_h$) = 10% of cost per piece
$= 0.10 \times 100 = 10$

$$EOQ = \sqrt{\frac{2DC_o}{C_h}}$$

$$EOQ = \sqrt{\frac{2 \times 400 \times 20}{10}} = \sqrt{\frac{16000}{10}}$$

$$EOQ = 40.$$

**99. A thin cylindrical pressure vessel with inside radius 'R' and metal thickness 't' is subject to an internal fluid pressure 'P.' What is the value of longitudinal stress?**

(a) $\frac{2PR}{t}$ (b) $\frac{PR}{2t}$
(c) $\frac{PR}{t}$ (d) $\frac{3PR}{2t}$

**Ans. (b) :** Given,
Inside radius = R
Metal thickness = t
Internal fluid pressure = P

$$\text{Longitudinal stress } (\sigma_\ell) = \frac{Pd}{4t}$$

$$= \frac{P \times 2R}{4t} = \frac{PR}{2t}$$

**100. What type of abrasive is suitable for grinding glass and ceramic materials?**

(a) Diamond (b) Magnesium oxide
(c) Silicon carbide (d) Copper boron nitride

**Ans. (c) :** Silicon Carbide (SiC) is suitable for grinding glass and ceramic materials.

# RAILWAY RECRUITMENT BOARD (RRB)
# JUNIOR ENGINEER MECHANICAL
# Cancelled EXAM-2025

**EXAM DATE : 22.04.2025** **EXAM TIME : 2.30pm-4.30pm**

**1. The type of lasers commonly used in laser interferometers for metrology applications are _____.**

(a) solid-state lasers (b) dye lasers
(c) gas lasers (d) excimer lasers

**Ans. (c) :** Gas lasers are the must commonly used types of laser interferometers for metrology applications. The reason for their widespread use lies in their stability coherence and ability to produce high quality beams.

1. High stability
2. Long coherence length
3. High beam quality
4. Reliability and longevity
5. Narrow linewidth.

**2. What is the primary function of the a lathe machine?**

(a) To support the compound rest rotational movement
(b) To control the feed rate and d during machining
(c) To hold and adjust the tool fo working position
(d) To secure the workpiece firmly on the machine bed

**Ans. (c) :** Primary function of the tool post is to hold and adjust the tool for a suitable working position.

- It provides a secure and stable plateform for the cutting tool, reducing, vibrations and improving machining accuracy.
- The tool post is used in various machining operations on a lathe machine, including turning, facing, threading and parting-off.

**3. Which of the following is an operational function that comes under pre-planning?**

(a) Dispatching
(b) Forecasting
(c) Material planning and control
(d) Loading

**Ans. (b) :** Forecasting is an operational function that comes under pre-planning.

- Forecasting is the process of predicting future production requirements based on past data, market trends, and expected demand.
- **Dispatching** : It is the action, doing or implementation stage. It comes after routing and scheduling state. Dispatching means starting the process of production.

**4. Which of the following types of steel would NOT typically undergo the normalizing process?**

(a) Medium-carbon steel (b) High-carbon steel
(c) Stainless steel (d) Alloy steel

**Ans. (c) : Normalizing Process-** Normalizing is a heat treatment process used to refine the grain structure of steel and to make its composition uniform.

- This process involves heating the steel to a re above its critical point, usually between 950ºC, and then allowing it to cool in air. ose of normalizing is to remove internal enhance mechanical properties and improve bility

steel is typically not normalised because it alloying element such as chromium, nickel bdenum that provide corrosion resistance.

**t is the capability of a profilometer instrument?**

(a) Measure surface flaws only
(b) Measure surface roughness only
(c) Measure surface waviness only
(d) Measure roughness together with waviness and any other surface flaws

**Ans. (d) :** The capability of a profilometer instrument is to measure roughness together with waviness and any other surface flaws. It is widely used in manufacturing and quality control processes to ensure that surfaces meet the required specification & standards.

- A profilometer typically works by tracing the surface of material using a stylus or an optical sensor. The sensor move over the surface and measure its deviation from a reference plane.

**6. Drill chuck is the major part of drilling machines, which _____.**

(a) holds electric motor, V-pulleys and V-belt
(b) transmits rotary motion to the drill spindle at a number of speeds
(c) holds the drill bit
(d) rests on the base and supports the head and the table

**Ans. (c) :** Drill chuck is the major part of drilling machines, which hold the drill bit securely in place during the drilling operation. The drill chuck ensure that the drill bit remain stable and aligned, allowing for precise and accurate drilling.

- Drilling machine is used to create a circular hole. In this a tool is used to drill hole of varying size and other operations called a drill bit holes can be drilled on various surfaces from metal to work.

**7. In the CPM technique, the critical path slack is :**

(a) zero (b) negative

(c) positive (d) either negative or zero

**Ans. (a) : Critical path method (CPM)-** CPM is a project management technique used to determine the sequence to activities that directly affect the project completion time. It identify the longest path of dependent activities in the project schedule, known as critical path.

- In the CPM technique, the critical path slack is zero.

**8. In which of the following situations would brittleness be most UNDESIRABLE?**

(a) In materials exposed to high temperatures

(b) In tools that need to withstand hea

(c) In structural beams under static lo

(d) In materials used in high-speed ap

**Ans. (b) :** Brittleness is a property of m causes them to break or shatter without deformation when subjected to stress. Brit absorb very little energy before fracture, m susceptible to sudden catastrophic failure.

1. In materials exposed to high temperatures
2. In structural beam under static load.
3. In material used in high speed applications.

**9. While measuring surface texture, the part of the profilometer that makes contact with the workpiece surface is:**

(a) a finely pointed stylus

(b) an electrical pickup

(c) a motorised mechanism

(d) a recording unit

**Ans. (a) : Profilometer-** A profilometer is an instrument used to measure the surface texture of a workpiece. This measurement is crucial in various manufacturing processes, as it can affect the functionality, appearance and performance of the finished product.

- The part of the profilometer that makes contact with the workpiece surface is a finely pointed stylus. It is made of diamond or tungsten carbide.

**10. When two equal forces F act at an angle $\theta$, the resultant force is given by which of the following expressions?**

(a) $R = F_1 - F_2$ (b) $R = F_1 + F_2$

(c) $R = 2F\cos\left(\frac{\theta}{2}\right)$ (d) $R = 2F\sin\left(\frac{\theta}{2}\right)$

**Ans. (c) :** When two equal forces F act at an angle $\theta$, the resultant force.

$$R = \sqrt{F^2 + F^2 + 2\times F\times F\times\cos\theta}$$

$$R = \sqrt{2F^2 + 2F^2\cos\theta}$$

$$R = \sqrt{2F^2(1+\cos\theta)}$$

$$R = \sqrt{2F^2 2\cos^2\left(\frac{\theta}{2}\right)}$$

$$= \sqrt{4F^2\cos^2\left(\frac{\theta}{2}\right)}$$

$$\boxed{R = 2F\cos\left(\frac{\theta}{2}\right)}$$

**11. What is a characteristic of a coplanar parallel force system?**

(a) Forces act in the same plane but are not arallel.

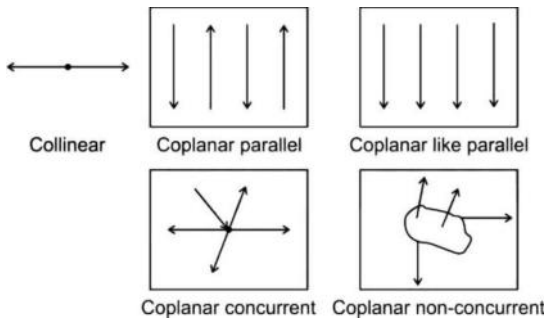
orces act in different planes and are parallel.

orces act in the same plane and are parallel.

orces act in different planes and are not arallel.

Coplanar parallel force system in which all ct in the same plane and are parallel to each

- Concurrent coplanar force system is a system of two or more forces whose line of action intersect at a common point in the same plane.




**12. In climb milling, metal is removed by the cutter rotating in the _____.**

(a) diagonal direction of the feed of the workpiece

(b) same direction of the feed of the workpiece

(c) opposite direction of the feed of the workpiece

(d) perpendicular direction of the feed of the workpiece

**Ans. (b) :** In climb milling, metal is remove by the cutter rotating in the same direction of the feed of the workpiece.

| Up milling | Down milling |
|---|---|
| 1. Cutter rotates again the direction of feed | Cutter rotate along the feed direction of the workpiece. |
| 2. Conventional milling | Climb milling |
| 3. Chip thickness minimum to maximum | Chip thickness maximum to minimum |
| 4. More chance of tool wear | Less chance of tool wear. |

**13. Which of the following is the surface coating process?**

(a) Pickling (b) Hot dipping
(c) Hot doping (d) Tumbling

**Ans. (b) :** Surface coating is the process of applying a thin layer of a material onto a surface to enhance its properties, appearance or functionality. A hot dipping is the surface coating process.

**14. If the temperature of a black body doubles, how many times will its emis increase?**

(a) 2 times (b) 8 times
(c) 16 times (d) 4 times

**Ans. (c) :** Given,

From Stefan-Boltzmann law (σ)-

Initial temperature = T

Initial emissive power $E_1 = \sigma T^4$

New absolute temperature = 2T

The final emissive power

$E_2 = \sigma(2T)^4$

$= 16\ \sigma T^4$

$\boxed{E_2 = 16E_1}$

**15. According to Maslow's Hierarchy of Needs, the basic requirements of the human body such as food, water, sleep, etc. are categorised into:**

(a) esteem needs
(b) social needs
(c) self-actualisation needs
(d) physiological needs

**Ans. (d) :** According to Maslow's Hierarchy of Needs, the basic requirements of the human body such as food, water, sleep are categorised into physiological needs, that describe human motivation.

**16. What is the function of coolants in metal cutting or machining operation?**

(a) Provides higher friction and wear between tool and workpiece
(b) Decreases adhesion between chip and tool
(c) Reduces machinability and machining forces
(d) Increases wear and tear of tools and decrease tool life

**Ans. (b) :** Function of coolants in metal cutting or machining operation is coolants are machining operations to manage the heat generated during these processes.

Benefits of using coolants-

- Decreased adhesion between chip and tool
- Reduced tool wear
- Improved surface finish
- Enhanced machinability
- Lubrication

**17. How many mirrors are used for magnification in the Zeiss Ultra-Optimeter?**

(a) One (b) Four
(c) Two (d) Three

**Ans. (c) :** Zeiss Ultra-Optimeter uses two mirrors to achieve magnification. One mirror is positioned near the workpiece (objective mirror) and the other receives the reflected image from the first mirror (projection mirror).

**h of the following represents the polar ulus of the hollow shaft? [If $D_o$ = External eter and $D_i$ = Internal diameter]**

$16\pi/D_o][D_o^4 - D_i^4]$

$\pi/16D_o][D_o^4 - D_i^4]$

$\pi/16D_o][D_o^3 - D_i^3]$

$16/\pi D_o][D_o^4 - D_i^4]$

$$\text{Polar modules } (Z_p) = \frac{\text{Polar moment of inertia (J)}}{\text{Outer radius of the shaft (R)}}$$

$$Z_p = \frac{\pi/32\left(D_0^4 - D_i^4\right)}{D_0/2}$$

$$Z_p = \frac{\pi}{16D_0}\left[D_0^4 - D_i^4\right]$$

**19. The primary reason for diesel engines having more efficiency than gasoline engines is they _____.**

(a) operate at higher temperatures
(b) use a different fuel
(c) have a higher compression ratio
(d) have a longer stroke

**Ans. (c) :** Diesel engines achieve greater thermal efficiency primarily because of their higher compression ratio as compared to gasoline engines.

- Diesel engines typically have compression ration 14:1 to 25:1 whereas gasoline engines usually have compression ratio 8:1 to 12:1.

**20. Which alloying element in alloy steel is primarily responsible for enhancing corrosion resistance?**

(a) Silicon (b) Manganese
(c) Chromium (d) Carbon

**Ans. (c) :** The alloying element primarily responsible for enhancing corrosion resistance in alloy steel is chromium.

Properties of chromium in alloy steel

- Improves resistance to oxidation and corrosion
- Forms a self-healing protective oxide layer
- Enhances hardness and wear resistance
- Increases tensile strength and toughness.

**21. Which of the following centre-less grinding can be preferred for headed, stepped, or taper-shaped workpieces?**

(a) Taper out grinding
(b) Rotation feed center-less grinding
(c) Out feed grinding
(d) Plunge cut grinding

**Ans. (d) :** Plunge cut grinding is preferred for headed, stepped or tapered workpieces.

In plunge grinding, the grinding wheel is into the workpiece allowing for precise c material removal and creation of complex steps and tapers.

**22. Why does stainless steel resist ru regular carbon steel does not?**

(a) Stainless steel has higher car which makes it corrosion resistant
(b) Stainless steel is coated with a rust chemical.
(c) Stainless steel has a thicker iron content.
(d) Stainless steel has a protective chromium oxide layer that prevents rusting.

