ESE-2018 PRELIMS TEST SERIES

Date: 11th November, 2017

GS–TEST 7(OBJECTIVE SOLUTION)...

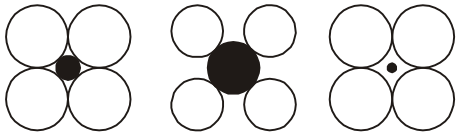
ANSWERS

1.	(c)	21.	(a)	41.	(c)	61.	(b)	81.	(b)
2.	(a)	22.	(a)	42.	(b)	62.	(d)	82.	(a)
3.	(a)	23.	(c)	43.	(c)	63.	(c)	83.	(a)
4.	(c)	24.	(b)	44.	(c)	64.	(d)	84.	(b)
5.	(b)	25.	(a)	45.	(b)	65.	(b)	85.	(b)
6.	(d)	26.	(b)	46.	(c)	66.	(c)	86.	(b)
7.	(c)	27.	(a)	47.	(*)	67.	(a)	87.	(c)
8.	(d)	28.	(d)	48.	(b)	68.	(c)	88.	(a)
9.	(a)	29.	(c)	49.	(b)	69.	(b)	89.	(a)
10.	(c)	30.	(a)	50.	(b)	70.	(d)	90.	(b)
11.	(d)	31.	(b)	51.	(a)	71.	(c)	91.	(a)
12.	(a)	32.	(c)	52.	(a)	72.	(d)	92.	(a)
13.	(c)	33.	(b)	53.	(d)	73.	(d)	93.	(b)
14.	(c)	34.	(b)	54.	(a)	74.	(a)	94.	(d)
15.	(d)	35.	(d)	55.	(a)	75.	(b)	95.	(a)
16.	(c)	36.	(a)	56.	(d)	76.	(c)	96.	(c)
17.	(c)	37.	(c)	57.	(a)	77.	(d)	97.	(a)
18.	(b)	38.	(b)	58.	(b)	78.	(b)	98.	(b)
19.	(a)	39.	(b)	59.	(a)	79.	(d)	99.	(b)
20.	(c)	40.	(c)	60.	(b)	80.	(a)	100.	(a)

1. (c)

∵ Ceramic crystal bonding is mainly due to ionic bonding and ionic bonding depend upon amount of electrostatic force. So there crystal influenced by magnitude of electrical charge.

⇒



Stable Stable Unstable

● →Positive ion

◯ →Negative ion

So contact b/w cation and anion must required for high amount of electrostatic force.

2. (a)

In ceramic bonding is due to Ionic and covalent, both but ionic bonding is more predominantly.

3. (a)

Basic consituents of engineering ceramics are

I. alumina (Al_2O_3)

II. silicon carbide (Sic)

III. silicon nitrite (Si_3N_4)

IV. zirconia (Zro_2)

4. (c)

In rock salt strucutre, we consider chloride ions in FCC positions and Na^+ in the octahedral voids because Na^+ ions are smaller, so co-ordination number is '6'.

5. (b)

⇒ Ceramics have high value of dielectric constant and have very low value of dielectric loss and this property make them highly suitable for insulation purpose.

⇒ Ceramics have high corrosion resistance to prevent any action of chemical and weather due to this property these are used in refractory material in nuclear plant.

⇒ Two most chemical bons for ceramic are covalent and ionic due to much stronger in covalent bond and ionic bonding than metallic they are brittle in nature.

6. (d)

Glass ceramics have an amorphous phase and one or more crystalline phases are produced by a so called "controlled crystallization".

7. (c)

Vitrification is the transformation of a substance into a glass that is to say a non crystalline amorphous solid. It is usually achieved by heating material until the liquidize, then cooling the liquid, often rapidly, so that it passes through the glass transition to form a vitrified solid.

8. (d)

Workability of concrete easily transported, placed, compacted and finished without any segregation.

Bleeding of concrete free water in the mix is pushed upward to the surface due to settlement of heavier solid particles.

9. (a)

Composite: When two or more constitute material that remain seperate and distinct while forming a single component.

⇒ Generally one of the material forms continous matrix while the other provide reinforcement.

⇒ The two material must be inert with respect to each other so that no interaction take place b/w them upon heating untill & unless it exist in molten form.

10. (c)

⇒ For every 1% of entrapped air, the strength falls by somewhere b/w 5 to 7%.

⇒ Due to air void permeability increases that means reduces it durability. If the concrete in not dense and impermeable, it will not be water tight.

