

Frequently asked questions:

1. Explain the functions of calcium.

Ans: The functions of calcium are described as below.

1. Bone formation: The major mineral ions of the bone is Calcium. For proper calcification of bones, (deposition of minerals on the bone matrix) which occurs during the growing years, adequate supply of Ca is essential.
2. Tooth formation: Calcium is essential for the formation of dentin and enamel.
3. Physiological Process:
 - i. Calcium is essential for the clotting of blood.
 - ii. Calcium regulates the permeability of the capillary walls and ion transport across the cell membranes.
 - iii. It is essential for the contraction of the heart and skeletal muscle.
 - iv. Ca regulates the excitability of the nerve fibres.
 - v. Ca acts as an activator for enzymes such as rennin and pancreatic lipase.

2. Discuss the deficiencies caused by calcium.

Ans: Calcium related health problems occur due to inadequate intake, improper absorption or utilization of calcium.

i. Osteoporosis:

Osteoporosis is a condition found primarily among middle aged and elderly woman, where the bone mass of the skeleton is diminished. It results due to the following reasons:

- a. Prolonged dietary inadequacy
- b. Poor absorption and utilization of calcium
- c. Immobility
- d. Decreased levels of oestrogen in post menopausal women.
- e. Hyper parathyroidism
- f. Vitamin-D deficiency

ii. Osteomalacia – is a condition in which the quality but not the quantity of bone is reduced.

iii. Tetany- Tetany occurs when Calcium in the blood drops below the critical level. There is a change in the stimulation of nerve cells resulting in increased excitability of the nerve and uncontrolled contraction of the muscle tissue.

3. What are the results of hypercalcaemia?

Ans: Intake of calcium in amounts up to 2,500 mg daily appears to be safe for most people. The large intake of calcium resulted in hypercalcemia and deposition of calcium in soft tissues. Constipation also can occur when large amounts of calcium are ingested.

4. What is the Phosphorus content of the body? What are the functions of Phosphorus?

Ans: Phosphorus is second only to calcium in abundance in the body. Approximately 560-850g are present in a 70kg human, representing about 0.8-1.2% of body weight. Of total body phosphorus, about 85% is in the skeleton, 1% is in the blood and body fluids, and the remaining 14% is associated with soft tissue such as muscle.

The functions of phosphorus includes in

1. Bone formation: The major mineral ion of the bone is Phosphorous. For proper calcification of bones adequate supply of Phosphorous is essential.
2. Tooth formation: Phosphorous is essential for the formation of dentin and enamel.
3. Phosphorous is essential for the storage and release of adenosine triphosphate (ATP) molecules
4. Phosphates plays an important role as buffers to prevent changes in acidity of the body fluids.
5. Phospholipids are major components of cell membrane and intracellular organelles
6. In the DNA and RNA phosphate is an essential part of the nucleic acids

5. What happens when Phosphorus in deficit and excess in body?

Ans: Deficiency of Phosphorus: Phosphate deficiency is rare, but it could possibly develop in individuals who are taking drugs known as phosphate binders. Symptoms result

primarily from decreased synthesis of ATP and other organic phosphate molecules. Neural, muscular, skeletal, hematologic, renal, and other abnormalities occur. Clinical phosphate depletion and hypophosphatemia can result from long-term administration of glucose or Total Parental Nutrition without sufficient phosphate, excessive use of phosphate-binding antacids, hyperparathyroidism or treatment of diabetic acidosis and it may develop in those who have alcoholism with or without decompensated liver disease.

Excess: Toxicity from phosphorus is rare. Problems have been reported only in infants when calcium:phosphorus ratios are altered significantly in favor of phosphorus. Phosphorus toxicity is characterized predominantly by hypocalcemia and tetany.

6. What is the Magnesium content of the body? What are the functions of Magnesium?

Ans: Like calcium, magnesium is closely associated with skeletal system. About 20-25g magnesium is present in adult human body and about 60-70% of it occurs in the bone, 25-30% in the muscle, 6-8% in soft tissues and 1% in the extracellular fluid.

The functions of phosphorus are

1. Stabilize the structure of ATP in ATP-dependent enzyme reactions
2. Magnesium is a cofactor for more than 300enzymes involved in the metabolism of food components.
3. Magnesium plays a role in neuromuscular transmission and activity
4. In a normal muscle contraction, calcium acts as a stimulator, and magnesium acts as a relaxant. Magnesium acts as a physiologic calcium-channel blocker.

