

ENTRANCE EXAMINATIONS 2021
Ph.D. (Materials Engineering)

Marks: 70

Time: 2 h Hall Ticket No:

- I. Write your Hall Ticket Number on the OMR Answer Sheet given to you. Also write the Hall Ticket Number in the Space provided above.
- II. Read the following instructions carefully before answering the questions.
- III. This Question paper has TWO parts: PART 'A' AND PART 'B'

1. Part 'A': It consists of 20 objective type questions of 1.75 marks each.
2. Part 'B': It consists of 35 objective questions of one mark each.
3. All questions are to be answered. Answers for these questions are to be entered on the OMR sheet, filling the appropriate circle against each question. For example, if the answer to a question is D, it should be marked as below:



No additional sheets will be provided. Rough work can be done in the question paper itself.

4. Hand over the OMR answer sheet at the end of the examination to the invigilator.
5. Mobile phones, log tables and calculators of any type are NOT permitted inside the Examination Hall.
6. This book contains 12 pages including this cover sheet.

PART A

1. What is the resultant curve if a function $f(x) = x^2$ is plotted with the domain consisting of all real numbers and the range consisting of all $f(x)$ -values greater than or equal to zero?
 - A. straight line
 - B. circle
 - C. parabola
 - D. a horizontal asymptote

2. What does the absolute value function represent?
 - A. Distance to the origin on a number line
 - B. Square of distance to the origin on a number line
 - C. Cube of distance to the origin on a number line
 - D. Square root of distance to the origin on a number line

3. Mass of a body scales in the
 - A. cubic form
 - B. square form
 - C. exponential form
 - D. circular form

4. The graph of the equation $5x + 2y = 40$ intersects the X-axis at the point
 - A. (8, 0)
 - B. (-8, 0)
 - C. (0, 8)
 - D. (0, -8)

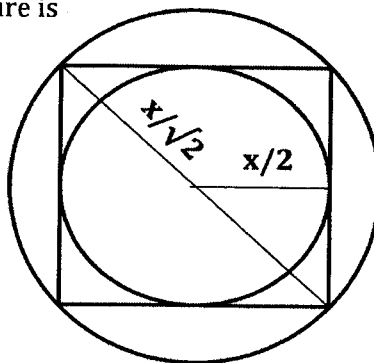
5. Two circles of equal radius of 6 cm intersect each other. Each circle passes through center of the other. In such a scenario, the length of the common chord is
 - A. 6 cm
 - B. 12 cm
 - C. 18 cm
 - D. 3 cm

6. The kinetic energy of a body can be estimated by $K. E. = \frac{1}{2} mv^2$. If the mass is changed to 105 gm from 100 gm and the velocity is changed to 30 cm²/s from 40 cm²/s. The overall change in K. E (in SI units) is
 - A. 2000
 - B. 1575
 - C. 425
 - D. 0

7. A body falls from a height of 200 m. If gravitational attraction ceases after 2 s, further time taken by it to reach the ground is (Take $g = 10 \text{ ms}^{-2}$)
- A. 5 s
 - B. 9 s
 - C. 13 s
 - D. 17 s
8. A particle starts moving from rest with uniform acceleration. It travels a distance X in the first three seconds and a distance Y in next three seconds, then
- A. $Y = X$
 - B. $Y = 3X$
 - C. $Y = 2X$
 - D. $Y = 4X$
9. A lift is moving down with a retardation of 5 ms^{-2} . The percentage change in weight of person in the lift is ($g = 10 \text{ ms}^{-2}$)
- A. 100
 - B. 25
 - C. 50
 - D. 75
10. A body of mass 2 kg is thrown up vertically with a KE of 490 J. If the acceleration due to gravity is 9.8 ms^{-2} , the height at which the KE of the body becomes half of the original value is
- A. 50 m
 - B. 25 m
 - C. 12.5 m
 - D. 10 m
11. If a force F is applied on a body and it moves with a velocity V, the power will be
- A. $F \times V$
 - B. F/V
 - C. F/V^2
 - D. $F \times V^2$
12. A bicycle tire in motion has
- A. linear motion only
 - B. rotary motion only
 - C. linear and rotary motion
 - D. vibration motion only