11. (d)

I. Hall cofficient (R_H) = $\frac{1}{qn}$

$q \rightarrow$ charge of charge carrier

$n \rightarrow$ no. of charge carrier/m^3

II. For metal $n \rightarrow \infty$; there are lot of electron present in metal.

So, for metal $R_H = 0$, so by determining

the R_H, we can find out whether the speciment is metal or semiconductor

III. Mobility of carriers can also be find out by hall method.

12. (a)

⇒ Pneumatic structure: It is a membrane structure having a soft envelop whose internal volume is supplied with atmospheric air from pumping equipment to provide stability and resistance to external load.

⇒ Posibility of covering large span without internal support.

13. (c)

Concrete ⇒ (13 – 14) x 10^{-6} /°C

Steel ⇒ (11 – 12.5) × 10^{-6} /°C

14. (c)

Tensile strength of port land cement is approximatly 10-15 times lesser than its compressive strength.

15. (d)

Glass is a ceramic which is a mixture of substances with principal constituent of silica that has solidified from the liquid state without crystallization so they are an amorphous substance.

∵ Manufacturing process required high temperature, It makes glass process, difficult and expensive.

16. (c)

Degree of polymerization

$$= \frac{\text{molecular weight of ploymer}}{\text{molecular weight of monomer}}$$

Molecular weight of C_8H_8 = 12×8+8×1=104

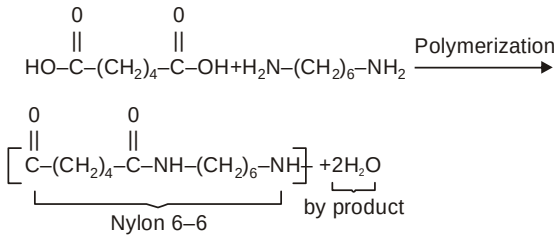
$$8000 = \frac{x}{104}$$

molecular weight of polymer = 8000×104

= 832000

17. (c)

Condensation polymer:



18. (b)

Thermo plastic polymer: They have long chains of polymers which are not cross-linked. They become softer on heating hence they can be remoulded into different shapes, under certain condition. It formed by addition polymerization.

19. (a)

Thermo setting plastics: They have long chains of polymers which are cross linked.

⇒ Once set, It can not be remoulded again.

⇒ It is a condensation process.

⇒ They have three-dimensional molecular structure.

20. (c)

Thermo plastic becomes softer on heating hence they can be moulded into different shapes.

Thermo plastic are formed by addition polymerization and thermo settings are formed by condensation polymerization.

21. (a)

Vulcanisation: It is a chemical process. For converting natural rubber or related polymers into more durable materials by the addition of sulfur.

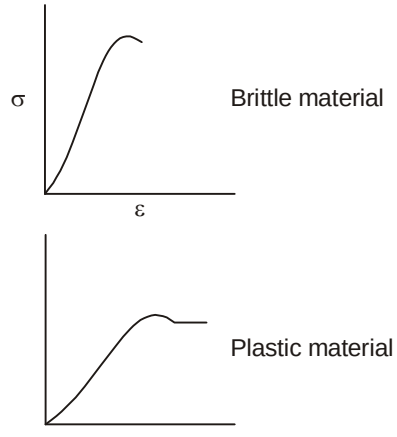
It increase the modulus of earticity of rubber.

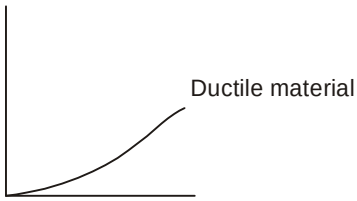
22. (a)

Filler material are added to polymers to improve tensile and compressive strength abrasion resistance, toughness, dimensional stability etc.

Plasticizers: There improve flexibility, ductility and toughness of polymers but reduces hardness and stiffness.

23. (c)





24. (b)

Characteristic of plastic are low density, machinability, low strength, large plastic deformation etc.

25. (a)

Example of thermoplastic materials are

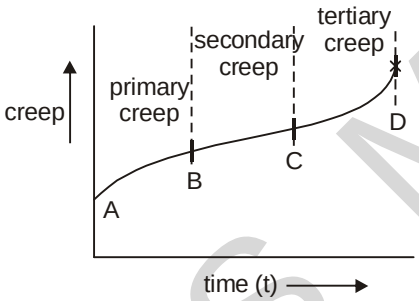
(1) polytheleve (2) polyvinyl chlride (PVC) (3) teflon (4) polystyrene etc.

