n PGMEE books, visit our website **www.jaypeebrothers.com,** for detailed information on PGMEE books

PG Entrance Examination

AIIMS November 2015

With Explanatory Answers

Includes colored image-based questions

Rituraj Upadhyay

JAYPEE

Contents

Preparation Tips		*viii*
1.	Anatomy (16 Questions)	1
2.	Physiology (11 Questions)	25
3.	Biochemistry (11 Questions)	41
4.	Pathology (11 Questions)	57
5.	Pharmacology (19 Questions)	79
6.	Microbiology (12 Questions)	98
7.	Forensic Medicine (11 Questions)	133
8.	Orthopedics (5 Questions)	153
9.	Ophthalmology (2 Questions)	162
10.	ENT (4 Questions)	168
11.	PSM (19 Questions)	179
12.	Medicine (18 Questions)	221
13.	Surgery (7 Questions)	255
14.	Pediatrics (7 Questions)	265
15.	Obstetrics and Gynecology (19 Questions)	279
16.	Skin (8 Questions)	317
17.	Anesthesia (11 Questions)	331
18.	Radiology (3 Questions)	355
19.	Psychiatry (6 Questions)	361

28. What is the codon for Selenocysteine?

a. UAG
b. UGA
c. UAA
d. GUA

Ans. b. UGA

Ref: Harper: Illustrated Biochemistry 30/e p18,286

Selenocysteine is commonly termed the "21st amino acid" which unlike other amino acids present in biological proteins, is not coded for directly in the genetic code. **Instead, it is encoded by a UGA codon, which is normally a** *stop codon*. **Such a mechanism is called translational recoding.**

- Selenocysteine is a *cysteine* analogue with a *selenium*-containing *selenol* group in place of the *sulfur*-containing *thiol* group.
- It is present in several *enzymes* (for example *glutathione peroxidases, tetraiodothyronine 5′ deiodinases, thioredoxin reductases, formate dehydrogenases, glycine reductases, selenophosphate synthetase* 2, methionine-R-sulfoxide reductase B1 (SEPX1), and some *hydrogenases*).
- Biosynthesis requires cysteine, selenate (SeO_4), ATP, a specific tRNA, and several enzymes. Serine provides the carbon skeleton. Selenophosphate, formed from ATP and selenate, serves as the selenium donor.
- Unlike hydroxyproline or hydroxylysine, selenocysteine arises cotranslationally during its incorporation into peptides.
- The UGA anticodon of the unusual tRNA called tRNASec normally signals STOP. The ability of the protein synthetic apparatus to identify a selenocysteine specific UGA codon involves the selenocysteine insertion element, a stem-loop structure in the untranslated region of the mRNA. tRNASec is first charged with serine by the ligase that charges tRNASer. Subsequent replacement of the serine oxygen by selenium involves selenophosphate formed by selenophosphate synthetase.

JAYPEE BROTHERS

- Successive enzyme-catalyzed reactions convert cysteyl-tRNASec to aminoacrylyl-tRNASec and then to selenocysteyl-tRNASec. In the presence of a specific elongation factor that recognizes selenocysteyl-tRNASec, selenocysteine can then be incorporated into proteins.
- When cells are grown in the absence of selenium, translation of selenoproteins terminates at the UGA codon, resulting in a truncated, nonfunctional enzyme. The UGA codon is made to encode selenocysteine by the presence of a *selenocysteine insertion sequence* (SECIS) in the *mRNA*. The SECIS element is defined by characteristic nucleotide sequences and secondary structure base-pairing patterns.
- Biotechnological applications of selenocysteine include use of ^{73}Se-labeled Sec (half-life of ^{73}Se = 7.2 hours) in *positron emission tomography* (PET) studies and ^{75}Se-labeled Sec (half-life of ^{75}Se = 118.5 days) in specific *radiolabeling*, facilitation of phase determination by *multi-wavelength anomalous diffraction* in X-ray *crystallography* of proteins by introducing Sec alone, or Sec together with *selenomethionine* (SeMet), and incorporation of the stable ^{77}Se isotope, which has a *nuclear* spin of 1/2 and can be used for high-resolution *NMR*.

