

Q1) Titanium is produced commercially by \_\_\_\_\_

- (A) smelting reduction of  $\text{TiO}_2$
- (B) thermal dissociation of  $\text{TiH}_2$
- (C) reduction of  $\text{TiCl}_4$  by Mg
- (D) reduction of  $\text{TiO}_2$  by  $\text{H}_2$

Q2) Magnesium treatment is carried out to produce \_\_\_\_\_ cast iron.

- (A) white
- (B) grey
- (C) spheroidal graphite
- (D) malleable

Q3) The sequence of peaks corresponding to the planes (in the order of increasing  $2\theta$ ) observed in the X-ray diffractogram of a pure copper powder sample is \_\_\_\_\_

- (A) 111, 200, 220, 311
- (B) 110, 200, 211, 220
- (C) 110, 200, 211, 311
- (D) 111, 200, 311, 220

Q4) Which one of the following Non Destructive Testing (NDT) techniques CANNOT be used to identify volume defects in the interior of a casting?

- (A) Ultrasonic testing
- (B) X-ray computed tomography
- (C) Dye-penetrant testing
- (D) Gamma ray radiography

Q5) Neutral point in rolling is defined as the point along the surface of contact between the roll and the sheet, where the surface velocity of the roll is \_\_\_\_\_

- (A) zero
- (B) half the velocity of the sheet
- (C) twice the velocity of the sheet
- (D) equal to the velocity of the sheet

Q6) In fluid flow, the dimensionless number that describes the transition from laminar to turbulent flow is \_\_\_\_\_

- (A) Reynolds number
- (B) Schmidt number
- (C) Biot number

(D) Prandtl number

Q7) Which one of the following elements has the slowest removal rate from hot metal in basic oxygen furnace (BOF) steelmaking?

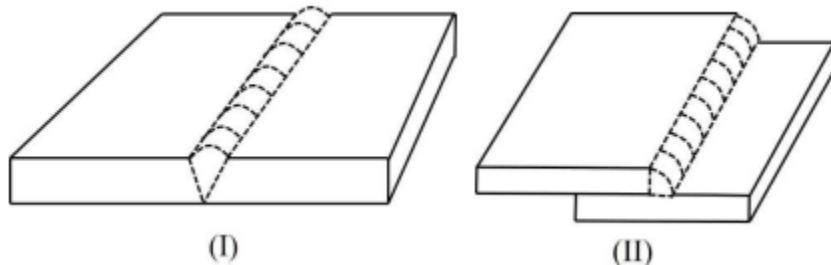
- (A) Carbon
- (B) Sulphur
- (C) Silicon
- (D) Phosphorus

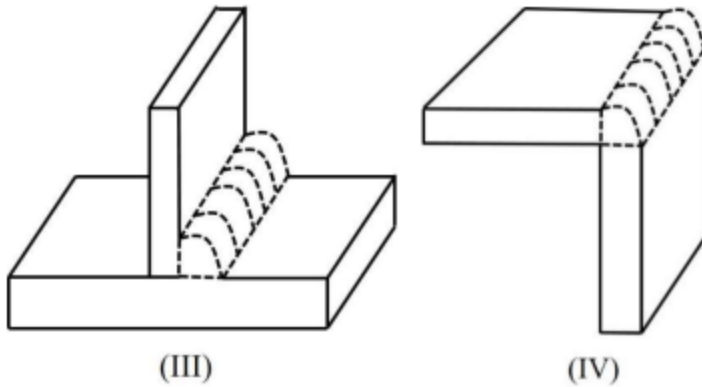
Q8) Match the nature of bonding (Column I) with material (Column II)

Column I	Column II
(P) Ionic	(1) Diamond
(Q) Covalent	(2) Silver
(R) Metallic	(3) NaCl
(S) Secondary	(4) Solid argon

- (A) P – 4, Q – 3, R – 2, S – 1
- (B) P – 2, Q – 1, R – 3, S – 4
- (C) P – 3, Q – 1, R – 4, S – 2
- (D) P – 3, Q – 1, R – 2, S – 4