26. (b)

Example of thermosetting materials are

1. bakelite
2. polyester
3. melamine
4. epoxies etc.

27. (a)



A to B is primary creep and it is non linear. The rate of creep is initially fast because there is no strain hardening but slows down later on because material becomes harder due to strain hardening effect i.e. more amount of dislocation is produced with in a crystal and they hinder the motion of other dislocation movement. This occurs even at very low temperatures.

28. (d)

Ceramic material are made of different compositions and have wide range of neutron capture and scatter characteristics. Thus they find nuclear applications and are used as moderators, shielding, controllers and fuel elements. These materials are refractory chemical resistant.

Vrania and plutonia are widely used as ceramic oxide fuel.

29. (c)

Ceramic material are non crystalline or crystalline. Non crystalline ceramics become brittle below recrystallization temperature. Ceramic materials are ionic or covalent bonded materials and can be crystalline or amorphous.

30. (a)

Annealing is a process in which the metal is relieved from internal stresses. Metal is heated below melting point temperature and the metal losses its stored energy and comes back to strain-free condition. Recovery, recrystallization and grain growth are the methods by which metal losses its stored energy.

Cold working: It is the plastic deformation of metals below the recrystallization temperature.

31. (b)

Screw dislocation: The displacement of the atoms is such that the Burgers vector is parallel to the dislocation line. Screw dislocation is generated by shear stresses acting on two parts of the crystal.

32. (c)

Temperature lower than '–157ºC' is called as cryogenic temperature.

Impact test measure toughness this property require for cryo service.

33. (b)

Atomization is a process of machanically disintegrating molten metal into fine particles using compressed air, water or inert gas.

34. (b)

Line defect: When slipping of one portion of crystal with respect to other portion by a distance of about one atomic spacing.

35. (d)

Total volume occupied by 4 atoms

= 4×20% of unit cell

= 80% volume of unit cell

$$\text{Packing factor} = \frac{\text{volume occupied by the atoms in unit cell}}{\text{volume of the unit cell}}$$

36. (a)

The permanent deformation of a material under steady load as a function of time is called creep.

It is appreciable at temperature above 0.4 T_m where T_m is melting point of material.

37. (c)

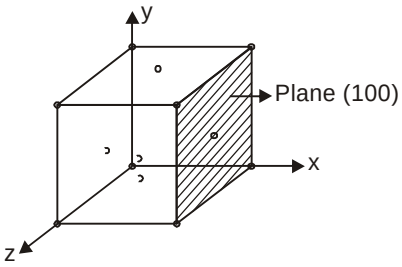
Tetragonal $a = b \neq c$ $\alpha = \beta = r = 90^o$

Monoclinic $a \neq b \neq c$ $\alpha = r = 90, \beta \neq 90^o$

Triclinic $a \neq b \neq c$ $\alpha \neq \beta \neq r \neq 90^o$

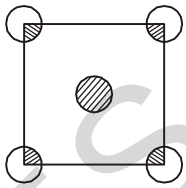
Rhombohedral $a = b = c$ $\alpha = \beta = r \neq 90^o$

38. (b)



Planar density = $\frac{\text{No. of atoms on a plane}}{\text{Area of plane}}$

$= \frac{\frac{1}{4}\times 4 + 1}{a^2} = \frac{2}{a^2}$



39. (b)

Brittle fracture occurs with little or no plastic deformation. Thus strain energy required for it is lower. Thus failure sign can not be marked.

Stress required duruing crack propogation is constant in nature due to less deformation and crack propagates at a faster rate.

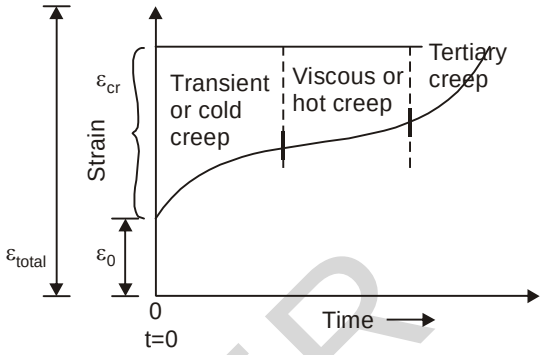
40. (c)

The yield strength is defined as the maximum stress at which a marked elongation occurs without increase in the load. Thus lower yield point is considered as yield strength of material.

