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| 1 | Mathematics | الرياضيات |
| 2 | Mechanical Vibration | الاهتزازات الميكانيكية |
| 3 | Fluid Mechanics | ميكانيك الموائع |
| 4 | Heat Transfer | انتقال الحرارة |
| 5 | Thermodynamics | ديناميك الحرارة |
| 6 | Metallurgical Engineering | هندسة المعادن |
| 7 | Machines Design | تصميم المكائن |
| 8 | Manufacturing Process | عمليات تصنيع |

***Math:***

**Q1:** The evaluation of the integral $\int \frac{cosx}{sin^2x} dx$ is equal to

$A. -cot\, x + c$ $B. \ -csc\, x + c$

$C. -sec\, x + c$ $D. \ -sin\, x + c$

---

**Q2:** If $z = e^r cos\theta, r = st$ and $\theta = \sqrt{s^2 + t^2}$, then $\frac{\partial z}{\partial t}$ is

$A. \ e^r \left(s\, cos\theta - \frac{t^2}{\sqrt{s^2+t^2}} sin\theta\right)$ $B. \ e^r (s\, cos\theta - \frac{2t}{\sqrt{s^2+t^2}} sin\theta)$

$C. \ e^r \left(s\, cos\theta - \frac{1}{\sqrt{s^2+t^2}} sin\theta\right)$ $D. \ e^r (s\, cos\theta - \frac{t}{\sqrt{s^2+t^2}} sin\theta)$

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**Q3:** When solving a 1-Dimensional heat equation using a variable separable method, we get the solution if _____

A . k is positive B. k is negative

C. k is 0 D. k can be anything

---

**Q4:** The dot product of $3i + 5j + 7k$ and $11i + 13j + 17k$ is

*A. 14.8* *B. 33*

C. *56* *D.* 217

---

**Q5:** The Laplace transform of $t\ cos2t$ *is*

A. $\frac{s^4-4}{(s^2+4)^2}$ *B.* $\frac{s^2-4}{(s^2+4)^2}$

*C.* $\frac{s^2-4}{(s^2-4)^2}$ *D.* $\frac{s^2+4}{(s^2-4)^2}$

---

**Q6:** The partial differential equation $\frac{\partial^2 z}{\partial x^2} - 5\frac{\partial^2 z}{\partial y^2} = 0$ is classified as

A. elliptic B. parabolic

C. hyperbolic D. Non-linear

---

**Q7:** Depending on gamma function, the evaluation of the integral $(\int_0^\infty e^{-2x}\ x^3 dx)$ is

*A.* $\frac{\Gamma(4)}{2^4}$ B. $\Gamma(4)$

C. $\frac{\Gamma(3)}{2^3}$ D. $\frac{\Gamma(3)\Gamma(4)}{\Gamma(2)}$

---

**Q8:** If the auxiliary equation $ar^2 + br + c = 0$ as only one real root , then the general solution of $ay'' + by' + cy = 0$ is:

A. $y = c_1 e^{rx} + c_2 x e^{rx}$ *B.* $y = c_1 e^{rx} + c_2 e^{-rx}$

*C.* $y = c_1 e^{rx} + c_2 e^{rx}$ *D.* $y = c_1 e^{-rx} + c_2 e^{-rx}$

---

**Q9:** If the points (-1,-1,2), (2,m,5) and (3,11,6) are collinear, the value of the $m$ is

*A. 4* *B. 7*

C. *8* *D.* 12

---

**Q10:** The evaluation of the integral $\int sin^2 x\ cosx\ dx$ is equal to

A. $\frac{cos^3x}{3} + c$

B. $cosx\ sinx + c$

C. $-\frac{sin^3x}{3} + c$

D. $\frac{sin^3x}{3} + c$

---

**Q11:** the partial derivative of the function $f(x;\ y) = \frac{x^2}{y^2+1} - \frac{y^2}{y^2+x^2}$ with respect to $x$.

A. $\frac{2x}{y^2+1} + \frac{2xy^2}{(y^2+x^2)^2}$

B. $\frac{2x}{y^2+1} - \frac{2xy^2}{(y^2+x^2)^2}$

C. $\frac{2x}{y^2+1} + \frac{2xy^2}{y^2+x^2}$

D. $\frac{2x}{y^2+1} + \frac{2xy^2}{y^2+x^2}$

---

**Q12:** When solving a 1-Dimensional wave equation using variable separable method, we get the solution if

A . k is positive

B. k is negative

C. k is 0

D. k can be anything

---

**Q13:** What is the general formula for finding the magnitude of the cross product of two vectors a and b with angle θ between them

B. $|a|.|b|$

B. $|a|.|b|\ cos(\theta$

**C.** $|a|.|b|\ sin(\theta)$

D. $|a|.|b|\ tan(\theta)$

---

**Q14:** The Laplace transform of $y''(t)$ *is*

B. $sy(0) - y'(0)$

B. $sy(0) - y'(0)$

C. $s^2y(t) - sy(0) - y'(0)$

D. $s^2y(1) - sy(0) - y'(0)$

---

**Q15:** Find the second order derivative of $y = 9\ log\ t^3$.

A) $\frac{27}{t^2}$

B) $-\frac{27}{t^2}$

C) $-\frac{1}{t^2}$

D) $-\frac{27}{2t^2}$

---

**Q16 :** If the function $f(x)$ is even, then which of the following is zero?

A. $a_n$

B. $b_n$

C. $a_0$

D. nothing is zero

**Q17:** The solution of the differential equation $y'' - 10y' + 25y = 0$ is:

A. $y = c_1 x e^{-5x} - c_2 e^{5x}$

B. $y = c_1 e^{5x} + c_2 x e^{5x}$

C. $y = c_1 e^{5x} + c_2 e^{-5x}$

D. $y = c_1 e^{-25x} + c_2 e^{25x}$

---

**Q18:** Using beta function the evaluation of the integral $\int_0^1 x^5 (1-x)^4 \, dx$ is

B. $\frac{5!\,4!}{10!}$

B. $\frac{6!\,5!}{12!}$

C. $\frac{10!}{5!4!}$

D. $\frac{6!\,4!}{12!}$

---

**Q19:** The partial derivative of the function $f(x;\ y;\ z) = e^{1-xcosy} + z\, e^{y}$ with respect to $x$ at the point $(1;\ 0;\ \pi)$.

A. $-1$

B. $\frac{-1}{e}$

C. $\pi$

D. 0

---

**Q20:** The value of $\frac{\partial z}{\partial y} = 8x^3 + 6xy^2 + 4$. What is the function z expressed as?

A. $z = 8x^3 + 2x^2\, y^2 + 4x$

B. $z = 8x^3 y + 2x\, y^3 + 4y$

C. $z = 8y + 2xy^2 + 4y$

D. $z = 16x + 6y^2$

---

**Q21:** While solving a partial differential equation using a variable separable method, we equate the ratio to a constant which?

A . can be positive or negative integer or zero

B. must be a negative integer

C. must be a positive integer

D. can be positive or negative rational number or zero

---

**Q22:** The scalar product of $5i + j - 3k$ and $3i - 4j + 7k$ is

A. 15

B. -15

C. 10

D. -10

**Q23:** The inverse Laplace transform of $\frac{4}{s(s^2-16)}$ *is*

*A.* $\int_0^t sinh4x\ dx$ *B.* $\int_0^t cosh4x\ dx$

*C.* $sinh4t$ *D.* $cosh4x$

**Q24:** Consider the following partial differential equation $z_{xx} + B\,z_{xy} - z_{yy} = 0$. For this equation to be classified as hyperbolic, the value of $B$ must be

A. 3 B. 2

C. 0 D. 1

**Q25:** The rectangular equation of the polar equation $4r\cos\theta + r\sin\theta = 8$ is

A. $y = -8 - 4x$ B. $y = 8 + 4x$

C. $y = -8 + 4x$ D. $y = 8 - 4x$

**Q26:** The solution of the differential equation $2y'' - 5y' - 3y = 0$ is:

*A.* $y = c_1xe^{6x} - c_2e^{6x}$ *B.* $y = c_1e^{-x/2} + c_2e^{3x}$

*C.* $y = c_1e^{2x} - c_2e^{-3x}$ *D.* $y = c_1e^{-2x} + c_2e^{x/3}$

**Q27:** Cross product of two vectors can be used to find?

A. area of rectangle *B.* area of parallelogram square

C. area of square *D.* perimeter of rectangle

**Q28:** The partial differential equation $5\frac{\partial^2 z}{\partial x^2} + 6\frac{\partial^2 z}{\partial y^2} = xy$ is classified as

