

Set Code : **T2**

Booklet Code : **B**

Note: (1) Answer all questions.

(2) Each question carries 1 mark. There are no negative marks.

(3) Answer to the questions must be entered only on OMR Response Sheet provided separately by completely shading with H.B. Pencil, only one of the circles 1, 2, 3 or 4 provided against each question, and which is most appropriate to the question.

(MET)

METALLURGICAL ENGINEERING
INSTRUCTIONS TO CANDIDATES

1. Candidates should write their Hall Ticket Number only in the space provided at the top left hand corner of this page, on the leaflet attached to this booklet and also in the space provided on the OMR Response Sheet. **BESIDES WRITING, THE CANDIDATE SHOULD ENSURE THAT THE APPROPRIATE CIRCLES PROVIDED FOR THE HALL TICKET NUMBERS ARE SHADED USING H.B. PENCIL ONLY ON THE OMR RESPONSE SHEET. DO NOT WRITE HALL TICKET NUMBER ANY WHERE ELSE.**
2. Immediately on opening this Question Paper Booklet, check:
 - (a) Whether **200** multiple choice questions are printed (**50** questions in Mathematics, **25** questions in Physics, **25** questions in Chemistry and **100** questions in Engineering)
 - (b) In case of any discrepancy immediately exchange the Question paper Booklet of same code by bringing the error to the notice of invigilator.
3. Use of Calculators, Mathematical Tables and Log books is not permitted.
4. **Candidate must ensure that he/she has received the Correct Question Booklet, corresponding to his/her branch of Engineering.**
5. **Candidate should ensure that the booklet Code and the Booklet Serial Number, as it appears on this page is entered at the appropriate place on the OMR Response Sheet by shading the appropriate circles provided therein using H.B. pencil only. Candidate should note that if they fail to enter the Booklet Serial Number and the Booklet Code on the OMR Response Sheet, their Answer Sheet will not be valued.**
6. **Candidate shall shade one of the circles 1, 2, 3 or 4 corresponding question on the OMR Response Sheet using H.B. Pencil only. Candidate should note that their OMR Response Sheet will be invalidated if the circles against the question are shaded using Black / Blue ink pen / Ball pen / any other pencil other than H.B. Pencil or if more than one circle is shaded against any question.**
7. One mark will be awarded for every correct answer. **There are no negative marks.**
8. The OMR Response Sheet will not be valued if the candidate :
 - (a) Writes the Hall Ticket Number in any part of the OMR Response Sheet except in the space provided for the purpose.
 - (b) Writes any irrelevant matter including religious symbols, words, prayers or any communication whatsoever in any part of the OMR Response Sheet.
 - (c) Adopts any other malpractice.
9. Rough work should be done only in the space provided in the Question Paper Booklet.
10. No loose sheets or papers will be allowed in the examination hall.
11. Timings of Test: 10.00 A.M. to 1.00 P.M.
12. Candidate should ensure that he / she enters his / her name and appends signature on the Question paper booklet, leaflet attached to this question paper booklet and also on the OMR Response Sheet in the space provided. Candidate should ensure that the invigilator puts his signature on this question paper booklet, leaflet attached to the question paper booklet and also on the OMR Response Sheet.
13. Before leaving the examination hall candidate should **return both the OMR Response Sheet and the leaflet attached to this question paper booklet** to the invigilator. Failure to return any of the above shall be construed as malpractice in the examination. **Question paper booklet may be retained by the candidate.**
14. This booklet contains a total of **32** pages including Cover page and the pages for Rough Work.

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(4) The OMR Response Sheet will be invalidated if the circle is shaded using ink / ball pen or if more than one circle is shaded against each question.

MATHEMATICS

1. If $A+B+C = \pi$, then $\sin 2A + \sin 2B + \sin 2C =$
(1) $4 \cos A \sin B \cos C$ (2) $4 \sin A \cos B \sin C$
(3) $4 \cos A \cos B \cos C$ (4) $4 \sin A \sin B \sin C$
2. The principal solution of $\tan x = 0$ is
(1) $x = n\pi, n \in \mathbb{Z}$ (2) $x = 0$
(3) $x = (2n+1)\pi/2, n \in \mathbb{Z}$ (4) $x = n\pi + \alpha, n \in \mathbb{Z}$
3. The value of $\tan^{-1}(2) + \tan^{-1}(3)$ is
(1) $\frac{\pi}{4}$ (2) $\frac{\pi}{2}$ (3) $\frac{\pi}{3}$ (4) $\frac{3\pi}{4}$
4. If the sides of a right angle triangle are in A.P., then the ratio of its sides is
(1) 1:2:3 (2) 2:3:4 (3) 3:4:5 (4) 4:5:6
5. The value of $r.r_1.r_2.r_3$ is
(1) Δ^2 (2) Δ^{-2} (3) Δ^{-3} (4) Δ^4
6. $\frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} =$
(1) $\frac{1}{r}$ (2) $\frac{1}{2r}$ (3) $\frac{1}{R}$ (4) $\frac{1}{\Delta}$