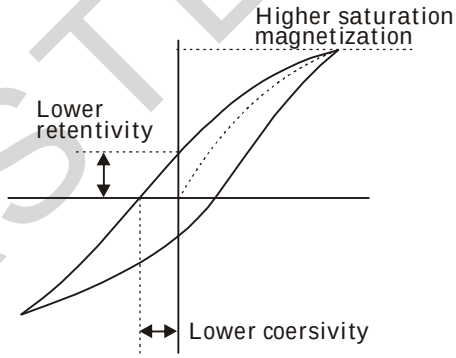
41. (c)

When the deformation is time dependent and recovery is also time dependent but the original shape and size is not fully recovered then such material are called visco elastic and such phenomenon is called visco elasticity.

42. (b)



43. (c)



From graph :

$\because$ Low hysteresis, so, hysteresis curve area so hysteresis losses are smaller.

44. (c)

Neel temp : Temperature about this antiferro magnetic material change to paramagnetic material

45. (b)

$\because$ parmanent magnetic moment is due to electron spin dipole moment.

$\because$ e^- spin dipole moment = np_B

p_m – Bohr magnetron

$n \rightarrow$ no. of unpaired electron given that unpaired e^- = 0

$\therefore$ $\boxed{\text{Parmanent magnetic moment} = 0}$

46. (c)

$\because$ $R_T = R_0 (1 + \alpha T)$

$6 = R_0 (1 + \alpha \times 40)$ ...(i)

$8 = R0 (1 + \alpha \times 40)$ ...(ii)

eq. (i) and (ii)

$$\frac{6}{8} = \frac{1+40\alpha}{1+60\alpha} \Rightarrow 3+180\alpha$$

$$= 4 + 160\alpha\ 20\alpha = 1$$

$$\Rightarrow \boxed{\alpha = \frac{1}{20}}$$

$$6 = R_0\left(1+\frac{1}{20}\times 40\right)$$

$$\Rightarrow \boxed{R_0 = 2\Omega}$$

47. (*)

Resistance $R = \frac{\rho\ell}{A}$

$$R_1 = \frac{\rho\ell}{w\times t} \qquad R_2 = \frac{\rho w}{\ell\times t}$$

$$R_1/R_2 = \frac{\ell^2}{w^2}$$

48. (b)

Longitudianl strain = $\frac{\Delta\ell}{\ell}$

Given $\Delta\ell = \ell$

Longitudinal strain = $\frac{\ell}{\ell} = 1$.

49. (b)

During strain hardening the strength of the metal is increased and ductility decreased.

50. (b)

Ductility : It is the ability of material to deform to a greater extent before the sign of crack. When it subjected to tensile force. Ductility is measured in units of percentage elongation or percentage reduction in area in a tension test.

51. (a)

Miller indices: It is a system of notation of planes and direction of atoms within a crystal or unit cell. They are based on the intercepts of plane with three crystal axes. The intercept are measured in terms of edge length i.e., dimensions of unit cell.

52. (a)

In zinc sulphide, Zns, the radius ratio of .40 suggests a tetrahedral arrangement. Each Zn^{+2} ion is tetrahedrally surrounded by four s^{2-} ions and each s^{2-} ion is tetrahedrally surrounded by four zn^{+2} ions so co-ordination number is 4, this is called a 4 : 4 arrangement.

53. (d)

Atom packing factor for hcp = .74

APF for BCC = .68

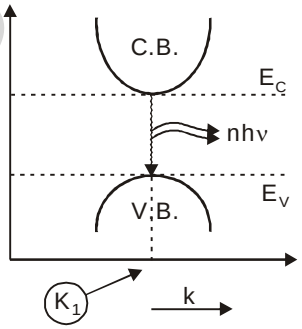
APF for FCC = .74

54. (a)

The structure of many ionic solids can be accounted for by considering relative sizes of the positive and negative ions, and their relative numbers.

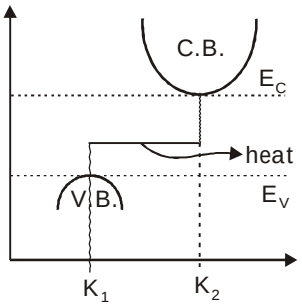
55. (a)

Direct band gap semiconductor



1. Carrier life is less
2. Energy released in the form of light.

Indirect band gap semiconductor.



$\Rightarrow$ Carrier life is more

$\Rightarrow$ Energy released in the form of heat.