7. What happens when Magnesium in deficit and excess in body?

Ans: Deficiency of Magnesium: Poor magnesium status may be related to cardiovascular disease, renal disease, diabetes mellitus, toxemia of pregnancy, hypertension, or postsurgical complications. Symptoms of abnormal neuromuscular function occur in magnesium depletion associated with malabsorption syndromes like inflammatory bowel disease or sprue, primary idiopathic hypomagnesemia and severe protein energy malnutrition. In severe

deficiency, the subjects suffer often from tetany and convulsions. Hypomagnesemia, hypocalcemia and hypokalemia are always associated with magnesium deficiency and are reversed by magnesium repletion. A syndrome of magnesium-dependent, vitamin D-resistant rickets is observed.

Excess: Although excess magnesium can inhibit bone calcification, magnesium excesses from dietary sources, including supplements, are very unlikely to result in toxicity. The only cases of toxicity that have been reported involve smelter workers who inhale.

8. Explain Sodium under the following headings

- a. Distribution in the body**
- b. Functions**
- c. Deficiency**
- d. Excess**

Ans: a. Distribution in the body: Approximately 30% of the ~105g of sodium in the body (70kg human) is located on the surface of bone crystals. The remainder of the body's sodium is in the extracellular fluid, primarily plasma, and in nerve and muscle tissue. Sodium constitutes about 93% of the cations in the body, making it by far the most abundant member of this family.

b. Functions: Within the body, sodium plays important roles in the maintenance of fluid balance, nerve transmission/impulse conduction, and muscle contraction. Sodium, potassium and chloride display the most movement across cell membranes to maintain osmotic pressure and thus fluid balance. Sodium's roles in nerve transmission and muscle contraction involve sodium as part of the Na^+/K^+ -ATPase pump found in the plasma membrane of cells.

c. Deficiency: Dietary deficiencies of sodium do not normally occur because of the abundance of the mineral across a broad spectrum of foods. Excess sodium in the diet is said to contribute to hypertension in genetically prone individuals. Symptoms include muscle cramps, nausea, vomiting, dizziness, shock and coma.

d. Excess: Apart from its relationship to hypertension, at intakes of 590-680mmol daily, healthy individuals can develop fluid retention

9. Explain Potassium under the following headings

- a. **Distribution in the body**
- b. **Functions**
- c. **Deficiency**
- d. **Excess**

Ans: Distribution in the body: Potassium is the major intracellular cation. About 95-98% of the body's potassium is found within body cells. Potassium constitutes up to ~0.35% of total body weight, or upto ~245 g in a 70 kg human

b. Functions: Potassium contributes to intracellular osmolality. Enzymes involved in glycolysis and oxidative phosphorylation are potassium-dependent. It is involved in the maintenance of acid-base balance. Potassium is vaso-active, increasing blood flow and sustains metabolic needs of the tissue. Potassium supplements lower blood pressure. Potassium influences the contractility of smooth, skeletal and cardiac muscle and profoundly affects the excitability of nerve tissue.

c. Deficiency: Hyperkalemia is toxic, resulting in severe cardiac arrhythmias and even cardiac arrest. Similarly, hypokalemia does not occur by dietary deficiency because of the abundance of potassium in common foods. Hypokalemia is associated with cardiac arrhythmias, muscular weakness, nervous irritability, hypercalciuria, glucose intolerance, and mental disorientation and can result from profound fluid loss, such as the losses that occur with severe vomiting and diarrhea or with use of some diuretic medications. A moderate deficiency of potassium is associated with elevations in blood pressure, increased urinary calcium excretion, and abnormal bone turnover.

d. Excess: Hyperkalaemia can be fatal and result in cardiac arrest. Individuals with sub-clinical/clinical renal failure are at risk of hyperkalaemia.

10. What are the functions of Chloride and Sulphur?

Ans: Functions of Chloride: Chloride has important functions in addition to its role as a major electrolyte. The formation of gastric hydrochloric acid requires chloride. Chloride is released by white blood cells during phagocytosis to assist in the destruction of foreign substances.

Functions of Sulphur: Sulfhydryl groups of proteins participate in diverse cellular reactions. The sulfur of cysteine is involved in photosynthesis, nitrogen fixation and oxidative phosphorylation. In the broadest sense, sulfur can be considered an antioxidant. Sulfur exists as a component of heparin, an anticoagulant found in liver and some other tissues and as chondroitin sulfate in bone and cartilage. Sulfur is also an essential component of three vitamins-thiamin, biotin and pantothenic acid.

11. What are the Deficiencies of Chloride and Sulphur?

Ans: Deficiency of Chloride: Dietary deficiency of chloride does not occur under normal conditions. As is the case for the other electrolytes, deficiency arises chiefly through gastrointestinal tract disturbance such as severe diarrhea and vomiting

Deficiency of Sulphur: Excess inorganic sulfur generated as a result of hepatic or renal metabolism is excreted in the urine as sulfates. These sulfates are thought to combine with calcium ions in the glomerular ultrafiltrate, thereby reducing the renal tubular resorption of calcium. Sulfur deficiency or toxicity is highly unlikely.