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7. If $a=6, b=5, c=9$, then the value of angle A is
(1) $\cos^{-1}(2/9)$ (2) $\cos^{-1}(2/5)$ (3) $\cos^{-1}(7/9)$ (4) $\cos^{-1}(1/3)$
8. The polar form of complex number $1-i$ is
(1) $\sqrt{2}e^{-i\pi/4}$ (2) $\sqrt{2}e^{i\pi/4}$ (3) $\sqrt{2}e^{i\pi/2}$ (4) $\sqrt{2}e^{-i\pi/2}$
9. If $1, \omega, \omega^2$ be the cube roots of unity, then the value of $2^{\omega^3} \cdot 2^{\omega^5} \cdot 2^{\omega}$ is
(1) ω (2) ω^2 (3) 1 (4) 0
10. The intercept made on X-axis by the circle $x^2+y^2+2gx+2fy+c=0$ is
(1) $\sqrt{g^2-c}$ (2) $\sqrt{f^2-c}$ (3) $2\sqrt{g^2-c}$ (4) $2\sqrt{f^2-c}$
11. If one end of the diameter of the circle $x^2+y^2-5x-8y+13=0$ is $(2, 7)$, then the other end of the diameter is
(1) $(3, 1)$ (2) $(1, 3)$ (3) $(-3, -1)$ (4) $(-1, -3)$
12. The radius of the circle $\sqrt{1+m^2}(x^2+y^2)-2cx-2mcy=0$ is
(1) $2c$ (2) $4c$ (3) $c/2$ (4) c
13. The parametric equations of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ are
(1) $x = a \sec\theta, y = b \tan\theta$ (2) $x = b \sin\theta, y = a \cos\theta$
(3) $x = a \cos\theta, y = b \sin\theta$ (4) $x = a \operatorname{cosec}\theta, y = b \cot\theta$
14. The equation of the directrix of the parabola $2x^2 = -7y$ is
(1) $8y+7=0$ (2) $8y-7=0$ (3) $7y+8=0$ (4) $8x-7=0$
15. The condition for a straight line $y = mx+c$ to be a tangent to the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ is
(1) $c = a/m$ (2) $c^2 = a^2m^2 - b^2$ (3) $c^2 = a^2m^2 + b^2$ (4) $c^2 = a/m$

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16. $\lim_{x \rightarrow 1} \frac{\sqrt{5x-4} - \sqrt{x}}{x-1}$ is

- (1) 3 (2) 2 (3) 4 (4) 1

17. $\log i =$

- (1) $\pi/2$ (2) $\pi/4$ (3) $i\pi/2$ (4) $i\pi/4$

18. $\frac{d}{dx} [\log_7 X] =$

- (1) $\frac{1}{x}$ (2) $X \log_7 e$ (3) $\frac{1}{x} \log_7 e$ (4) $\frac{1}{x} \log_7 e$

19. $\frac{d}{dx} [2 \cosh x] =$

- (1) $\frac{e^x + e^{-x}}{2}$ (2) $\frac{e^x - e^{-x}}{2}$ (3) $e^x + e^{-x}$ (4) $e^x - e^{-x}$

20. $\frac{d}{dx} \left[\cos^{-1} \left(\frac{1-x^2}{1+x^2} \right) \right] =$

- (1) $\frac{1}{1+x^2}$ (2) $\frac{-1}{1+x^2}$ (3) $\frac{2}{1+x^2}$ (4) $\frac{-2}{1+x^2}$

21. If $x = at^2, y = 2at$, then $\frac{dy}{dx} =$

- (1) $\sqrt{\frac{y}{x}}$ (2) $\sqrt{\frac{x}{a}}$ (3) $\sqrt{\frac{a}{x}}$ (4) $\sqrt{\frac{x}{y}}$

22. The derivative of e^x with respect to \sqrt{x} is

- (1) $\frac{2\sqrt{x}}{e^x}$ (2) $2\sqrt{x} e^x$ (3) $\frac{e^x}{2\sqrt{x}}$ (4) $\sqrt{x} e^x$

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23. The equation of the normal to the curve $y = 5x^4$ at the point (1, 5) is
(1) $x + 20y = 99$ (2) $x + 20y = 101$ (3) $x - 20y = 99$ (4) $x - 20y = 101$
24. The angle between the curves $y^2 = 4x$ and $x^2 + y^2 = 5$ is
(1) $\frac{\pi}{4}$ (2) $\tan^{-1}(2)$ (3) $\tan^{-1}(3)$ (4) $\tan^{-1}(4)$
25. If $u = x^3y^3$ then $\frac{\partial^3 u}{\partial x^3} + \frac{\partial^3 u}{\partial y^3} =$
(1) $6(x^3 + y^3)$ (2) $6x^3y^3$ (3) $6x^3$ (4) $6y^3$
26. $\int \operatorname{cosec} x \, dx =$
(1) $\log(\operatorname{cosec} x + \cot x) + C$ (2) $\log(\cot x/2) + C$
(3) $\log(\tan x/2) + C$ (4) $-\operatorname{cosec} x \cdot \cot x + C$
27. $\int_0^{\frac{\pi}{2}} \cos^{11} x \, dx =$
(1) $\frac{256}{693}$ (2) $\frac{256\pi}{693}$ (3) $\frac{\pi}{4}$ (4) $\frac{128}{693}$
28. $\int f^{-1}(x) [f(x)]^n \, dx =$
(1) $\frac{[f(x)]^{n-1}}{n-1} + C$ (2) $\frac{[f(x)]^{n+1}}{n+1} + C$ (3) $n[f(x)]^{n-1} + C$ (4) $(n+1)[f(x)]^{n+1} + C$
29. $\int \frac{dx}{(x+7)\sqrt{x+6}} =$
(1) $\operatorname{Tan}^{-1}(\sqrt{x+6}) + C$ (2) $2\operatorname{Tan}^{-1}(\sqrt{x+6}) + C$
(3) $\operatorname{Tan}^{-1}(x+7) + C$ (4) $2\operatorname{Tan}^{-1}(x+7) + C$

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30. $\int \tan^{-1} x \, dx =$