**Ans. (d) :** Stainless steel has a protective chromium oxide layer that prevents rusting. The corrosion resistance of stainless steel is chromium oxide layer, which prevention rust by blowing oxygen and moisture from reaching the iron in the steel

This feature combine with the self healing property of the chromium oxide layer make stainless steel an ideal material for application requiring durability and resistance to environmental factor.

In contrast regular carbon steel lacks the protective layer and is prone to rust when exposed to moisture and air.

**23. What is the designated function of a 'planetary internal grinder machine'?**

(a) For a very small work piece
(b) For a work piece of regular shape
(c) For low precision surface finishes
(d) For a work piece of irregular shape

**Ans. (d) :** A planetary internal grinder is designed to grind and inside of holes in workpieces especially those with irregular shapes.

**24. Which of the following materials is likely to have the highest thermal conductivity?**

(a) Aluminium (b) Rubber
(c) Air (d) Wood

**Ans. (a) :** Aluminium is a metal known for its excellent thermal conductivity. It transfers heat very efficiently, making it a common choice for application like heat sinks and crakware.

**25. Which of the following processes produces the minimum surface roughness on workpieces?**

(a) Superfinishing (b) Grinding
(c) Lapping (d) Honing

**Ans. (a) :** Superfinishing is specifically designed to achieve externally smooth surface with very low roughness values making it the best choice for minimal surface roughness.

**26. Which of the following happens when two l and opposite forces are applied at a point rigid body?**

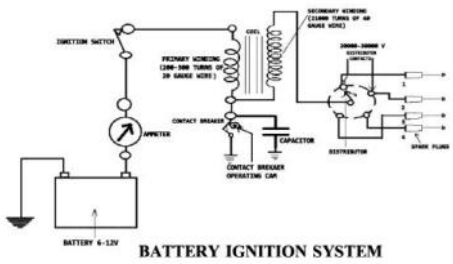
hey cancel each other and have no effect.
hey produce an additional force on the body.
hey create rotational motion in the body.
hey change the magnitude of the original orce.

When two equal and opposite forces are applied at a point on a rigid body. They cancel each other and have no effect this means that the body remains in its state of rest or uniform motion.

**27. Which statement best compares battery and magneto ignition systems in internal combustion engines?**

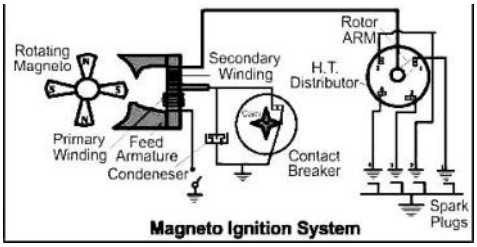
(a) Both systems depend on an external battery for operation.
(b) Magneto systems require more frequent maintenance than battery systems.
(c) Battery ignition systems are independent of engine speed, unlike magneto systems.
(d) Battery ignition systems rely on stored electrical energy, whereas magneto systems generate power on-demand via electromagnetic induction.

**Ans. (d) :** In battery ignition system it utilizes a rechargeable lead-acid battery that stores electrical energy and supplies power for ignition. It gets changed by the engine-driven dynamo and is connected to the ignition switch.



BATTERY IGNITION SYSTEM

- Magneto ignition system revolutionized internal combustion engines by generating high voltage sparks without relying on external electrical sources. Employed in early auto mobile and aircraft it function through a rotating magnet that induces electrical rules igniting the fuel air mixture.




Magneto Ignition System

**28. In brazing, the filler metal is dra joint by means of _____.**

(a) friction (b) dampin
(c) surface tension (d) capillar

**Ans. (d) :** Both brazing and soldering ar joining process in which parent metal does only filler metal melts filling the joint wi action.

In brazing filler metal is having a melting more than 420ºC, but lower than the melting temperature of component. In soldering the melting temperature of filler metal is lower than 420ºC and lower than the meling point of the material of component.

**29. In a two-stroke petrol engine, the primary function of the crankcase is to :**

(a) cool the engine
(b) act as a primary pumping chamber for the air-fuel mixture
(c) store lubricating oil
(d) house the transfer port

**Ans. (b) :** crankcase acts as a primary pumping chamber for the air-fuel mixture. This process is facilitated through the movement of the piston, which helps to draw the mixture into the crankcase and then transfer it to the combustion chamber.

**30. In an ideal four-stroke petrol engine, the assumption made about the burning process during the power stroke i.e. after compression is :**

(a) It is a gradual process that starts before the piston reaches top dead centre.
(b) It occurs instantaneously when the piston is at the top dead centre.
(c) It takes a significant amount of time.
(d) It starts at the bottom dead centre and continues as the piston moves up.

**Ans. (b) :** The assumption of instantaneous combustion at TDC is made to ensure that the combustion process occurs at a constant volume. This is because at TDC the piston momentarily stop moving before reversing direction and during the brief moment the volume of the combustion chamber remain constant.

**31. Which of the following factors generally increases the brittleness of a material?**

(a) Low temperature
(b) High alloy content
(c) High strain rate
(d) High temperature

**Ans. (a) :** Brittleness is a material property that indicates how easily a material can fracture or break without significant-deformation. It is the opposite of

erials absorb relatively little energy prior is ven those of high strength. Common f brittle materials include glass and ceramic.

**ck and pinion gear, the rack is a _____ he pinion is a _____.**

ircular wheel; straight line gear
traight line gear; straight line gear
ircular wheel; circular wheel
(d) straight line gear; circular wheel

**Ans. (d) :** Rack and pinion gear system is a type of linear actuator that comprise a circular gear (the pinion) engaging a linear gear (the rack). This system converts rotational motion into linear motion and widely used in various mechanical application.

**33. The S-N curve in fatigue testing shows the relationship between:**

(a) stress and strain
(b) the number of cycles and strain amplitude
(c) the number of cycles and stress amplitude
(d) stress and displacement

**Ans. (c) :** During fatigue testing a sample material is subjected to repeated cyclic stress loading until failure occurs. The stress amplitude and the number of cycles to failure occurs.

The stress amplitude and the number of cycles to failure are recorded. This data is then use to plot the S-N curve where the x-axis represent the number of cycle to failure (N) on a logarithmic scale and the y-axis represents the stress amplitudes.

**34. Which of the following is a common metrological application of interferometry?**

(a) Analysing chemical composition
(b) Determining surface hardness
(c) Inspecting machine parts for straightness
(d) Measuring temperature

**Ans. (c) :** Interferometry is a precise measurement technique that use the phenomenon of interference of light waves to measure small distance surface irregularities and refractive index changes.
Interferometry is extensively used to inspect the straightness of machine parts.

**35. Tungsten Inert Gas Welding (TIG) is also called _____.**

(a) Metal Inert Gas Welding
(b) Gas Metal Arc Welding
(c) Thermo-compression Welding
(d) Gas Tungsten Arc Welding

**Ans. (d) :** Tungsten inert gas (TIG) welding is also known as gas tungsten arc welding (GTAW) is a welding process that utilizes a non consumable tungsten electrode to produce the weld.
The weld area and electrode are protected from atmospheric contamination by an inert shi typically Argon or Helium.

**36. The primary purpose of job evaluation is to:**

(a) provide benefits like leave and ho
(b) determine the relative worth of dif
(c) assess an employee's performance
(d) motivate employees for higher pr

**Ans. (b) :** The primary purpose of jo evaluation is determine the relative worth of different jobs. This process helps on organization creates a structured and logical hierarchy of positions ensuring fair pay and fostering a transparent compensation system.
By identifying the value of jobs companies can allocate resources effectively maintain internal equity and remain competitive in the job market.

**37. A beam with a symmetrical T section has a top flange 50 mm wide and 20 mm thick, and a web 40 mm high and 10 mm thick. An additional plate, 10 mm thick and 60 mm wide, is welded above the flange. The moment of inertia of this symmetrical planar cross-section about an axis in its plane normal to the web and in line with the upper face of the 10 mm thick plate works out to 1506,666.66 mm$^4$. The centroidal axis of the combined area is 21.5 mm below this axis, normal to the web. The moment of inertia of this built-up area about the centroidal axis is (in mm$^4$):**

(a) 70,077.52 (b) 5,82,166.66
(c) 1.33 × 105 (d) 2,17,833.34

**Ans. (b) :** Determine the individual moment of inertia and area.

Top plate

$b_1 = 60$ mm

$h_1 = 10$ mm

$A_1 = b_1 \times h_1 = 60 \times 10 = 600$ mm$^2$

Distance from the top of the top plate to its centroid = 5 mm

$$I_1 = \frac{b_1 \times h_1^3}{12} = \frac{60 \times (10)^3}{12}$$

$= 5000$ mm$^4$

Top flange of T-section-

$b_2 = 50$ mm

$h_2 = 20$ mm

$A_2 = b_2 \times h_2 = 50 \times 20 = 1000$ mm$^2$

$\simeq 196$ kPa

Web of T-section:

$h_3 = 40$ mm

$t_3 = 10$ mm

$A_3 = h_3 \times t_3 = 40 \times 10 = 400$ mm$^2$

$$\frac{t_3 \times h_3^3}{12} = \frac{10 \times (40)^3}{12}$$

$3333.33$mm$^4$

he moment of inertial about the centroidal entroidal axis is 21.5 mm below the upper 10 mm thick plate.

centroidal axis = 5 – 21.5

$d_1 = -16.5$ mm

Parallel axis theorem

$I_{1c} = I_1 + A_1 \times (d_1)^2$

$= 5000 + 600 \times (-16.5)^2$

$= 500 + 600 \times 272.25$

$I_{1c} = 168350$ mm$^4$

Top flange:

$d_2 = 20 - 21.5 = -1.5$ mm

$I_{2c} = I_2 \times A_2 \times (d_2)^2$

$= 33333.3 + 1000 \times (-1.5)^2$

$= 33333.3 + 1000 \times 2.25$

$= 35583.33$ mm$^4$

web:

$d_3 = 50 - 21.5 = 28.5$ mm

$I_{3c} = I_3 \times 5\ A_3 \times (d_3)^2$

$= 53333.33 + 400 \times (28.5)^2$

$= 378233.33$ mm$^4$

Sum of moments of inertia

Total $I_c = I_{1c} + I_{2c} + I_{3c}$

$= 168350 + 35583.33 + 378233.33$

$I_c = 582166.6$ mm$^4$

**38. An engine is assumed to be working on ideal Otto cycle with the temperatures at the beginning and end of compression as 27ºC and 327ºC. The air-standard efficiency of the engine is :**

(a) 50% (b) 78%

(c) 87% (d) 60%

**Ans. (a) :** Given-

$T_1 = 27ºC + 273 = 300\ K$

$T_2 = 327ºC + 273 = 600\ K$

$$\eta = 1 - \frac{T_1}{T_2}$$

$$= \frac{600 - 300}{600}$$

$= 1 - 0.5$

$\eta = 0.5$

$= 0.5 \times 100$

$\boxed{\eta = 50\%}$

**39. Frictional power in an engine is calculated as:**

(a) Brake power / Mechanical efficiency

(b) Indicated power + Brake power

(c) Indicated power − Brake power

(d) Indicated power × Mechanical eff

**Ans. (c) :** The brake power (B.P.) of a always less than the indicated power (I.P.) because some power is lost in overcoming friction known as frictional power.

Frictional power F.P. = I.P. – B.P.

**40. A gray body is defined as a body tha**

(a) reflects all radiation incident upon

(b) has an emissivity that varies with wavelength of radiation

(c) absorbs all radiation incident upon its surface

(d) has emissivity less than 1 but constant for all wavelengths

**Ans. (d) :** A grey body is a theoretical object that has an emissivity lens than 1 but remains constant over all wavelengths of radiation.

**41. The Bell-Coleman cycle is also known as :**

(a) Rankine cycle (b) Reversed Brayton cycle

(c) Carnot cycle (d) Brayton cycle

**Ans. (b) :** Bell Coleman cycle is also known as reversed Brayton cycle or reversed joule cycle. The working fluid of the bell Coleman refrigeration cycle is air.

This system of refrigeration is used for air craft refrigeration and is has light weight.

**42. In which type of oxy-acetylene welding flames are both acetylene and oxygen in equal proportions?**

(a) Oxidizing welding flame

(b) Carburizing welding flame

(c) Reducing welding flame

(d) Neutral welding flame

**Ans. (d) :** oxy-acetylene welding, also known as gas welding is a process that uses the combustion of acetylene ($C_2H_2$) and oxygen ($O_2$) to produce a flame capable of melting metals. Types of oxy-acetylene welding flames:

- **Neutral flame-** A neutral flame is achieved when acetylene and oxygen are mixed in equal proportions. The temperature of a neutral flame is around 3200ºC (5,792ºF).
- **Oxidizing flame-** This flame is produced when there is an excess of oxygen in the mixture. It has a shorter inner cone and a sharp, hissing sound. The temper of a oxidizing flame 3500ºC (6332ºF). It is used for welding material likes brass and bronze.
- **Reducing flame** (Carburizing Flame)- A reducing Flame also known as a carburizing Flame, there is an excess of acetylene in the mixture. It has a longer feathered inner cone and cooler than neutral flame with temperatures around 2900ºC (5252ºF). This type of flame is used for welding high-carbon steel.