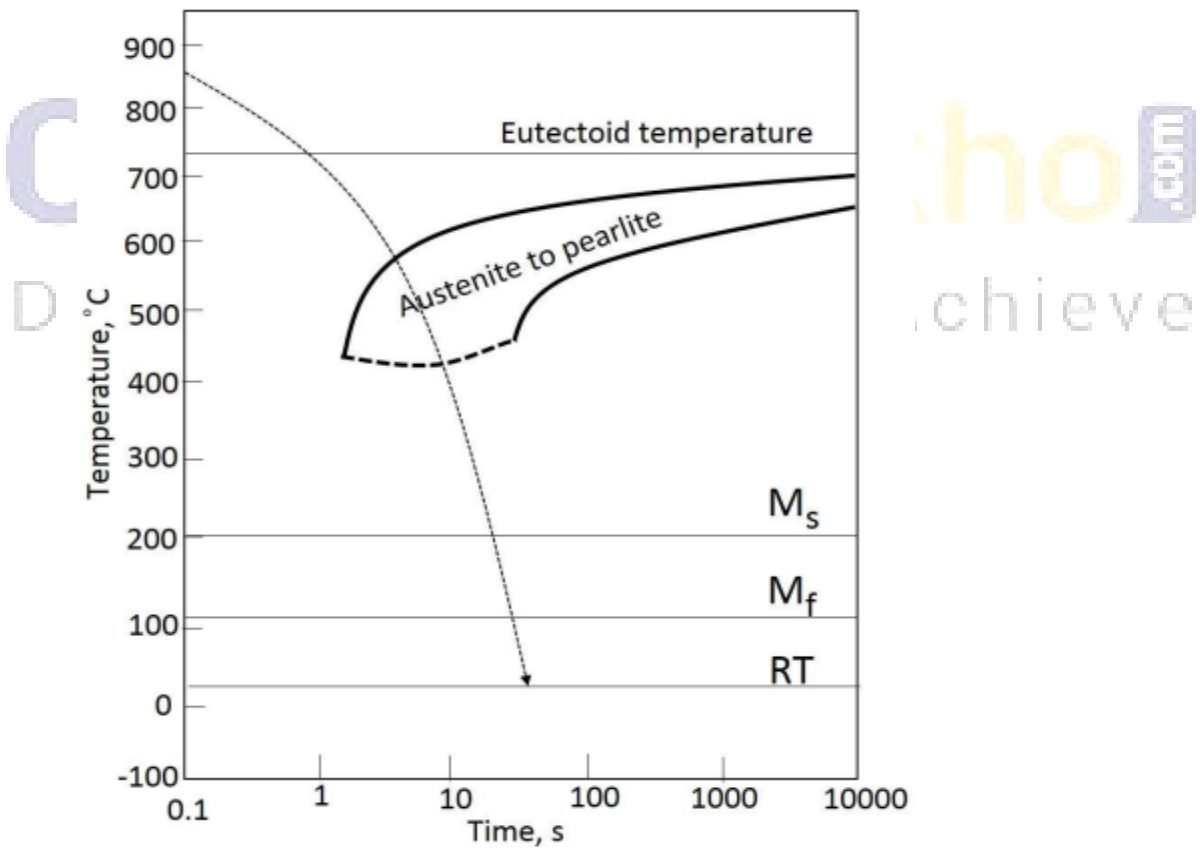
Q9) Which one of the following figures illustrates a lap joint with fillet weld?





- (A) I
- (B) II
- (C) III
- (D) IV

Q10) The CCT diagram of a eutectoid steel with a superimposed cooling curve is shown in the figure. The microstructure at room temperature (RT) after this heat treatment is \_\_\_\_\_



- (A) pearlite only
- (B) pearlite + retained austenite
- (C) martensite only
- (D) pearlite + martensite

Q11) In green sand moulding, the casting defect resulting from the displacement of mould cavity by an oversized core is known as \_\_\_\_\_

- (A) crush
- (B) hot tear
- (C) blow
- (D) fin

Q12) Which one of the following modern practices is used for retarding the solution loss reaction in blast furnace ironmaking?