(1) $x \cdot \tan^{-1} x + \frac{1}{2} \log(1+x^2) + C$

(2) $\frac{1}{1+x^2} + C$

(3) $x^2 \cdot \tan^{-1} x + C$

(4) $x \cdot \tan^{-1} x - \log \sqrt{1+x^2} + C$

31. $\int \frac{dx}{1+e^{-x}} =$

(1) $\log(1+e^{-x}) + C$

(2) $\log(1+e^x) + C$

(3) $e^{-x} + C$

(4) $e^x + C$

32. $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \sin |x| \, dx =$

(1) 0

(2) 1

(3) 2

(4) -1

33. Area under the curve $f(x) = \sin x$ in $[0, \pi]$ is

(1) 4 sq. units

(2) 2 sq. units

(3) 6 sq. units

(4) 8 sq. units

34. The order of $x^3 \frac{d^3 y}{dx^3} + 2x^2 \frac{d^2 y}{dx^2} - 3y = x$ is

(1) 1

(2) 4

(3) 3

(4) 2

35. The degree of $\left[\frac{d^2 y}{dx^2} + \left(\frac{dy}{dx} \right)^2 \right]^{\frac{3}{2}} = a \frac{d^2 y}{dx^2}$ is

(1) 4

(2) 2

(3) 1

(4) 3

36. The family of straight lines passing through the origin is represented by the differential equation

(1) $y \, dx + x \, dy = 0$

(2) $x \, dy - y \, dx = 0$

(3) $x \, dx + y \, dy = 0$

(4) $x \, dx - y \, dy = 0$

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37. The differential equation $\frac{dy}{dx} + \frac{ax + hy + g}{hx + by + f} = 0$ is called
(1) Homogeneous (2) Exact (3) Linear (4) Legendre
38. The solution of differential equation $\frac{dy}{dx} = e^{-x^2} - 2xy$ is
(1) $y.e^{-x^2} = x + c$ (2) $ye^x = x + c$ (3) $ye^{x^2} = x + c$ (4) $y = x + c$
39. The complementary function of $(D^3 + D^2 + D + 1)y = 10$ is
(1) $C_1 \cos x + C_2 \sin x + C_3 e^{-x}$ (2) $C_1 \cos x + C_2 \sin x + C_3 e^x$
(3) $C_1 + C_2 \cos x + C_3 \sin x$ (4) $(C_1 + C_2 x + C_3 x^2) e^x$
40. Particular Integral of $(D-1)^4 y = e^x$ is
(1) $x^4 e^x$ (2) $\frac{x^4}{24} e^{-x}$ (3) $\frac{x^4}{12} e^x$ (4) $\frac{x^4}{24} e^x$
41. If $A = \begin{bmatrix} 3 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 3 \end{bmatrix}$, then $A^4 =$
(1) $3I$ (2) $9I$ (3) $27I$ (4) $81I$
42. If $A = \begin{bmatrix} 0 & 2 & 1 \\ -2 & 0 & -2 \\ -1 & x & 0 \end{bmatrix}$ is a skew symmetric matrix, then the value of x is
(1) 1 (2) 2 (3) 3 (4) 4
43. What is the number of all possible matrices with each entry as 0 or 1 if the order of matrices is 3×3
(1) 64 (2) 268 (3) 512 (4) 256

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44. If $A = \begin{bmatrix} 1 & i & -i \\ i & -i & 1 \\ -i & 1 & i \end{bmatrix}$, then $|A| =$

- (1) 1 (2) 2 (3) 3 (4) 4

45. The solution of a system of linear equations $2x - y + 3z = 9, x + y + z = 6, x - y + z = 2$ is

- (1) $x = -1, y = -2, z = -3$ (2) $x = 3, y = 2, z = 1$
(3) $x = 2, y = 1, z = 3$ (4) $x = 1, y = 2, z = 3$

46. If $\frac{1}{x^2 + a^2} = \frac{A}{x + ai} + \frac{B}{x - ai}$ then $A =$ _____, $B =$ _____.

- (1) $\frac{1}{2ai}, -\frac{1}{2ai}$ (2) $-\frac{1}{2ai}, \frac{1}{2ai}$ (3) $\frac{1}{ai}, -\frac{1}{ai}$ (4) $-\frac{1}{ai}, \frac{1}{ai}$

47. If $\frac{2x+4}{(x-1)^3} = \frac{A_1}{(x-1)} + \frac{A_2}{(x-1)^2} + \frac{A_3}{(x-1)^3}$ then $\sum_{i=1}^3 A_i$ is equal to

- (1) A_2 (2) $2A_2$ (3) $4A_2$ (4) $4A_1$

48. The period of the function $f(x) = |\sin x|$ is

- (1) π (2) 2π (3) 3π (4) 4π

49. If $A+B=45^\circ$, then $(1-\cot A) \cdot (1-\cot B)$ is

- (1) 1 (2) 0 (3) 2 (4) -1

50. The value of $\sin 78^\circ + \cos 132^\circ$ is

- (1) $\frac{\sqrt{5}+1}{4}$ (2) $\frac{\sqrt{5}+1}{2}$ (3) $\frac{\sqrt{5}-1}{2}$ (4) $\frac{\sqrt{5}-1}{4}$