A. Elliptic B. parabolic

C. hyperbolic D. none of the above

**Q29:** Find $a_n$ if the function $f(x) = x$

A. finite value B. infinite value

C. zero D. can't be found

**Q30:** Integrate $\int 2x\ cos\ (x^2 + 3)$.

A. $sin\ (x^2 + 3) + C$

B. $sin^2\ (x^2 + 3) + C$

C. $cot\ (x^2 + 3) + C$

D. $-sin\ (x^2 + 3) + C$

---

**Q31:** the Laplace transform of the $\int_0^t \cos h6x\ dx$ is

A. $\frac{s}{s(s^2+36\_)}$

B. $\frac{s}{s(s^2-36\_)}$

C. $\frac{s}{s^2-36}$

D. $\frac{6}{s^2+36}$

---

**Q32:** The scalar product of 5i + j – 3k and 3i – 4j + 7k is

A. -10

B. -15

C. 15

D. 10

---

**Q33:** The order of the D.E $7\frac{d^2y}{dx^2} - 6\frac{dy}{dx} = 1$ is

A. 4

B. 2

C. 3

D. 1

**Q34:** A point from a vector starts is called ____ and where it ends is called its ____.

A) origin, endpoint

B) terminal point, endpoint.

C) initial point, terminal point

D) initial point, endpoint

---

**Q35:** Find $\frac{\partial z}{\partial x}$ where $z = ax^2 + 2by^2 + 2bxy$.

A. $3by$

B. $2ax$

C. $3(ax + by)$

D. $2(ax + by)$

---

**Q36:** $xy^3(\frac{dy}{dx})^2 + xy^2 + \frac{dy}{dx} = 0$ is a _____

A. Second order, third degree, linear differential equation

B. First order, third degree, non-linear differential equation

C. First order, third degree, linear differential equation

D. Second order, third degree, non-linear differential equation

---

**Q37:** The solution of the differential equation $y'' + 11y' + 24y = 0$ is:

A. $y = c_1e^{-8x} + c_2e^{-3x}$ $B.$ $y = c_1e^{8x} + c_2xe^{8x}$

$C.$ $y = c_1e^{3x} + c_2e^{-3x}$ $D.$ $y = c_1e^{-9x} + c_2e^{-9x}$

**Q38:** If vectors |A.B| = |A×B|, then angle between A and B is

A) 90° B) 60°

C) 45° D) 30°

**Q39:** If differentiation of any function is zero at any point and constant at other points then it means?

A. Function is parallel to x-axis at that point B. Function is parallel to y-axis at that point

C. Function is constant D. Function is discontinuous at that point

---

**Q40:** What is the value of β(3,2)?

A) $\frac{1}{14}$ B) $\frac{1}{16}$

C) $\frac{1}{12}$ D) $\frac{1}{10}$

---

**Q41:** Solution of the differential equation $\frac{dy}{dx} = 6y^2x$ *is* at $y(1) = \frac{1}{25}$

A) $y(x) = \frac{1}{28-3x^2}$ B) $y(x) = \frac{1}{28+3x^2}$

C) $y(x) = \frac{1}{25-3x^2}$ D) $y(x) = \frac{1}{25-3x^2}$

---

**Q42:** If the function f(x) is odd, then which of the only coefficient is present?

A. $a_n$ B. $b_n$

C. $a_0$ D. everything is present

---

**Q43:** The solution of the differential equation $3y'' + 2y' - 8y = 0$ is:

A. $y = c_1e^{-\frac{8}{3}x} + c_2e^{-3x}$ $B.$ $y == c_1xe^{-\frac{8}{3}x} + c_2e^{-3x}$

$C.$ $y = c_1e^{4x} + c_2e^{-2x}$ $D.$ $= c_1e^{\frac{4}{3}x} + c_2e^{-2}$

Q44: Which of the given qualities is a vector?

A) Velocity B) Weight

C) Time D) Volume

---

Q45: The Laplace transform of $e^{4t}\ sin2t$ *is*

A. $\frac{s-4}{(s^2-4)^2+4}$ *B.* $\frac{2}{(s^2-4)^2+4}$

*C.* $\frac{2}{(s^2-4)^2+2}$ *D.* $\frac{s-2}{(s^2-4)^2+2}$

---

Q46: The inverse Laplace transform of $\frac{6}{s}-\frac{1}{s-8}$ *is*

A. $6-e^{-8t}$ *B.* $6+e^{8t}$

*C.* $6-e^{8t}$ *D.* $6t-e^{8t}$

---

**Q47:** The constant $b_n$ of the half range Fourier cosine series is equal

A) 1 B) $\frac{2}{l}\int x\ cos\frac{n\pi x}{l}dx$

C) $\frac{2}{l}\int x\ sin\frac{n\pi x}{l}dx$ D) 0

---

**Q48:** What is the value of $\frac{d}{dx}\ (sin\ x\ tan\ x)$?

A) $sin\ x\ +\ tan\ x\ sec\ \ x$ B) $cos\ x\ +\ tan\ x\ sec\ x$

C) $sin\ x + \tan x$ D) $sin\ x\ +\ tan\ x\ sec^2 x$

---

**Q49:** $f(x,y) = x^2\ +\ xyz\ +\ z\ then\ \frac{\partial f}{\partial x}\ at\ (1,1,1) is$

A. 0 B. 1

C. 3 D. -1

---

**Q50:** In half range cosine Fourier series, we assume the function to be _____

A. Odd function B) Even function

C) Can't be determined D) Can be anything

## Mechanical Vibration:

① The equation of motion for a single degree of freedom undamped system is:

ⓐ $M\ddot{x} + C\dot{x} + Kx = 0$ ⓑ $m\ddot{x} + Kx = 0$

ⓒ $\ddot{x} + Kx = 0$ ⓓ $M\ddot{x} = Kx$

② The unit of natural frequency ($\omega_n$) is:

ⓐ m/s ⓑ rad/s

ⓒ $Hz \cdot S$ ⓓ N/m

③ Which of following factors affect the natural frequency of mechanical system?

ⓐ mass only ⓑ stiffness only

ⓒ Both mass and stiffness ⓓ Damping Coefficient only.

④ In the absence of damping and external force, the total mechanical energy of a vibrating system is:

ⓐ Constant ⓑ increasing

ⓒ Decreasing ⓓ Zero

⑤ Forced vibration occurs when:

ⓐ The system vibrates at its natural frequency

ⓑ An external periodic force is applied to the system.

ⓒ The damping in the system is zero.

ⓓ The system is isolated from all forces.

⑥ In a hormonic forced vibration, the system reaches steady-state after:

ⓐ The first cycle ⓑ infinite time

ⓒ Transient vibrations die out. ⓓ damping is removed.

---

⑦ The equation of motion for damped forced vibration is:

ⓐ $m\ddot{x}+Kx=0$ ⓑ $m\ddot{x}+C\dot{x}+Kx=F_0\cos(\omega t)$

ⓒ $m\ddot{x}+Kx=F_0\cos(\omega t)$ ⓓ $m\ddot{x}+C\dot{x}=0$

---

⑧ The term of "Amplitude Ratio" in forced vibration is refer to:

ⓐ Ratio of damping to stiffness.

ⓑ Ratio of forcing frequency to natural frequency.

ⓒ Ratio of amplitude under force to static displacement

ⓓ Natural frequency squared.

---

⑨ Base excitation refers to:

ⓐ A force applied directly to the mass.

ⓑ Displacement of the support or foundation.

ⓒ Vibration due to internal damping.

ⓓ Thermal expansion of base.

---

⑩ Eccentricity in rotating mechainery causes:

ⓐ pure torsional vibration.

ⓑ vibration due to imbalance of mass.

ⓒ Axial deformation.

ⓓ change in stiffness.