- (A) High top pressure
- (B) Bell-less top
- (C) Pulverised coal injection
- (D) Rotating chute for burden distribution

Q13) Formation of an ideal solution leads to

- (A) increase in entropy
- (B) decrease in volume
- (C) increase in enthalpy
- (D) decrease in entropy

Q14) Among the following options, a process for liquid-liquid separation is

- (A) Smelting
- (B) Roasting
- (C) Sintering
- (D) Calcination

Q15) The most effective concentration step for sulphide ores is

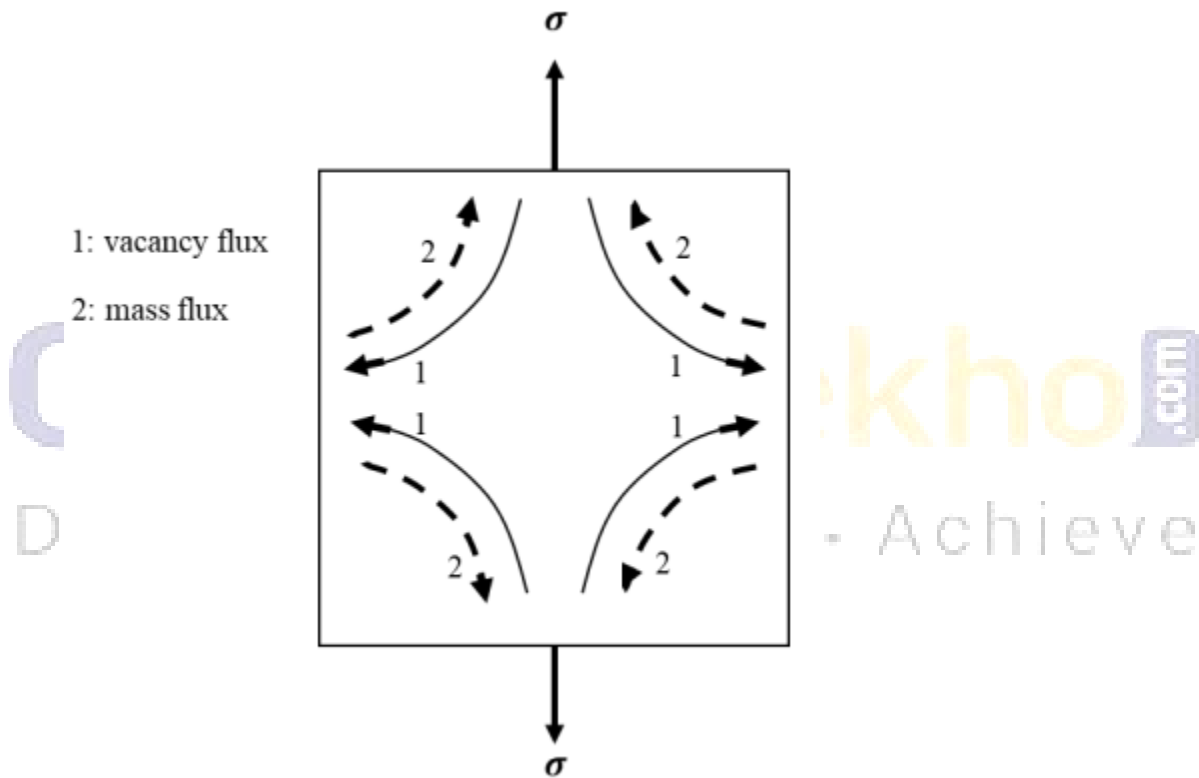
- (A) Froth flotation
- (B) Magnetic separation
- (C) Gravity separation
- (D) Electrostatic separation

Q16) The gas distribution in a blast furnace is controlled by the shape of

- (A) Cohesive zone
- (B) Deadman zone
- (C) Raceway zone
- (D) Chemical reserve zone

- Q17) Diamond has low
- (A) electrical conductivity
  - (B) modulus of elasticity
  - (C) hardness
  - (D) thermal conductivity

Q18) The mechanism of creep for a single crystal as depicted in the schematic is



- (A) Nabarro-Herring creep
- (B) Grain boundary sliding
- (C) Dislocation creep
- (D) Coble creep

Q19) In rolling, the point on the surface of contact between roll and sheet where surface velocity of the roll is equal to velocity of the sheet is referred as

- (A) no-slip point
- (B) no-stick point
- (C) maximum slip point
- (D) maximum stick point

Q20) When cracks propagate in a brittle material, the following option(s) is/are correct

- (A) elastic strain energy decreases
- (B) surface energy increases
- (C) surface energy decreases
- (D) elastic strain energy increases

Q21) Which of the following is/are responsible for reducing the high cycle fatigue life of a component?

