GENERAL STUDIES & ENGINEERING APTITUDE

PRACTICE QUESTIONS BOOK

UPSC Engineering Services

Preliminary Examinations Paper-I

IES MASTER PUBLICATION

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Preface

Engineering Services Exam (ESE) is one of most coveted exams written by engineering students aspiring for reputed posts in the country. As all the senior engineering posts come under the Government of India, ESE is conducted by the Union Public Services Commission (UPSC), and therefore the standards to clear this exam too are very high. To clear the ESE, a candidate needs to clear three stages – ESE Prelims, ESE Mains and Personality Test.

This revised and updated self-practice question book is an endeavour by IES Master to help ESE aspirants clear the Paper-1 i.e. General Studies & Engineering Aptitude of the very first stage i.e. ESE Prelims. The Paper-1 carries 200 marks, and should not be taken lightly. With more than 3,400 practice questions sorted subject-wise, students will get a chance to quickly brush through all the subjects in a short span. Practising as many questions possible will help candidates in going through whatever they have learned so far, and will count as a round of revision. The detailed solution to each question will help them identify their strengths and weaknesses, and build confidence before taking the real ESE Prelims. The detailed solutions to questions will also help candidates in understanding the appropriate methods in answering a question and improve their speed and accuracy.

IES Master feels immense pride in bringing out this new edition of practice book as every care has been taken to build upon the exam preparedness of a student right up to UPSC standards. The credit for flawless preparing of this book for ESE aspirants goes to the entire team of IES Master Publications. Teachers, students, and professional engineers are welcome to share their suggestions to make this book more valuable.

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Basics of Material Science & Engineering

1. Which of the following statement(s) is/are correct sregarding ionic bond.

(a) These are directional in nature

(b) These are non-directional in nature

(c) These are not brittle

(d) These are ductile

2. Which of the statement is/are correct regarding electron affinity of the atom

I. Inert gases has no affinity for an extra electron

II. Halogens are just one electron short to achieve the stable inert gas configuration

III. When extra e^- added to a neutral atom, there is a weakening of the repulsion of electrons to the nucleus.

(a) I, II (c) II, III

(b) I, III (d) All

3. Which of the following statement is/are correct

Statement (I) : Ionic bonds are strongest bond while metallic bonds are weakest bond among the primary bond

Statement (II) : In metals, atom move from one position to another without breaking of the bonds

(a) I (b) II

(c) Both (d) None

4. Which of the following statement is/are correct regarding to paramagnetic material.

I. Magnetic susceptibility of these material is small but positive.

II. Magnetic susceptibility of these material is higher and greater than ferromagnetic.

III. Increase in temperature of material, randomness of dipole increase.

IV. Randomness in dipole independent of temperature.

(a) I, III (b) I, V

(c) II, III (d) II, IV

5. Which of the following statement is/are correct

Statement I : Ferromagnetic material shows spontaneous magnetization.

Statement II : Diamagnetic materials are repelled from applied magnetic field

(a) I (b) II

(c) Both I & II (d) Neither I nor II

6. The materials with permeability less than unity are called

(a) Diamagnetic materials

(b) Paramagnetic materials

(c) Ferromagnetic materials

(d) Anti ferromagnetic material

7. Retentivity is/are

I. Maximum value of residual magnetization

II. Minimum value of permanent magnetization

III. Maximum value of spontaneous magnetization

IV. Maximum value which a coercive field can attain

(a) I, II, IV (b) I, III

(c) III, IV (d) II, III

8. Which of the statement is/are correct regarding antiferro magnetic material.

I. Magnetic susceptibility for these material is small but –ve

II. Magnetic susceptibility for these material is small but +ve

III. Above Neels temperature they behave as paramagnetic material

IV. Above Neels temperature they behave as diamagnetic material.

(a) I, III (b) I, IV

(c) II, III (d) II, IV

Statement I : Frenkel's defect occurs when cations are displaced into the interstitial space formed between anions.