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PHYSICS

51. The linear momentum of a particle varies with time t as $p = a+bt+ct^2$ which of the following is correct?
- (1) Force varies with time in a quadratic manner.
 - (2) Force is time-dependent.
 - (3) The velocity of the particle is proportional to time.
 - (4) The displacement of the particle is proportional to t .
52. A shell of mass m moving with a velocity v suddenly explodes into two pieces. One part of mass $m/4$ remains stationary. The velocity of the other part is
- (1) v
 - (2) $2v$
 - (3) $3v/4$
 - (4) $4v/3$
53. The velocity of a freely falling body after 2s is
- (1) 9.8 ms^{-1}
 - (2) 10.2 ms^{-1}
 - (3) 18.6 ms^{-1}
 - (4) 19.6 ms^{-1}
54. A large number of bullets are fired in all directions with the same speed u . The maximum area on the ground on which these bullets will spread is
- (1) $\frac{\pi u^2}{g^2}$
 - (2) $\frac{\pi u^4}{g^2}$
 - (3) $\frac{\pi u^2}{g^4}$
 - (4) $\frac{\pi u}{g^4}$
55. The minimum stopping distance for a car of mass m , moving with a speed v along a level road, if the coefficient of friction between the tyres and the road is μ , will be
- (1) $\frac{v^2}{2\mu g}$
 - (2) $\frac{v^2}{\mu g}$
 - (3) $\frac{v^2}{4\mu g}$
 - (4) $\frac{v}{2\mu g}$
56. When a bicycle is in motion, the force of friction exerted by the ground on the two wheels is such that it acts
- (1) In the backward direction on the front wheel and in the forward direction on the rear wheel
 - (2) In the forward direction on the front wheel and in the backward direction on the rear wheel
 - (3) In the backward direction on both the front and the rear wheels
 - (4) In the forward direction on both the front and the rear wheels

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57. In a perfectly inelastic collision, the two bodies
- (1) strike and explode (2) explode without striking
(3) implode and explode (4) combine and move together
58. Under the action of a constant force, a particle is experiencing a constant acceleration, then the power is
- (1) zero (2) positive
(3) negative (4) increasing uniformly with time
59. Consider the following two statements:
A: Linear momentum of a system of particles is zero.
B: Kinetic energy of a system of particles is zero.
Then
- (1) A implies B & B implies A
(2) A does not imply B & B does not imply A
(3) A implies B but B does not imply A
(4) A does not imply B but B implies A
60. An engine develops 10 kW of power. How much time will it take to lift a mass of 200 kg to a height of 40 m? (Given $g = 10 \text{ ms}^{-2}$)
- (1) 4s (2) 5s (3) 8s (4) 10s
61. If a spring has time period T , and is cut into n equal parts, then the time period will be
- (1) $T\sqrt{n}$ (2) $\frac{T}{\sqrt{n}}$ (3) nT (4) T
62. When temperature increases, the frequency of a tuning fork
- (1) increases
(2) decreases
(3) remains same
(4) increases or decreases depending on the materials

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63. If a simple harmonic motion is represented by $\frac{d^2x}{dy^2} + \alpha x = 0$, its time period is
- (1) $2\pi\sqrt{\alpha}$ (2) $2\pi\alpha$ (3) $\frac{2\pi}{\sqrt{\alpha}}$ (4) $\frac{2\pi}{\alpha}$
64. A cinema hall has volume of 7500 m^3 . It is required to have reverberation time of 1.5 seconds. The total absorption in the hall should be
- (1) 850 w-m^2 (2) 82.50 w-m^2
(3) 8.250 w-m^2 (4) 0.825 w-m^2
65. To absorb the sound in a hall which of the following are used
- (1) Glasses, stores (2) Carpets, curtains
(3) Polished surfaces (4) Platforms
66. If N represents avagadro's number, then the number of molecules in 6 gm of hydrogen at NTP is
- (1) $2N$ (2) $3N$ (3) N (4) $N/6$
67. The mean translational kinetic energy of a perfect gas molecule at the temperature T K is
- (1) $\frac{1}{2}kT$ (2) kT (3) $\frac{3}{2}kT$ (4) $2kT$
68. The amount of heat given to a body which raises its temperature by 1°C
- (1) water equivalent (2) thermal heat capacity
(3) specific heat (4) temperature gradient
69. During an adiabatic process, the pressure of a gas is found to be proportional to the cube of its absolute temperature. The ratio C_p/C_v for gas is
- (1) $\frac{3}{2}$ (2) $\frac{4}{3}$ (3) 2 (4) $\frac{5}{3}$

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70. Cladding in the optical fiber is mainly used to
- (1) to protect the fiber from mechanical stresses
 - (2) to protect the fiber from corrosion
 - (3) to protect the fiber from mechanical strength
 - (4) to protect the fiber from electromagnetic guidance
71. Two quantities A and B are related by the relation $A/B = m$ where m is linear mass density and A is force. The dimensions of B will be
- (1) same as that of latent heat
 - (2) same as that of pressure
 - (3) same as that of work
 - (4) same as that of momentum
72. The dimensional formula of capacitance in terms of M, L, T and I is
- (1) $[ML^2T^2I^2]$
 - (2) $[ML^{-2}T^4I^2]$
 - (3) $[M^{-1}L^3T^3I]$
 - (4) $[M^{-1}L^{-2}T^4I^2]$
73. If l , m and n are the direction cosines of a vector, then
- (1) $l + m + n = 1$
 - (2) $l^2 + m^2 + n^2 = 1$
 - (3) $\frac{1}{l} + \frac{1}{m} + \frac{1}{n} = 1$
 - (4) $lmn = 1$
74. The angle between $i+j$ and $j+k$ is
- (1) 0°
 - (2) 90°
 - (3) 45°
 - (4) 60°
75. A particle is moving eastwards with a velocity of 5 ms^{-1} . In 10 seconds the velocity changes to 5 ms^{-1} northwards. The average acceleration in this time is
- (1) $\frac{1}{\sqrt{2}} \text{ ms}^{-2}$ towards north-west
 - (2) zero
 - (3) $\frac{1}{2} \text{ ms}^{-2}$ towards north
 - (4) $\frac{1}{\sqrt{2}} \text{ ms}^{-2}$ towards north-east