- (A) increasing the mean stress at constant amplitude
- (B) increasing the surface roughness
- (C) employing shot peening
- (D) absence of sharp corners in the component

Q22) The non-destructive testing technique(s) for detecting internal defects in a steel component is/are

- (A) X-ray tomography
- (B) Ultrasonic technique
- (C) Gamma radiography
- (D) Dye penetrant technique

Q23) The condition(s) for high degree of mutual substitutional solid solubility for two metals is/are

- (A) metals should have same valence
- (B) metals should have same crystal structure
- (C) the difference in atomic size of metals should be less than 15%
- (D) the difference in electronegativity of metals should be large

Q24) Match the processes (Column I) with the corresponding defects (Column II)

Column I	Column II
(P) Extrusion	(1) Earing

(Q) Deep drawing	(2) Cold shut
(R) Forging	(3) Edge cracking
(S) Rolling	(4) Fir-tree cracking

- (A) P - 1, Q - 4, R - 2, S - 3  
 (B) P - 2, Q - 1, R - 4, S - 3  
 (C) P - 4, Q - 1, R - 3, S - 2  
 (D) P - 4, Q - 1, R - 2, S - 3

Q25) In continuous casting of steel, mould flux is used for \_\_\_\_\_

- (A) lubrication  
 (B) reducing heat loss  
 (C) inclusion control  
 (D) reducing solidification shrinkage

Q26) Taking S as entropy, T as temperature, P as pressure, and V as volume, match Column I with Column II.

Column I	Column II
(A) Gibbs Free Energy	(1) depends on T, V and composition
(B) Helmholtz Free Energy	(2) depends on T, P and composition
(C) Enthalpy	(3) depends on S, P and composition
(D) Internal Energy	(4) depends on S, V and composition

- (A) A - 2, B - 1, C - 3, D - 4  
 (B) A - 4, B - 3, C - 2, D - 1  
 (C) A - 3, B - 1, C - 4, D - 2  
 (D) A - 2, B - 1, C - 4, D - 3

Q27) Identify the correct statement(s) with respect to the role of nickel as an alloying element in steels.

- (A) It increases the  $M_s$  temperature  
 (B) It is an austenite stabilisers

- (C) It decreases the  $M_s$  temperature
- (D) It is a carbide former

Q28) While designing a material for high temperature application, which of the following characteristic(s)/attribute(s) is(are) desirable for achieving better creep resistance?

- (A) Fine grain size
- (B) FCC crystal structure
- (C) High melting point
- (D) Cold worked microstructure

Q29) Match the transport processes in Column I with the relationships in Column II

Column I	Column II
(P) Molecular momentum transport	(1) Stefan-Boltzmann law
(Q) Molecular mass transport	(2) Newton's law of viscosity
(R) Molecular energy transport	(3) Fick's law
(S) Radiation energy transport	(4) Fourier law

- (A) P – 2, Q – 3, R – 4, S – 1
- (B) P – 4, Q – 3, R – 2, S – 1
- (C) P – 3, Q – 1, R – 4, S – 2
- (D) P – 2, Q – 1, R – 4, S – 3

Q30) For supersonic  $O_2$  jet in basic oxygen furnace steelmaking, choose the correct combination from the following:

- (1) Converging-diverging nozzle
- (2) Diverging-converging nozzle
- (3)  $O_2$  velocity greater than sound velocity at nozzle throat (Mach number  $> 1$ )
- (4)  $O_2$  velocity equal to sound velocity at nozzle throat (Mach number = 1)
- (5) Exit  $O_2$  jet pressure  $\geq$  atmospheric pressure
- (6) Exit  $O_2$  jet pressure  $<$  atmospheric pressure

- (A) (1), (4), (5)
- (B) (1), (3), (6)
- (C) (2), (3), (5)



(D) (2), (4), (5)

Q31) Match the processes in Column I with the corresponding applications in Column II.

Column I	Column II
(P) Fused salt electrolysis	(1) Ironmaking
(Q) Carbothermal reduction	(2) Aluminium extraction
(R) Oxidation-refining	(3) Copper extraction
(S) Matte converting	(4) Steelmaking

(A) P – 2, Q – 1, R – 4, S – 3

(B) P – 4, Q – 3, R – 2, S – 1

(C) P – 3, Q – 1, R – 4, S – 2

(D) P – 2, Q – 4, R – 1, S – 3

Q32) Match Column I with Column II.