Statement II : Over all electrical neutrality of the ionic crystal is maintained in Frenkel's defect but disturbed in schottky's defect.

Statement III : Schottky's defect in mainly interstitial type point defect.

(a) I (b) II, III
(c) I, II (d) All

21. Consider the following statements with regard to BCC structure.

1. Number of nearest neighbour atoms is six
2. Packing efficiency is .68
3. There is an atom at the body centre of the unit cell

(a) 1, 2 (b) 2, 3
(c) 1, 3 (d) All

22. A solid in which all similar atoms are in similar position relative to their neighbours is said to

I. have long-range order
II. be crystalline
III. be amorphous

(a) I (b) II
(c) I, II (d) All

23. Which of the following are closed packed structures

I. h.c.p. II. tetragonal
III. bcc IV. FCC
(a) I, II (b) II, III
(c) III, IV (d) I, IV

24. A polymorphic material is one that

I. is found naturally in many different shapes
II. has more than one kind of crystal structure
III. displays allotropic forms

(a) I, II (b) II, III
(c) I, III (d) All

25. In defining Miller Indices we set up coordinate axes

I. along the edge of the unit cell
II. along the (100) directions
III. perpendicular to the faces of the unit cell

(a) I (b) II, III
(c) III (d) I, III

26. The (110) direction in a unit cell is parallel to

I. the diagonal of one face of the cell
II. the body diagonal of the cell
III. one edge of the cube

(a) I (b) I, II
(c) II (d) III

27. Which of the following statement is/are correct regarding intrinsic semiconductors

I. at room temperature intrinsic semi conductors shows conductivity
II. electron and hole both moves in conduction band from valance band

(a) I (b) II
(c) Both I and II (d) Neither I nor II

28. Which of the statement is correct

I. Mobility of electron is always greater than mobility of hole
II. at room temperature intrinsic carrier concentration (n_i) in G_e is greater than si

(a) I (b) II
(c) Both (d) None

29. Which of the following statement is/are correct regarding extrinsic semi conductors.

I. For n-type semiconductors pentavalent impurity is added
II. For p-type semiconductors IIIrd group impurity is added
III. N-type semiconductors are over all electrically neutral.

(a) I, II (b) II, III
(c) III, I (d) All

30. Which statement is/are correct

I. For n-type semiconductor majority charge carrier concentration proportional to donar concentration.
II. For p-type semiconductor, conductivity is proportional to accepter concentration

(a) I (b) II
(c) Both (d) None

31. Which of statement is correct regarding to valance band

I. It is the highest band in which electron are still associated with their parent atom
II. V.B. electron used thermal energy to free themselves from grip of their parent atom
III. V.B. electron are responsible for current flow.

(a) I, II (b) II, III
(c) I, III (d) All

42. The elastic strain obtained on applying a stress to a material is

I. time-dependent

II. instantaneous

III. reversible

IV. directly proportional to the stress

V. inversely proportional to the stress

(a) I, II, III, IV (b) II, III, IV

(c) II, III, V (d) I, II, III

43. If poisson's ratio during elastic deformation under uniaxial tensile stress is less than 0.5

I. there is a contraction in each of the two lateral direction

II. There is a expansion in each of the two lateral directions

III. There is a decrease in specimen volume

IV. There is an increase in specimen volume

(a) I, III (b) I, IV

(c) II, III (d) II, IV

44. The elastic resilience of a material is

I. the stored energy per unit volume during elastic deformation

II. the stored energy per unit volume associated with dislocations

III. given by $\frac{1}{2}\in^2 E$

IV. given by $\frac{1}{2}\sigma \in$

(a) I, II, IV (b) I, III, IV

(c) I, III (d) II, III, IV

45. The true strain is given by

I. $\ell n\left(\frac{\ell_1}{\ell_0}\right)$ II. $\frac{\Delta \ell}{\ell_0}$

III. $\frac{l}{l_0}$ IV. $\ell n(1+e)$

(a) I, III (b) II, III

(c) I, IV (d) III, IV

46. The Application of Hall effect is/are

I. To determine the carrier concentration

II. To determine whether the specimen is metal or semiconductor

III. To calculate the mobility of carriers

(a) I, II (b) II, III

(c) I, III (d) all

47. Find out correct statement/statements regarding to hall effect.

Statement I: Hall coefficient for metal is zero.