(11) The Logarithmic decrement for damped system is Calculated as:

(a) $\delta = \frac{2\pi}{\xi}$ (b) $\delta = \frac{1}{n} \ln \frac{x_0}{x_n}$

(c) $\delta = \xi . \omega_n$ (d) $\delta = \xi^2$

---

(12) The unit of measurment for Accelerometers is usually:

(a) m (b) $m/sec^2$

(c) m/sec (d) Hz

---

(13) The degree of freedom (Dof) of system refers to:

(a) Number of external forces acting on the System.

(b) Number of masses in the System.

(c) Number of independent Cordinates required to describe the motion.

(d) Number of Springs in the System.

---

(14) The equation of motion for two degree of freedom system lead to:

(a) One differential equation.

(b) Two algebric equations

(c) Two Coupled differntial equations.

(d) A single Scalar equation.

(15) In two degree of freedom systems natural frequenics are:

(a) Always equal frequencies.
(b) Always in multiples of frist frequency.
(c) Determined by mass and stiffness matrix.
(d) Independent of system Configuration.

---

(16) A Two-mass, Two-spring system Connected in Series typically has:

(a) one Dof (b) Two Dof
(c) Three Dof (d) Zero Dof

---

(17) A mode shape represents:

(a) The magnitude of damping.
(b) The static deflection.
(c) The shape of the system during free vibration at a Specific natural frequency.
(d) A forced response pattern.

---

(18) For springs $k_1 = 100\ N/m$, $k_2 = 200\ N/m$ in parallel, the equivalent stiffness is:

(a) 100 N/m (b) 200 N/m
(c) 300 N/m (d) 66.67 N/m

(19) The natural frequency of a torsional system is given by:

(a) $\sqrt{\frac{M}{K}}$ (b) $\sqrt{\frac{K_t}{I}}$

(c) $\sqrt{\frac{K}{m}}$ (d) $\sqrt{\frac{I}{K_t}}$

---

(20) Damping ratio $\zeta = 1$ indicates:

(a) undamped. (b) underdamped.

(c) critically. (d) over damped.

# Fluid Mechanics:

**Q1:** Two parallel plates, one moving at 4 m/s and the other stationary, are separated by 5 mm thick layer of oil with specific gravity ($\delta$ =0.8) and kinematic viscosity ($\upsilon = 1.25\times10^{-4}$ $m^2/s$). **What is the average shear stress in the oil?** Take the densities of water 1000 $kg/m^3$.

A. 80 Pa
B. 100 Pa
C. 125 Pa
D. 160 Pa

---

**Q2:** Determined the location of the pressure center over the surface that immersed in a liquid.

A. always above the centroid
B. will be at the centroid
C. will be below the centroid
D. All are true

---

**Q3:** Bulk modulus is the ratio of what

A. Shear stress to volumetric strain
B. volumetric strain to shear stress
C. compressive stress to volumetric strain
D. volumetric strain to compressive stress

---

**Q4:** An open tank contains 1 m deep water with 50 cm depth of oil of specific gravity 0.8 above it (g=9.81 $m/s^2$). The intensity of pressure at the bottom of tank will be

A. 4 $kN/m^2$
B. 10 $kN/m^2$
C. 12 $kN/m^2$
D. 14 $kN/m^2$

---

**Q5:** In the Turbulent flow of entrance region length to the diameter of pipe is equal to:

A. 0.6 $Re_D^2$
B. 0.08 $Re_D^{1/2}$
C. 4.4 $Re_D^{1/3}$
D. 4.4 $Re_D^{1/6}$

---

**Q6:** Mercury does not wet glass. This is due to property of liquid known as

A. adhesion
B. cohesion
C. surface tension
D. viscosity

---

**Q7:** A rectangular block 2 m long, 1 m wide and 1 m deep floats in water, the depth of immersion being 0.5 m. If water weighs 10 kN/$m^3$, then calculate the weight of the block.

C. 5 KN
D. 10 KN
C. 15 KN
D. 20 KN

---

**Q8:** The bulk modulus of elasticity ..... with an increase in pressure.

C. increases
D. decreases
C. remains constant
D. increases first up to certain limit and then decreases

---

**Q9:** The pressure at the surface of the ocean is 1 atm (1 $\times 10^5$ Pa). At what approximate depth in the ocean water ($\rho$ = 1025 kg/$m^3$) would the absolute pressure be 2 atm, Take g = 10 m/$s^2$?

C. 1 m
D. 5 m
C. 10 m
D. 100 m

---

**Q10:** An ideal flow of any fluid must fulfill the following

C. Newton's law of motion
D. Newton's law of viscosity
C. Pascal' law
D. Continuity equation

---

**Q11:** Density of water is maximum at:

C. 0 °C
D. 0 K
C. 4 °C
D. 100 °C

**Q12:** A uniform solid body weights 4 kg in air and 3.5 kg in water. What is its specific gravity?

C. 4.0 D. 7.5

C. 8.0 D. 0.5

**Q13:** Calculate the specific volume for one-liter of a certain fluid weighs 8N?

E. $2.03 \times 10^{-3}$ $m^3/kg$ F. $20.3 \times 10^{-3}$ $m^3/kg$

C. $12.3 \times 10^{-3}$ $m^3/kg$ D. $1.23 \times 10^{-3}$ $m^3/kg$

**Q14:** The three sections of the pipe shown in Figure (1) have areas $A_1$, $A_2$, and $A_3$. The speeds of the fluid passing through each section of the pipe are $v_1$, $v_2$, and $v_3$, respectively. The areas are related by $A_2 = 4A_1 = 8A_3$. Assume the fluid flows horizontally. Then, which of the following is true of the speeds of the fluid in each section in the pipe?

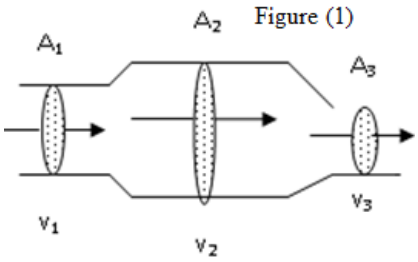

Figure (1)

E. $v_3 = 2v_1$ F. $v_3 = 6v_2$

C. $v_2 = ½\ v_1$ D. $v_2 = 16v_1$

**Q15:** A fluid is said to be ideal, if it is

E. Incompressible. F. Inviscous and incompressible.

C. Viscous and incompressible. D. Inviscous and compressible.

**Q16:** Specific weight of water in S.I. units is equal to

E. $1000\ N/m^3$ F. $10000\ N/m^3$

C. $9.81 \times 10^3\ N/m^3$ D. $9.81 \times 10^6\ N/m^3$

---

**Q17:** If mercury in a barometer is replaced by water, the height of 3.75 cm of mercury will be following cm of water?

E. 51 cm F. 50 cm

C. 52 cm D. 51.7 cm

---

**Q18:** A 15-kg steel gas tank holds 300 L of liquid gasoline, having a density of 800 $kg/m^3$. If the system is decelerated with 6 $m/s^2$ what is the needed force?

E. 1250 N F. 1000 N

C. 1530 N D. 1770 N

---

**Q19:** Prove the **Torque** unite in (N.m) by using this formula

$$\left[T = \mu \frac{2\pi\omega L R^3}{l}\right]$$

---

**Q20:** What is viscosity? What is the cause of it in liquids and in gases? Do liquids or gases have higher dynamic viscosities?

---

**Q21** What is surface tension? What is it caused by? Why the surface tension is also called surface energy?

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**Q22:** Explain why some people experience nose bleeding and some others experience shortness of breath at high elevations.

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**Q23:** You dive 5 m down in the ocean ($\rho$ = 997 $kg/m^3$). What is the **absolute pressure** there in which of the following choices**?**

---

**Q24:** You dive 5 m down in the ocean (ρ = 997 kg/m$^3$). What is the **absolute pressure** there in which of the following choices**?**

---

**Q25:** What **pressure difference** in (kPa) does a 10 m column of atmospheric air (ρ=1.2 kg/m$^3$) show in which of the following choices**?**

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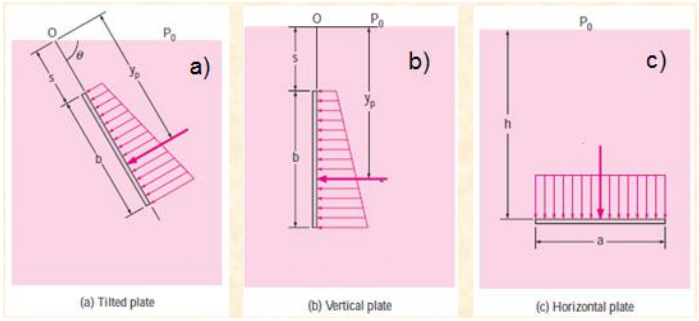
**Q26:** Calculate the Hydrostatic force that acting on the top surface of a submerged rectangular plate for **a) tilted, b) vertical, and c) horizontal cases**.?