56. (d)

57. (a)

$\Rightarrow$ Statement (I) is correct

⇒ In both the defect over all electrical neutrality is maintained

⇒ Schottky's defect is mainly vacancy type of point defect because in schottky's defect a pair of cation and anion are missing from the ionic crystal.

58. (b)

W → at corners of a cube = $8\times\frac{1}{8}=1$

O → at centre of edges = $12\times\frac{1}{4}=3$

Na → at centre of cube = 1 × 1 = 1

Formula → $NaW0_3$

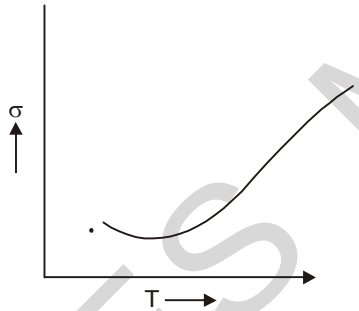
59. (a)

⇒ Valenced Band : It is the highest band in which e^- are still associated with their parent atom.

⇒ V.B.e– are not capable of taking energy from external applied and they do not contribute in current flow.

60. (b)

Graph b/w conductivity and temperature.



61. (b)

Seeback effect : When two dissimilar metals are joint at their ends and one is kept at higher temperature than the otehr, then an e.m.f. is developed across the junction.

62. (d)

Hot working : If the process of deformation carried out above recrystallization temperature.

It leats to fine grain structure, improve ductility and toughness, large deformation can be achieved and better homoginity of material.

63. (c)

True strain is given by

$$Et = \int_{L_0}^{L_1}\frac{dL}{L}$$

$$Et = \ell_u\left(\frac{L_1}{L_0}\right)=\ell_u\left(\frac{L_0+\Delta_L}{L_0}\right)$$

$$= e_n\,(1+e).$$

64. (d)

⇒ Dielectric are used for storage of charge example → Capicitor

⇒ Applied electric field induced due to polarization of dielectric in opposite direction to applied electric field.

65. (b)

66. (c)

67. (a)

68. (c)

69. (b)

70. (d)

71. (c)

72. (d)

73. (d)

74. (a)

Examples of nano technology is red coloured glass window seen in medieval churches.

75. (b)

The structure shown is basically known as ammonia in the industries.

76. (c)

In Brinell hardness test both sinking effect and piling up effect occur. Sinking effect is found in magnesium steel which piling up effect is found in lead, Sn, Mg.

77. (d)

78. (b)

79. (d)

In magnetostriction ferromagnetic material are magnetized in certain preferred direction not in all directions. When ferromagnetic crystal is magnetized in the easy direction the crystal gets elongated in that direction while in hard direction it gets contracted.

80. (a)

When anion and cation are in direct contact then distance b/w them is minimum and electrostatic force is maximum, so stable ceramic crystal is formed.

Electrostatic force (F) = $\frac{kq_1q_2}{r^2}$

$\Rightarrow \quad F \propto \frac{1}{r^2}$

$r \rightarrow$ dischance b/w the posite and –ve ions

81. (b)

Ceramics have high covalent and ionic bond. So they are brittle in nature.

82. (a)

Air voids increase concrete's permeability. If the concrete is not dense and impermeable, it will not be water tight. It will be less able to withstand aggressive liquids and its exposed surfaces will be weather badly.

83. (a)

Hall cofficient $R_H = \frac{1}{qn}$

$q \rightarrow$ charge of charge carrier

$n \rightarrow$ no. of charge carrier/m^3

For metal $R_H = 0$

$\because$ No. of election in metal tends to infinite.

So $R_H = 0$

So we can find out whether the specimen is metal or semicondutor by R_H

84. (b)

Critical fiber length

$$l_c = \frac{\sigma_f^* d}{2\tau_c}$$

σ_f^* = ultimate strength of fiber

d = fiber diameter

τ_c = fiber-matrix bond strength

85. (b)

In composite, two material must be inert with respect to each other so that no interaction take place b/w them upon heating untill & unless it exist in molten form.

86. (b)

The carbon atom in diamond are sp^3 hybridized and diamond is a uniform, continous 3-Dimensional network of C-C single (sigma) bonds. Where as graphite formed sp^2 hybridized carbon atoms that form a continous 2-D network. This 2-D sheet of graphite has little connection b/w other sheets of graphite. So heat conduction in 2-D sheet is greater than diamond but in per pendicular direction heat conduction is very less than diamond. So over all heat conduction of diamond is more than graphite.

