



INSTITUTE OF ENGINEERING

Model Entrance Exam

(Set-13)

Instructions:

There are 100 multiple-choice questions, each having four choices of which only one choice is correct.

- 20) If $\sin \theta + \cos \theta = \sin 2\theta + \cos 2\theta$, then θ is equal to:
 a) $\frac{\pi}{6}$ b) $\frac{\pi}{3}$ c) $\frac{\pi}{4}$ d) $\frac{\pi}{2}$
- 21) If $\sec^{-1} x = \operatorname{cosec}^{-1} y$, then the value of $\cos^{-1} \frac{1}{x} + \cos^{-1} \frac{1}{y}$ is:
 a) $\frac{\pi}{4}$ b) $\frac{\pi}{6}$ c) $\frac{\pi}{2}$ d) π
- 22) $\lim_{x \rightarrow 0} \frac{e^x - e^{-x}}{\sin x} =$
 a) 1 b) -1 c) 3 d) 2
- 23) A function defined by $f(x) = \frac{|x-2|}{(x-2)}$ is:
 a) continuous at $x = 2$
 b) discontinuous at $x = 2$
 c) continuous at $x = 2$ and discontinuous at $x = -2$
 d) continuous on \mathfrak{R}
- 24) If $y = e^{\sqrt{2x}}$, then $\frac{dy}{dx} =$
 a) $\frac{e^{\sqrt{2x}}}{\sqrt{2x}}$ b) e^{2x} c) $\frac{e^{\sqrt{2x}}}{2}$ d) $\sqrt{2}e^{\sqrt{2x}}$
- 25) $\int \frac{1+\cos^2 x}{\sin^2 x} dx =$
 a) $-\cot 2x - 2x + c$ b) $-2 \cot x - 2x + c$
 c) $-2 \cot x - x + c$ d) $-2 \cot x + x + c$
- 26) $\int_0^a \frac{dx}{a^2+x^2} =$
 a) $\frac{\pi}{a}$ b) $\frac{\pi}{2a}$ c) $\frac{\pi}{3a}$ d) $\frac{\pi}{4a}$
- 27) The function $y = x^3 + 3x^2 - 9x + 2$ has point of inflection at:
 a) $x = -2$ b) $x = 3$
 c) $x = \frac{1}{2}$ d) $x = -1$
- 28) The least number of subsets of a non-empty set is:
 a) 1 b) 4 c) 3 d) 2
- 29) The range of the function $f(x) = e^x + 1$ is:
 a) $(1, \infty)$ b) $\mathbb{R} - \{0\}$ c) $(0, \infty)$ d) $(-\infty, \infty)$
- 30) If $A = \begin{bmatrix} -3 & 4 \\ 2 & -1 \end{bmatrix}$, then its characteristic roots are:
 a) 1, 5 b) 6, 1 c) 1, -5 d) -1, 5
- 31) If $x + iy = (a - ib)$, then $(x - iy) =$
 a) $a - ib$ b) $2(a + ib)$ c) $\frac{1}{a+ib}$ d) $a + ib$
- 32) p and q are the roots of the equation $x^2 + pq = (p + 1)x$. Then, the value of q is:
 a) -1 b) 1 c) 0 d) 2
- 33) The emitter of a transistor is doped the heaviest because it:
 a) acts as a supplier of charge carriers b) dissipates maximum power
 c) has a larger resistance d) has a small resistance
- 34) The wavelength of matter wave is independent of:
 a) mass b) velocity c) momentum d) charge
- 35) To observe diffraction, the size of the obstacle:
 a) should be $\lambda/2$, where λ is the wavelength
 b) should be of the order of wavelength
 c) has no relation to wavelength
 d) should be much larger than the wavelength
- 36) Which of the following is associated with refraction of light?
 a) working of optical fibre b) difference between apparent and real depth of a pond
 c) mirage on hot summer days d) brilliance of diamond