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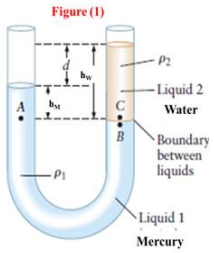
**Q27:** The U-tube in the following **Figure (1)** has a 2 cm ID ( internal diameter) and contains mercury as shown. If 30 cm$^3$ of water is poured into the right-hand leg, **calculate the height of each fluid inside the U-tube in centimetre unit**. Take the The densities of water, and mercury are given to be 998 kg/m$^3$, and 13,550 kg/m$^3$, respectively.

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**Q28:** In **Figure (2)** two parallel plates, one moving at 4 m/s and the other stationary, are separated by 5 mm thick layer of oil with specific gravity (**δ** =0.8) and kinematic viscosity ($\upsilon = 1.25*10^{-4}$ $m^2/s$). **Calculated the average shear stress in the oil.** Take the densities of water 1000 $kg/m^3$, and using this formula $\upsilon = \mu/\rho$.

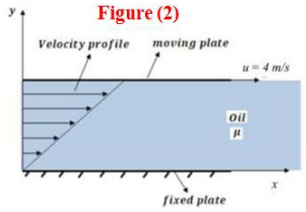

Figure (2)

**Q29: what the difference etween the normal stress, shear stress?**

**Q30: Explain the meta centric?**

## Heat Transfer:

1. Nusselt Number (Nu) defined as

a. The ratio of the heat flow by radiation process under a unit temperature gradient to the heat flow rate by convection under a unit temperature gradient through a stationary thickness (L).

b. the ratio of the heat flow by convection process under a unit temperature gradient to the heat flow rate by conduction under a unit temperature gradient through a stationary thickness (L).

c. the ratio of the heat flow by conduction process under a unit temperature gradient to the heat flow rate by convection under a unit temperature gradient through a stationary thickness (L).

d. the ratio of the heat flow by conduction process under a unit temperature gradient to the heat flow rate by radiation under a unit temperature gradient through a stationary thickness (L).

1. In free con-vection heat transfer, Nusselt number is function of

(a) Grashoff no. and Reynold no.

(b) Grashoff no. and Prandtl no.

(c) Prandtl no. and Reynold no.

(d) Grashoff no., Prandtl no. and Reynold no.

(e) none of the above.

2. The unit of stefan poltzmann constant is

a. W/m.k
b. $W^2/m^2.k$
c. $W/m^2.k^4$
d. $W/m^2.k^3$
e. None of the above

3. In liquids and gases, heat transmission is primarily caused by

A. Radiation

B. Conduction

C. Convection

D. Conduction as well as convection.

4. Heat transfer in liquid and gases takes place by

(a) conduction

(b) convection

(c) radiation

(d) conduction and convection

(e) convection and radiation.

5. The concept of overall coefficient of heat transfer is used in heat transfer problems of

(a) conduction

(b) convection

(c) radiation

(d) all the three combined

(e) conduction and convection.

6. In forced convection, the heat transfer depends primarily on:

(a) Fluid properties only
(b) Surface roughness
(c) External means of fluid movement
(d) Radiation from the surface

7. Which of the following is the correct dimensionless number used in forced convection heat transfer analysis?

(a) Grashof number

(b) Nusselt number

(c) Stefan number

(d) Rayleigh number

8. In turbulent flow, the Nusselt number is generally:
   (a) Constant
   (b) Directly proportional to the Reynolds number
   (c) Inversely proportional to Prandtl number
   (d) Independent of the flow
9. In forced convection, increasing the velocity of the fluid typically:
   (a) Decreases the heat transfer coefficient
   (b) Has no effect on the heat transfer coefficient
   (c) Increases the heat transfer coefficient
   (d) Decreases the Reynolds number
10. The formela to calculate the Nusselt number for the force convection over flat plate is
   (a) $Nu = \frac{hd}{k}$
   (b) $Nu = \frac{h}{k}$
   (c) $Nu = \frac{k}{hL}$
   (d) $Nu = \frac{hL}{k}$

12. A device used to transfer heat between two or more fluids is called a:

   (a) Radiator
   (b) Heat exchanger
   (c) Condenser
   (d) Evaporator

13. Which of the following is NOT a type of heat exchanger?

   (a) Shell and tube
   (b) Plate
   (c) Jet
   (d) Finned tube

14. In a counter-flow heat exchanger, the two fluids:

(a) Flow parallel in the same direction
(b) Flow in opposite directions
(c) Flow perpendicular to each other
(d) The two fluids are mix

15. The effectiveness of a heat exchanger is defined as:

(a) Ratio of heat lost to heat gained
(b) Ratio of actual heat transfer to maximum possible heat transfer
(c) Ratio of outlet to inlet temperature
(d) Inverse of NTU

16. The critical Reynolds number for the force convection in external flow over flat plate is

G. $5 \times 10^{10}$ H. $6 \times 10^{6}$

I. $2300$ J. $5 \times 10^{5}$

17. Heat exchanger with a hot fluid inlet temperature of 75 °C and cold fluid inlet temperature is 25 °C. Through the heat exchanger, the temperature difference of the minimum fluid is 30°C. calculate the heat exchanger effectiveness.

A. 50% B. 60%

C. 70% D. 80%

18. In parallel flow double pipe heat exchanger the hot fluid inters at 90 °C and leaves at 60 °C. the cold fluid inters at 25 °C and leaves at 55 °C. calculate the Log Mean Temperature Difference.

A. 20.13 B. 25.55

C. 27.57 D. 23.39

19. The critical Reynolds number for the force convection in internal flow inside tube is

A. 50000 B. 5000000

C. 2300 D. 500000

20. The Log Mean Temperature Difference (LMTD) method is used when:

A. Effectiveness is unknown
B. Heat capacity rates are equal
C. Inlet and outlet temperatures of both fluids are known
D. NTU method fails

21. When the effectiveness of a heat exchanger is 1, it means:

A. The heat exchanger is inefficient
B. The outlet temperatures are equal
C. Maximum possible heat transfer is achieved
D. Heat transfer is zero

22. The Number of Transfer Units (NTU) is defined as:

A. $NTU = \frac{hA}{C_{min}}$
B. $NTU = \frac{UA}{C_{min}}$
C. $NTU = \frac{UA}{C_{max}}$
D. $NTU = \frac{A}{C_{min}}$

23. Natural convection occurs due to:

A. External force applied on fluid
B. Density differences due to temperature variation
C. Mechanical stirring
D. Pressure difference applied externally

*24. The Grashof number is the ratio of:*

A. Viscous forces to buoyant forces
B. Inertial forces to viscous forces
C. Buoyant forces to viscous forces
D. Buoyant forces to inertial forces

25. Which dimensionless number characterizes natural convection?

A. Reynolds number
B. Prandtl number
C. Grashof number
D. Stanton number

26. The heat transfer coefficient in natural convection is generally:

A. Higher than in forced convection
B. Lower than in forced convection
C. Same as forced convection
D. Independent of temperature gradient

Q2: fill the blanks.

1. All radiation incident the black body are ……..
2. A hot fluid enters the counter flow heat exchanger at 100°C and leaves at 60°C. A cold fluid enters the heat exchanger at 40°C and leaves at 60. Therefore, the Log Mean Temperature Difference for the heat exchanger equel to …….
3. …….. is neither created nor destroyed it can only change one form to another.
4. …….. is the type of heat transfer transferred in the vacuum.