29. Biotin is not required as a cofactor in which of these conversions?

a. Gamma carboxylation of glutamate
b. Acetyl CoA to Malonyl CoA
c. Propionyl CoA to methylmalonyl CoA
d. Pyruvate to oxaloacetate

Ans. a. Gamma carboxylation of glutamate

Ref: Harper: Illustrated Biochemistry 30/e p550, 561

The reaction described in "A" is carried out by Gamma-glutamyl carboxylase. It is a Vitamin-K dependent enzyme that catalyzes the post-translational modification of vitamin K-dependent proteins.

Biotin (Vitamin B_7) is a Coenzyme of Carboxylase Enzymes

Function

Cofactor for carboxylation enzymes (which add a 1-carbon group):

- Pyruvate carboxylase: pyruvate (3C) to oxaloacetate (4C)—Gluconeogenesis

JAYPEE BROTHERS

- Acetyl-CoA carboxylase: acetyl-CoA (2C) to malonyl-CoA (3C): Lipid Synthesis
- Propionyl-CoA carboxylase: propionyl-Co A(3C) to methylmalonyl-CoA (4C): Gluconeogenesis
- Methylmalonyl CoA carboxyltransferase: Propionic acid synthesis (bacteria)
- Methylcrotonyl-CoA carboxylase: Leucine Catabolism Biotin also has a role in regulation of the cell cycle, acting to biotinylate key nuclear proteins.

Deficiency

- Relatively rare. Dermatitis, alopecia, enteritis.
- Caused by antibiotic use or excessive ingestion of raw egg whites. A**vid**in in egg whites a**vid**ly binds biotin.

Vitamins

Vitamin	Name	Functions	Deficiency disease
Lipid-soluble			
A	Retinal, β-carotene	Visual pigments in the retina; regulation of gene expression and cell differentiation (β-carotene is an antioxidant)	Night blindness, xerophthalmia; keratinization of skin
D	Calciferol	Maintenance of calcium balance enhances intestinal absorption of Ca^{2+} and mobilizes bone mineral; regulation of gene expression and cell differentiation	Rickets = poor mineralization of bone; osteomalacia = bone demineralization
E	Tocopherols tocotrienols	Antioxidant, especially in cell membanes; roles in cell signaling	Extremely rare—serious neurologic dysfunction
K	Phylloquinone: menaquinones	Coenzyme in formation of γ-carboxyglutamate in enzymes of blood clotting and bone matrix	Impaired blood clotting, hemorrhagic disease
Water-soluble			
B_1	Thiamin	Coenzyme in pyruvate and α-ketoglutarate dehydrogenases and transketolase; regulates Cl^- channel in nerve conduction	Peripheral nerve damage (beriberi) or central nervous system lesions (Wernicke-Korsakoff syndrome)

Contd...

JAYPEE BROTHERS

Contd...

Vitamin	Name	Functions	Deficiency disease
B_2	Riboflavin	Coenzyme in oxidation and reduction reactions (FAD and FMN); prosthetic group of flavoproteins	Lesions of corner of mouth, lips, and tongue, seborrheic dermatitis
Niacin	Nicotinic acid, nicotinamide	Coenzyme in oxidation and reduction reactions, functional part of NAD and NADP; role in intracellular calcium regulation and cell signaling	Pellagra—photosensitive dermatitis, depressive psychosis
B_6	Pyridoxine, pyridoxal, pyridoxamine	Coenzyme in transamination and decarboxylation of amino acids and glycogen phosphorylase; modulation of steroid hormone action	Disorders of amino acid metabolism, convulsions
	Folic acid	Coenzyme in transfer of one-carbon fragments	Megaloblastic anemia
B_{12}	Cobalamin	Coenzyme in transfer of one-carbon fragments and metabolism of folic acid	Pernicious anemia-megaloblastic anemia with degeneration of the spinal cord
	Pantothenic acid	Functional part of CoA and acyl carrier protein: fatty acid synthesis and metabolism	Peripheral nerve damage (nutritional melalgia or burning foot syndrome)
H	Biotin	Coenzyme in carboxylation reactions in gluconeogenesis and fatty acid synthesis; role in regulation of cell cycle	Impaired fat and carbohydrate metabolism dermatitis
C	Ascorbic Acid	Coenzym in hydroxylation of proline and lysine in collagen synthesis; antioxidant; enhances absorption of iron	Scurvy—impaired wound healing, loss of dental cement, subcutaneous hemorrhage