13. If the radius of the earth shrinks by 1.5% (mass remaining same), then the value of acceleration due to gravity changes by
- A. 1%
 - B. 2%
 - C. 3%
 - D. 4%
14. A box contains 25 parts of which 10 are defective. Two parts are being drawn simultaneously in a random manner from the box. The probability of both the parts being good is
- A. $\frac{7}{20}$
 - B. $\frac{42}{125}$
 - C. $\frac{25}{29}$
 - D. $\frac{5}{9}$
15. If two fair coins are flipped and at least one of the outcomes is known to be a head, what is the probability that both outcomes are heads?
- A. $\frac{1}{3}$
 - B. $\frac{1}{4}$
 - C. $\frac{1}{2}$
 - D. $\frac{2}{3}$
16. In an examination a student scores 4 marks for every correct answer and loses 1 mark for every wrong answer. If the student attempts 60 questions in all and secures 130 marks, the number of questions attempt correctly is
- A. 35
 - B. 38
 - C. 40
 - D. 42
17. The average temperature of a town in the first four days of a month was 58 degrees. The average for the second, third, fourth and fifth days was 60 degrees. If the temperatures of the first and fifth days were in the ratio 7:8, then what was the temperature on the fifth day?
- A. 64 degrees
 - B. 62 degrees
 - C. 56 degrees
 - D. 50 degrees

18. The ratio of the areas of the inner circle and the circumcircle of a square as shown in the given figure is



- A. 3:1
 B. 1:2
 C. 3:5
 D. 1:3
19. Find the solution of the ordinary differential equation, $\frac{dy}{dx} = x^2$. It is known that at $x = 1, y = 0$.

- A. $y = \frac{(x^3-1)}{3}$
 B. $y = \frac{(x^3+1)}{3}$
 C. $y = x^3 + \frac{1}{3}$
 D. $y = x^3 - \frac{1}{3}$

20. The eigenvalues of the matrix $A = \begin{bmatrix} 1 & 2 \\ 3 & 2 \end{bmatrix}$ are

- A. 4, -1
 B. 8, -2
 C. 5, -5
 D. -4, 3

PART B

21. In an irreversible process, the total entropy change is
- negative
 - positive
 - constant
 - zero
22. Which of the following is involved in a Carnot's cycle?
- At least one isothermal step
 - At least one isobaric step
 - At least one isochoric step
 - Only one adiabatic step
23. In a crystalline solid, which of the following diffusion paths will have the highest activation energy?
- Surface diffusion
 - Grain boundary diffusion
 - Lattice diffusion
 - Dislocation pipe diffusion
24. For a FCC structure element with a cell edge "a", the distance between the centers of two neighboring tetrahedral voids in the lattice is
- $\frac{3}{2} a$
 - a
 - $\frac{1}{2} a$
 - $\sqrt{2} a$
25. The relation between Young's modulus (E), bulk modulus (K) and modulus of rigidity (η) is expressed as
- $\frac{9}{Y} = \frac{1}{K} + \frac{3}{\eta}$
 - $\frac{9}{K} = \frac{1}{Y} + \frac{3}{\eta}$
 - $\frac{9}{\eta} = \frac{1}{K} + \frac{3}{Y}$
 - $\frac{9}{\eta} = \frac{1}{Y} + \frac{3}{K}$
26. The relationship between group velocity (v_p), angular frequency (ω) and wave number is expressed as
- $v_p = \frac{k}{\omega}$
 - $v_p = \frac{\omega}{k}$
 - $v_p = k \omega$
 - $v_p = \sqrt{k \omega}$