## Thermodynamics :

**Q1: Choose the correct answer for each of the following:**

**1.** …….. those that are independent of the mass of a system.

**A.** Intensive properties **B.** Extensive propertie **C.** Equilibrium

**2.** If as a special case, even energy is not allowed to cross the boundary, that system is called ……

**A.** Isolated system **B.** Adiabatic process **C.** Specific weight

**3.** A process during which there is no heat transfer called ……

**A.** Adiabatic process **B.** Isolated process **C.** State

**4.** ……. is a process during which the temperature (T) remains constant.

**A.** Isothermal process **B.** Isobaric process **C.** Isochoric process

**5.** If the density of mercury is (13600 $Kg/m^3$), then the specific gravity of mercury is …….

**A.** 13.6 **B.** 15.9 **C.** 20.2

**6.** ……. is defined as a quantity of matter or a region in space chosen for study

**A.** System **B.** Process **C.** Path

**7.** If the properties of the liquid do not change with time, it is called ……. process.

**A.** Steady **B.** Unsteady **C.** Uniform

**8.** ……..if two bodies are in thermal equilibrium with a third body, they are also in thermal equilibrium with each other.

**A.** Second Law **B.** The zeroth law **C.** First Law

**9.** Through throttling devices ……..

**A.** $h_1 > h_2$ **B.** $h_1 \cong h_2$ **C.** $h_1 < h_2$

**10.** …… is the sum of the internal energy (U) and the product of pressure (P) and volume (V).

**A.** Power **B.** Enthalpy **C.** Work done

**11.** The work done (W) during an isobaric process (constant pressure) for an ideal gas is:

**A.** $W = T(V_2 - V_1)$ **B.** $W = P(V_2 + V_1)$ **C.** $W = P(V_2 - V_1)$

**12.** Potential energy (PE) is …….

**A.** $mgz$ **B.** $\frac{mV^2}{2}$ **C.** $AV$

**13.** The gas constant (R) is equal to the …….

**A.** $C_p + C_v$ **B.** $\frac{C_p}{C_v}$ **C.** $C_p - C_v$

**14.** The efficiency of (*Stirling cycle*) is …… (*Carnot cycle*).

**A.** Greater than **B.** Less than **C.** Equal to

**15.** Diesel cycle consists of ……..

**A.** one constant pressure, one constant volume, and two isentropic.

**B.** Two constant Pressure and two isentropic.

**C.** Two constant volume and two isentropic.

**16.** The value of specific heat ratio for air is ……

**A.** 1 **B.** 1.4 **C.** 1.9

**17.** Otto cycle is also known as …….

**A.** Constant volume cycle **B.** Constant pressure cycle **C.** Constant temperature cycle

**18.** The entropy generation ($S_{gen}$) for reversible process …….

**A.** $S_{gen} = 0$ **B.** $S_{gen} > 0$ **C.** $S_{gen} < 0$

**19.** During (Isobaric process), …….

**A.** $P_1 = P_2$ **B.** $V_1 = V_2$ **C.** $T_1 = T_2$

**20.** In closed cycle gas turbine, the air is compressed ……..

**A.** Isothermally **B.** Isentropically **C.** Polytropically

## Metallurgical Engineering

Q1: Which of the following best describes a *crystalline material*?

A) A material with no long-range atomic order

B) A solid composed of random molecular chains

C) A material with atoms arranged in a repeating 3D pattern

D) A gas at room temperature

Q2: The smallest repeating unit in a crystal lattice is called the:

A) Cell wall

B) Crystal face

C) Unit cell

D) Primitive plane

Q3: Which of the following metals has a Body-Centered Cubic (BCC) crystal structure at room temperature?

A) Aluminum

B) Copper

C) Chromium

D) Lead

Q4: Face-Centered Cubic (FCC) crystal structures are generally:

A) Less dense and weak

B) Highly ductile with close-packed atoms

C) Brittle and directional

D) Non-metallic and insulators

Q5: The theoretical density of a crystalline metal can be calculated using which of the following parameters?

A) Atomic weight, Avogadro's number, and atomic radius

B) Unit cell volume, number of atoms/unit cell, and atomic weight

C) Grain size and crystal orientation

D) Specific heat and thermal conductivity

Q6: Which metal would have the highest density assuming similar atomic radii?

A) A metal with a BCC structure

B) A metal with a simple cubic structure

C) A metal with an FCC structure

D) A metal with amorphous arrangement

Q7: The Miller indices for a plane that intercepts the x-axis at 1, the y-axis at 2, and is parallel to the z-axis are:

A) (1 2 ∞)

B) (2 1 0)

C) (1 2 0)

D) (2 1 ∞)

Q8: The family of equivalent planes in a cubic system is represented using:

A) Curly brackets {hkl}

B) Parentheses (hkl)

C) Square brackets [hkl]

D) Angle brackets ⟨hkl⟩

Q9: Linear density is defined as:

A) Number of atoms per unit volume

B) Number of planes in a unit length

C) Number of atoms centered on a direction vector per unit length

D) Number of voids per unit distance

Q10: Which direction in the FCC structure has the highest linear density?

A) [100]

B) [110]

C) [111]

D) [010]

Q11: A crystal contains 1 vacancy per $10^8$ atoms. If the total number of atoms in the crystal is $2 \times 10^{23}$, how many vacancies are present?

A) $2 \times 10^{15}$

B) $2 \times 10^{13}$

C) $2 \times 10^{14}$

D) $2 \times 10^{12}$

Q12: Schottky defects increase with temperature. If the number of defects at 500 K is $1 \times 10^{15}$, and activation energy is 1.5 eV, which factor most likely increases the defects significantly?

A) Lowering pressure

B) Increasing crystal purity

C) Raising temperature

D) Removing interstitials

Q13: A metal alloy contains 12 g of Cu and 4 g of Sn. What is the weight percent of Sn in the alloy?

A) 25%

B) 20%

C) 33%

D) 40%

Q14: An alloy has 5 atomic percent of component B. If the atomic weights are A = 60 g/mol and B = 100 g/mol, what is the weight percent of B?

A) 10.5%

B) 7.8%

C) 20.0%

D) 30.5%

Q15: A metallurgical microscope has a total magnification of 800×. If the eyepiece magnification is 10×, what is the magnification of the objective lens?

A) 80×

B) 10×

C) 800×

D) 100×

Q16: In an SEM image, a feature measures 2 mm on screen and the scale bar indicates 10 µm = 1 mm. What is the actual size of the feature?

A) 10 µm

B) 15 µm

C) 20 µm

D) 5 µm

Q17: In interstitial diffusion, the diffusing atoms:

A) Replace host atoms

B) Migrate through voids between host atoms

C) Remain stationary

D) Move with the lattice

Q18: Compared to substitutional diffusion, interstitial diffusion is:

A) Slower due to size mismatch

B) Faster due to smaller atom size

C) Equal in rate

D) Only occurs at high temperatures

Q19: In steady-state diffusion, the concentration gradient:

A) Changes with time

B) Is constant with time

C) Increases with time

D) Is zero everywhere

Q20: Fick's First Law applies best to:

A) Non-steady state diffusion

B) Transient diffusion

C) Steady-state diffusion

D) Diffusion in gases only

Q21: Which of the following does NOT influence the rate of diffusion?

A) Temperature

B) Atomic size

C) Grain size

D) Color of the material

Q22: If the temperature is increased, the diffusion coefficient:

A) Increases

B) Decreases

C) Remains constant

D) Becomes zero

Q23" The diffusion rate is typically higher in:

A) Crystalline solids

B) Liquids

C) Amorphous solids

D) Gases

Q24: Which equation describes the temperature dependence of the diffusion coefficient?

A) $D = D_0 * \exp(-Q/RT)$

B) $D = kT$

C) $D = P/RT$

D) $D = \sigma/\varepsilon$

Q25: Stress is defined as:

A) Force per unit length
B) Force per unit volume
C) Force per unit area
D) Area per unit force

Q26: Strain is a measure of:

A) Deformation per unit area
B) Deformation per unit length
C) Load applied to a material
D) Resistance to fracture

Q27: In elastic deformation, the material:

A) Fractures under stress
B) Returns to original shape after load removal
C) Becomes permanently deformed
D) Melts when heated

Q28: The slope of the linear portion of a stress-strain curve is:

A) Yield strength
B) Elastic modulus
C) Fracture toughness
D) Ductility

Q29: Anelastic behavior in materials refers to:

A) Time-dependent elastic recovery
B) Instantaneous elastic recovery

C) Irreversible deformation D) Viscous flow only

Q30: Which material typically has the highest Young's modulus?