- 37) When an ac voltage of 220 V is applied to the capacitor C, then:
a) the maximum voltage between plates is 220 V.
b) the current is in phase with the applied voltage.
c) the charge on the plate is not in phase with the applied voltage.
d) power delivered to the capacitor per cycle is zero.
- 38) A conducting loop is placed in a uniform magnetic field with its plane perpendicular to the field. An emf is induced in the loop if it is:
a) rotated about its axis
b) rotated about a diameter
c) not moved
d) given translational motion in the field
- 39) A test charge is moved from lower potential point to a higher potential point. The potential energy of test charge will:
a) remain the same
b) increase
c) decrease
d) become zero
- 40) When a string fixed at its both ends vibrate in 1 loop, 2 loops, 3 loops and 4 loops, the frequencies are in the ratio:
a) 1: 1: 1: 1
b) 1: 2: 3: 4
c) 4: 3: 2: 1
d) 1: 4: 9: 16
- 41) A simple pendulum suspended from the roof of a lift oscillates with frequency f when the lift is at rest. If the lift falls freely under gravity, its frequency of oscillation becomes:
a) zero
b) f
c) $2f$
d) infinite
- 42) A heat engine has an efficiency η . Temperatures of source and sink are each decreased by 100 K. The efficiency of the engine:
a) increases
b) decreases
c) remains constant
d) becomes 1
- 43) If α, β, γ are coefficients of linear, superficial and volume expansion respectively, then:
a) $\frac{\beta}{\alpha} = \frac{1}{2}$
b) $\frac{\beta}{\gamma} = \frac{2}{3}$
c) $\frac{\gamma}{\alpha} = \frac{3}{2}$
d) $\frac{\beta}{\alpha} = \frac{\gamma}{\beta}$
- 44) A body is just floating on the surface of liquid. The density of the body is same as that of the liquid. If the body is slightly pushed down, then it will:
a) come back slowly to its earlier position
b) remain submerged where it is left
c) sink in liquid
d) come out vigorously
- 45) In motion of an object under the gravitational influence of another object, which of the following quantities is not conserved?
a) Angular momentum
b) Mass of an object
c) Total mechanical energy
d) Linear momentum
- 46) The displacement of a body is given to be proportional to the cube of time elapsed. The magnitude of acceleration of the body is:
a) increasing with time
b) decreasing with time
c) constant but not zero
d) zero
- 47) When water is cooled to ice, its entropy:
a) increases
b) decreases
c) remains same
d) becomes zero
- 48) Total number of metal atoms per unit cell in a face-centered cubic lattice is:
a) 14
b) 8
c) 6
d) 4
- 49) Number of atoms of oxygen present in 10.6 g of Na_2CO_3 will be:
a) 6.02×10^{22}
b) 12.04×10^{22}
c) 1.806×10^{23}
d) 31.8×10^{28}
- 50) For azimuthal quantum number $l = 3$, the maximum number of electrons will be:
a) 2
b) 6
c) 0
d) 14
- 51) The molecule having smallest bond angle is:
a) NCl_3
b) $AsCl_3$
c) $SbCl_3$
d) PCl_3
- 52) Hydrogen can be prepared by the action of dil. H_2SO_4 on:
a) Cu
b) Pb
c) Fe
d) Hg
- 53) The metallurgical process in which a metal is obtained in a fused state is called:
a) smelting
b) roasting
c) calcination
d) froth floatation