Statement II: Hall voltage for metals are in the range of micro meter while for the n-type semiconductor it is in the range of millimeter.

(a) I (b) II

(c) both (d) neither I nor II

48. Basic constituents of engineering ceramics are

I. alumina II. silicon carbide

III. silicon nitrite IV. silicon phosphite

(a) I, II, III (b) II, III, IV

(c) I, III, IV (d) all

49. Which of the following is/are correct related to ceramic materials

I. crystal structuature of ceramic is influenced by the magnitude of electrical charge on each of the component ions.

II. stable ceramic crystal structure is formed when all the anion surrounding the cation are in direct contact with that cation.

(a) I (b) II

(c) both (d) none

50. Which of the following statement is/are correct related to rock salt structure.

I. Co-ordination for both cation and anion is '6'

II. Radius ratio varies from $.414 < \frac{r_C}{r_A} < .732$

(a) I (b) II

(c) both (d) none

51. Which of the following is/are correct regarding ceramics?

I. Ceramics have high value of dielectric constant.

II. Ceramics materials have high value of corrosion resistance

III. Ceramics are ductile in nature

(a) I, III (b) I, II

(c) II, III (d) I, II, III

52. Vitrification is

I. The transformation from a glassy to a crystalline state

II. The densification in the presence of a viscous liquid

III. Important during the firing of clays

I. It consist of 12 hexagonal and 20 pentagonal structure.

II. It consist of 20 hexagonal and 12 pentagonal structure.

III. No two hexagon share a common side.

IV. No two pentagon share a common side.

(a) I, III (b) I, IV

(c) II, III (d) II, IV

64. Which of the following statement is/are correct regarding sintering?

I. This thermal treatment in ceramic manufacturing result in the transformation of porous compact into a dense.

II. Particles are coalesced by solid state diffusion.

III. Temperature is always less than melting point, throughout the process.

(a) I, II (b) II, III

(c) III, I (d) all

65. Which of the following statement is/are correct regarding sintering?

I. Thermoplastic are more temperature senstive than thermo setting polymer.

II. Thermoplasltic are formed by polymeriza-tion where as thermo settings are formed by condensation polymerization.

(a) I (b) II

(c) both (d) none

66. In pack car burising, energizer used is :

(a) 5%$CaCO_3$ (b) 5%Na_2CO_3

(c) 20%$CaCO_3$ (d) 20%Ba_2CO_3

67. Vulcanisation is/are

I. It is a cross linking process in elastomers.

II. Sulphur componds are added.

III. Decrease the modulus of elasticity of rubber.

(a) I, II (b) II, III

(c) I, III (d) all

68. Which of the following statement is/are correct regarding polymer additions?

I. Filler materials are added to polymer to improve tensile and compressive strength, abrasion resistance, toughness etc.