A) Rubber B) Aluminum

C) Steel D) Diamond

Q31: Poisson's ratio is defined as the ratio of:

A) Axial stress to strain B) Lateral strain to axial strain

C) Elastic modulus to strain D) Plastic strain to total strain

Q32: Plastic deformation occurs:

A) After the material fractures B) Below the elastic limit

C) Beyond the yield point D) During unloading

Q33: The ability of a material to deform permanently without breaking is called:

A) Toughness B) Hardness

C) Ductility D) Stiffness

Q34: The yield strength of a material is:

A) The stress at fracture

B) The stress where elastic behavior ends

C) The total strain at failure

D) The slope of the stress-strain curve

Q35: Dislocations in crystals are responsible for:

A) Increasing electrical resistance

B) Enhancing thermal conductivity

C) Plastic deformation

D) Increasing optical properties

Q36: The motion of dislocations under applied stress is called:

A) Creep

B) Fracture

C) Slip

D) Twinning

Q37: The Burgers vector describes:

A) The speed of dislocation motion

B) The direction of applied force

C) The magnitude and direction of lattice distortion

D) Crystal grain size

Q38: Edge dislocations are characterized by:

A) A helical distortion

B) An extra half-plane of atoms

C) A missing plane of atoms

D) Grain boundary sliding

Q39: The energy of a dislocation is proportional to:

A) Grain size

B) Burgers vector squared

C) Dislocation velocity

D) Temperature

Q40: Deformation by twinning differs from slip because:

A) It involves dislocation motion

B) It reorients the crystal lattice

C) It only occurs at high temperatures

D) It breaks atomic bonds

Q41: Twinning is most commonly observed in:

A) FCC metals

B) BCC metals

C) Amorphous solids

D) HCP metals

Q42: One main feature of twinning is that:

A) It is reversible

B) It produces a mirror-image orientation

C) It occurs slowly over time

D) It requires a grain boundary

Q43: A metal has a Burgers vector of 0.286 nm and a dislocation line length of 1 μm. If the energy per unit length is proportional to $b^2$, which is the dislocation energy per μm (in arbitrary units)?

A) 0.082

B) 0.286

C) 0.000082

D) 0.000286

Q44: If the shear stress required to move a dislocation is $\tau = Gb / L$, where G = 25 GPa, b = 0.25 nm, and $L = 10^{-6}$ m, calculate $\tau$.

A) 6.25 MPa

B) 25 MPa

C) 12.5 MPa

D) 50 MPa

## Machines Design:

Below is a curated list of 100 multiple-choice questions in Machine Design, organized into 10 core topics with 10 questions each. Each question is suitable for graduate-level written interviews, and some include instructions for figures where needed.

**1. Static Failure**

1. The maximum distortion energy theory is best suited for:
   a) Brittle materials under uniaxial tension
   b) Ductile materials under static loading
   c) Materials under cyclic loading
   d) Rigid materials under compression

2. For a brittle material, the preferred failure theory is:
   a) Maximum shear stress theory
   b) Maximum distortion energy theory
   c) Maximum normal stress theory
   d) Strain energy theory

3. A shaft is subjected to bending stress $\sigma_b$=80 MPa and torsional stress $\tau$ =50 MPa. The equivalent von Mises stress is:
   a) 96.8 MPa
   b) 114.6 MPa
   c) 130.0 MPa
   d) 145.5 MPa

4. *(2D stress element with σx=100 MPa, σy=−50 MPa, τxy=30 MPa).* The maximum shear stress is:
   a) 75 MPa
   b) 85.4 MPa
   c) 92.2 MPa
   d) 100.6 MPa

5. The factor of safety for a ductile material under static loading is calculated using:
   a) Ultimate tensile strength / Working stress
   b) Yield strength / Working stress
   c) Endurance limit / Working stress
   d) Shear strength / Working stress

6. For a material with yield strength *Sy*=400 MPa, the maximum shear stress theory predicts failure when:
   a) $\tau_{max} = 200$ MPa
   b) $\tau_{max} = 400$ MPa
   c) $\sigma_1 = 400$ MPa
   d) $\sigma_1 - \sigma_3 = 400$ MPa

7. A thin-walled pressure vessel (radius = 500 mm, thickness = 10 mm) carries internal pressure. The principal stresses are:
   a) Hoop: $pd/2t$, Longitudinal: $pd/4t$
   b) Hoop: $pd/t$, Longitudinal: $pd/2t$
   c) Hoop: $pd/2t$, Radial: $-p$
   d) Hoop: $pd/t$, Radial: $-p/2$

8. The von Mises stress for pure torsion is:
   a) Equal to the shear stress
   b) 33 times the shear stress
   c) Half the shear stress
   d) Twice the shear stress

9. A component has $\sigma 1$=120 MPa, $\sigma 2$=−60 MPa. Using maximum normal stress theory (*Sut* =200 MPa), the factor of safety is:
   a) 1.25
   b) 1.67
   c) 2.00
   d) 3.33

10. Stress concentration in static failure is ignored for ductile materials because:
    a) Ductile materials have low toughness
    b) Plastic deformation redistributes stress
    c) Yield strength is strain-rate dependent
    d) Brittle materials have higher *Kt*

---

**2. Fatigue & Dynamic Failure**

1. The endurance limit of steel:
   a) Decreases with surface roughness
   b) Is unaffected by mean stress
   c) Is the stress for failure at 103103 cycles
   d) Is higher than its ultimate strength

2. The S-N curve for aluminum alloys:
   a) Shows a distinct endurance limit

b) Continuously declines with cycles
c) Is independent of temperature
d) Has a slope of -1/10

3. The fatigue stress concentration factor *Kf* is related to *Kt* by:
   a) $K_f = K_t$
   b) $K_f = 1 + q(K_t - 1)$
   c) $K_f = q/K_t$
   d) $K_f = K_t/q$

4. *(Modified Goodman diagram).* For $\sigma m$=100 MPa, $\sigma a$=150 MPa, *Sut*=600 MPa, *Se* =300 MPa, the factor of safety is:
   a) 1.2
   b) 1.5
   c) 1.8
   d) 2.0

5. Shot peening improves fatigue life by:
   a) Reducing surface roughness
   b) Introducing compressive residual stresses
   c) Increasing hardness
   d) Refining grain structure

6. The stress ratio $R=-1$ implies:
   a) Zero mean stress
   b) Pulsating tension
   c) Fully reversed loading
   d) Static compression

7. Miner's rule is used for:
   a) Cumulative fatigue damage
   b) Crack propagation rate
   c) Stress concentration
   d) Endurance limit estimation

8. Fatigue failure typically initiates:
   a) At the core of the material
   b) At surface discontinuities
   c) Under compressive stress
   d) In high-ductility regions

9. For a rotating beam specimen, the stress is:
   a) Constant amplitude
   b) Random amplitude
   c) Fully reversed
   d)

10. non-proportional

11. The size factor in endurance limit calculations:
    a) Is negligible for small components
    b) Reduces *Se* for larger diameters
    c) Increases with surface finish
    d) Depends on Poisson's ratio

---

**3. Material Selection & Properties**

1. High strength-to-weight ratio is a key advantage of:
    a) Cast iron
    b) Titanium alloys
    c) Mild steel
    d) Brass

2. Creep resistance is critical for components operating:
    a) Below 0°C
    b) At high temperatures
    c) Under cyclic loading
    d) In corrosive environments

3. The Charpy test measures:
    a) Hardness
    b) Impact toughness
    c) Fatigue strength
    d) Young's modulus

4. Case hardening improves:
    a) Core ductility
    b) Surface hardness
    c) Uniform strength
    d) Thermal conductivity

