

ENTRANCE EXAMINATIONS – 2018
(Ph.D. Admissions - January 2019 Session)

Ph.D. (Materials Engineering)

Marks: 80

Time: 2.00 hrs

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 **TWO** marks each.
There is a negative marking of **0.66** marks for every wrong answer.
2. Part 'B': It consists of 40 objective questions of one mark each with no negative marking.
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.

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PART A

1. An independent variable in an experiment is the one that
 - A. is varied
 - B. shows the effect of variation
 - C. is the aim of an experiment
 - D. is used only in controlled experiments
2. Which of the following has no intersections in a graph?
 - A. diverging lines
 - B. parallel lines
 - C. converging lines
 - D. lines crossing each other
3. The individual velocities of 20 gas molecules in a container are 10, 20, 10, 20, 10, 15, 10, 15, 10, 15, 10, 13, 13, 13, 10, 13, 15, 10, 15, and 15 kmph. What is the most probable velocity?
 - A. 10 kmph
 - B. 13 kmph
 - C. 15 kmph
 - D. 20 kmph
4. X can complete a task in 2 hours, Y can complete the same task in 4 hours while X, Y and Z together can complete the same task in 1 hour. If Z alone has to complete the same task, how much time Z would take?
 - A. 2 hours
 - B. 4 hours
 - C. 6 hours
 - D. 6 hours
5. If L is any linear dimension in a 3D object, the object's volume scales
 - A. always as L , irrespective of the shape of the object
 - B. as L or L^2 , depending on the shape of the object
 - C. always as L^3 , irrespective of the shape of the object
 - D. as L , L^2 or L^3 , depending on the shape of the object
6. If the linear dimension of a solid cuboid of weight 8 kg is uniformly decreased to half of its original value then what is the weight of the smaller cuboid?
 - A. 4 kg
 - B. 2 kg
 - C. 1 kg
 - D. 0.5 kg

7. The average of fifty numbers is 28. If two numbers, 25 and 35 are removed from the set, the average of the remaining numbers is approximately:
- A. 29.27
 - B. 27.92
 - C. 27.29
 - D. 29.72
8. In a certain code 'LIGHT' is written as 'KJFIS'. How is 'PLUGH' written in that code?
- A. OMTHG
 - B. OKTFG
 - C. OMTGH
 - D. OKTHG
9. In an entrance examination, each question carries +1 mark for the correct answer and -0.25 mark for the wrong answer. If a student attempts all 20 questions and scores 15 marks, how many questions are correctly answered?
- A. 14
 - B. 15
 - C. 16
 - D. 17
10. A woman plants 12321 rose plants in such a way that the number of rose plants in each row is equal to the number of rows. The number of rose plants in each row is?
- A. 121
 - B. 111
 - C. 101
 - D. 201
11. If the areas of the three adjacent faces of a cuboid are 120 cm^2 , 72 cm^2 and 60 cm^2 , respectively, then the volume of the cuboid is
- A. 7200 cm^3
 - B. 720 cm^3
 - C. 864 cm^3
 - D. $(72)^3 \text{ cm}^3$
12. One cup is filled with juice and water in the ratio 5:2 while in another cup the ratio is 7:4. If the contents of both the cups are mixed, what will be the ratio of water to juice in the mixture?
- A. 35:8
 - B. 8:35
 - C. 52:25
 - D. 25:52

13. What is the value of x in the following equation?
 $60\% \text{ of } x + \frac{2}{3} \text{ of } 39 = 44$
A. 50
B. 60
C. 30
D. 20
14. What is the value of the question mark in $\frac{72}{?^{8/5}} = \frac{?^{7/5}}{24}$
A. 16
B. 12
C. 8
D. 6
15. Pick the odd one out from 275, 132, 462, 396, 327, 891, 121
A. 327
B. 275
C. 121
D. 396
16. A University wished to raise a fund of Rs. 10 Lakhs by collecting equal contributions from each of its teachers, for a flood relief. If each of the teachers contributed Rs. 1000 extra, the University would have raised a fund of Rs. 15 Lakhs. How many teachers are there in the University?
A. 490
B. 510
C. 515
D. 500
17. $\sqrt{246} + \sqrt{100} = ?$
A. 12
B. 14
C. 16
D. 18
18. What is the probability of drawing two clubs from a well shuffled pack of 52 cards?
A. $\frac{13}{51}$
B. $\frac{1}{17}$
C. $\frac{1}{28}$
D. $\frac{13}{17}$

19. $\sqrt{1\frac{17}{64}} = ?$

A. $1\frac{1}{8}$

B. $1\frac{1}{6}$

C. $1\frac{1}{4}$

D. $1\frac{1}{2}$

20. 50 buckets of water are required to fill a big tank. If the volume of each bucket is increased to two-thirds of its present volume, how many buckets of water are required to fill the big tank?