Column I	Column II
(P) Gallium arsenide	(1) Superconductor
(Q) Barium titanate	(2) Soft magnetic material
(R) Iron - 4 wt.% silicon	(3) Semiconductor
(S) Yttrium-barium-copper oxide	(4) Piezoelectric material

(A) P – 3, Q – 4, R – 2, S – 1

(B) P – 2, Q – 4, R – 3, S – 1

(C) P – 3, Q – 2, R – 1, S – 4

(D) P – 4, Q – 2, R – 1, S – 3

Q33) Match the components in Column I with corresponding manufacturing processes in Column II.

Column I	Column II
(P) Crank shaft	(1) Sheet metal forming
(Q) Machine bed	(2) Forging
(R) Automobile brake pad	(3) Casting
(S) Beverage can	(4) Powder metallurgy

- (A) P - 2, Q - 3, R - 4, S - 1  
 (B) P - 3, Q - 4, R - 1, S - 2  
 (C) P - 4, Q - 1, R - 3, S - 2  
 (D) P - 2, Q - 3, R - 1, S - 4

Q34) Match the following mineral processing operations (Column I) with the corresponding physical principles (Column II)

Column I	Column II
(P) Flotation	(1) Difference in speed of lateral movements
(Q) Jigging	(2) Hydrophobicity
(R) Tabling	(3) Difference in size reduction
(S) Comminution	(4) Difference in initial acceleration

- (A) P - 2, Q - 4, R - 1, S - 3  
 (B) P - 2, Q - 3, R - 1, S - 4  
 (C) P - 3, Q - 1, R - 4, S - 2  
 (D) P - 1, Q - 4, R - 2, S - 3

Q35) Match the welding techniques in Column I with the most appropriate applications in Column II.

Column I	Column II
(P) Submerged arc welding	(1) Thick sections
(Q) Electroslag welding	(2) Surfacing and repair
(R) Shielded metal arc welding	(3) Thin sheets
(S) Resistance spot welding	(4) Flat position

- (A) P – 4, Q – 1, R – 2, S – 3
- (B) P – 3, Q – 2, R – 1, S – 4
- (C) P – 1, Q – 3, R – 4, S – 2
- (D) P – 2, Q – 4, R – 3, S – 1

Q36) Concerning the chemical potentials of components in a binary system at constant pressure, the correct statement(s) is/are

- (A) For single-phase equilibrium at a given temperature, chemical potentials of the components change with alloy composition.
- (B) For two-phase equilibrium at a given temperature, the chemical potential of any component in both phases is same.
- (C) For two-phase equilibrium at a given temperature, chemical potentials of the components change with alloy composition.
- (D) For single-phase equilibrium of a given composition, chemical potentials of the components do not change with temperature.

Q37) Which of the following is/are the role(s) of coke in a blast furnace?

- (A) reducing agent
- (B) heat source
- (C) gas permeable medium
- (D) flux

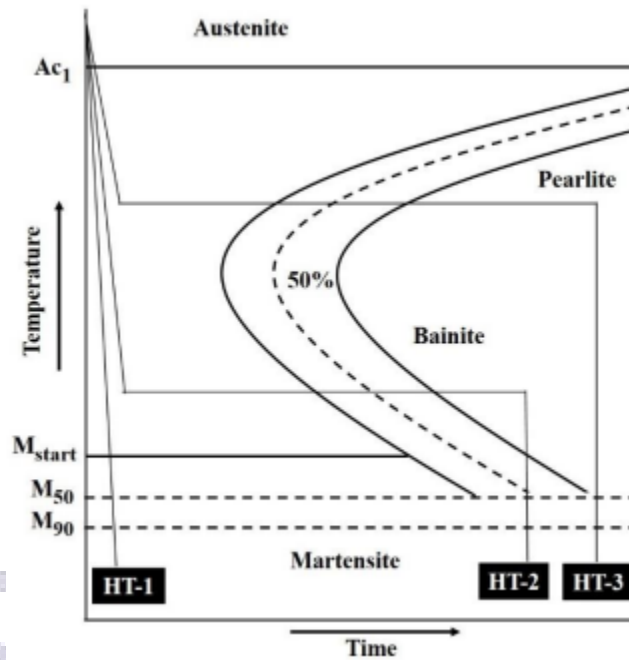
Q38) Identify the INCORRECT statement(s)

- (A) Calcination is typically exothermic and roasting is usually endothermic.
- (B) Coking of coal is carried out in a shaft furnace.