**43. A steel bar (E = 200 N/m$^2$, α = 12 × 10$^{-6}$ /ºC) nds by 0.3 mm due to a temperature ase. If the original length of the bar was 15 hat was the temperature rise?**

66.6ºC (b) 100ºC

20.6ºC (d) 180ºC

iven:

of linear expansion (α) = 12×10$^{-6}$/ºC

gth of the steel bar ($L_o$) = 15 cm = 150 mm

Expansion of the bar (ΔL) = 0.3 mm

$\boxed{\text{linear expansion } (\Delta L) = \alpha \times L_o \times \Delta T}$

$$\Delta T = \frac{\Delta L}{(\alpha \times L_o)}$$

$$\Delta T = \frac{0.3}{(12 \times 10^{-6} \times 150)}$$

$$\Delta T = \frac{0.3}{(1.8 \times 10^{-3})}$$

$\Delta T = 166.67ºC$

**44. Which of the following options best describes non-coplanar concurrent forces?**

(a) Forces that meet at one point and their lines of action lie on the same plane

(b) Forces that meet at one point but their lines of action do not lie on the same plane

(c) Forces that do not meet at one point but their lines of action lie on different planes

(d) Forces that do not meet at one point and their lines of action lie on the same plane

**Ans. (b) :** Non-coplanar concurrent forces are forces that meet at a single point, but their lines of action do not lie within the same plane. These forces exist in three dimensional space and are commonly encountered in engineering problems involving structures, mechanics or physics.

**45. _____ type of electrode is used in Gas Tungsten Arc Welding (GTAW).**

(a) Consumable coated
(b) Consumable bare
(c) Non-consumable tungsten
(d) Non-consumable carbon

**Ans. (c) :** Gas Tungsten Arc Welding (GTAW):

- Gas Tungsten Arc Welding (GTAW), also know as Tungsten Inert gas (TIG) welding is a welding process in which an arc is formed between a non consumable tungsten electrode and the metal being welded. The weld area and the electrode are protected from oxidation or other atmospheric contamination by an inert shielding gas (Argon or Helium).
- In GTAW a high-frequency electric current is passed through a non-consumable tungsten electr an arc between the electrode and workpie generated by this arc melts the base metal molten weld pool. Applications: GTAW used for thin sections of stainless stee ferrous such as Al, Mg, Cu alloys.

**46. For a symmetrical T-section, the inertia through centroidal axes i parallel to the flange $I_{xx}$ = 2 × 10 mm , and perpendicular to the flange is $I_{yy} = 1.5 \times 10^7$ $mm^4$. The moment of inertia about the centroidal axis normal to the planar area works out to (in $mm^4$):**

(a) $2.5 \times 10^7$ (b) $1.33 \times 10^7$
(c) $3.5 \times 10^7$ (d) $0.5 \times 10^7$

**Ans. (c) :** Given:

Moment of inertia about the centroidal axis parallel to the flange $(I_{xx}) = 2\times10^7$ $mm^4$

Moment of inertia about the centroidal axis perpendicular to the flange $(I_{yy}) = 1.5\times10^7$ $mm^4$

Polar moment of inertia = $(I_{xx}) + (I_{yy})$

$I = (2\times10^7) + (1.5\times10^7) = 3.5\times10^7$ $mm^4$

**47. The intake valve closes at _____ for a low-speed engine and at _____ for high-speed four-stroke petrol engines.**

(a) 60 deg before BDC; 10 deg before BDC
(b) 60 deg after BDC; 10 deg after BDC
(c) 10 deg before BDC; 60 deg before BDC
(d) 10 deg after BDC; 60 deg after BDC

**Ans. (d) :** The intake valve closes at 10º after bottom dead center (BDC) for a low-speed engine and 60º after bottom dead center (BDC) for high speed four stroke petrol engine.

- **Low Speed Engine-** In low speed engines, the intake valve closes shortly after the piston reaches BDC during the intake stroke. This timing (10º after BDC) ensures that the cylinder is filled adequately with the air fuel mixture before the piston starts its compression stoke.
- **High Speed Engine-** High Speed Engine require more time for the air-fuel mixture to enter the cylinder due to the rapid movement of the piston. To compensate for the inertia of the incoming mixture the intake valve remains open longer (up to 60º after BDC) even after the piston has started its compression stroke.

**48. Which of the following is a benefit of using Material Requirements Planning (MRP)?**

(a) Reduced customer service and satisfaction
(b) Better inventory planning and scheduling
(c) Increased raw material costs
(d) Slower response to market changes

**Ans. (b) :** Material requirements planning (MRP) is a approach to production planning, scheduling, tory control. It is primarily used in ing to ensure that the right materials are t the right time and in the right quantities to ction demands.

**arbon Arc Welding, DCSP stands for _____.**

irect current straight pressure
ual current straight polarity
(c) Direct current straight porosity
(d) Direct current straight polarity

**Ans. (d) :** Direct current straight polarity (DCSP) is crucial in the context of carbon arc welding. DCSP involves connecting the carbon electrode to the negative terminal and the workpiece to the positive terminal, resulting in deeper penetration stable arc and extended electrode life. Approximately two-third of arc heat is concentrated at the workpiece and one-third at the electrode.

Application: structural welding, Repair work.

**50. Compared to axial flow pumps, radial flow pumps typically :**

(a) generate higher pressures with lower flow rates
(b) have lower efficiency in all applications
(c) produce higher flow rates at lower pressures
(d) are used exclusively for pumping gases

**Ans. (a) :** Radial flow pumps are a type of centrifugal pump where the fluid enters axially into the impeller but exits radially, perpendicular to the pump shaft. These pump are designed to develop high pressures with relatively low flow rates.

**51. Fluid pressure is defined as :**

(a) the weight of a fluid per unit volume
(b) the force acting parallel to a surface
(c) the rate of the flow of fluid through a given area
(d) the force per unit area exerted by a fluid at rest

**Ans. (d) :** Fluid pressure is defined as the force per unit area exerted by a fluid at rest.

**mathematical expression-** Fluid pressure (P) can be mathematically expressed as:

$$P = \frac{F}{A}$$

Where,

P is the fluid pressure.
F is the force exerted by the fluid
A is the area over which the force is exerted

**52. The Zeroth Law of Thermodynamics establishes the basis for which of the following?**

(a) Entropy increase in isolated systems
(b) Measurement of temperature
(c) Conservation of energy
(d) Heat transfer through conduction

**Ans. (b) :** The Zeroth Law of Thermodyn that if two Thermodynamics system are eac equilibrium with a third system then they ar equilibrium with each other. This law fundamental basis for the concept of temper

**53. Electroplating is the opposite of w following?**

(a) Galvanic cell (b) Battery
(c) Fuel cell (d) Electrolysis

**Ans. (a) :** Electroplating uses an external power source to deposit metal ions onto a surface. A galvanic cell, on the other hand, generates electrical energy through spontaneous redox reactions, meaning it produces electricity rather than depositing metal.

**54. Which type of fracture is most likely to occur in a material with high tensile strength but low ductility?**

(a) Brittle fracture (b) Ductile fracture
(c) Creep failure (d) Fatigue failure

**Ans. (a) :** Brittle fracture is a type of catastrophic failure that occurs in materials when they break suddenly without significant plastic deformation. It is characterized by a rapid propagation of cracks through the material. This type of failure is most common in materials with high tensile strength but low ductility.

**55. Which of the following beams is classified as a statically determinate beam?**

(a) Overhanging beam
(b) Propped cantilever beam
(c) Continuous beam
(d) Fixed beam

**Ans. (a) :** A statically determinate beam is one where the reactions can be found using only the equations of static equilibrium. The stability and determinacy of a beam depend on the types and arrangement of supports and the way load are applied. For a beam to be statically determinate the sum of the vertical forces the sum of the horizontal forces and the sum of the moments must equal zero.

Overhanging beam : ($\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma M = 0$)

**56. _____ is a welding defect caused by trapping of gas during the welding process.**

(a) Undercut (b) Burn through
(c) Porosity (d) Cracking

**Ans. (c) :** Porosity is a welding defect caused by the trapping of gas within the weld metal during the welding process. This trapping results in voids or pores within the weld.

**57. Manometric head is defined as:**

(a) the weight of the pump
(b) the height of a fluid column corresponding to the pump's output pressure
(c) the temperature difference across the pump
he fluid velocity within the pump

Manometric head is the pressure developed p expressed as an equivalent height of a fluid

$$= \frac{P}{\rho g}$$

Pressure
ρ = Density
g = Acceleration due to gravity

- This represents the energy imparted to the fluid by the pump in the form of pressure head.

**58. What will be the nature of longitudinal stress in a thin closed cylinder containing hydrostatic fluid pressure?**

(a) Shear (b) Tensile
(c) Compressive (d) Bending

**Ans. (b) :** When a thin-walled cylindrical vessel is subjected to internal hydrostatic fluid pressure, it experiences stress in both the longitudinal (axial) and circumferential (hoop) directions. The longitudinal stress in the stress along the length of the cylinder and it is caused by the internal pressure passing the end of the cylinder apart.

Hence, the nature of longitudinal stress is tensile.

Formula- Hoop stress $(\sigma_h) = \frac{Pd}{2t}$

Longitudinal stress $(\sigma_l) = \frac{Pd}{4t}$

**59. Which of the following is NOT a function of the spirit level measuring instrument?**

(a) For determining flatness and straightness
(b) For measuring surface roughness
(c) For measuring alignment of machine parts
(d) For measuring angles

**Ans. (b) :** A spirit level also known as a bubble level, is a measuring instrument designed to indicate whether a surface is horizontal (level) of vertical (plumb). It is widely used in constructions carpentry and engineering.

**Function of a spirit level:**

- Determining a surface is horizontal or vertical
- Checking the flatness or straightness of a surface
- Measuring angles
- Ensuring alignment and proper installation of machine part or construction materials.

**60. How does atmospheric pressure influence gauge pressure measurements?**

(a) Gauge pressure is the sum of absolute and atmospheric pressure.
(b) Gauge pressure equals atmospheric pressure minus absolute pressure.
(c) Gauge pressure is independent of pressure.
(d) Gauge pressure is the differen absolute pressure and atmospheric

**Ans. (d) :** Gauge pressure is differen absolute pressure and atmospheric pressure.

$$\boxed{P_{gauge} = P_{absolute} - P_{atmospheric}}$$

**61. Priming of a pump refers to:**

(a) lubricating the pump bearings
(b) increasing the rotational speed of the pump
(c) removing air from the pump casing and suction line
(d) adjusting the impeller clearance

**Ans. (c) :** Priming of a pump refers to the process of removing air from the pump casing and suction line to ensure that the pump operates efficiently. This process is crucial for the proper functioning of the pump especially in case where the pump is used to lift fluids from a lower level to a higher level.

**62. A symmetrical I-section has a moment of inertia about the centroidal axis in its plane perpendicular to the web, of $22.34\times10^4$ mm$^4$. The moment of inertia of the full rectangular area occupied by the I-beam cross section about this axis is $65\times10^4$ mm$^4$. The two empty spaces on either side of the web are square. What is the height of the web?**

(a) 50 mm (b) 55 mm
(c) 40 mm (d) 30 mm

**Ans. (c) :** Moment of inertia of full rectangle :

$$I_{full} = \frac{1}{12}BH^3$$

Moment of inertia of I-section about the same axis is less than the full rectangle due to the presence of empty squares on either side of the web.

$I_{empty} = I_{full} - I_{I\text{-section}}$

Each empty space is a square, so their dimensions will be equal (side = a)

Given,

$I_{full} = 65 \times 10^4$ mm$^4$

$I_{I\text{-section}} = 22.34 \times 10^4$ mm$^4$

$I_{empty} = 65 - 22.34 = 42.66 \times 10^4$ mm$^4$

So, two squares contribute this amount :

$$2\times\frac{1}{12}a^4 = 42.66\times10^4$$

$$\Rightarrow \frac{a^4}{6} = 42.66\times10^4$$

$\Rightarrow$ a = 40 mm

**63. How is the resultant force calculated if two forces act along the same straight line but in site directions?**

$= 2F_1F_2\cos\theta$ (b) $R = F_1 + F_2$

$= F_1 - F_2$ (d) $R = \sqrt{F_1^2 + F_2^2}$

et the two resultant force $F_1$ and $F_2$ and their then

$$= \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$$

hey act in opposite direction $\theta = 180^o$

$$F = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos180^o}$$

$$F = \sqrt{F_1^2 + F_2^2 - 2F_1F_2}$$

$$F = \sqrt{(F_1 - F_2)^2}$$

$$\boxed{F = F_1 - F_2}$$

**64. If a component has a Factor of Safety (FOS) of 1.0, what does it indicate?**

(a) The component will never fail irrespective of any load.
(b) The design is highly conservative.
(c) The material will fail exactly at the expected load.
(d) The design is unsafe and should not be designed.

**Ans. (c) :** The component has a factor of safety 1.0 indicates that the component is at the point of failure.

- FOS is the ratio of the maximum stress a material can with stand to the actual stress applied.

$$FOS = \frac{\text{Failure stress/ultimate stress}}{\text{Working stress/design stress}}$$

**65. Which characteristic best describes an axial flow pump?**

(a) The fluid flows perpendicular to the pump shaft.
(b) The fluid flows parallel to the pump shaft.
(c) The fluid flow is converted to heat energy.
(d) The fluid flows radially outward from the shaft.