27. Which of the following is NOT correct?
- A. Dislocations are thermodynamically unstable defects
 - B. Dislocations can move inside a crystal under the action of an applied stress
 - C. Screw dislocations can change the slip plane without climb
 - D. Burger's vector of an edge dislocation is parallel to the dislocation line
28. Which one of the following metals is commonly alloyed with iron to improve its corrosion resistance?
- A. Co
 - B. Cr
 - C. Ni
 - D. Ti
29. The number of slip systems in a metal with FCC crystal structure is
- A. 4
 - B. 6
 - C. 8
 - D. 12
30. Upon recrystallization of a cold worked metal, it's
- A. strength increases and ductility decreases
 - B. strength decreases but ductility increases
 - C. both strength and ductility increase
 - D. both strength and ductility decrease
31. Which of the following types of corrosion is autocatalytic in nature?
- A. Stress corrosion cracking
 - B. Fatigue corrosion
 - C. Pitting corrosion
 - D. H embrittlement corrosion
32. The magnitude of stresses necessary for metal forming is
- A. higher than the yield strength of the metal
 - B. lower than the yield strength of the metal
 - C. does not depend on the yield strength of the metal
 - D. equal to the yield strength of the metal

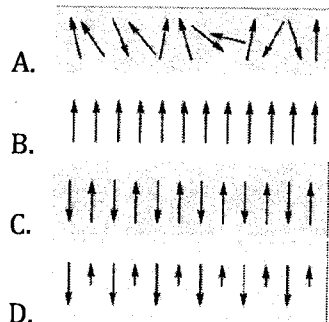
33. The warm working temperature range of the metal is
- A. in between recrystallization and room temperature
 - B. in between transformation and room temperature
 - C. in between melting and transformation temperature
 - D. in between melting and recrystallization temperature
34. Core of the earth is made up of
- A. Iron- Nickel alloy
 - B. Iron alloy
 - C. Nickel alloy
 - D. Meteorites
35. The resolution of an image is limited by the _____ of the radiation used to generate the image
- A. wavelength
 - B. intensity
 - C. frequency
 - D. diffraction
36. Which of the following is applicable in the case of rusting of iron?
- A. Third law of thermodynamics
 - B. Second law of thermodynamics
 - C. First law of thermodynamics
 - D. Zeroth law of thermodynamics
37. Which of the following materials exhibits a very good creep resistance?
- A. Nanocrystalline
 - B. Single crystalline
 - C. Microcrystalline
 - D. Directionally solidified
38. Which optical property of liquid crystals is exploited in Liquid Crystal Displays?
- A. Reflection
 - B. Polarization
 - C. Refraction
 - D. Dispersion
39. Which of the following statement is correct?
- A. All piezoelectrics are ferroelectrics
 - B. All piezoelectrics are pyroelectrics
 - C. All ferroelectrics are piezoelectrics
 - D. All pyroelectrics are ferroelectrics

40. Solid state sintering of covalently bonded SiC or Si₃N₄ results in coarsening rather than densifying because they have
- relatively high vapor pressure in the sintering conditions
 - relatively low vapor pressure in the sintering conditions
 - low diffusion coefficients
 - low surface energies
41. Grain boundary sensitization of stainless steel cannot be controlled by
- reducing the carbon content
 - addition of Ti or Nb
 - controlling the cooling rate
 - cathodic protection
42. Which one of the following furnaces is generally used for steel making?
- Cupola
 - Blast furnace
 - Rotary Kiln furnace
 - LD Furnace
43. Leaching with a cyanide is adapted for the extraction of
- Silver
 - Magnesium
 - Copper
 - Sodium
44. The X Ray Diffraction pattern of nickel powder (FCC) should show the starting four peaks due to which of the following (hkl) planes?
- (100), (110), (111), (200)
 - (111), (200), (220), (311)
 - (111), (220), (311), (400)
 - (110), (200), (211), (220)
45. Which of the following Pilling-Bedworth ratios is ideal for the formation of a protective oxide film?
- 0.45
 - 1.16
 - 3.40
 - 2.61

46. In a polycrystalline material, if d is the average grain diameter, the dependence of flow stress on d is,

- A. $\sigma_f = \sigma_0 + kd^{-1}$
- B. $\sigma_f = \sigma_0 + kd^{-3}$
- C. $\sigma_f = \sigma_0 + kd^{\frac{3}{2}}$
- D. $\sigma_f = \sigma_0 + kd^{\frac{1}{2}}$