- 64) He first worked under President McKinley in what capacity?
 a) assistant Navy secretary during the Spanish-American War
 b) police commissioner
 c) governor of New York
 d) civil service reformer
- 65) The equation $x - y = 4$ and $x^2 + 4yx + y^2 = 0$ represents the side of:
 a) an equilateral triangle
 b) a right-angled triangle
 c) an isosceles triangle
 d) a scalene triangle
- 66) If $y = mx$ lies outside the circle $x^2 + y^2 - 20y + 90 = 0$, then:
 a) $|m| > 3$
 b) $|m| < 3$
 c) $m > 3$
 d) $m < 3$
- 67) The area of a triangle formed by joining the vertex and the end points of latus rectum of $x^2 = 12y$ is:
 a) 12
 b) 18
 c) 24
 d) 36
- 68) If length of perpendicular from origin on a plane be 7 and it dr's be -3, 2, 6, then it's equation will be:
 a) $3x - 2y + 6z + 7 = 0$
 b) $-3x + 2y - 6z - 49 = 0$
 c) $-3x + 2y + 6z - 7 = 0$
 d) $-3x + 2y + 6z - 49 = 0$
- 69) The vector \vec{a} lies in the plane of \vec{b} and \vec{c} , then which of the following is correct?
 a) $\vec{a} \cdot \vec{b} \times \vec{c} = -1$
 b) $\vec{a} \cdot \vec{b} \times \vec{c} = 1$
 c) $\vec{a} \cdot (\vec{b} \times \vec{c}) = 0$
 d) $\vec{a} \cdot \vec{b} \times \vec{c} = 3$
- 70) The mean of 50 observations is 36. If two observations 30 and 42 are to be excluded, then the mean of the remaining observations will be:
 a) 36
 b) 38
 c) 48
 d) 50
- 71) In a triangle ABC, $\angle C = \frac{\pi}{2}$. If its inradius and circumradius be r and R respectively, then $2(r + R)$ is equal to:
 a) $a + b$
 b) $b + c$
 c) $c + a$
 d) $a + b + c$
- 72) The coefficient of r^{th} and $(r + 1)^{th}$ term in the expansion of $(1 + x)^{20}$ are in the ratio 1:2, then $r =$
 a) 6
 b) 8
 c) 9
 d) 7
- 73) If $T_n = \frac{3^n}{2(n!)} - \frac{1}{2(n!)}$, then $S_\infty =$
 a) $\frac{e^3 - 1}{2}$
 b) $\frac{e^3 - e}{2}$
 c) $\frac{e - 3}{2}$
 d) $\frac{e^2 - 3}{2}$
- 74) A committee of 5 is to be formed out of 6 gentlemen and 4 ladies. In how many ways this can be done if at least 2 ladies are included?
 a) 186
 b) 200
 c) 316
 d) 420
- 75) For $f(x) = x^2$ and $g(x) = 2^x$, the solution set of $f \circ g(x) = g \circ f(x)$ is:
 a) \mathbb{R}
 b) \mathbb{Z}^+
 c) $\{0\}$
 d) $\{0, 2\}$
- 76) Sum of $3 + 3\alpha + 3\alpha^2 + \dots + \infty$ is equal to $\frac{45}{8}$, ($\alpha > 0$), then $\alpha =$
 a) $\frac{3}{16}$
 b) $\frac{1}{4}$
 c) $\frac{7}{15}$
 d) $\frac{5}{8}$
- 77) $\lim_{x \rightarrow 0} \left(\frac{1+2x}{1-3x} \right)^{\frac{1}{x}} =$
 a) e^2
 b) e^3
 c) e^4
 d) e^5
- 78) If $x = a(t + \sin t)$ and $y = a(1 - \cos t)$, then $\frac{dy}{dx} =$
 a) $\cot t$
 b) $2 \sin t \cos t$
 c) $\tan \frac{t}{2}$
 d) $-\tan t$
- 79) The area between the curves $x^2 = 4by$ and the ordinate at the point $(b, 0)$ is:
 a) $4b^2$
 b) $\frac{b^2}{12}$
 c) $\frac{4b^2}{3}$
 d) $\frac{2b^2}{3}$
- 80) The integrating factor of the differential equation $\frac{dy}{dx}(x \log x) + y = 2 \log x$ is:
 a) $\log x$
 b) e^x
 c) $\log(\log x)$
 d) x
- 81) At a given instant, there are 25% undecayed radioactive nuclei in a sample. After 10 seconds, the number of undecayed nuclei reduces to 12.5%, then the mean life of the nuclei is:

- a) 10.21 s b) 14.43 s c) 5.31 s d) 7.43 s
- 82) The wavelength of radiation emitted is λ_0 when an electron jumps from the third to second orbit of hydrogen atom. For the electron jumping from the fourth to the second orbit of the hydrogen atom, the wavelength of radiation emitted will be:
a) $(16/25)\lambda_0$ b) $(20/27)\lambda_0$ c) $(27/20)\lambda_0$ d) $(25/16)\lambda_0$
- 83) When the angle of incidence is 60° on the surface of a glass slab, it is found that the reflected ray is completely polarized. The velocity of light in glass is:
a) $\sqrt{2} \times 10^8$ m/s b) $\sqrt{3} \times 10^8$ m/s c) 2×10^8 m/s d) 3×10^8 m/s
- 84) A monochromatic light is incident at a certain angle on an equilateral triangular prism and suffers minimum deviation. If the refractive index of the material of the prism is $\sqrt{3}$, then the angle of incidence is:
a) 60° b) 45° c) 90° d) 30°
- 85) A circular coil of 25 turns and radius of 12 cm is placed in a uniform magnetic field of 0.5 T normal to the plane of coil. If the current in the coil is 5 A, then the total torque experienced by the coil is:
a) 1.5 Nm b) 2.5 Nm c) 3.5 Nm d) zero
- 86) The battery of a trunk has an emf of 24 V. If the internal resistance of the battery is 0.8Ω , the maximum current that can be drawn from the battery is:
a) 30 A b) 32 A c) 33 A d) 34 A
- 87) Consider a thin spherical shell of radius R consisting of uniform surface charge density σ . The electric field at a point outside the shell at a distance x from its centre is:
a) inversely proportional to σ b) directly proportional to x^2
c) directly proportional to R d) inversely proportional to x^2
- 88) A train standing at the outer signal of a railway station blows a whistle of frequency 400 Hz in still air. The train begins to move with a speed of 30 m/s towards the platform. The frequency of the sound heard by an observer standing on the platform is (speed of sound in air = 330 m/s):
a) 420 Hz b) 430 Hz c) 440 Hz d) 450 Hz
- 89) The temperature of 'n' moles of an ideal gas is increased from T to 4T through a process for which pressure $P = aT^{-1}$, where 'a' is a constant. Then, the work done by the gas is:
a) nRT b) $4nRT$ c) $2nRT$ d) $6nRT$
- 90) A steel wire can support a maximum load of W before reaching its elastic limit. How much load another wire, made out of identical steel, but with a radius one half the radius of the first wire, support before reaching its elastic limit?
a) W b) W/2 c) W/4 d) 4W
- 91) When a solid sphere rolls without slipping down an inclined plane making an angle θ with the horizontal, the acceleration at its centre of mass is a. If the same sphere slides without friction, its acceleration a' will be:
a) $\frac{7}{2}a$ b) $\frac{5}{7}a$ c) $\frac{7}{5}a$ d) $\frac{5}{2}a$
- 92) A shell is fired from a fixed artillery gun with an initial speed u such that it hits the target on the ground at a distance R from it. If t_1 and t_2 are the values of the time taken by it to hit the target in two possible ways, the product $t_1 t_2$ is:
a) R/g b) R/4g c) R/2g d) 2R/g
- 93) 1.0 g of Magnesium is burnt with 0.56 g O_2 in a closed vessel. Which reactant is left in excess and how much?
a) Mg, 0.16 g b) O_2 , 0.16 g c) Mg, 0.44 g d) O_2 , 0.28 g
- 94) When $KMnO_4$ reacts with KBr in alkaline medium, bromate ion is formed. The oxidation state of Mn changes from +7 to:
a) +6 b) +4 c) +3 d) +2
- 95) For the reaction equilibrium, $N_2O_4(g) \rightleftharpoons 2NO_2$, the concentration of N_2O_4 and NO_2 at equilibrium are 4.8×10^{-2} and 1.2×10^{-2} mol L^{-1} respectively. The value of K_c for the reaction is:
a) 3.3×10^2 mol L^{-1} b) 3×10^{-3} mol L^{-1}