30. Which of the following is not a technique for protein precipitation?

JAYPEE BROTHERS

a. Trichloroacetic acid
b. Heat precipitation
c. Isoelectric point method
d. Titration with reducing sugar

Ans. d. Titration with reducing sugar

Ref: Harper: Illustrated Biochemistry 30/e p26

Titration with reducing sugar is not used for protein precipitation. Protein precipitation is widely used to concentrate proteins and *purify* them from various contaminants.

Methods of Protein Precipitation

Selective precipitation exploits differences in relative solubility of individual proteins:

- pH (isoelectric precipitation), (protein is least soluble at isoelectric point)
- Polarity (precipitation with ethanol or acetone), or
- Salt concentration (salting out with ammonium sulfate). (Half saturation—globulin, casein) (Full saturation = albumin)
- By heavy metals (lead, cadmium, mercury).

Chromatographic techniques separate one protein from another based upon difference in their:

- Size (size exclusion chromatography)
- Charge (ion-exchange chromatography)
- Hydrophobicity (hydrophobic interaction chromatography) or
- Ability to bind a specific ligand (affinity chromatography).

Isoelectric precipitation

- Proteins are less soluble at their isoelectric point where they have zero net charge and can most easily approach each other with minimal charge repulsion. Since proteins are also less soluble at very low ionic strength, isoelectric precipitation is usually done at very low or no salt.
- The *isoelectric point* (pI) is the pH of a solution at which the net primary charge of a protein becomes zero.
- At a solution, pH that is above the pI, the surface of the protein is predominantly negatively charged and therefore like-charged molecules will exhibit repulsive forces. Likewise, at a solution pH that is below the pI, the surface of the protein is predominantly positively charged and repulsion between proteins occur. However, at the pI the negative and positive

JAYPEE BROTHERS

charges cancel, repulsive electrostatic forces are reduced and the attraction forces predominate. The attraction forces will cause aggregation and precipitation.

- The pI of most proteins is in the pH range of 4–6.
- Mineral acids, such as *hydrochloric* and *sulfuric* acid are used as precipitants.
- The greatest disadvantage to isoelectric point precipitation is the irreversible *denaturation* caused by the mineral acids. For this reason isoelectric point precipitation is most often used to precipitate contaminant proteins, rather than the target protein.

31. Which of these is not a cofactor for glycogen phosphorylase, an important enzyme of the glycogenolysis pathway?

a. Calmodulin
b. cAMP
c. Protein Kinase A
d. Glycogenin

Ans. d. Glycogenin

Ref: Harper: Illustrated Biochemistry 30/e p181

Glycogenin is an *enzyme* involved in converting *glucose* to *glycogen*. It acts as a *primer*, by polymerizing the first few glucose molecules, after which other enzymes take over. Thus it is involved in the glycogen synthesis pathway rather than glycogenolysis.

- **Glycogen phosphorylase** catalyzes the rate-limiting step in glycogenolysis—the phosphorolytic cleavage of the 1 → 4 linkages of glycogen to yield glucose 1-phosphate.
- There are different isoenzymes of glycogen phosphorylase in liver, muscle, and brain, encoded by different genes.
- Glycogen phosphorylase requires pyridoxal phosphate as its coenzyme.
- The principal enzymes controlling glycogen metabolism—glycogen phosphorylase and glycogen synthase—are regulated in opposite directions by allosteric mechanisms and covalent modification by reversible phosphorylation and dephosphorylation of enzyme protein in response to hormone action.
- Phosphorylation of glycogen phosphorylase increases its activity; phosphorylation of glycogen synthase reduces its activity.