47. Which of the following represents ferrimagnetism?



48. A tensile stress is applied along the long axis of a cylindrical rod that has a diameter of 10 mm. As a result, a reduction in diameter of 2.5×10^{-3} mm is observed. If the Poisson ratio for the material is 0.25, the strain along the long axis is

- A. -10^{-4}
- B. 10^{-3}
- C. -10^{-3}
- D. 1.25×10^{-4}

49. The degradation behaviour of a polymeric material as a response to temperature can be characterized by

- A. transmission electron microscopy
- B. thermogravimetric analysis
- C. temperature dependent Fourier transform infrared spectroscopy
- D. scanning electron microscopy

50. At 0 K, the probability of finding an electron at an energy level, E , is one,

- A. only if E is equal to Fermi energy
- B. if E is less than or equal to Fermi energy
- C. if E is greater than Fermi energy
- D. if E is greater than or equal to Fermi energy

51. The number of degrees of freedom available to a two-component system at the eutectic point (at atmospheric pressure) is
- A. 0
 - B. 1
 - C. 2
 - D. -1
52. The reaction, $\text{Liquid}_1 \rightarrow \text{Liquid}_2 + \text{Solid}_1$ is a
- A. eutectic reaction
 - B. monotectic reaction
 - C. eutectoid reaction
 - D. non-existent reaction
53. As a precipitate grows, the precipitate-matrix interface
- A. is likely to change from coherent to incoherent at a critical size
 - B. is likely to change from incoherent to coherent at a critical size
 - C. will never change its character
 - D. is likely to change from coherent to incoherent in some systems and incoherent to coherent in other systems
54. A steel sample and an epoxy sample have Young's Moduli equal to 200 GPa and 10 GPa, respectively. If they are both stretched to 0.1% strain, then the stress in steel and epoxy sample is
- A. 2×10^5 GPa and 104 GPa, respectively
 - B. 20 GPa and 1 GPa, respectively
 - C. 0.2 GPa and 0.01 GPa, respectively
 - D. equal in both but cannot be calculated from the data given
55. Which of the following is a position of an octahedral void in FCC?
- A. $0, 0, \frac{1}{2}$
 - B. $0, \frac{1}{4}, 0$
 - C. $\frac{1}{4}, \frac{1}{4}, \frac{1}{4}$
 - D. $1, \frac{1}{4}, \frac{3}{4}$

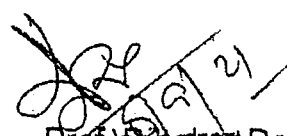
University of Hyderabad
Entrance Examinations - 2021

School/Department/Centre : SEST
Course/Subject : PhD Materials Engineering

Q.No.	Answer	Q.No.	Answer	Q.No.	Answer	Q.No.	Answer
1	C	26	B	51	A	76	
2	A	27	D	52	B	77	
3	A	28	B	53	A	78	
4	A	29	D	54	C	79	
5	Not listed	30	B or C	55	A	80	
6	C	31	C	56		81	
7	B	32	A	57		82	
8	B	33	A	58		83	
9	C	34	A	59		84	
10	C	35	A	60		85	
11	A	36	B	61		86	
12	C	37	B	62		87	
13	C	38	B	63		88	
14	A	39	C	64		89	
15	A	40	A	65		90	
16	B	41	D	66		91	
17	A	42	D	67		92	
18	B	43	A	68		93	
19	A	44	B	69		94	
20	A	45	B	70		95	
21	B	46	A	71		96	
22	A	47	D	72		97	
23	C	48	B	73		98	
24	C	49	B	74		99	
25	A	50	B	75		100	

Note/Remarks :

- *Question 5: Correct answer is 10.39, which is not listed. Marks may be given to everybody who have attempted the question
- **Question 30: Both answers may be correct. Marks may be given to those who have answered either B or C.


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