5. Poisson's ratio ν for most metals is approximately:
    a) 0.1
    b) 0.3
    c) 0.5
    d) 1.0

6. Stainless steel is preferred for:
    a) High thermal conductivity

b) Corrosion resistance

c) Low cost

d) Magnetic properties

7. The endurance limit of steel is approximately:

   a) 0.2 *Sut*

   b) 0.5 *Sut*

   c) 0.7 *Sut*

   d) *Sut*

8. Resilience is the ability to absorb energy under:

   a) Plastic deformation

   b) Impact loading

   c) Elastic deformation

   d) Cyclic loading

9. Grey cast iron has:

   a) High tensile strength

   b) Excellent weldability

   c) Good damping capacity

   d) High ductility

10. The modulus of elasticity *E* is a measure of:

    a) Stiffness

    b) Strength

    c) Toughness

    d) Hardness

**4. Bolts & Screws**

1. M10 × 1.5 bolt designation implies:
   a) 10 mm pitch, 1.5 mm diameter
   b) 10 mm diameter, 1.5 mm pitch
   c) 10 mm length, 1.5 mm thread depth
   d) 10 mm head size, 1.5 mm pitch

2. Pre-tension in bolts:
   a) Reduces fatigue strength
   b) Prevents loosening under dynamic loads
   c) Decreases stiffness
   d) Increases shear stress

3. The bolt stiffness $k_b$ is:
   a) Proportional to length
   b) Inversely proportional to length
   c) Independent of length
   d) Proportional to d2*d*2

4. *(Bolted joint under external tensile load).* The load shared by the bolt is:

   a) $F_e \frac{k_b}{k_b+k_m}$
   b) $F_e \frac{k_m}{k_b+k_m}$
   c) $F_e(k_b - k_m)$
   d) $F_e/k_b$

5. Proof strength is:
   a) The stress causing permanent deformation
   b) The ultimate tensile strength
   c) The yield strength
   d) The shear strength

6. Torque-tension relationship is given by $T=K \cdot F \cdot d$, where $K$ is:
   a) Thread angle
   b) Friction coefficient factor
   c) Material constant
   d) Pitch

7. A bolt under combined tension and torsion has equivalent stress calculated using:
   a) Maximum normal stress theory
   b) Maximum shear stress theory
   c) Distortion energy theory
   d) Strain energy theory

8. Thread stripping failure occurs in:
   a) The bolt shank
   b) The nut threads
   c) The bolt head
   d) The washer

9. Lock washers are used to:
   a) Distribute load
   b) Prevent corrosion

c) Resist loosening
d) Reduce stress concentration

10. The stress area of a bolt thread is based on:
    a) Minor diameter
    b) Major diameter
    c) Pitch diameter
    d) Mean diameter

**5. Welding**

1. The throat area of a fillet weld is:
    a) 0.707×leg size×length
    b) leg size×length
    c) 0.5×leg size×length
    d) leg size2×length

2. *(Fillet weld under transverse loading).* Critical stress is:
    a) Tensile stress
    b) Compressive stress
    c) Shear stress
    d) Bending stress

3. Weld reinforcement increases:
    a) Strength
    b) Fatigue life
    c) Stress concentration
    d) Ductility

4. Residual stresses in welding are caused by:
    a) Rapid cooling
    b) Low heat input
    c) Uniform heating
    d) Low melting point

5. Shielded Metal Arc Welding (SMAW) uses:
    a) non-consumable electrode
    b) Consumable electrode with flux
    c) Inert gas shield
    d) Laser beam

6. Undercut in welding is a:
    a) Surface defect
    b) Subsurface porosity

c) Crack in HAZ
d) Slag inclusion

7. Preheating before welding reduces:
   a) Distortion
   b) Hardness in HAZ
   c) Risk of cracking
   d) All of the above

8. The heat-affected zone (HAZ) has:
   a) Higher toughness than base metal
   b) Altered microstructure
   c) Lower hardness
   d) No residual stress

9. For fatigue loading, the best weld joint type is:
   a) Lap joint
   b) Butt joint with reinforcement
   c) Butt joint ground flush
   d) T-joint

10. Electrode designation E7018 indicates:
    a) Tensile strength = 70 ksi, welding position = all
    b) Yield strength = 70 ksi, electrode coating
    c) Tensile strength = 700 MPa, current type
    d) Hardness = 70 HRC, flux type

**6. Coil Springs**

1. Spring index $C$ is defined as:
   a) $D/d$ (mean coil diameter / wire diameter)
   b) $d/D$
   c) $G/E$
   d) $N/d$

2. Wahl correction factor accounts for:
   a) Shear stress due to curvature
   b) Bending stress
   c) Tensile stress
   d) Buckling

3. For a helical spring, deflection $\delta$=:
   a) $\frac{8FD^3N}{Gd^4}$
   b) $\frac{FD^3}{Gd^4}$
   c) $\frac{8FDN}{Gd^3}$
   d) $\frac{\pi FD^3N}{Gd^4}$

4. Two springs in series have equivalent stiffness:
   a) $k_1 + k_2$
   b) $\frac{k_1 k_2}{k_1 + k_2}$
   c) $\frac{k_1 + k_2}{k_1 k_2}$
   d) $\sqrt{k_1 k_2}$

5. Spring surge occurs when:
   a) Natural frequency matches excitation frequency
   b) Load exceeds yield strength
   c) Buckling occurs
   d) Corrosion is present

6. For high-stress applications, use:
   a) Phosphor bronze
   b) Music wire
   c) Aluminum
   d) Copper

7. The active coils in a compression spring:
   a) Exclude end coils
   b) Include end coils
   c) Are ground flat
   d) Carry no load

8. A spring with squared and ground ends has:
   a) $N$ active coils, $N$+2 total coils
   b) $N$ active coils, $N$ total coils
   c) $N$+2 active coils, $N$ total coils
   d) Variable pitch

9. Clash allowance prevents:
   a) Buckling
   b) Solid stress
   c) Corrosion
   d) Fatigue

10. Torsion springs are designed for:
    a) Axial loads
    b) Bending stress
    c) Shear stress
    d) Compression

**7. Roller & Sliding Bearings**

1. Basic dynamic load rating $C$ for bearings is defined for:
   a) $10^6$ revolutions with 90% reliability
   b) Static load capacity
   c) $10^3$ revolutions
   d) Infinite life

2. Life $L_{10}$ of a bearing is inversely proportional to:
   a) $P$ (load)
   b) $P^3$
   c) $P^{10/3}$
   d) $P^{1/3}$

3. Tapered roller bearings support:
   a) Radial loads only
   b) Axial loads only
   c) Combined radial and axial loads
   d) Moment loads only

4. Hydrodynamic bearings rely on:
   a) Rolling elements
   b) Fluid film pressure
   c) Solid lubrication
   d) Magnetic levitation

5. The Sommerfeld number is a function of:
   a) Load, speed, viscosity, clearance
   b) Temperature, material, surface finish
   c) Bearing diameter, length, friction
   d) Elastic modulus, Poisson's ratio

6. *(Bearing with radial load $Fr$=5 kN, axial load $Fa$=2 kN). For $X$=0.56, $Y$=1.5, equivalent load $P$=:
   a) 5.0 kN
   b) 5.6 kN
   c) 6.2 kN
   d) 7.0 kN

7. Cage in rolling bearings:
   a) Increases friction
   b) Separates rolling elements
   c) Carries load
   d) Reduces noise

8. Stribeck curve illustrates:
   a) Fatigue life vs. load
   b) Friction vs. speed

c) Temperature vs. viscosity
d) Wear vs. time

9. Boundary lubrication occurs when:
   a) Fluid film is thick
   b) Surfaces contact asperities
   c) Hydrodynamic pressure is high
   d) Temperature is low

10. Static load rating ensures:
    a) No permanent deformation
    b) Infinite fatigue life
    c) No wear
    d) Low friction

**8. Spur & Helical Gears**

1. Module $m$ is:
   a) Diameter/teeth no.
   b) Teeth no./diameter
   c) $\pi$/circular pitch
   d) 25.4/diametral pitch

2. To avoid interference, minimum pinion teeth for $\phi$=20 degree is:
   a) 12
   b) 14
   c) 18
   d) 20

3. Helical gears have:
   a) Higher noise than spur gears
   b) Lower load capacity
   c) Axial thrust
   d) Only parallel shaft mounting

4. Lewis form factor $Y$ depends on:
   a) Module
   b) Pressure angle and teeth number
   c) Face width
   d) Material

5. AGMA standards are used for:
   a) Gear design and rating
   b) Material selection only
   c) Lubrication viscosity
   d) Shaft alignment