12. Explain Cobalt under the following headings

- a. Distribution in the body**
- b. Functions**
- c. Deficiency**
- d. Excess**

Ans: a. Distribution in the body: Most of the cobalt in the body exists with vitamin B₁₂ stores in the liver. Blood plasma contains approximately 1mcg of cobalt per 100.

b. Functions: The well-known essential role of cobalt is as a component of vitamin B₁₂ (cobalamin) which is essential for the maturation of red blood cells and the normal function of all cells. In addition, methionine aminopeptidase, an enzyme involved in the regulation of translation is the only enzyme in humans known to have an established requirement of this trace element.

c. Deficiency: A cobalt deficiency develops only in relation to a vitamin B₁₂ deficiency. Insufficient vitamin B₁₂ causes a macrocytic anemia and genetic defect limiting vitamin B₁₂ absorption results in pernicious anemia.

d. Excess: A high intake of inorganic cobalt in animal diets produces polycythemia (an overproduction of red blood cells), hyperplasia of bone marrow reticulocytosis, and increased blood volume.

13. Discuss the functions and deficiencies of Arsenic and Boron.

Ans: Functions and deficiencies of Arsenic: More than any other ultratrace mineral, arsenic, which is colorless and odorless, conjures an image of toxicity as a poison rather than of nutritional essentiality.

a. Functions: Arsenic appears to be needed to form and use methyl groups, generated in methionine metabolism to S-adenosylmethionine (SAM). SAM is a major methyl donor in the body and functions in synthesizing a variety of compounds and in methylating compounds needed for DNA synthesis.

b. Deficiency: Arsenic deficiency impairs metabolism of methionine, resulting in decreased SAM concentrations. Arsenic-deficient rats fed, experienced growth deficits compared with arsenic-supplemented rats. Effects of arsenic deprivation in animals include curtailed growth, reduced conception rate, and increased neonatal mortality.

Boron

Boron, as boric acid and sodium borate (called borax), was used to preserve foods such as fish, meat, cream, butter, and margarine for over 50 years—that is, until about the 1920s, when it was considered dangerous for humans but deemed essential for plants.

a. Functions: Boron is thought to have several functions in the body, including roles in embryogenesis, bone development, cell membrane function and stability, metabolic regulation, and the immune response. Because of its anti-inflammatory effects, boron is purported to reduce the severity of rheumatoid arthritis

b. Deficiency: Boron deficiency has not been reported in humans, and no toxicity level has been established.

14. Discuss the functions and deficiencies of Nickel and Vanadium.

Ans: Nickel: Nickel is used industrially in various capacities, such as production of stainless steel and nickel-cadmium batteries. Nickel's essentiality in human nutrition was first suggested in the 1930s.

a. Functions: A specific role of nickel in human and animal nutrition has not yet been defined, although roles for nickel in plants and microorganisms have been documented.

b. Deficiency: Signs of nickel deprivation continue to be described for some animal species. Among the more consistent signs are depressed growth, altered distribution of some minerals, changes in blood glucose, and impaired hematopoiesis.

Vanadium

Vanadium was first discovered in the early 1800s and named for a Swedish goddess, Vanadis. In solution, vanadium produces a range of colors, which accounts for its being named after the goddess. In its pentavalent state it is yellowish orange, whereas in its divalent state it is blue.

a. Functions: No specific biochemical function has been identified for vanadium. Vanadium mimics the action of insulin. Vanadium stimulates glucose uptake into cells, enhances glucose metabolism, and inhibits catecholamine induced lipolysis in adipose tissue. Vanadium also stimulates glycogen synthesis in the liver and inhibits gluconeogenesis. Vanadium also can substitute for other metals such as zinc, copper, and iron in metallo enzyme activity.

b. Deficiency: Vanadium deficiency has suggested that the element is associated with iodine metabolism, thyroid gland function, or both. Controlled depletion of vanadium has been reported to adversely affect growth rate, perinatal survival, physical appearance, hematocrit, and other manifestations in various animal species.

15. Discuss the functions, deficiencies and excess of Silicon

Ans: Silicon occupies a unique position among the essential trace elements in that it is second only to oxygen in earthwide abundance.

a. Functions: The physiological role of silicon centers on normal formation, growth and development of bone, connective tissue, and cartilage. Silicon is thought to play both a metabolic and a structural role.

b. Deficiency: Silicon deficiency results in smaller, less flexible long bones and in skull deformation. Silicon deprivation in rats diminished bone collagen formation and increased collagen breakdown.

c. Excess: No tolerable upper intake level has been established for silicon. The major potential adverse effect reported is kidney stone. Toxicity of silicon also has been associated with diminished activities of several enzymes that prevent free radical damage. Silicosis occurs from inhaling dust high in silica; the condition is characterized by a progressive fibrosis of the lungs that leads to respiratory problems.