**Ans. (b) :** An axial flow pump is a type of pump where the fluid flows parallel to the pump shaft. In an axial flow pump the fluid enters the pump impeller along the axis of the shaft and discharge parallel to the axis. The design of the impeller blades in axial flow pumps is such that they impart energy to the fluid primarily in the axial direction causing the fluid to move in a straight line parallel to the shaft.

**66. Angle gauges are generally made from which material?**

(a) Carbon fibre (b) Hardened steel
(c) Wood (d) Plastic

**Ans. (b) :** Angle gauges are also known as angle blocks or angle plates. Precision tools used to measure and verify angles. They are commonly used in various field including engineering, manufacturing and metal working. The material are used in angle from hardened steel.

**67. Which of the following material has compressive strength?**

(a) Copper (b) Rubber
(c) Mild Steel (d) Cast Iro

**Ans. (d) :** Compressive strength is the ca material to withstand axially directed pus When the limit of compressive strength materials are crushed. It is measured by applyıng a force to the material until it fails and recording the amount of force per unit area

- The cast iron has a compressive strength in the range of 600 MPa to 700 MPa.
- The mild steel compressive strength in the range 250 MPa to 400 MPa
- The rubber compressive strength in the range 10 MPa to 20 MPa

**68. What is the primary function of the tailstock in a lathe?**

(a) To hold the cutting tool for machining operations
(b) To change the direction of the spindle movement
(c) To provide support and bearing for the rotating job
(d) To control the speed of the spindle rotation

**Ans. (c) :** The tailstock is an essential component of a lathe machine, primarily used to provide support and bearing for the rotating workpiece during machining operations. It is located at the opposite end of the head stock on the lathe bed can be adjusted along the bed to accommodate different workpiece lengths.

**69. In the Charpy impact test, the specimen is typically:**

(a) a cylindrical rod with no defects
(b) subjected to a gradual tensile load
(c) a rectangular bar with a notch in the middle
(d) a sheet of material placed under compression

**Ans. (c) :** The Charpy impact test also known as the Charpy V-notch test is a standardised high strain rate test that determines the amount of energy absorbed by a material during fracture. The specimen shape of the Charpy test is a rectangular bar with a notch. The notch is typically a U-shaped or V-shaped cut.

**70. Which of the following best defines vapour pressure in a liquid?**

(a) The pressure exerted by the vapour in equilibrium with its liquid at a given temperature
(b) The pressure exerted by the liquid molecules
(c) The pressure required to force the liquid into a capillary tube
(d) The difference between atmospheric pressure and absolute pressure

Vapour pressure is a fundamental concept in of liquids and their phase transitions. It is the pressure exerted by the vapour in with it liquid at a given temperature.

**stic strength increases 3 times, then Proof ience :**

ncreases 9 times (b) increases 3 times
ecreases 9 times (d) decreases 3 times

**Ans. (a) :** Given that,

$\sigma_{e_1} = 3\sigma_e$

Proof Resilience formula

$$U = \frac{\sigma_e^{\,2}}{2E}$$

$$U_{new} = \frac{\sigma_{e_1}^{\,2}}{2E}$$

$$U_{new} = \frac{(3\sigma_e)^2}{2E} = \frac{9\sigma_e^{\,2}}{2E}$$

$$\boxed{U_{new} = 9U}$$

**72. In most of the SI engines, the intake valve opens a few degrees before the TDC on the exhaust stroke to:**

(a) ensure complete combustion of the fuel-air mixture
(b) ensure that the intake valve is fully open when the piston reaches the TDC
(c) allow for better scavenging of exhaust gases
(d) increase the engine's compression ratio

**Ans. (c) :** In the most spark ignition engines the intake valve opens a few degree before top dead center (TDC) on the exhaust stroke to improve scavenging and maximize the fresh air fuel change drawn into the cylinder.

**73. In the _____ welding technique, the welding rod is applied before the welding torch in the direction of motion.**

(a) backhand (b) electric arc
(c) laser (d) forehand

**Ans. (d) :** The forehand welding technique, also known as the forward welding technique is a method where the welding rod is applied before the welding torch in the direction of motion. In this technique the welder moves the torch in a forward direction, leading the rod along the path of the weld.

**74. Which of the following elements provides the necessary horizontal force to the workpiece in centerless grinding?**

(a) Regulating wheel (b) Stationary wheel
(c) Revolving wheel (d) Work test blade

**Ans. (a) :** Centerless grinding is a machining process that uses abrasive cutting to remove material from a workpiece. Centerless grinding holds the between two wheels a grinding wheel and wheel. The regulating wheel is a key comp centerless grinding process. It provides th horizontal force to the workpiece ensuring t securely and fed through the grinding w correct speed and orientation.

**75. In which type of engine is a mist system most commonly used?**

(a) Four-stroke diesel engines
(b) Two-stroke petrol engines
(c) Gas turbine engines
(d) Rotary engines

**Ans. (b) :** The mist lubricating most commonly used in two stroke petrol engines. This is because in two stroke engines the crankcase is also used for compression making if unsuitable like splash lubrication. Instead oil is mixed with the fuel and enters the crank case or a mist lubricating the bearing piston and cylinder walls.

**76. Slag inclusion is the welding defect caused by _____.**

(a) insufficient cleaning and preparation of the base metal before welding commences
(b) incorrect edge penetration
(c) gas being trapped, due to moisture
(d) contamination of either the filler or parent metals

**Ans. (a) :** Slag inclusion in welding are caused by the trapping of non-metallic, solid particles (like oxide fluxes) of electrode coating material with the weld metal often due to improper welding techniques or inadequate cleaning of the weld area.

**77. One challenge associated with double volute casings is :**

(a) reduced flow rates
(b) decreased efficiency in converting kinetic to pressure energy
(c) higher risk of leakage due to multiple seams
(d) increased complexity in manufacturing and alignment

**Ans. (d) :** A double volute casings is type of pump casing where the volute (The spiral-shaped casing that collects fluid discharge from the impeller) is divided into two separate channels or volutes. These channels are designed to balance the hydraulic forces on the impeller, thereby reducing radial loads and prolonging the life of the pump components.

**78. The master production schedule represents the :**

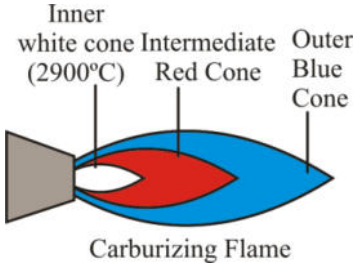
(a) finishing time of component manufacturing
(b) starting and finishing time of different products
(c) starting time of component manufacturing
(d) financial requirements for the production

The master production schedule (MPS) is a omponent of production planning in ing operation.
ts a detailed plan that specifies the starting ng times of different products. The primary the MPS is to ensure that production aligns mer demand while optimizing the use of sources. The MPS specifies the quantity of each product to be produced over a specific time period.

**79. In carburising welding flame, there is a supply of _____ in the combustible mixture.**

(a) acetylene and oxygen in equal proportion
(b) more acetylene proportion and limited oxygen proportion
(c) only oxygen
(d) limited acetylene proportion and more oxygen proportion

**Ans. (b) :** Carburising flame.
For this flame excess fuel gas ($C_2H_2$) is used. It is used for welding medium carbon steel, nickle etc. ($C_2H_2 > O_2$).

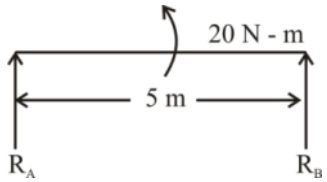


Carburizing Flame

**80. A simply supported beam with a span length of 5 m carries a moment of 20 N-m (counter clockwise direction) at the middle of the beam. What will the value of reactions be at both the ends of the beam?**

(a) 2 N, −2 N (b) 5 N, −5 N
(c) 8 N, −8 N (d) 4 N, −4 N

**Ans. (d) :**




$\Sigma F_y = 0$

$R_A + R_B = 0$ ...(i)

$\Sigma M_A = 0$

Moment due to the reaction at B : $(R_B \times 5)$

External moment applied at the centre of beam : 20 N-m (cc)

Equating the moments

$(R_B \times 5) - 20 = 0$

$R_B = 20 \div 5 = 4N$ ...(ii)

Substitute $R_B$ into Equation (i)

$R_A + R_B = 0$

$R_A = -R_B$

$R_A = -4N$

So,

$R_A = -4N$

$R_B = 4N$

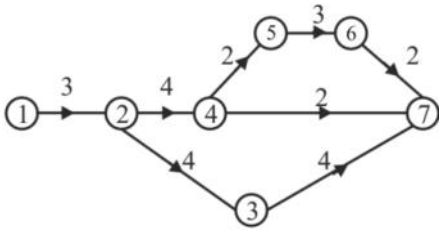
**81. Which of the following are used to improve pigment dispersion and the stability of coatings during organic coating?**

(a) Plasticisers (b) Curing stabilisers
(c) Pigment analyser (d) Colloidal stabilisers

**Ans. (d) : Organic coating:** In organic coating pigments are used to provide color, opacity and protection role of colloidal stabilizers.

• Colloidal stabilizer are added to enhance pigment dispersion by preventing the particles from aggregating.

**82. Identify the critical path from the given diagram.**




(a) 1-2-3-7 (b) 1-2-4-5-6
(c) 1-2-4-5-6-7 (d) 1-2-4-7

**Ans. (c) :** The diagram shows the project activities and their duration.

The possible paths are

(a) 1-2-3-7
(b) 1-2-4-5-6
(c) 1-2-4-5-6-7
(d) 1-2-4-7

The critical path is the longest path through the network diagram from the calculation. Path C (1-2-4-5-6-7) has longest duration. Therefore, it is the critical path.

**83. Which of the following is a limitation of taper turning by swiveling the compound rest?**

(a) It is suitable only for short tapers.
(b) It provides high production efficiency.
(c) It cannot turn any type of taper.
(d) It ensures the best surface finish.

**Ans. (a) : Limitation of taper turning by swiveling the compound rest-**

1. Suitable for only short taper due to the constraints of compound rest travel.
2. Not suitable for high production efficiency as the setup and operation are relatively slow.

finish may not be optimal compared to other ning methods.

**t is the full form of 'CBN', which is used abrasive in grinding processes?**

opper boron nitride
arbon boron nitrate
alcium bi nitrous
ubic boron nitride

**Ans. (d) :** Full form of 'CBN' is Cubic Boron Nitride (CBN) is an abrasive material used in grinding processes due to its high hardness and thermal stability.

**85. In Arc Welding Processes, GMAW stands for _____.**

(a) Gas Molten Arc Welding
(b) Gas Molten Arbour Welding
(c) Gang Metal Arc Welding
(d) Gas Metal Arc Welding

**Ans. (d) :** In Arc Welding Processes, GMAW stands for gas metal arc welding. It also known as metal inert gas (MIG) welding. In gas metal arc welding consumable wire electrode is used.

**86. Which of the following is a special case of a spirit-level device?**

(a) Micrometer (b) Clinometer
(c) Autocollimator (d) Kelvinometer

**Ans. (b) :** A clinometer is a device used to measure inclination or elevation of an object with respect to gravity. It uses the principle of spirit level to determine angular displacement.

**87. The radius of gyration about the polar axis of a circular lamina of radius 0.2 m is:**

(a) 4.1 cm (b) 0.1 m

(c) $\pi$ cm (d) 0.14 m

**Ans. (d) :** Give circular lamina radius (R) = 0.2 m

The radius of gyration about the Polar axis is given by:

$$k = \sqrt{\frac{J}{A}}$$

For circular lamina:

Polar moment of inertia $(J) = \frac{\pi}{2}R^4$

$$\text{Area, } A = \pi R^2$$

$$k = \sqrt{\frac{\frac{\pi}{2}R^4}{\pi R^2}}$$

$$= \frac{R}{\sqrt{2}} = \frac{0.2}{1.41}$$

$$= 0.141\text{m}$$

$$k \simeq 0.14\text{m}$$

**88. To machine an internal hole in a broaching operation, the broach is gripped by**

(a) puller at the pilot

(b) puller at the face of the teeth

(c) puller at the flute

(d) puller at the shank end

**Ans. (a) :**

- To machine an internal hole in a broachin the broach is gripped by the puller at the p
- Broaching is machining process, that us tool, called a broach, to remove material. There are two main types of broaching, linear and rotary. In both processes, the broach is used to machine internal holes, splines, key ways, or other shapes in a workpiece.

**89. A pitot tube is primarily used to measure:**

(a) flow velocity (b) static pressure

(c) atmospheric pressure (d) dynamic pressure

**Ans. (a) : Pitot tube-** It is a device for measuring the velocity of flow.

**Basic principle-** The velocity of flow of a particular point is reduced to zero which is known as stagnation point the pressure there is increased due to conversion of kinetic energy into pressure energy and by measuring the increase in the pressure energy at this point; the velocity of flow may determined.

$$V_{actual} = C_v\sqrt{2gh}$$

$C_v \rightarrow$ Coefficient of velocity

**90. Which type of light is generally used in the photo etching process?**

(a) X-ray (b) Ultraviolet (UV) light

(c) Infrared (IR) light (d) Visible light

**Ans. (b) :** Ultraviolet (UV) light is generally used in the photo etching process.

- Photo etching process involves the application of photographic image onto a metal surface and subsequently etching away the exposed area to create the pattern.