II. Plasticizers provide flexibility, ductility and toughness to polymers.

III. Plasticizers improve hardness and toughness of polymers.

(a) I, II (b) II, III

(c) I, III (d) all

69. Plasticizers

I. improve flexibility II. improve toughness

III. improve stiffness IV. decrease hardness

(a) I, II, III (b) I, II, IV

(c) I, III, IV (d) all

70. Thermoplastic material is/are

I. PVC II. Teflon

III. Polystyrene IV. Polyester

(a) I, II, III (b) I, II, IV

(c) II, III, IV (d) all

71. Which of the following are characteristic of plastics?

I. Low density II. Machinability

III. High strength

IV. Large plastic deformation

(a) I, II, III (b) I, II, IV

(c) II, III, IV (d) all

72. In a termoplastic polymer, adjacent molecules are bonded by

I. primary bonds

II. secondary bonds

III. covalent bonds

IV. vander waals or hydrogen bonds

(a) I, III (b) II, III, IV

(c) II, IV (d) I, III, IV

73. In a thermoplastic polymer, side groups are bonded to the backbone by

I. primary bonds

II. secondary bonds

III. covalent bonds

IV. vander waals or hydrogen bonds

(a) I, III (b) II, IV

(c) I, III, IV (d) I, II, III

74. Thermosetting polymers is/are

I. consist of a network of polymer chains

II. can not be remoulded

III. are generally more rigid than thermoplastic polymer

IV. have very temperature sensitive mechanical

SOLUTION...

1. (b) Atom moment within the crystal is not possible without breaking the bond which makes there material characteristically non directional i.e., in ionic compounds there is no intrinsically preferred direction in which a neighbour should lie for the strength of bonding to be maximum.

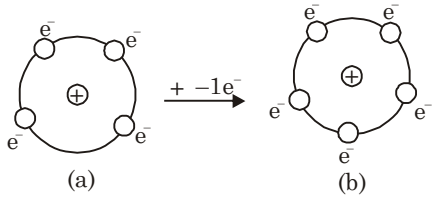
2. (a)

⇒ Inert gases have completed their octet so they are stable and has no affinity for an extra e^-

⇒ Halogens are required e^- to complete their octate so that can achieve inert gas configuration

⇒ When extra e^- added to a neutral atom, there is an increase in the repulsion b/w the e–'s.

Ex.



From figure clearly seen that state 'a' have $4e^-$ which have less repulsion than state 'b' which have $5e^-$

3. (c) Due to high electrostatic attraction b/w atoms ionic bonds are strongest bond in among the primary bond.

⇒ Statement II is correct.

4. (a) On the application of magnetic field we get a small value of magnetization in the field direction hence for these material magnetic susceptibility small but positive

⇒ ↑T randomness ↑

5. (c)

⇒ Ferromagnetic material get magnetised in the direction of applied magnetic field and remain magnetised even after removal of field. This property of ferro megnetic material is called sponteneous magnetisation

⇒ Dia magnetic materials are repelled from applied magnetic field because magnetic susceptibility is '–ve'.

6. (a) For diamagnetic materials $\chi_m < 0$

$$\mu_r - 1 < 0$$

$$\boxed{\mu_r < 1}$$

7. (b) Retentivity is the maximum value of residual permanent/sponteneous magnetization.

8. (c) Anti-ferromagnetic material are charecterised by anti parallel arrangement of dipole so net magnetization is zero, even in the presence of an applied filed these material have small positive suceptibility at all the temperature.

⇒ They remain antiferro magnetic upto Neel's temp. and above Neel's temperature they behave like paramagnetic materials.

9. (b) Ferrite have more resitivity than ferro magnetic material so eddy losses are less in ferrite also, ferrites have DC resistivity of many orders of ten higher than in iron, and are used for frequencies upto microwave in transformer.

Above curie temperature thermal agitation is so great that internal field is not sufficient to maintain alignment of magnetic dipole.

10. (c)

∵ Diamagnetic material has negative magnetic susceptivilityso they repelled by magnetic field because of this they moves from stronger magnetic field to weaker magnetic field.

∵ Diamagnetic material reduces the applied magnetic field so these permeability is less than free space permeability i.e., $\boxed{\mu < \mu_0}$.

11. (a) Magnetostriction : Is a property of ferro-magnetic materials that cause them to change their shape or dimensions during the process of magnetization.

12. (c) The magnetostriction characterizes the shape change of a ferro magnetic material during magnetization, where as the inverse magnetostrictive effect charecterizes the change of sample magnetization when mechanical stresses σ are applied to the sample.