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CHEMISTRY

76. Potassium metal and potassium ions
(1) both react with water (2) have the same number of protons
(3) both react with chlorine gas (4) have the same electronic configuration
77. 5.85 gms of sodium chloride were dissolved in water and the solution made up to 100 ml in a standard flask. 10 ml of this solution were pipetted out into another flask and made up with distilled water into 100 ml of solution. The concentration of the sodium chloride solution now is
(1) 0.1 M (2) 1.0 M (3) 0.5 M (4) 0.25 M
78. Concentration of a 1.0 M solution of phosphoric acid in water is
(1) 0.33 N (2) 1.0 N (3) 2.0 N (4) 3.0 N
79. Which of the following is a Lewis acid?
(1) Ammonia (2) Beryllium chloride
(3) Boron trifluoride (4) Magnesium oxide
80. Which of the following constitutes the components of a buffer solution?
(1) Potassium chloride and potassium hydroxide
(2) Sodium acetate and acetic acid
(3) Magnesium sulphate and sulphuric acid
(4) Calcium chloride and calcium acetate
81. Which of the following is an electrolyte?
(1) Acetic acid (2) Glucose (3) Urea (4) Pyridine
82. Calculate the Standard emf of the cell, $\text{Cd}/\text{Cd}^{2+}/\text{Cu}^{2+}/\text{Cu}$ given that $E^{\circ} \text{Cd}/\text{Cd}^{2+} = 0.44\text{V}$ and $E^{\circ} \text{Cu}/\text{Cu}^{2+} = (-) 0.34\text{V}$.
(1) $(-) 1.0\text{V}$ (2) 1.0V (3) $(-) 0.78\text{V}$ (4) 0.78V
83. A solution of nickel chloride was electrolysed using Platinum electrodes. After electrolysis,
(1) nickel will be deposited on the anode (2) Cl_2 gas will be liberated at the cathode
(3) H_2 gas will be liberated at the anode (4) nickel will be deposited on the cathode

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84. Which of the following metals will undergo oxidation fastest?
(1) Cu (2) Li (3) Zinc (4) Iron
85. Which of the following cannot be used for the sterilization of drinking water?
(1) Ozone (2) Calcium Oxychloride
(3) Potassium Chloride (4) Chlorine water
86. A water sample showed it to contain 1.20 mg/litre of magnesium sulphate. Then, its hardness in terms of calcium carbonate equivalent is
(1) 1.0 ppm (2) 1.20 ppm (3) 0.60 ppm (4) 2.40 ppm
87. Soda used in the L-S process for softening of water is, Chemically.
(1) sodium bicarbonate (2) sodium carbonate decahydrate
(3) sodium carbonate (4) sodium hydroxide (40%)
88. The process of cementation with zinc powder is known as
(1) sherardizing (2) zincing (3) metal cladding (4) electroplating
89. Carrosion of a metal is fastest in
(1) rain-water (2) acidulated water (3) distilled water (4) de-ionised water
90. Which of the following is a thermoset polymer?
(1) Polystyrene (2) PVC
(3) Polythene (4) Urea-formaldehyde resin
91. Chemically, neoprene is
(1) polyvinyl benzene (2) polyacetylene
(3) polychloroprene (4) poly-1,3-butadiene
92. Vulcanization involves heating of raw rubber with
(1) selenium element (2) elemental sulphur
(3) a mixture of Se and elemental sulphur (4) a mixture of selenium and sulphur dioxide

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93. Petrol largely contains
- (1) a mixture of unsaturated hydrocarbons $C_5 - C_8$
 - (2) a mixture of benzene, toluene and xylene
 - (3) a mixture of saturated hydrocarbons $C_{12} - C_{14}$
 - (4) a mixture of saturated hydrocarbons $C_6 - C_8$
94. Which of the following gases is largely responsible for acid-rain?
- (1) SO_2 & NO_2
 - (2) CO_2 & water vapour
 - (3) CO_2 & N_2
 - (4) N_2 & CO_2
95. BOD stands for
- (1) Biogenetic Oxygen Demand
 - (2) Biometric Oxygen Demand
 - (3) Biological Oxygen Demand
 - (4) Biospecific Oxygen Demand
96. The valency electronic configuration of Phosphorous atom (At.No. 15) is
- (1) $3s^2 3p^3$
 - (2) $3s^1 3p^3 3d^1$
 - (3) $3s^2 3p^2 3d^1$
 - (4) $3s^1 3p^2 3d^2$
97. An element 'A' of At.No.12 combines with an element 'B' of At.No.17. The compound formed is
- (1) covalent AB
 - (2) ionic AB_2
 - (3) covalent AB_2
 - (4) ionic AB
98. The number of neutrons present in the atom of ${}_{56}Ba^{137}$ is
- (1) 56
 - (2) 137
 - (3) 193
 - (4) 81
99. Hydrogen bonding in water molecule is responsible for
- (1) decrease in its freezing point
 - (2) increase in its degree of ionization
 - (3) increase in its boiling point
 - (4) decrease in its boiling point
100. In the HCl molecule, the bonding between hydrogen and chlorine is
- (1) purely covalent
 - (2) purely ionic
 - (3) polar covalent
 - (4) complex coordinate