JAYPEE BROTHERS

- Phosphorylation is increased in response to cyclic AMP (cAMP) formed from ATP by **adenylyl cyclase** at the inner surface of cell membranes in response to hormones such as **epinephrine**, **norepinephrine**, and **glucagon**.
- cAMP is hydrolyzed by **phosphodiesterase**, so terminating hormone action; in liver insulin increases the activity of phosphodiesterase.

Glycogen Phosphorylase Regulation is Different in Liver and Muscle

- In the liver, the role of glycogen is to provide free glucose for export to maintain the blood concentration of glucose; in muscle the role of glycogen is to provide a source of glucose-6-phosphate for glycolysis in response to the need for ATP for muscle contraction.
- In both tissues, the enzyme is activated by phosphorylation catalyzed by phosphorylase kinase (to yield phosphorylase **a)** and inactivated by dephosphorylation catalyzed by phosphoprotein phosphatase (to yield phosphorylase **b)**, in response to hormonal and other signals.
- Active phosphorylase **a** in both tissues is allosterically inhibited by ATP and glucose-6-phosphate; in liver, but not muscle, free glucose is also an inhibitor. Muscle phosphorylase differs from the liver isoenzyme in having a binding site for 5′ AMP, which acts as an allosteric activator of the (inactive) dephosphorylated **b**-form of the enzyme. 5′ AMP acts as a potent signal of the energy state of the muscle cell; it is formed as the concentration of ADP begins to increase (indicating the need for increased substrate metabolism to permit ATP formation).

Ca^{2+} Synchronizes the Activation of Glycogen Phosphorylase with Muscle Contraction

- Glycogenolysis in muscle increases several hundred-fold at the onset of contraction; the same signal (increased cytosolic Ca^{2+} ion concentration) is responsible for initiation of both contraction and glycogenolysis. Muscle phosphorylase kinase, which activates glycogen phosphorylase, is a tetramer of four different subunits, α, β, γ, and δ. The α and β subunits contain serine residues that are phosphorylated by cAMP-dependent protein kinase. **The δ subunit is identical to the**

JAYPEE BROTHERS

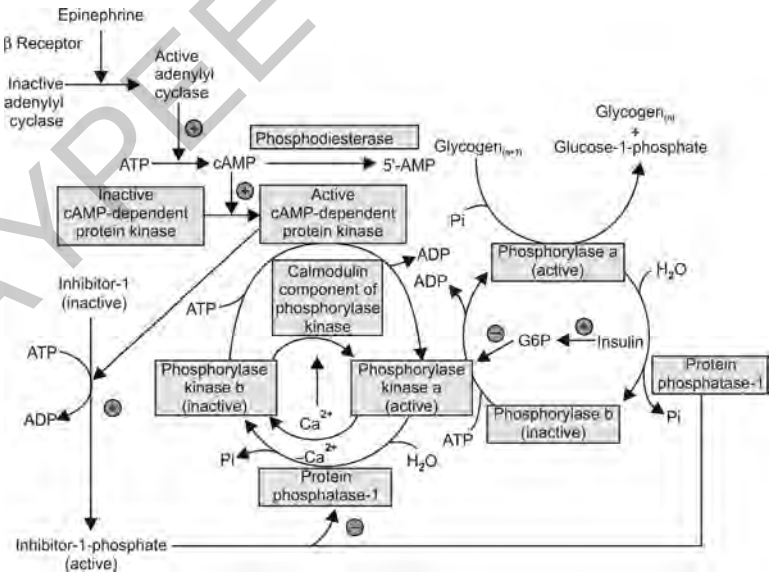
Ca^{2+}-binding protein calmodulin, and binds four Ca^{2+}. The binding of Ca^{2+} activates the catalytic site of the γ subunit even while the enzyme is in the dephosphorylated **b** state; the phosphorylated **a** form is only fully activated in the presence of high concentrations of Ca^{2+}.