**91. If the external diameter of a hollow shaft is three times greater than its internal diameter, what is the ratio of its torque-carrying capacity compared to that of a solid shaft of identical material and the same outer diameter?**

(a) 65/81 (b) 26/27

(c) 81/80 (d) 80/81

**Ans. (d) :** Let,

Outer diameter of hollow shaft is D

Inner diameter of hollow shaft is d

Given condition, D = 3d

$$\Rightarrow d = \frac{D}{3}$$

The torque capacity of a shaft is proportional to polar moment of inertia

$$T \propto J$$

$$\text{aft} \Rightarrow T_s = \frac{\pi}{16}D^4$$

$$\text{shaft} \quad T_h = \frac{\pi}{16}\left(D^4 - d^4\right)$$

$$= \frac{\pi}{16}\left(D^4 - \left(\frac{D}{3}\right)^4\right)$$

$$= \frac{\pi}{16}D^4\left(\frac{80}{81}\right)$$

Ratio of torque hollow shaft to solid shaft.

$$\frac{T_h}{T_s} = \frac{\frac{\pi}{16}D^4 \times \frac{80}{81}}{\frac{\pi}{16}D^4}$$

$$\boxed{\frac{T_h}{T_s} = \frac{80}{81}}$$

**92. While scheduling decisions, the most influencing parameter is:**

(a) competitor pricing

(b) market research

(c) sales forecasting

(d) availability of skilled personnel

**Ans. (c) :** While scheduling decisions the most influencing parameter is sales forecasting.

- Sales forecasting is the process of estimating future sales of a product or service over a specific period using historical data marked trends and analysis.

**93. Broaching of outside surfaces is called _____.**

(a) internal broaching (b) hole broaching

(c) hallow broaching (d) surface broaching

**Ans. (d) : Broaching-** Broaching is a machining processes that used a toothed tool called a broach to remove material.

**Surface broaching-** When broaching is applied to outside surface, it is referred to as surface broaching.

**94. How does the volute shape in a single volute pump casing affect performance?**

(a) It helps maintain a uniform flow distribution.
(b) It serves only an aesthetic purpose.
(c) It increases turbulence within the pump.
(d) It restricts the pump's operating range.

**Ans. (a) : Advantages of single volute pump casing-**

1. The single volute design helps maintain a uniform flow distribution around the impeller and reducing the chances of flow separation.
2. By maintain a uniform flow distribution, the single volute design helps achieving higher pump efficiencies.
3. Single volute pump casing are generally simpler and less expensive to manufacture compared to more complex designs.

**95. The factor considered for wage determination in the flat day rate basic wage incentive plan is:**

(a) individual performance
(b) company profit
(c) hours worked
(d) number of pieces produced

**Ans. (c) :** The flat day rate basic wage ince a wage payment system where emp compensated based on the number of ho irrespective of their individual performa quantity of output produced.

**96. A pump discharges water with a manometric head of 20 m. If the density of water is 1000 kg/m$^3$ and gravity is 9.81 m/s$^2$, what is the approximate pressure increase provided by the pump?**

(a) 196 kPa (b) 20 kPa
(c) 2 kPa (d) 9.81 kPa

**Ans. (a) :** Given,

Manometric head (h) = 20 m

Density of water ($\rho$) = 1000 kg/m$^3$

Acceleration due to gravity (g) = 9.81 m/s$^2$

Hydrostatic pressure (P) = $\rho gh$

$= 1000 \times 9.81 \times 20$

$= 196.2$ kPa

$P \simeq 196$ kPa

**97. In Arc Welding process, chipping hammer is used to _____ .**

(a) clean the surface to be welded
(b) protect the eyes
(c) remove the slag by striking
(d) hold the electrode manually and conducting current to it

**Ans. (c) :** In the arc welding process, a chipping hammer is used to remove slag from by striking.

Slag is a hardened layer of flux residue that forms on the weld after welding.

**98. The primary purpose of a shadow projector is to _____.**

(a) produce an undistorted magnified reflected image of an object
(b) detect internal flaws in a material
(c) analyse material composition
(d) measure surface roughness

**Ans. (a) :** The primary purpose of a shadow projector, also known as profile projector or shadowgraph is to project and enlarge the shadow of an object onto a screen, enabling precise inspection and measurement of its shape dimensions and features.

**99. What does specific fuel consumption (SFC) measure in an internal combustion engine?**

(a) The total mass of the fuel used during engine operation
(b) The fuel efficiency expressed as the amount of fuel consumed per unit of power produced
(c) The ratio of air intake to fuel delivered per ombustion cycle
he efficiency of the engine's exhaust system

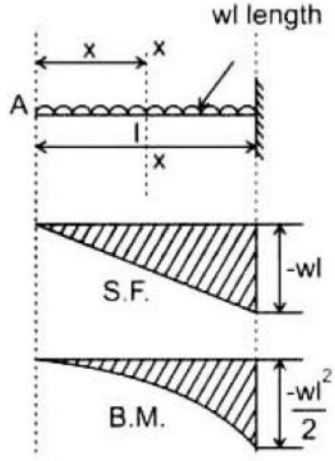
pecific fuel consumption (SFC) is a measure unt of fuel required to generate a unit of wer in a given unit of time.

$$C = \frac{\text{Fuel Consumption Rate}}{\text{Power Output}}$$

**t will be the shape of the bending moment diagram for a cantilever beam carrying a uniformly distributed load throughout its length?**

(a) A hyperbola (b) A parabola
(c) A straight line (d) Cubical

**Ans. (b) :** A cantilever beam carrying a uniformly distributed load throughout its length gives a parabola shape of the bending moment diagram.



# RAILWAY RECRUITMENT BOARD (RRB)
# JUNIOR ENGINEER MECHANICAL
# EXAM - 2025

**EXAM DATE : 22.04.2025** **EXAM TIME :9.00AM-11.00AM**

**1. If torsional rigidity increases in the torsion equation, then the:**

(a) angle of twist decreases
(b) angle of twist increases
(c) angle of twist first increases then decreases
(d) angle of twist remains constant

**Ans. (a) :** By the torsion equation-

$$\frac{T}{J} = \frac{G\theta}{l}$$

Then the angle of twist

$$\theta = \frac{Tl}{GJ}$$

$$\theta \propto \frac{1}{GJ}$$

When torsional rigidity (GJ) increase then a (θ) decreases because the angle of twist proportional to the torsional rigidity.

**2. What defines a black body in the thermal radiation?**

(a) An object with perfect thermal ins
(b) A material that only emits visible light
(c) An idealised object that absorbs all incident radiation and emits the maximum possible radiation at a given temperature
(d) A surface that reflects all incident radiation without absorption

**Ans. (c) :** In thermal radiation a black body is an ideal object that perfectly absorbed all incident radiation of all wavelength and angles and emits radiation with a spectrum determined.

**3. In torch brazing, heat is produced by burning a mixture of _____.**

(a) oxy-hydrogen gas (b) oxy-acetylene gas
(c) oxy-nitrogen gas (d) oxy-neon gas

**Ans. (b) :** The torch brazing is a process of joining two or more metals by melting and flowing a filler metal into the joint which has a lower melting point than the base metals being joined. In torch brazing heat is produced by burning a mixture of oxy-acetylene gas.

**4. Despite having the highest possible efficiency for Carnot cycle, it is not suitable for a practical engine using a gaseous working fluid as :**

(a) it is easy to maintain isothermal processes in practice
(b) the cycle requires very high pressures that are hard to manage
(c) it is impossible to achieve perfectly reversible processes
(d) the work output from the cycle is quite low

**Ans. (c) :** The Carnot cycle consists of two Isothermal processes and two reversible adiabatic processes. To achieve the highest efficiency each of these processes must be perfectly reversible. A reversible process is an idealization and assumes no entropy generation, no friction, no unrestrained expansion and no heat transfer through a finite temperature difference. In reality these are impossible to meet.

**structured list of components and sub- blies needed to manufacture a final uct is represented by the :**

omponents directory (b) bill of materials
aster file (d) lead time

The structured list of components and sub- needed to manufacture a final product is by a bill of material. It is a comprehensive list of all raw materials, components and sub-assemblies required to manufacture a product.

**6. In a battery or coil ignition system, what is the role of the ignition coil?**

(a) To transform the low battery voltage into a high voltage required for spark generation
(b) To regulate the fuel injection timing
(c) To compress the air entering the combustion chamber
(d) To control the engine's exhaust temperature

**Ans. (a) :** The ignition coil is a crucial component in a battery or coil ignition system. Its primary role is to transform the low battery voltage into high voltage required for spark generation in the internal combustion engines. This high voltage is necessary to ignite the air fuel mixture within the engine's combustion chamber ensuring the engine runs smoothly and efficiently.

**7. Which welding process is NOT classified under arc welding processes?**

(a) Stud Arc Welding
(b) Electroslag Welding
(c) Atomic Hydrogen Welding
(d) Tungsten Inert Gas Welding

**Ans. (c) :** In an arc welding the arc is struck between a flux covered stick electrode and the work-piece. Arc welding are classified into two categories.

1. Consumable electrode method
2. Non-consumable electrode method

**1. Consumable electrode method:** It is classified as;

(i) Shielding Metal Arc Welding (SMAW)
(ii) Gas Metal Arc Welding (GMAW) (MIG welding)
(iii) Flux-Cored Arc Welding (FCAW)
(iv) Submerged Arc Welding (SAW)

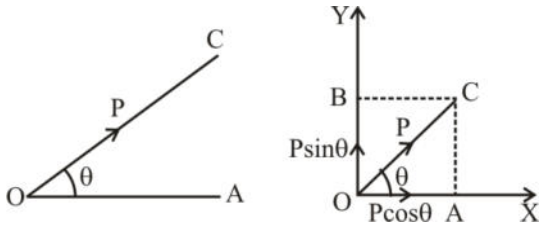
**2. Non-consumable electrode method:** It is classified as;

(i) Gas Tungsten Arc Welding (GTAW) (TIG)
(ii) Plasma Arc Welding (PAW)
(iii) Atomic Hydrogen Welding (AHW)
(iv) Carbon Arc Welding

**8. What is meant by the resolution of a force?**

(a) Reducing the magnitude of a force in a given direction
(b) Splitting a force into components without changing its effect
(c) Changing the direction of a force without altering magnitude
(d) Combining multiple forces to fo resultant

**Ans. (b) :** Resolution of forces is the breaking down a single force into its comp along two perpendicular directions (hori vertical) without changing the overall ef original force.




Horizontal component (ΣH) = Pcosθ
Vertical component (ΣV) = Psinθ

**9. _____ is/are the most widely used material for the broaches in a broaching operation.**

(a) High speed steel
(b) Silver-copper combination
(c) Metal matrix composites
(d) Copper

**Ans. (a) :** Broaching is a machining process that involves removing material using a special tool is called a broach. High speed steel is widely used material for broaches in a broaching operation.

**10. What should be the included angle of the cutting tool used for machining metric threads in a thread-cutting operation?**

(a) 45 degrees (b) 60 degrees
(c) 55 degrees (d) 75 degrees

**Ans. (b) :** The Bureau of Indian standard has adopted a unified screw thread profile based on the metric system as the standard thread profile for use in India and designated it as the metric screw thread. The Included angle of the cutting tool used for machining metric threads in a thread-cutting operation is 60º.

**11. What will be the value of the maximum absolute shear stress produced in a thin cylinder if hoop stress = 40 MPa and longitudinal stress = 20 MPa?**

(a) 20 MPa (b) 30 MPa
(c) 60 MPa (d) 10 MPa

**Ans. (a) :** Given that,

Hoop stress ($\sigma_h$) = 40MPa
Longitudinal stress ($\sigma_l$) = 20MPa
Radial stress = 0

For maximum absolute shear stress

$$\tau_{max} = \frac{1}{2}(\sigma_{max} - \sigma_{min})$$

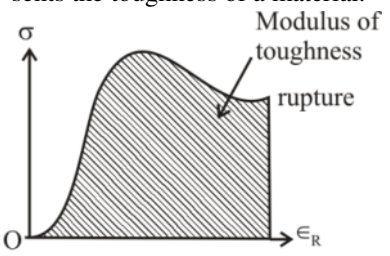
$$\tau_{max} = \frac{1}{2}(40 - 0)$$

$$\boxed{\tau_{max} = 20 \text{ MPa}}$$

**12. Which area under the stress-strain curve esents the toughness of a material?**

otal area under the curve
rea of plastic region
lope of the elastic region
rea of elastic region

The total area under the entire stress-strain sents the toughness of a material.