A. 25

B. 30

C. 35

D. 40

PART B

21. The number of atoms in the unit cell of a Diamond Cubic Structure is
 A. 4
 B. 6
 C. 8
 D. 10
22. The atomic packing fraction% in Al and Mg is
 A. 34%
 B. 52%
 C. 68%
 D. 74%
23. The ratio of density of lattice points in (111) plane to (110) plane of a Simple Cubic lattice is
 A. $\frac{\sqrt{3}}{\sqrt{2}}$
 B. $\frac{\sqrt{2}}{\sqrt{3}}$
 C. $\frac{1}{\sqrt{2}}$
 D. $\frac{2}{\sqrt{3}}$
24. The photoelectric work function of a metal is expressed in
 A. Joule
 B. Watt
 C. Ampere
 D. Volt
25. A substance that is reduced during a redox reaction
 A. loses mass
 B. is the anode
 C. is the reducing agent
 D. is the oxidizing agent
26. de Broglie wavelength of an electron accelerated by V Volts is given by
 A. $1.227\sqrt{V}$ nm
 B. $\frac{1.227}{\sqrt{V}}$ nm
 C. $\frac{\sqrt{V}}{1.227}$ nm
 D. \sqrt{V} nm

27. Which of the following methods is used to produce 3D bulk nanomaterials
- A. Chemical Vapor Deposition
 - B. Self-assembly
 - C. Equi-Channel Angular Pressing
 - D. LASER ablation
28. The resolution of an optical microscope fitted with a high quality objective of numerical aperture = 1.4 and illuminated with light of wavelength 480 nm, according to Rayleigh criterion, is
- A. 342.8 nm
 - B. 171.4 nm
 - C. 85.7 nm
 - D. 480 nm
29. The reciprocal lattice of Copper (Cu) is
- A. Face-centered cubic lattice
 - B. Body-centered cubic lattice
 - C. Simple cubic lattice
 - D. Not a cubic lattice
30. Among F_2 , F_2^+ and F_2^-
- A. F_2 has the highest bond energy and F_2^+ has the lowest bond energy
 - B. F_2^+ has the highest bond energy and F_2^- has the lowest bond energy
 - C. F_2^- has the highest bond energy and F_2 has the lowest bond energy
 - D. F_2^- has the highest bond energy and F_2^+ has the lowest bond energy
31. In the context of superstructures, expand CSL
- A. Coincident Site Lattice
 - B. Common Slip Length
 - C. Combined Shaped Lattice
 - D. Common Site Line
32. Solid hydrogen consists of H_2 molecules held together by
- A. van der Waals bonds
 - B. Covalent bonds
 - C. Ionic bonds
 - D. Metallic bonds
33. Which one of the following is correct with respect to their atomic radius
- A. Tungsten (W) > Iron (Fe) > Lithium (Li)
 - B. Iron (Fe) > Tungsten (W) > Lithium (Li)
 - C. Tungsten (W) > Lithium (Li) > Iron (Fe)
 - D. Lithium (Li) > Tungsten (W) > Iron (Fe)
34. Which of the following reactions are classified under super cooling?
- A. Peritectic
 - B. Eutectic and Peritectic
 - C. Eutectic and Eutectoid
 - D. Peritectic and Eutectoid