87. (c)

$\Rightarrow$ Manufacturing process of glass required high temperature. So it makes the process difficult and expensive.

$\Rightarrow$ Silica is present in abundence in nature and having very low cost.

88. (a)

With in the layers of graphite, each carbon atoms is bonded to three coplanar neighbor atoms by strong covalent bonds, The fourth bonding electron participates in a weak vander walls type of bond between layers as a consequence of these weak interplanar bonds, interplanar cleavage is fragile, which gives size to the excellent lubricative properties of graphite.

89. (a)

In thermoplastic polymers, secondary weak forces like vander waals' forces are present. When they heated, secondary bonds are reduced and the sliding of these long chain molecules can easily occur one over the other at a reduced stress level.

90. (b)

The ductility of a metal decreases with decreasing temperature because metals becomes brittle at decreasing temperature. Ductility is affected by grain size which dependent on temperature.

91. (a)

Ferrite have higher resistivity than ferro magnetic materials so ferrite having lesser eddy current as compare to ferro magnetic material. So they are used for construction of core of high frequency transformer.

92. (a)

In Ferrite the magnetic moment of dipoles are not equal, so despite arranging in opposite direction of dipole there is existance of net moment. Because of this it can used as permanent magnet.

High coercivity is the features of ferrite and it is also required for hard magnets.

93. (b)

Brittle material in tension has smaller strength as compare to that in compression. That is because of presence of microscopic cracks in tension. The microscopic cracks are elolngated hence early failure occure in tension but in compresion the microscopic cracks are combined and hence strength in compression is greater. So test is done in compression.

94. (d)

Viscosity of a solid is a measure of its resistance to gradual deformation. When temperature increases motion of atom in solid increase so resistance to gradual deformation decreases means viscosity decreases with temperature increase.

95. (a)

In a single crystal, the physical and mechanical properties often differ with orientation. When the properties of a material vary with different crystallographic orientation, the material is said to be anisotropic.

96. (c)

In poly crystalline materail the crystal have different orientation with respect to each other and the grain boundary obstruct the movement of dislocation such crystal are isotropic because the exibits same properties in every plane and direction where as single crystal is called unisotropic long range ordering is present in poly crystalline material.

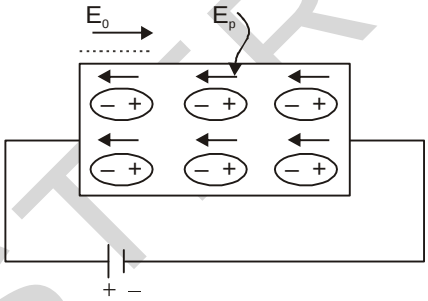
97. (a)

NaCl, the raio is .52 and this suggests an octahetral arrangement. Each Na^+ ion is surrounded by six Cl^- ions at the corners of a regular octahedron and similarly each Cl^- ion is surrounded by six Na^+ ion where as in CSCe radius ratio = .93. This indicates a body centered cubic type of arrangement, where each CS^+ ion id surrounded by eight Cl^- ions and vice versa.

98. (b)

Poly crystalline materials are stronger than single crystalline materials b'coz in poly crystalline material the crystal have different orientation with respect to each other and the grain boundary obstruct the movement of dislocation such crystals are called isotropic b'coz they exibits same properties in every plane and direction where as single crystal is called unisotropic.

99. (b)



E_0= initial applied electric field.

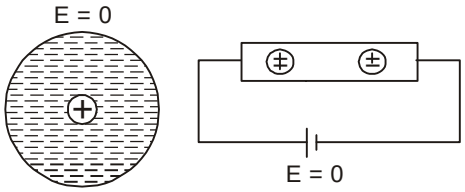
E_p= electric field due to polarisation and opposite to applied electric field.

Net electric field = $E_0 - E_p = \frac{E_0}{k}$

Net electric field decreases.

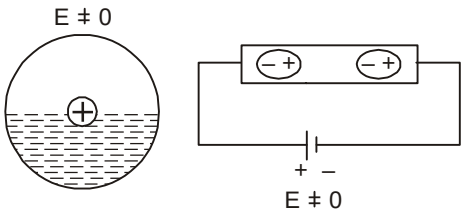
Reason not give clear explanation.

100.(a)



P = 0 ∵ Center of mass '+ve' ion coinside with center of mass '–ve' ion.

P = Polerisation



P ≠ 0 ∵ Center of mass of '+ve' ion not coinside with center of mass of '–ve' ion

E = electric field.