METALLURGICAL ENGINEERING

101. Pearlite is a mixture of _____
(1) Alpha iron and cementite (2) Gamma iron and cementite
(3) Ferrite and austenite (4) Ledebrite and austenite
102. Ferrite is _____
(1) *bcc* (2) *fcc* (3) *hcp* (4) *sc*
103. Hot hardness of the high speed tool steel owes to the presence of _____
(1) Pearlite (2) Bainite (3) Martensite (4) Carbides
104. The packing factor of simple cubic is _____
(1) 45% (2) 52% (3) 68% (4) 74%
105. The effective number of atoms in a fcc unit cell is
(1) 2 (2) 4 (3) 12 (4) 14
106. The packing sequence of atoms in *hcp* lattice is _____
(1) ABABAB... (2) BCBCBC... (3) ACACAC... (4) ABCABCABC...
107. _____ rules predict extensive mutual solid solubility of metals.
(1) Lever's (2) Hund's (3) Henry's (4) Hume-Rothery's
108. The crystal structure of cementite is _____
(1) cubic (2) tetragonal (3) orthorhombic (4) hexagonal
109. _____ is a diffusionless phenomenon.
(1) Solidification (2) Martensitic transformation
(3) Recrystallization (4) Precipitation reaction

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110. In annealing process, the hypoeutectoid steel is _____
- (1) heated above A3 line and cooled very slowly in furnace
 - (2) heated below A1 line with a view to make steel ductile for cold working
 - (3) heated below A1 line and cooled slowly with a view to remove internal stresses
 - (4) heated above A3 line and cooled in air
111. Austempering produces _____
- (1) austenite
 - (2) martensite
 - (3) bainite
 - (4) Ferrite
112. Sub-zero treatment of steel is carried out for _____
- (1) Converting austenite to martensite.
 - (2) Converting austenite to pearlite.
 - (3) Converting austenite to bainite.
 - (4) Converting austenite to ferrite.
113. Hardenability is the measure of _____
- (1) degree of depth to which steel can be hardened
 - (2) degree of hardness of steels
 - (3) the number of fine martensite flakes
 - (4) the degree of transformation of austenite to pearlite
114. Tempering lead to the formaion of _____
- (1) bainite and low carbon martensite
 - (2) austenite and low carbon martensite
 - (3) ferrite and cementite
 - (4) bainite and epsilon-carbide
115. Hardening is not required after _____
- (1) case carburizing
 - (2) cyaniding
 - (3) nitriding
 - (4) core hardening

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116. Hardenability of steels, can be increased by _____
(1) alloy with tungsten (2) grain refinement
(3) cobalt addition (4) hot working
117. In TTT diagram _____ is plotted on a logarithmic scale.
(1) temperature (2) time (3) transformation (4) texture
118. In steel, the most effective grain growth inhibitor is _____
(1) Cu (2) V (3) Mn (4) Co
119. _____ system can be age hardenable.
(1) Fe-C (2) Cu-Ni (3) Al-Cu (4) Al-Pb
120. Except _____ all other metal shift TTT diagram toward right.
(1) Al (2) Ni (3) Cr (4) Co
121. _____ is not a mineral of iron.
(1) Goethite (2) Siderite (3) Limonite (4) Ilmenite
122. _____ is not equipment for cleaning of blast furnace exhaust gas.
(1) Dust catcher (2) Gas scrubber
(3) Electro-static precipitator (4) regenerator
123. Puddling process is for converting pig iron to _____
(1) steel (2) wrought iron (3) cast iron (4) alloy steel
124. _____ is also known as Cinder
(1) fuel (2) flux (3) sinter (4) slag

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125. $\text{CO}_2 + \text{C} = 2\text{CO}$ occurs, every moment in blast furnace is called _____ reaction.
- (1) Boudourd (2) direct reduction
(3) solution loss (4) double composition
126. _____ is a direct reduction process.
- (1) $\text{FeO} + \text{CO} \rightarrow \text{Fe} + \text{CO}_2$ (2) $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$
(3) $\text{FeO} + \text{C} \rightarrow \text{Fe} + \text{CO}$ (4) $\text{Fe}_3\text{O}_4 + 4\text{CO} \rightarrow \text{Fe} + 4\text{CO}_2$
127. Hot shortness is caused due to _____
- (1) excess P (2) excess S (3) excess C (4) excess O_2
128. The solubility of gases in steel may be explained by _____ law.
- (1) Roul't's (2) Henry's (3) Vant Hoff's (4) Sievert's
129. Aluminium is added in the LD converter during steel making as a _____
- (1) deoxidizer (2) grain refiner
(3) deoxidizer & grain refiner (4) grain coarsener
130. Stainless steel may be produced by _____ process.
- (1) Bessemer (2) LD (3) HYL (4) VAR
131. Rimming action is steel in due to the liberation of _____
- (1) N_2 (2) Ar (3) CO_2 (4) CO
132. The top portion of the blast furnace is called
- (1) hearth (2) bosh (3) stack (4) bustle pipe
133. _____ process is done for refining of blister copper.
- (1) Zone refining (2) Hoop'e's (3) Poling (4) Fire refining