**13. If two forces act at a right angle (90º), what will be the magnitude of their resultant force?**

(a) $R = F_1 + F_2$ (b) $R = \sqrt{F_1^2 + F_2^2}$
(c) $R = 2F_1F_2\cos\theta$ (d) $R = F_1 - F_2$

**Ans. (b) :** When two forces act at a right angle (90º) their resultant is found using vector addition based on the Pythagorean theorem. Then resultant

$$R = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$$

$$R = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos 90^o}$$

$$\boxed{R = \sqrt{F_1^2 + F_2^2}}$$

**14. Which of the following hardness scales uses a diamond cone indenter?**

(a) Rockwell C scale (b) Brinell scale
(c) Mohs scale (d) Vickers scale

**Ans. (a) :** The Rockwell C scale is used in a conical diamond indenter with a 120º angle and applies a major load of 150 kg to measure the hardness of hard material like steel.

**15. Soldering is a _____ similar or dissimilar metals by heating them to a required temperature.**

(a) method of cutting (b) method of boring
(c) method of joining (d) method of cooling

**Ans. (c) :** Soldering is a metal joining process where two or more similar or dissimilar metal are joined together by melting a filler metal (solder) that has a lower melting point than the base metals.

**16. What is the impact of effective preplanning on the economic efficiency of a manufacturing operation?**

(a) Increase in the complexity of the production process
(b) Elimination of the need for any forecasting
(c) Focus on the design of jigs and tools
(d) Prevention of the production of large uneconomic output

**Ans. (d) :** Effective preplanning involves through preparation and strategic foresight before the commencement of the manufacturing proces significant impacts of effective preplann prevention of the production of large output.

**17. The key step in making a measurement using a tool maker's is _____.**

(a) viewing the magnified image
(b) adjusting the focus on the work pi
(c) aligning the cross-wires measurement points
(d) changing the objective lens power

**Ans. (c) :** A tool maker's microscope is used to take precise linear and angular measurement of small parts. The key step in making a dimensional measurement using a tool maker's microscope is aligning the cross-wires with the measurement points.
**Note:-** The answer given by RRB is (b).

**18. Which of the following is NOT an angular measurement device?**

(a) Sine Bar (b) Digital Micrometer
(c) Autocollimator (d) Spirit Level

**Ans. (b) : Digital Micrometer:-** It is a precision measuring instrument used to measure dimensions, typically the thickness or diameter of an object. It provides highly accurate measurements in the sub-millimeter range.
**Angle measuring instruments;**
1. Bevel protector
2. Sine bar
3. Spirit level
4. Clinometer
5. Autocollimators
6. Protector's head

**19. Pressure head in a fluid system is best described as:**

(a) the difference between absolute and gauge pressure
(b) the height of a fluid column equivalent to the pressure exerted by the fluid
(c) the rate of fluid flow per unit cross-sectional area
(d) the kinetic energy per unit weight of the fluid

**Ans. (b) :** Pressure head in a fluid system is best described as the height of a fluid column equivalent to the pressure exerted by the fluid.

$$\Delta P = \rho g h$$

$$\boxed{h = \frac{\Delta P}{\rho g}}$$

**20. In gas welding process, gas pressure regulators are employed for _____.**

(a) increasing the oxygen and acetylene mixture pressure
(b) mixing oxygen and acetylene thoroughly
(c) reducing the pressure of acetylene and oxygen gas from the cylinders to working pressure
gniting the welding torch

In gas welding gas pressure regulators are o control and reduce the gas pressure that is orking pressure suitable for welding These regulators provide a steady and w of gas.

**t is the function of shielding gas in Gas sten Arc Welding (GTAW)?**

rotects the tungsten electrode and the molten metal weld pool from the atmospheric contamination
(b) Protects the consumable coated electrode and the molten metal weld pool from the atmospheric contamination
(c) Removes the slag by striking and conducts current to pass through it
(d) Protects the consumable bare electrode and the molten metal weld pool from the atmospheric contamination

**Ans. (a) :** The function of shielding gas in Gas Tungsten Arc Welding (GTAW) is to protects the tungsten electrode and the molten metal weld pool from the atmospheric contamination by creating a barrier around the weld area, preventing harmful gases like oxygen and nitrogen from interacting with the molten metal and compromising the weld quality.

**22. In which type of welding flame is oxygen proportion more compared to acetylene proportion?**

(a) Neutral welding flame
(b) Oxidizing welding flame
(c) Reducing welding flame
(d) Carburizing welding flame

**Ans. (b) : Oxidizing flame:-** In Oxidizing flame, the amount of oxygen is more as compare to acetylene.

$$\frac{O_2}{C_2H_2} = \frac{1.15 \text{ to } 1.5}{1}$$

- It produced a roaring or hissing sound.
- Useful for welding of brass and brazing of ferrous metals.

**23. The Vickers hardness number (VHN) for a material with a 20 kg load and an average indentation diagonal of 0.3 mm is:**

(a) 78 (b) 412
(c) 324 (d) 115

**Ans. (b) :** Given,

Load (F) = 20 kg

Diagonal of indentation (d) = 0.3 mm

We know that,

$$\text{Vickers Hardness Number } (\text{VHN}) = \frac{1.854\,F}{d^2}$$

$$= \frac{1.854 \times 20}{(0.3)^2}$$

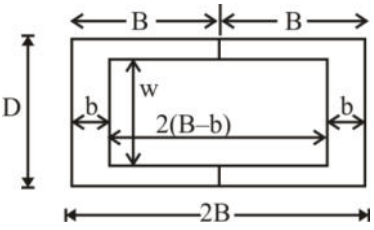
$$\text{VHN} = \frac{1.854 \times 20}{0.0} = 412$$

**24. A symmetrical planar built-up sect of two channel sections joined tog tips of their flanges to form rectangular area. The total width of is 'B'. Each web is 'w' units deep units deep at its outside (longer) f units thick. The moment of ine composite section about its cent perpendicular to the webs is given by:**

(a) $\frac{BD^3}{12} - \frac{(B-b)w^3}{12}$ (b) $\frac{BD^3}{12} + \frac{(B-b)w^3}{3}$

(c) $\frac{BD^3}{12} - \frac{Bw^3}{3}$ (d) $\frac{BD^3}{6} - \frac{(B-b)w^3}{6}$

**Ans. (d) :** Given,




Moment of Inertia about centroidal axis,

$$I_{zz} = \frac{2B \times D^3}{12} - \frac{(2B-2b)w^3}{12}$$

$$I_{zz} = 2\left[\frac{BD^3}{12} - \frac{(B-b)w^3}{12}\right]$$

$$I_{zz} = \frac{BD^3}{6} - \frac{(B-b)w^3}{6}$$

**25. In a modern optical measuring microscope, the 'cross-wires' are:**

(a) located on the objective lens
(b) located on the surface of the work piece
(c) etched on glass within the eyepiece
(d) located on the XY stage

**Ans. (c) :** In a modern optical measuring microscope, the cross-wires etched on glass within the eyepiece. The design allows for precise and accurate measurement and alignment.

**26. Which of the following is a key advantage of CNC lathes in turning operations?**

(a) They are less accurate than conventional chucking machines.
(b) They rely mainly on mechanical devices for control.
(c) They provide higher automation and complex machining cycles.
(d) They are limited to simple machining operations.

**Ans. (c) :** Advantage of CNC lathes in turning are-

rovide higher automation and complex
g cycles.
and repeatability.
production
labour costs.
ty.

**27. The creep rate in a material increases when:**

(a) the temperature is decreased
(b) stress is increased
(c) alloying elements are removed
(d) the material is stretched

**Ans. (b) :** Creep is a process of applied stress at elevated temperature greater than 40-50 percent of the absolute melting temperature, resulting in plastic deformation of the part.

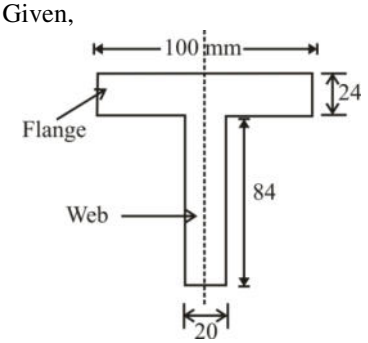
Creep is the time-dependent plastic deformation of a metal or material under load.

The creep rate in the material increases as the stress applied to a material is increased.

**28. A symmetrical T-section has its flange horizontal on top. Its dimensions are: Flange: Width = 100 mm, thickness = 24 mm; Web: Height = 84 mm, thickness = 20 mm. Its moment of inertia about a vertical axis through its centroid parallel to the web is (in $mm^4$):**

(a) 3840000 (b) $2056 \times 10^3$
(c) $431 \times 10^4$ (d) $451 \times 10^4$

**Ans. (b) :** Given,




**For flange-**

$$I_{flange} = \frac{bh^3}{12} = \frac{24\times100^3}{12} = 2\times10^6 \text{ mm}^4 = 2000\times10^3 \text{ mm}^4$$

**For web-**

$$I_{Web} = \frac{84\times20^3}{12} = 56\times10^3 \text{ mm}^4$$

$\therefore$ Moment of Inertia of T-section,

$I_{yy} = I_{flange} + I_{web}$

$= 2000\times10^3 + 56\times10^3$

$I_{yy} = 2056\times10^3 \text{ mm}^4$

**29. Shielded Metal Arc Welding (SMAW) is also called _____.**

(a) Manual Metal Arc Welding
(b) Gas Tungsten Arc Welding
(c) Tungsten Inert Gas Welding
(d) Metal Inert Gas Welding

**Ans. (a) :** Shielded Metal Arc Welding (S manual arc welding process that uses a electrode coated in flux. A manual arc weld where an electric arc is used to melt met pieces of metal.

**30. Which type of steel would be best suited for applications requiring both high strength and good corrosion resistance?**

(a) High-carbon steel (b) Stainless steel
(c) Mild steel (d) Low-alloy steel

**Ans. (b) :** Presence of Chromium in steel provide resistance to corrosion. The stainless steel is a type of alloy steel that contains a minimum of 10.5% chromium by mass and less than 1.2% of carbon.

**31. In a two-stroke petrol engine, which of the following best describes the sequence of events during an exhaust stroke?**

(a) Both ports open simultaneously.
(b) The exhaust port opens and closes before the transfer port opens.
(c) The transfer port opens first, followed by the exhaust port.
(d) The exhaust port opens first, followed by the transfer port.

**Ans. (d) :** In a two-stroke petrol engine, there are three ports.
Inlet port, exhaust port and transfer port.
The sequence during the exhaust stroke, the exhaust port opens first, followed by the transfer port.

**32. What is the function of a shank in a broaching machine?**

(a) Guides the broach through the material and maintains tool alignment
(b) Holds the broach in place and gives it a rotary motion
(c) Removes chips and coolant from the cutting area
(d) Breaks up the chips generated during the broaching process

**Ans. (a) :** In a broaching machine, the shank of the broach serves to connect the broach to the machine to guide the broach through the material and maintains tool alignment and providing support during the cutting process.

**33. A built-up section is made by joining two equal I-sections at the flanges at their outer faces so that the composite consists of one I-section above the other. The moment of inertia of each section through a centroidal axis parallel to the web is $I_{yy}$.**

**The moment of inertia of the composite built-up section about a similar axis is:**

$I_{yy}$ (b) $2I_{yy}$

$_{yy}$ (d) $\frac{I_{yy}}{2}$

A built-up section is made by joining two tions at the flanges at their outer faces so that ite consists of one I-section above the other. n has of intersect is parallel to the web.

$_{al} = I_{yy} + I_{yy}$

$I_{total} = 2I_{yy}$

**34. Which of the following wheels supports the workpiece in internal centreless grinding operation?**

(a) Only pressure roller
(b) Only regulating wheel
(c) Only supporting roller
(d) Pressure roller, supporting roller and regulating wheel

**Ans. (d) :** In centerless grinding, the workpiece is primarily supported by a pressure roller, supporting roller and regulating wheel.

**35. For machining yellow metals and free-cutting steels, _____ is/are used as cutting fluids.**

(a) insoluble oils (b) water soluble oils
(c) water (d) germicides and water

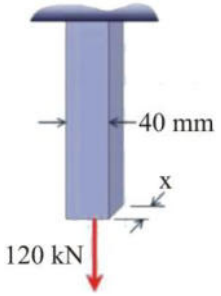
**Ans. (b) :** For machining yellow metals and free-cutting steels, water soluble oils are used as cutting fluids.
Water soluble oils, also known an emulsifiable oils are commonly used for machining yellow metals. They offer excellent cooling and lubrication properties, which are essential for these materials.

**36. Why does cast iron have high compressive strength but low tensile strength?**

(a) Due to its elastic properties
(b) Due to the presence of graphite flakes
(c) Due to its ductile nature
(d) Due to its high malleability

**Ans. (b) :** Cast iron have high compressive strength but low tensile strength due to the presence of graphite flakes. Cast iron typically has a micro-structure that includes graphite flakes or nodules, which can enhance its ability to withstand compression loads.