(C) The aims of extractive metallurgy processing are separation, compound formation, metal production, and metal purification.

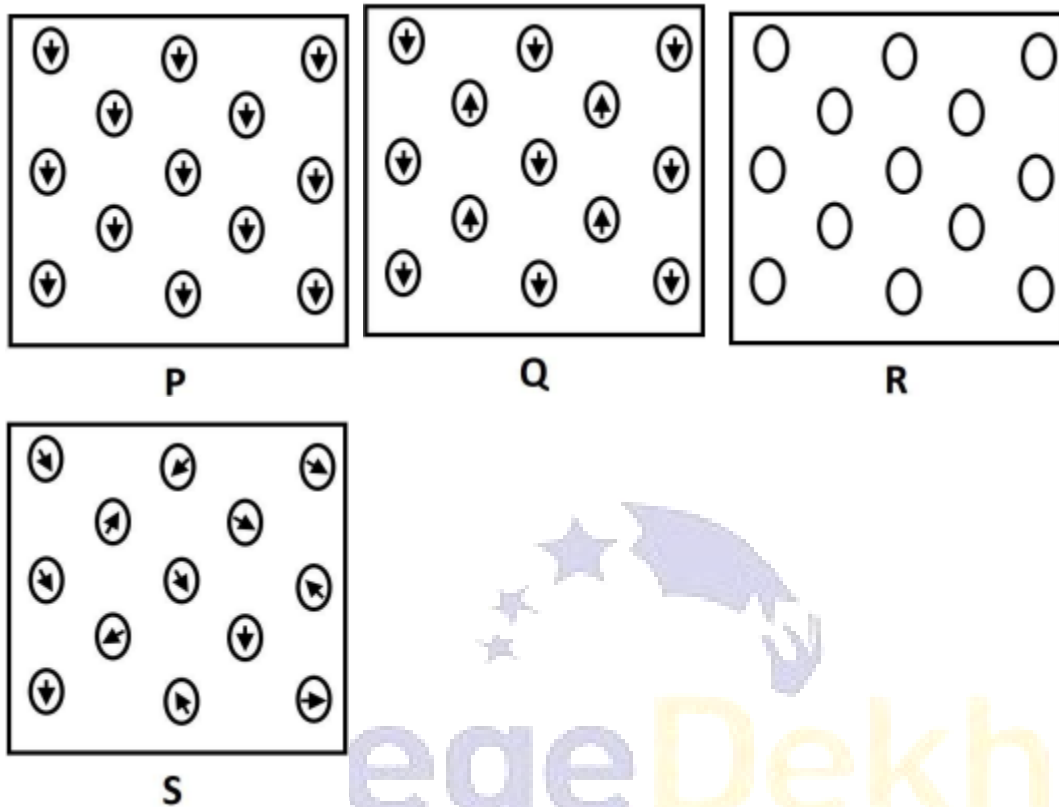
(D) The secondary steelmaking offers steel cleanliness, composition adjustments, and temperature adjustments.

Q39) For the given schematic TTT diagram of an eutectoid steel, the following statement(s) is/are true for the heat treatment schedules HT-1, HT-2, and HT-3.



- (A) HT-3 leads to the formation of a pearlite microstructure
- (B) HT-1 leads to a predominantly martensite microstructure
- (C) HT-2 leads to a bainite microstructure
- (D) HT-3 leads to a mixture of pearlite and bainite microstructure

Q40) Figures P, Q, R and S schematically show the atomic dipole moments in the absence of external magnetic field. Which one of the following is the correct mapping of nature of magnetism to atomic dipole moments?



- (A) P -Diamagnetism, Q - Antiferromagnetism, R - Paramagnetism, S - Ferromagnetism  
 (B) P – Ferromagnetism, Q - Antiferromagnetism, R – Diamagnetism, S - Paramagnetism  
 (C) P – Paramagnetism, Q – Ferromagnetism, R – Diamagnetism, S - Antiferromagnetism  
 (D) P – Ferromagnetism, Q – Diamagnetism, R – Antiferromagnetism, S - Paramagnetism