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134. _____ is a mixture of insoluble impurities separated after alkali treatment in Bayer's process.
(1) Green liquor (2) Spelter
(3) Matte (4) Red mud
135. In Hall-Heroult process _____ is used as anode and _____ is used as cathode.
(1) Carbon rod, Steel collector bar
(2) Carbon rod, copper bar
(3) Steel rod, Steel collector bar
(4) Copper rod, Graphite bar
136. Calamine is _____ ore of Zinc.
(1) sulphate (2) oxide (3) carbonate (4) sulphide
137. In _____ operation copper is separated from lead at 480°C.
(1) Softening (2) Drossing (3) Fuming (4) Distillation
138. Carbo-thermic reduction of MgO is known as _____ process.
(1) Kroll's (2) Dow (3) Hansgrig (4) Pidgeon's
139. _____ pressure leaching of concentrated nickel ore is performed for the extraction of nickel from its sulphide ores.
(1) O₂ (2) CO₂ (3) SO₂ (4) NH₃
140. Refining of Ti done by _____ process.
(1) Mond's (2) Hoopé's (3) Poling (4) Van Arkel-De boer
141. In _____ mineral both Ag and Au are present.
(1) Argentite (2) Horn Silver (3) Calaverite (4) Sylvanite

142. Young's modulus is equal to _____

- (1) strain/elastic limit
- (2) $(\text{strain}/\text{stress}) \times 100$
- (3) the slope of initial linear portion of the stress-strain curve
- (4) the slope of the plastic region of the stress-strain curve

143. The UTS of the specimen is equal to the _____

- (1) small specific plastic strain by the original cross-sectional area of the specimen
- (2) maximum load divided by the original cross-sectional area of the specimen
- (3) the average stress divided by the average strain of the specimen
- (4) applied stress at which fracture of the specimen take place

144. The unit of modulus of elasticity is _____

- (1) kg/m
- (2) kg/m²
- (3) kg.m
- (4) kg/s

145. The resilience of material is _____

- (1) its ability to absorb energy in the plastic range
- (2) the total area under the stress - strain curve
- (3) equal to the amount of work per unit volume, which can be done on the material without causing it to failure
- (4) the ability of a material to absorb energy when deformed elastically and to return it when unloaded

146. The ultimate tensile strength of metals _____ with increasing high strain rate.

- (1) decreases
- (2) increases
- (3) remain constant
- (4) first increases and then decreases

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147. Stress concentration in the central region of a tensile specimen leads to _____
(1) necking (2) branching (3) strengthening (4) redistribution
148. The unit of BHN is _____
(1) kg.mm (2) kg/mm (3) kg.mm² (4) kg/mm²
149. The included angle between opposite faces of the pyramid is _____ degree.
(1) 96 (2) 106 (3) 136 (4) 146
150. In Rockwell hardness test, softer materials are usually tested on the _____
(1) A-scale (2) B-scale (3) C-scale (4) D-scale
151. A line imperfection in a crystal is known as _____
(1) slip (2) twining (3) dislocation (4) vacancy
152. The crystal which is free from dislocation is known as _____
(1) lattice (2) Whiskers
(3) perfect material (4) kink
153. In fcc _____ plane has higher atomic density.
(1) (110) (2) (111) (3) (100) (4) (0001)
154. _____ is prominently observed in low C steel.
(1) Solid-solution strengthening (2) Dispersion Strengthening
(3) Strain hardening (4) Yield point phenomena
155. Single phase materials can be strengthened by _____
(1) Solid-solution strengthening (2) Dispersion Strengthening
(3) Strain hardening (4) Precipitation Hardening

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156. Hot working operation is carried out above _____
- (1) Recrystallisation temperature (2) Solvus Temperature
(3) DBT Temperature (4) equi-cohesive Temperature
157. Most of the energy expended in deforming a metal by cold working is _____
- (1) utilized in overcoming deformation stresses
(2) utilized in deforming the metal
(3) converted into heat
(4) consumed in overcoming internal stresses
158. Polygonization occurs during _____
- (1) recovery (2) Primary recrystallisation
(3) grain growth (4) Secondary recrystallisation
159. The temperature at which new grains are formed in a metal is _____
- (1) recrystallisation temperature (2) lower critical temperature
(3) upper critical temperature (4) eutectic temperature
160. In four high rolling mill, the bigger rolls are called _____
- (1) guide rolls (2) back up rolls (3) support rolls (4) main rolls
161. The mould used for continuous casting of steel is made of _____
- (1) stainless steel (2) copper (3) silver (4) cast iron
162. Bentonite is generally used in moulding sand to provide _____
- (1) high refractoriness of the mould
(2) improved hot strength of the mould
(3) strength and plasticity of moulding sand
(4) edge hardness of the mould

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163. _____ casting is best suited only for non-ferrous castings.

- (1) Sand (2) Die (3) Shell (4) Centrifugal

164. In shell moulding, we use _____

- (1) clay bonded silica sand
(2) cement bonded sand
(3) thermo-setting resin and fine sand
(4) gypsum and silica sand

165. _____ castings are free from porosity defect.

- (1) CO₂ (2) Die (3) Shell (4) Centrifugal

166. The purpose of good gating system is to _____

- (1) feed the casting at a rate consistent with the rate of solidification
(2) acts as a reservoir for molten metal
(3) help feed the casting until all solidification takes place
(4) feed molten metal from pouring basin to gate

167. The gating ratio is _____ cross-sectional area.

- (1) sprue : total runner : total gate (2) sprue : total runner
(3) sprue : total gate (4) total runner : total gate

168. Chvorinov's rule for solidification is given as _____

- (1) Solidification time = [volume of object / area of objects]²
(2) Solidification time = [volume of object / area of objects]³
(3) Solidification time = [volume of object]² / [area of objects]^{1/2}
(4) Solidification time = [volume of object / area of objects]^{1/2}