**37. Determine the minimum thickness of the rectangular axial bar shown against yielding. Given Factor of Safety (FOS) = 2 and Yield stress = 310 MPa.**




(a) 25 mm (b) 60 mm
(c) 155 mm (d) 19.4 m

**Ans. (d) :** Given,

Yield stress = 310 MPa

Factor of safety (FOS) = 2

$$\therefore \quad \sigma = \frac{\text{Yield stress}}{\text{FOS}}$$

$$\sigma = \frac{310}{2}$$

$$\frac{P}{A} = 155$$

$$\frac{120\times10^3}{40\times t} = 155$$

$$t = \frac{120\times10^3}{155\times40}$$

$$t = 19.354 \text{ mm}$$

$$\boxed{t \approx 19.4 \text{ mm}}$$

**38. For a closed system undergoing a thermodynamic cycle, the first law states which of the following?**

(a) Pressure and temperature are inversely related.
(b) Entropy always increases.
(c) Net work done equals net heat transfer.
(d) Internal energy remains constant.

**Ans. (c) :** For a closed system undergoing a thermodynamic cycle, the first law states that net heat transfer equals to net work done.

$$\boxed{\oint \partial Q = \oint \partial W}$$

**39. What is the complete form of 'LVDT', one of the most popular electromechanical comparators?**

(a) Linear versatile differential transformer
(b) Longitudinal variable differential transformer
(c) Linear variable dimensional transformer
(d) Linear variable differential transformer

**Ans. (d) : LVDT-** Linear variable differential transformer.

**40. Inventory control begins with _____ analysis, a fundamental supply chain activity frequently performed by inventory controllers and materials managers.**

(a) FSN (b) XYZ
(c) ABC (d) VED

**Ans. (c) :** ABC analysis stands for-
A item:- High value, low quantity
B item:- Moderate value, moderate quantity
C item:- Low value, high quantity

**41. The vaned diffuser in a centrifugal pump serves to:**

(a) reduce cavitation by increasing turbulence
ontrol the pump's rotational speed
ccelerate the fluid
onvert kinetic energy into pressure energy

he vaned diffuser in the pump is a stationary located just after the impeller. Its primary to convert the kinetic energy into pressure

**ng the following, which beam can be ified as a statically indeterminate beam?**

(a) Simply supported beam
(b) Overhanging beam
(c) Fixed beam
(d) Cantilever beam

**Ans. (c) : Statically Indeterminate Beam:-** Those beams in which the number of unknown support reaction and internal forces exceeds the number of available equilibrium equations are known as statically indeterminate beam.

Example- Fixed beam, propped cantilever beam, continuous beam etc

**43. Which of the following best describes the strength of mild steel compared to alloy steel?**

(a) Alloy steel generally has higher strength than mild steel.
(b) Mild steel is stronger in compression but weaker in tension than alloy steel.
(c) Mild steel generally has higher strength than alloy steel.
(d) Both mild steel and alloy steel have the same strength.

**Ans. (a) :** Alloy steel is manufactured by adding specific alloying element like chromium, nickel etc to carbon steel which significantly enhances their strength.

**Effect of alloying element-**

1. Carbon (C):- Strength
2. Chromium:- Corrosion resistance
3. Molybdenum:- Creep resistance
4. Sulphur:- Machinability
5. Aluminium:- Grain Refiner

**44. Which of the following is the correct sequence for the IS specification of any Grinding wheel?**

(a) Abrasive used - Structure - Grade - Grit number - Bond Type
(b) Abrasive used - Grit number - Grade - Structure - Bond Type
(c) Abrasive used - Grade - Structure - Grit number - Bond Type
(d) Abrasive used - Grit number - Structure - Grade - Bond Type

**Ans. (b) : Specification of Grinding Wheel-**

**Sequence:** Abrasive used → Grit number → Grade → Structure → Bond type

**Abrasive type:-** Indicates the type of abrasive material used.

**Grain size/Grit number:-** Represents the of abrasive particle.

**Grade structure:-** Refers to the hardne strength of wheel.

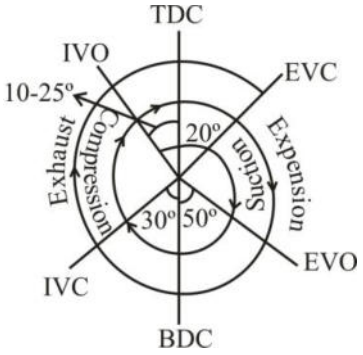
**Structure:-** Describe the spacing of wheel.

**Bond type:-** Indicates the material used to abrasive grain together.

**45. In a four-stroke cycle diesel engine valve starts to open at _____.**

(a) 10º - 25º before TDC
(b) 25º - 40º before BDC
(c) 25º - 40º after BDC
(d) 10º - 15º after TDC

**Ans. (a) :** Valve timing diagram for a four stroke diesel engine-




IVO- Inlet valve opens
IVC- Inlet valve closes
EVO- Exhaust valve open
EVC- Exhaust valve closes
TDC- Top dead center
BDC- Bottom dead center

In four stroke diesel engine, the intake valve begins to open before the piston reaches top dead center (TDC) on exhaust stroke. This early opening 10º-25º before TDC, ensure that the valve is fully open when the intake stroke begins, allowing optimal air flow into the cylinder.

**Note:-** The answer given by RRB is (b).

**46. Which of the following is used in organic coating as catalysts that speed up the cure reaction?**

(a) Plasticisers (b) Cure additives
(c) Colloidal stabilisers (d) UV stabilisers

**Ans. (b) :** In organic coating, cure additives acts as catalysts that accelerate curing (hardening) process of coating, which may be triggered by heat, UV light or chemical reactions. These additives are critical in reducing drying time and improving the efficiency of the coating process.

**47. Intensity of radiation varies with the:**

(a) square of the distance
(b) inverse square of the distance
(c) cube of the distance
(d) fourth power of the distance

**Ans. (b) : Inverse Square Law-** According to this law the intensity of radiation is inversely proportional to
e distance from the source.

$$\frac{1}{d^2}$$

of radiation
e from the radiation source.

**main objective of the sequencing problem oduction is to:**

inimise the idle time of machines
ncrease the processing time of jobs
(c) maximise the number of jobs processed
(d) ignore the order of job processing

**Ans. (a) :** The main objective of the sequencing problem is to minimise the idle time of machines.

**Sequencing-** Sequencing in the production refers to determining the optimal order in which multiple jobs are processed on one or more machines.

**49. What does the process of Principle of Arc welding involve?**

(a) Supplying oxygen and acetylene between the electrodes to melt the metal
(b) Creating friction between the electrode and the workpiece to melt the metal
(c) Creating flow of electric current in the air gap between the electrode and the workpiece to melt the metal
(d) Creating a chemical reaction between the electrode and the workpiece to melt the metal

**Ans. (c) : Working principle of arc welding:-** In arc welding an electric current is passed through an electrode creating an arc between the electrode and the worpiece by maintaining the gap between them. The intense heat from the arc melts the metal at the joint, creating a strong weld upon cooling.

**50. Identify the milling cutter used for parting-off operations or cutting thin slots.**

(a) Plain milling cutter (b) Fly milling cutter
(c) Metal slitting cutter (d) Angle milling cutter

**Ans. (c) : Metal slitting cutter:-** A milling cutter used for parting-off operation or slotting with narrow width.

**51. While measuring surface texture, the part of the profilometer that makes contact with the workpiece surface is _____.**

(a) a motorised mechanism
(b) a finely pointed stylus
(c) a recording unit
(d) an electrical pickup

**Ans. (b) :** A profilometer is measuring instrument used to quatify surface topography. It typically uses a diamond stylus probe that moves across the surface.

**Stylus:-** A small, typically diamond tip that makes contact with the wrokpiece surface.

**52. For a thin planar ring of radius 'r' mm and thickness 't' mm, its radius of gyration about the polar axis in mm is:**

(a) r/2 (b) r
(c) r/t (d) 2r

**Ans. (b) :** The moment of inertia (I) for thi polar axis is given by-

$I = mr^2$ ...(i)

The radius of gyration (k) is related to Inertia (I).

$I = mk^2$ ...(ii)

From equation (i) & (ii)

$mk^2 = mr^2$

$\boxed{k = r}$

**53. If a pump's theoretical manometric head is 30 meters and its measured head is 27 meters, what is its manometric efficiency?**

(a) 80% (b) 75%
(c) 90% (d) 85%

**Ans. (c) :** Given,

Theoretical manometric head ($h_{th}$) = 30 m

Actual manometric head ($h_{act}$) = 27 m

manometric efficiency $(\eta_m) = \frac{h_{act}}{h_{th}} \times 100$

$= \frac{27}{30} \times 100$

$= 90\%$

**54. In a profile projector, the magnified image of the workpiece is created by:**

(a) projection lens (b) a Vernier micrometer
(c) mirrors (d) condenser lens

**Ans. (a) :** In profile projector, the magnified image of workpiece is created by projection lens. It ensures that the image is clear and accurate, allowing precise measurement.

**55. What does the Polygon Law of Forces describe?**

(a) The equilibrium condition of multiple forces
(b) The force required to balance a single force
(c) The interaction between two perpendicular forces
(d) The method to find the resultant of multiple forces

**Ans. (d) :** Polygon law of forces describe the method to find the resultant of multiple forces.

The polygon law states that if a number of concurrent forces acting simultaneously on a body are represented in magnitude and direction by sides of a polygon taken in order then closing side of polygon represents the resultant in opposite order.

**56. Which of the following is the correct rule when selecting a Grinding Wheel?**

(a) Fine finish needs open structure
(b) Hard wheel for hard metal and soft wheel for soft metal
(c) Soft wheel for hard metal and hard wheel for soft metal
(d) Close structure for ductile and soft material

**Ans. (c) :** The correct rule for selecting a grinding wheel is "soft wheel for hard metal and hard wheel for .

ple is essential for achieving high quality finishes and ensuring safety in grinding

**rding to the Principle of Resolution, the raic sum of the resolved parts of multiple s in a given direction is equal to**

he total magnitude of all forces combined
he resolved part of their resultant in the same direction
(c) the sum of all forces acting in that direction
(d) the difference between the largest and smallest force

**Ans. (b) : Principle of Resolution in Mechanics:-** According to this principle the algebraic sum of the resolved parts of multiple forces in a given direction is equal to the resolved part of their resultant force in the same direction.

**58. Which of the following movements of the grinding wheel is possible in a chucking-type internal grinder?**

(a) Only rotational movement
(b) Both rotational and reciprocating movement
(c) Only reciprocating movement
(d) Only vibrational movement

**Ans. (b) :** The primary movements involved in chucking type internal grinder are rotational and reciprocating movements.

- The rotational movement of grinding wheel is essential for grinding process.
- The reciprocating movement involves the grinding wheel moving back and forth along the axis of workpiece.

**59. Which of the following does a cascade refrigeration system use?**

(a) A single refrigerant in both cycles
(b) Only ammonia as a refrigerant
(c) Only air as a working fluid
(d) Two or more refrigerants with different boiling points

**Ans. (d) : Cascade Refrigeration System -** A cascade refrigeration system is a specialized type of refrigeration system that uses two or more refrigeration cycles with different refrigerants to achieve very low temperature.

In two stage cascade system, the high temperature cycle might use a refrigerant such as R-134a while low temperature cycle uses a refrigerant like R-23. Both refrigerant have different boiling points.

**60. In drilling operations, a coolant is used to _____.**

(a) heat the drill bit
(b) cool down the drill bit
(c) reduce durability of drill bit
(d) clean the drill bit

**Ans. (b) :** In drilling operations, a coolant also known as cutting fluid is used to reduce the heat generated by the friction between the drill bit and the ma drilled.

**Advantages:**

- Reduces the operating temperature of t preventing overheating the extending its lif
- Improves the quality of drilled holes by optimal cutting conditions and reduci expansion
- Decreases the amount of wear on the drill the frequency of tool replacement and maintenance.

**61. Which of the following is NOT a mechanical finishing process?**

(a) Shot peening (b) Buffing
(c) Burnishing (d) Pickling

**Ans. (d) :** mechanical finishing processes are techniques used in manufacturing to improve the surface properties of a material such as its appearance, texture and functionality. Common mechanical finishing processes include burnishing shot peening and buffing.

**Pickling:**

Pickling is a chemical finishing process used in metallurgy to remove impurities such as stains, inorganic contaminants and rust from metal surfaces.

**62. Brazing is a process of _____ metals without melting the base metal.**

(a) joining (b) melting
(c) drilling (d) cutting

**Ans. (a) :** Brazing is a metal-joining process in which a filler metal is heated above its melting point and distributed between two or more close fitting parts by capillary action. The filler metal is drawn into the joint by capillary action and upon cooling. It solidifies to form a strong, sealed joint. Importantly the base metals are not melting during the process.

- Brazing occurs at lower temperatures compared to welding, reducing the risk of distorting or weakening the base metals.

**63. What distinguishes a semi-open impeller from an open impeller?**

(a) A semi-open impeller is completely enclosed by a casing.
(b) A semi-open impeller lacks any vanes.
(c) A semi-open impeller has a partial shroud on one side.
(d) A semi-open impeller has vanes on both sides.

**Ans. (c) :** A semi-open impeller is a type of impeller used in centrifugal pumps, where the impeller has a partial shroud on the side. This distinguishes it from other types of impellers such as open impellers, which have no shroud and closed impellers, which are enclosed by shrouds on both sides.

- Semi-open impellers are better suited for applications involving fluid with suspended solids or debris, as the design allows for easier passage of such materials without clogging.