35. The temperature at which the strength of grain boundary is equal to the strength of a grain is the
- A. Curie temperature
 - B. Equi-cohesive temperature
 - C. Hardening temperature
 - D. Recrystallization temperature
36. The crystal system with the lowest symmetry is
- A. Rhombohedral
 - B. Orthorhombic
 - C. Monoclinic
 - D. Triclinic
37. Which of the following should be present to produce rust by corrosion of Iron (Fe): (i) water (ii) oxygen and (iii) salt
- A. (i) only
 - B. (ii) only
 - C. (i) and (ii) only
 - D. (i), (ii) and (iii)
38. During cathodic protection of a metal, the sacrificial anode
- A. accepts electrons from the protected metal
 - B. reacts spontaneously with the protected metal
 - C. oxidizes more readily than the protected metal
 - D. causes the protected metal to become an anode
39. With respect to typical steels, killed steels will have
- A. More Carbon
 - B. Less Carbon
 - C. More Oxygen
 - D. Less Oxygen
40. Quasi crystals possess
- A. Both translational and rotational symmetry
 - B. Only rotational symmetry but not translational symmetry
 - C. Neither translational nor rotational symmetry
 - D. Only translational symmetry but not rotational symmetry
41. Loading in Mode II fracture refers to
- A. Opening mode
 - B. Sliding mode
 - C. Tearing mode
 - D. Twisting mode

42. Fatigue resistance of a steel is reduced by
- A. shock peening
 - B. shot peening
 - C. decarburization
 - D. refining the grain size
43. Single crystal microstructure is designed for
- A. Turbine blade applications
 - B. Automotive applications
 - C. Fatigue resistance based applications
 - D. Aesthetics based applications
44. Identify the appropriate sequence that would occur during heating of a deformed material:
- A. Recovery → Recrystallization → Grain growth
 - B. Recovery → Grain growth → Recrystallization
 - C. Grain growth → Recovery → Recrystallization
 - D. Recrystallization → Recovery → Grain growth
45. Which of the following alloy systems exhibit complete solid solubility
- A. Cu-Pb
 - B. Cu-Ni
 - C. Cu-Zn
 - D. Cu-Fe
46. If a polycrystalline, ideally plastic metallic piece which is 25 mm in length and 2 mm x 2 mm in cross-section is elongated to 100 mm, the cross-section of the deformed product will be
- A. 4 mm x 4 mm
 - B. 3 mm x 3 mm
 - C. 2 mm x 2 mm
 - D. 1 mm x 1 mm
47. Ferrite is a solid solution of Iron and
- A. Nitrogen
 - B. Carbon
 - C. Tin
 - D. Titanium
48. An intermetallic compound possesses
- A. only ordered structure and fixed composition
 - B. ordered structure and not fixed composition
 - C. only ordered structure
 - D. only disordered structure

49. The relationship between yield strength (σ_y) and grain size (L) of a polycrystalline material is

- A. $\sigma_y \propto L$
- B. $\sigma_y \propto 1/L$
- C. $\sigma_y \propto L^2$
- D. $\sigma_y \propto L^{-2}$

50. Which one of the following is not affected by crystal anisotropy?

- A. Magnetism
- B. Formability
- C. Specific heat
- D. Young's modulus

51. The de Broglie wavelength of an object of mass 1 kg moving with a velocity of 1 m/sec is

- A. 6.62×10^{-38} m
- B. 6.62×10^{-37} m
- C. 6.62×10^{-35} m
- D. 6.62×10^{-34} m

52. If atoms could contain electrons with principal quantum number (n) up to and including 6, how many elements would there be in the periodic table?

- A. 162
- B. 172
- C. 182
- D. 192

53. Which one of the following reflections will be observed in the X-ray diffractogram of a face centered cubic crystal?

- A. (331)
- B. (212)
- C. (310)
- D. (123)

54. Wolframite is an important source of

- A. Tin
- B. Tungsten
- C. Titanium
- D. Tellurium

55. If a closed system of fixed temperature and volume is in equilibrium, then its

- A. Gibbs free energy is minimum
- B. Helmholtz free energy is minimum
- C. entropy is minimum
- D. enthalpy is minimum

56. For an ideal HCP lattice the c/a ratio is
- A. 1.633
 - B. 1.732
 - C. 1.414
 - D. 1.225
57. Which one of the following properties cannot be determined by a tensile test?
- A. Yield strength
 - B. Toughness
 - C. Endurance limit
 - D. Ultimate tensile strength
58. Superalloys are not
- A. Ni based alloys
 - B. Co based alloys
 - C. Fe based alloys
 - D. Al based alloys
59. n-type semiconductor can be obtained by doping Si with
- A. Boron
 - B. Copper
 - C. Phosphorous
 - D. Sulphur
60. Which one of the following is not a solid state welding process?
- A. Friction stir welding
 - B. Ultrasonic welding
 - C. Explosive welding
 - D. Tungsten inert gas welding