6. *(Gear pair with center distance $C$=150 mm, $Np$=20, $Ng$=40). Module is:
   a) 2 mm
   b) 3 mm
   c) 4 mm
   d) 5 mm

7. Backlash is:
   a) Clearance between mating teeth
   b) Transmission error
   c) Axial play
   d) Radial runout

8. Gear hardening improves:
   a) Pitting resistance
   b) Noise reduction
   c) Lubrication
   d) Weight reduction

9. For high-speed gears, preferred tooth profile is:
   a) 14.5° involute
   b) 20° involute
   c) Cycloidal
   d) Trochoidal

10. Bevel gears transmit motion between:
    a) Parallel shafts
    b) Intersecting shafts
    c) Non-parallel non-intersecting shafts
    d) Flexible shafts

**9. Clutches & Brakes**

1. Torque in a disc clutch is proportional to:
   a) Number of friction surfaces
   b) Cube of radius
   c) Axial force
   d) All of the above

2. Self-energizing in brakes causes:
   a) Reduced actuating force
   b) Higher wear
   c) Fade
   d) Vibration

3. Brake fade is due to:
   a) Low friction at high temperature
   b) Moisture on lining

c) Wear
d) Vibration

4. Band brake tension ratio $T1/T2$=:
   a) $e^{\mu\theta}$
   b) $e^{-\mu\theta}$
   c) $\mu\theta$
   d) $1/\mu\theta$

5. Cone clutch advantage over disc clutch:
   a) Lower actuating force
   b) Simpler design
   c) No axial thrust
   d) Higher heat dissipation

6. Hydraulic brakes use:
   a) Pascal's law
   b) Bernoulli's principle
   c) Leverage
   d) Centrifugal force

7. Material for brake linings should have:
   a) High μ$\mu$ and heat resistance
   b) Low wear resistance
   c) High thermal conductivity
   d) Low compressive strength

8. Uniform wear theory assumes:
   a) Constant pressure
   b) Linear wear rate
   c) Variable $\mu$
   d) Temperature-dependent $\mu$

9. Disc brakes over drum brakes offer better:
   a) Heat dissipation
   b) Self-energizing
   c) Dust resistance
   d) Cost

10. Centrifugal clutch engages at:
    a) Low speed
    b) Critical speed
    c) High speed
    d) Variable speed

**10. Belts & Chains**

1. Velocity ratio for belt drives is:
   a) $D_{driver}/D_{driven}$
   b) $D_{driven}/D_{driver}$
   c) $N_{driver}/N_{driven}$
   d) $N_{driven}/N_{driver}$

2. Creep in belts is caused by:
   a) Elastic stretching
   b) Centrifugal force
   c) Bending stress
   d) Wear

3. V-belt wedge action increases friction by factor:
   a) $\mu / \sin \beta$
   b) $\mu \sin \beta$
   c) $\mu / \cos \beta$
   d) $\mu \cos \beta$

4. Initial belt tension affects:
   a) Power transmission
   b) Bending stress
   c) Centrifugal tension
   d) All of the above

5. Chain drives compared to belts:
   a) Slip less
   b) Are quieter
   c) Require less lubrication
   d) Have lower efficiency

6. Polygon effect in chains causes:
   a) Speed fluctuation
   b) Wear
   c) Noise
   d) All of the above

7. *(Open belt drive with $D1$=200 mm, $D2$=400 mm, $C$=1 m). Belt length is:
   a) 2.5 m
   b) 2.8 m
   c) 3.1 m
   d) 3.4 m

8. Belt material for high-temperature use:
   a) Leather
   b) Neoprene

c) Urethane
d) Steel-reinforced rubber

9. Idler pulleys adjust:
   a) Speed ratio
   b) Tension
   c) Power
   d) Direction

10. Roller chain pitch is:
    a) Distance between pins
    b) Roller diameter
    c) Width of chain
    d) Link length

# Manufacturing Process

عمليات تصنيع 2024/ 2025 تنافسي

أختر الاجابة الصحيحة لكل مما يأتي

**1- من اهم محاسن الفرن العاكس انه لايوجد دخول لعناصر مثل ..... الى المنصهر**

**2- في عملية الدرفلة يتم سحب المعدن بين الدرفيلين بوساطة.....**

**3- حدوث سطح فصل او قطع في استمرارية المسبوكة بسبب التقاء مجريين من المعدن بانصهار غير تام يسمى**

**4- معدل الانتاج الاعلى والخواص الميكانيكية الاعلى نحصل عليها من خلال الحدادة في**

**5- اهم مواد التبطين الحامضيه المستخدمة في تبطين الافران هي**

6- **جودة المنتج العاليه والكفاءه الحرارية العاليه تعتبر من محاسن**

**7- تهدف مرحلة الاختزال في انتاج الفولاذ الى التخلص من الاوكسجين المذاب وتقليل نسبة..... الى الحد المسموح**

**8- قيام الكلوريدات المعدنيه بامتصاص الرطوبه ودخولها الى المنصهر ينتج**

**9- اضافة مركبات او عناصر تتحد مع الهيدروجين المذاب في المعاملة بالمركبات الكونة للهيدريدات ومنها**

**10- يمكن تمييز السحب العميق عن السحب الضحل عندما يكون نسبة**

**11- يتراوح محتوى الشوائب المعدنيه المسموح بها في سبائك النحاس ذات الاستخدامات التقنيه الى**

**12- قابلية الرمل على تصريف الغازات من القالب بصورة منتظمة تسمى**

13- **الذي يقوم بتغذية المعدن السائل الى المجرى ويمنع ذوبان الغازات في المعدن السائل هو**

**14- الطريقة المستخدمة في صناعة الحلي والاعمال الفنيه ومثبتات الاسنان هي**

**15- الطريقة المستخدمة في انتاج المحاور القلابة وقواعد المكائن هي**

**16- البنيه البلورية الناعمة المنتجة ذات الخواص الميكانيكية العالية نحصل عليها من احد طرق السباكة هي**

**17- عدم التثبيت الصحيح لنصفي الصندوق مع لعضهما اوعدم تطابقهما بشكل صحيح في عملية السبكة يسمى**

**18- جد سرعة المعدن عند قاعدة المصب ومعدل الجريان الحجمي وزمن ملئ القالب اذا علمت ان ارتفاع المصب 20سم ومساحة مقطع قاعدته 2.5سم$^2$ وان حجم تجويف القالب 1560سم$^3$**

**19- توليد كمية كبيرة من الشرر والدخان وتتطلب عمليات تنظيف مسبقة لحافات اللحام يعد من محددات اللحام ب**

**20- الحاجة الى الفراغ بالاضافة الى مخاطر الاشعة السينية تعتبر من محددات طريقة لحام**

**21- تقسم عمليات الحدادة حسب نوع العملية الى..... بينما تقسم حسب المعدات المستخدمة الى.....**

**22- : عند القطع بسرعة 250 م/ دقيقة كان عمر اداة القطع 9 دقائق. ماهي سرعة القطع التي تعطي عمر للاداة مقداره 160 دقيقة اذا علمت ان قيمة الاس 0.22**

**23- القوة التي تؤثر في عملية الخراطة في مستوى افقي وبصورة عمودية على محور المشغولة تسمى**

**24- المأخذ الرئيسي على العدد السيراميكية والحاجة الى استخدام زاوية جرف سالبة هو**

**25- تحتاج عمليات سحب الاسلاك الى عمليات تخمير وسطية بين التمريرات**

**27- جد القوة اللازمة لسحب سلك من قطر ابتدائي 2.5 ملم الى قطر نهائي 2ملم خلال قالب مخروطي زاويته $\alpha=7.5$ اذا علمت ان معامل الاحتكاك بين الخامة والقالب هو 0.07 وان**

**$k=250$ Mpa $n=0.2$**

**28- القلاووظ عدة خاصة تستخدم في**

**29- العدد المستخدمة في القطع عند سرع تتراوح بين 200- 2000 م/ دقيقة هي**

**أ30- تجهز المكابس الهيدروليكية قدرة اعلى بكثير من المكابس اليكانيكية اذ يمكن لسعتها ان تصل الى**