**h of the following assumptions is essential pplying Bernoulli's theorem?**

he flow is turbulent and rotational.
he fluid is viscous and incompressible.
he flow is steady, incompressible and rictionless.
he fluid has high compressibility.

**ernoulli's theorem**

that the total mechanical energy of the luid comprising the energy associated with fluid pressure the gravitational potential energy of elevation and the kinetic energy of fluid motion remains constant.

- It is based on conservation of energy.

**Assumptions of Bernoulli's theorem:-**

- Flow is ideal i.e. inviscous
- Flow is steady i.e. time variation is zero.
- Flow is incompressible i.e. $\rho$ is constant.
- Flow is irrational i.e. $\omega_x = \omega_y = \omega_z = 0$
- All the other external forces except gravity and pressure forces should be zero.
- The energy of the system is constant hence there should be no loss of energy.

**65. What is the number of divisions on the vernier scale of a Universal Bevel Protractor?**

(a) 70 (b) 60
(c) 46 (d) 24

**Ans. (d) :** The number of divisions on the vernier scale of universal bevel protractor is 24.

A universal bevel protractor is a precision instrument used for measuring angles with high accuracy. It consists of a base a graduated circular scale and a vernier scale that allows for fine measurements.

**66. What is the primary function of the headstock in a lathe machine?**

(a) To control the movement of the carriage and tailstock
(b) To hold and rotate the workpiece at different speeds
(c) To provide support for cutting tools during operation
(d) To adjust the feed mechanism for thread-cutting

**Ans. (b) :** The primary function of the headstock in a lathe machine, which is primarily responsible for holding and rotating the workpiece at various speeds during machining operations. It is located at the left hand end of the lathe bed and houses the main spindle, speed change mechanism and the drive motor.

**67. The sensing element in the Tomlinson Surface Meter is _____.**

(a) the shoe (b) rollers
(c) the stylus (d) springs

**Ans. (c) :** The Tomlinson Surface meter is an instrument used to measure the surface roughness or texture of a material. Tomlinson Surface meter with its stylus-based sensing element is widely use industries, including automotive, aero precision manufacturing.

**68. In a 'spirit-level device', to which glass vial does the bubble always mo**

(a) Highest point
(b) Random point
(c) Middle point
(d) Lowest point

**Ans. (a) :** In a 'spirit-level device' the bubble always moves to the highest point of the glass vial. This is based on the principle of buoyancy and the behavior of the liquid inside the vial relative to gravity.

**69. Which cooling method is used in full annealing?**

(a) Air cooling
(b) Slow cooling inside a furnace
(c) Quenching in water
(d) Cooling in an oil bath

**Ans. (b) :** Full annealing is a heat treatment process applied mainly to steels to soften the material, improve ductility, and relieve internal stress.

**Steps in full annealing:**

1. The metal is heated to a temperature above its upper critical point.
2. It is held at that temperature for a specific time to allow transformation.
3. It is then slowly cooled inside the furnace to room temperature cooling method:

Slow cooling inside a furnace ensures uniform and gradual cooling allowing the structure to reform into a soft and ductile state.

**70. Which of the following expressions can determine the longitudinal feed rate in "Through Feed Centreless Grinding"?**
**(If the diameter of the regulating wheel = D, r.p.m. of the regulating wheel = N, angle of inclination of the regulating wheel = θ)**

(a) Longitudinal feed rate = $\pi \times D \times N \times \text{Sin}(\theta)$
(b) Longitudinal feed rate = $\pi \times D \times N \times \text{Cos}(\theta)$
(c) Longitudinal feed rate = $[\pi \times D \times N] / \text{Cos}(\theta)$
(d) Longitudinal feed rate = $[\pi \times D \times N] / \text{Sin}(\theta)$

**Ans. (a) :** For longitudinal feed rate in Through Feed Centreless Grinding is given by the formula:

$$\text{Feed rate} = \pi \times D \times N \times \sin(\theta)$$

Since the angle of inclination is given as θ, the formula becomes.

**71. Why is the concept of transmissibility of forces valid for a rigid body?**

(a) Because a rigid body does not deform under applied forces
(b) Because forces always act in the direction of motion
(c) Because internal forces in a rigid body do not exist
ecause a rigid body always has an infinite umber of forces acting on it

The transmissibility of force states that a at a point on a rigid body can be considered any other point along its line of action, he external effect (such as motion and ) remain the same. This principal is crucial ying the analysis of forces in mechanical

- Since a rigid body does not deform under applied forces, the internal distribution of forces and moments remain unaffected when a force is transmitted along its line of action.

**72. Specific volume of a fluid is the reciprocal of its _____.**

(a) surface tension (b) viscosity
(c) dynamic viscosity (d) mass density

**Ans. (d) : Specific volume:-** Specific volume is defined as the volume occupied by a unit mass of a substance.

- The specific volume of a fluid is a fundamental property that is reciprocal of its mass density.

$$\text{Specific volume}(V) = \frac{1}{\text{mass density}(\rho)} \left(\text{m}^3/\text{kg}\right)$$

**73. A simply supported beam with a span length of 4 m carries a uniform load of intensity 5 N/m throughout its length. What will the value of the maximum bending moment (in N-m) in the beam be?**

(a) 0 (b) 4
(c) 10 (d) 20

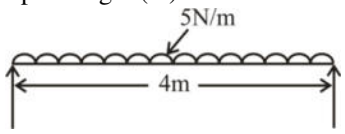
**Ans. (c) :** The maximum bending moment in a simply supported beam carrying a uniformly distributed load (UDL) occurs at the mid span and is calculated using the formula:

$$M_{max} = \frac{wL^2}{8}$$

Where,

w = Load intensity per unit length (N/m)

L = Span length (m)




Given,

Span length (L) = 4m

Load intensity (w) = 5N/m

$$\frac{5 \times 4^2}{8}$$

$$= 10$$

**74. Class _____ items are those that are 30-40% of all inventory items, and account for 30-40% of the total rupee consumption volume of the inventory. These are importa critical, and do NOT pose sourcing**

(a) C (b) X

(c) A (d) B

**Ans. (d) : A Items:-** These items are seen t Rupee consumption volume. "A" items usu 10-20% of all inventory items and account of the total Rupee consumption volume.

**B Items:-** "B" items are those that are 30 inventory items and account for 30-40% of the total Rupee consumption volume of the inventory. These are important but not critical and don't pose sourcing difficulties.

**C Items:-** "C" items account for 40-50% of all inventory items, but only 5-10% of the total.

**75. How is thermal efficiency defined in the context of internal combustion engines?**

(a) The ratio of the engine displacement to the fuel mass used

(b) The ratio of useful work output to the total chemical energy input from fuel

(c) The ratio of exhaust gas temperature to the intake air temperature

(d) The ratio of indicated power to frictional power losses

**Ans. (b) :** Thermal efficiency in the context of internal combustion engines is defined as the ratio of the useful work output to total chemical energy input from the fuel.

$$\text{Thermal efficiency}(\eta_{th}) = \frac{\text{useful work output}}{\text{Total chemical energy input from fuel}}$$

**76. In four-stroke diesel engine, which valves are closed during the expansion stroke?**

(a) Only the inlet valve

(b) Only the exhaust valve

(c) Neither inlet valve nor exhaust valve

(d) Both inlet and exhaust valves

**Ans. (d) :** During the expansion stroke in a four-stroke diesel engines the piston is at its top dead center (TDS) position and both the intake and exhaust valves are closed. This ensures that the combustion chamber is sealed.

**77. Impact strength is usually measured in units of :**

(a) Pascals (b) Newtons

(c) Watts (d) Joules

**Ans. (d) :** Impact strength is a measure of a material's ability to withstand a suddenly applied load or force without breaking.

- Impact strength is typically measured in units of energy, as it represents the amount of energy a material can absorb before fracturing. The standard unit of energy in the international system of units (SI) is the Joule (J).

**78. In a dry sump lubrication system, how is oil returned to the storage tank?**

ravity drains oil directly to the crankcase.

entrifugal force separates oil from air.

scavenge pump actively pumps oil back.

il remains in the engine block indefinitely.

In a dry sump lubrication system oil is the storage tank by the action of a scavenge scavenge pump actively pumps the oil from 's crankcase or other low points back to reservoir. Dry sump lubrication systems are commonly used in racing cars, high-performance sports cars, aircraft engines.

**79. Identify the class A items as per the ABC analysis in inventory.**

(a) 10-20% of the items account for 70-80% of the consumption

(b) The balance 65-75% account for 5-10% of the consumption

(c) The next 15-25% account for 10-20% of the consumption

(d) The balance 65-75% account for 70-80% of the consumption

**Ans. (a) :** ABC analysis is an inventory categorization technique where items are classified based on their consumption value.

| Class | % of items | % of consumption value | Priority |
|---|---|---|---|
| A | 10-20% | 70-80% | High |
| B | 30-40% | 15-25% | Medium |
| C | 50-60% | 5-10% | Low |

Therefore, Class A items are those for which 10-20% of the items account for 70-80% of the consumption.

**80. What is a primary advantage of using an open impeller design?**

(a) Complete elimination of cavitation risks
(b) Easier inspection and cleaning compared to closed impellers
(c) Improved efficiency due to reduced flow separation
(d) Higher pressure generation compared to radial flow pumps

**Ans. (b) :** The primary advantage of using an open impeller design is that it allows for easier inspection and cleaning compared to closed impellers.

This is due to the open structure, which provides better access to the impeller vanes and the areas around them. In applications where debris or particulate matter may be present in the fluid being pumped. The open design facilitates maintenance by allowing operators to quickly identify the remove and blockages or builup that could impede the performance of the pump.

**81. Atmospheric pressure is:**

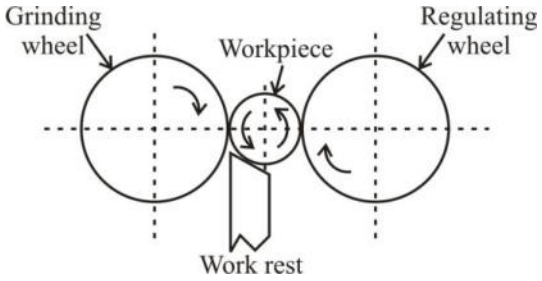
(a) the pressure exerted by the Earth's atmosphere at any given point
(b) the pressure difference between two fluids
(c) the pressure of a vacuum
(d) the pressure inside a fluid contain

**Ans. (a)** Atmospheric pressure is the pres point in the Earth's atmosphere. In most cir atmospheric pressure is closely approxim hydrostatic pressure caused by the weight the measurement point.

**82. Which of the following is the prim that supports the workpiece in centreless grinding?**

(a) Work rest blade (b) Stationary table
(c) Work test blade (d) Pressure roller blade

**Ans. (a) :**




In centreless grinding the workpiece is supported by three main components.

**Grinding wheel→** Removes material by rotating at high speed.

**Regulating wheel→** Controls the workpiece rotation and feed rate.

**Work Rest Blade→** Primary support element that holds the workpiece at the correct height and ensures stability during grinding.

**83. The work done by the load in stretching the bar is known as:**

(a) Strain Energy (b) Potential Energy
(c) Kinetic Energy (d) Dislocation Energy

**Ans. (a) :** The work done by the load in stretching the bar is known as strain energy.

**Resilience:-** The strain energy stored in a body due to external loading within the elastic limit is known as resilience.

**84. Two shafts, A and B, are of the same material. If the diameter of A is thrice the diameter of B, then the torque that can be transmitted by A will be:**

(a) 64 times that of B (b) 27 times that of B
(c) 9 times that of B (d) 16 times that of B

**Ans. (b) :** Given,

$D_A = 3D_B$

Power transmitting capacity, $P = \frac{2\pi NT}{60}$

Torsion equation, $\frac{T}{J} = \frac{\tau_{max}}{r} = \frac{G\theta}{\ell}$

$$\therefore T = \tau_{max} \times \frac{J}{r}$$

$$= \frac{\tau_{max} \times \pi D^3}{16}$$

, Power $\propto$ T, and T $\propto D^3$

$$\frac{P_A}{P_B} = \left(\frac{D_A}{D_B}\right)^3 = \left(\frac{3D_B}{D_B}\right)^3 = 27$$

$$\boxed{= 27P_B}$$

by A will be 27 times that of B.

**85. Relative efficiency of an engine is defined as the ratio of:**

(a) actual thermal efficiency to air-standard efficiency
(b) actual thermal efficiency to Carnot efficiency
(c) mechanical efficiency to volumetric efficiency
(d) brake thermal efficiency to indicated thermal efficiency

**Ans. (a) :** Relative efficiency or efficiency ratio, as it is sometimes called, the ratio of the actual efficiency obtained from an engine to the theoretical efficiency of the engine cycle.

$$\eta_{rel} = \frac{\text{Actual thermal efficiency}}{\text{Air standard eficiency}}$$

Relative efficiency for most of the engines varies from 75 to 95% with air standard efficiency.

**86. A bench mounted drilling machine is of the same type as a _____.**

(a) gang drilling machine
(b) deep hole drilling machine
(c) sensitive drilling machine
(d) radial drilling machine