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169. Cold shuts are casting defects _____
- (1) which occur due to some sand shearing from the cope surface
 - (2) which occur due to excessive gaseous material not able to escape
 - (3) which occur due to discontinuity in metal casting resulting from hindered contraction
 - (4) caused by two streams of metals that are too cold to fuse properly
170. Hot tears are casting defects _____
- (1) which occur due to some sand shearing from the cope surface
 - (2) which occur due to excessive gaseous material not able to escape
 - (3) which occur due to discontinuity in metal casting resulting from hindered contraction
 - (4) caused by two streams of metals that are too cold to fuse properly
171. In arc welding, arc is created between the electrode and work piece by _____
- (1) flow of current
 - (2) voltage
 - (3) material characteristics
 - (4) contact resistance
172. Most oxy-acetylene welding is done by using _____ flame.
- | | |
|---------------|-----------------|
| (1) oxidizing | (2) carburizing |
| (3) hydrogen | (4) neutral |
173. Oxygen to acetylene ratio in neutral flame is _____
- | | | | |
|-----------|---------|-----------|---------|
| (1) 0.8:1 | (2) 1:1 | (3) 1.2:1 | (4) 2:1 |
|-----------|---------|-----------|---------|
174. TIG welding, is best suited for welding _____
- | | |
|----------------|---------------------|
| (1) mild steel | (2) stainless steel |
| (3) silver | (4) aluminium |

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175. In MIG welding, the metal is transferred in the form of
(1) fine spray of metal (2) molten drops
(3) weld pool (4) molecules
176. Stud and projection welding belong to _____ welding.
(1) gas (2) arc
(3) resistance (4) pressure
177. Ignition temperature in thermit welding is _____
(1) 1050°C (2) 950°C (3) 1250°C (4) 1150°C
178. _____ is strongest brazing joints.
(1) butt (2) scraf (3) lap (4) spot
179. The commonly used flux for brazing is _____
(1) Resin (2) NH_4Cl
(3) Borax (4) Soft iron
180. Weld spelter is a _____
(1) flux (2) electrode casting
(3) welding defect (4) welding technique
181. _____ sampling of the ore particles gives accurate results.
(1) Mechanical (2) cone and quartering
(3) Jones riffles (4) pipe
182. _____ crusher have low reduction ratio.
(1) Jaw (2) gyratory
(3) roll (4) cone

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183. Match the following

- (p) Collectors (I) pine oil
(q) Frothers (II) lime
(r) Depressants (III) Xanthates
(s) pH Modifiers (IV) lactic acid
- (1) p - IV, q - II, r - I, s - III
(2) p - IV, q - III, r - II, s - I
(3) p - III, q - I, r - IV, s - II
(4) p - I, q - II, r - III, s - IV

184. 100 BSS screen means 100 _____

- (1) openings per cm² (2) openings per m²
(3) openings per linear inch (4) openings per mm²

185. Mineral dressing comprises of liberation and separation which deals with _____ respectively.

- (1) Communication and concentration
(2) communication and sizing
(3) Sizing and concentration
(4) concentration and dewatering

186. _____ pyrometer is based on blackbody.

- (1) Thermoelectric (2) Resistance
(3) Optical (4) Radiation

187. _____ thermocouples are used at the temperature range from 0° to 1650°C.

- (1) Chromel-Alumel (2) Iron-Constant
(3) Cu-Constant (4) Pt-(10%Rh-Pt)

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188. _____ does not combine chemically either by acid or basic slags.
- (1) Silica (2) Magnesite
(3) Carbon block (4) Dolomite
189. The manufacturing of coke is called _____
- (1) carbonization (2) decarbonisation
(3) hydrogenation (4) volatilization
190. Dwight-Llyod machine is _____
- (1) a machine used in sand moulding
(2) an oven to dry the sand moulds
(3) used for Sintering the iron ore
(4) used for smelting tin ore
191. The refractoriness of a refractory is determined by _____
- (1) proximate analysis (2) ultimate analysis
(3) pyrometric cone equivalent value (4) thermal expansion
192. _____ is an extensive property.
- (1) Pressure (2) Temperature (3) Volume (4) Density
193. The entropy _____ when a spontaneous change occurs in an isolated system.
- (1) decrease (2) increases (3) is unchanged (4) is equal to zero
194. The activity of a substance is _____
- (1) Fugacity^o / Fugacity
(2) Fugacity / Fugacity^o
(3) Mole fraction / Activity Coefficient
(4) Total number of atoms of a component / Total number of atoms of all components

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195. Thermodynamic equilibrium of any system is given as _____

- (1) $\Delta G = RT \ln K$ (2) $\Delta G = -RT \ln K$
(3) $\Delta G^\circ = -RT \ln K$ (4) $\Delta G^\circ = RT \ln K$

196. The activity of pure substance, in its standard state is _____

- (1) <unity (2) >unity (3) equal to unity (4) 0 to 2.5

197. Ellingham diagram for metal-oxide system does not give idea about _____

- (1) oxidation of metals
(2) reduction of metal oxides
(3) kinetics of the oxidation reaction
(4) values of partial pressure oxygen for the reaction.

198. An isolated system is that _____

- (1) whose internal energy is zero
(2) whose enthalpy value is negative
(3) whose thermal conductivity is infinite
(4) which is not affected by its surroundings

199. Heat capacity of a substance at constant pressure (C_p)= _____

- (1) $\left(\frac{dT}{dP}\right)_V$ (2) $\left(\frac{dH}{dT}\right)_P$ (3) $\left(\frac{dV}{dT}\right)_P$ (4) $\left(\frac{dS}{dT}\right)_P$

200. δ - Fe exists in the _____ range.

- (1) Room temperature - 600°C (2) 723 - 910°C
(3) 1400 - 1539°C (4) 910 - 1400°C