Glycogenolysis in Liver can be cAMP-Independent

- In the liver, there is cAMP-independent activation of glycogenolysis in response to stimulation of $\alpha 1$ **adrenergic** receptors by epinephrine and norepinephrine. This involves mobilization of Ca^{2+} into the cytosol, followed by the stimulation of a **Ca^{2+}/calmodulin-sensitive phosphorylase kinase**.
- cAMP-independent glycogenolysis is also activated by vasopressin, oxytocin, and angiotensin II acting either through calcium or the phosphatidylinositol bisphosphate pathway.

Protein Phosphatase-1 Inactivates Glycogen Phosphorylase

- Both phosphorylase **a** and phosphorylase kinase **a** are dephosphorylated and inactivated by **protein phosphatase-1**. Protein phosphatase-1 is inhibited by a protein, **inhibitor-1**, which is active only after it has been phosphorylated by cAMP-dependent protein kinase. Thus, cAMP controls both the activation and inactivation of phosphorylase.



JAYPEE BROTHERS

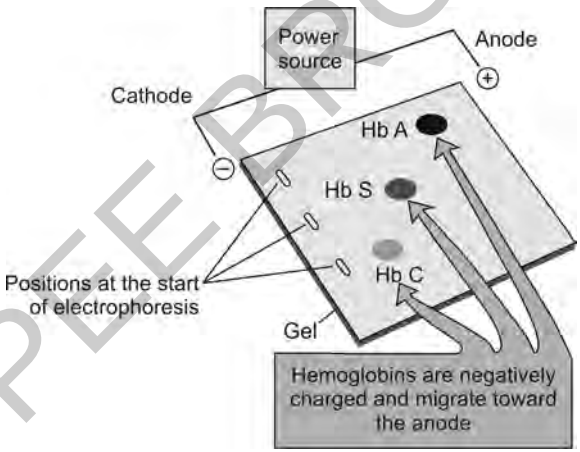
- **Insulin** reinforces this effect by inhibiting the activation of phosphorylase **b**. It does this indirectly by increasing uptake of glucose, leading to increased formation of glucose-6-phosphate, which is an inhibitor of phosphorylase kinase.

32. After a point mutation, glutamic acid is replaced by valine which leads to formation of sickle cell hemoglobin. The mobility of HbS as compared with normal hemoglobin on gel electrophoresis will be:

a. Decreased
b. Increased
c. Dependent on HbS concentration
d. Unchanged

Ans. a. Decreased

Ref: Harper: Illustrated Biochemistry 30/e p460
Lippincott's Illustrated Biochemistry 4/e p36 Chap 3



- **Sickle-cell disease**, which is caused by mutation of a single base (T-to-A DNA substitution), which in turn results in an A-to-U change in the mRNA corresponding to the sixth codon of the β-globin gene. The altered codon specifies a different amino acid (valine rather than glutamic acid), and this causes a structural abnormality of the β-globin molecule leading to hemoglobin aggregation and red blood cell 'sickling'.

JAYPEE BROTHERS

- A molecule of Hb S contains two normal α-globin chains and two mutant β-globin chains (β), in which glutamate at position six has been replaced with valine.
- Therefore, during electrophoresis at alkaline pH, Hb S migrates more slowly toward the anode (positive electrode) than does HbA
- **This altered mobility of Hb S is a result of the absence of the negatively charged glutamate residues in the two β chains, thus rendering Hb S less negative than Hb A**.
- Electrophoresis of hemoglobin obtained from lysed red blood cells is routinely used in the diagnosis of sickle cell trait and sickle cell disease.

Sequence of Movement: **HbA2 < HbC < HbS < HbF < HbA**

Gel Electrophoresis

It is the movement of charged solute of any size in a liquid medium under the effect of an electric field.

Rate of migration depends on

- Charge/mass ratio : Most important variable
- Charge
- Size and shape
- Properties of support media
- Electric field strength
- Temperature

D Electrophoresis:

- Treatment with SDS imparts negative charge to all
- Separation is based on mass rather than C/M ratio

33. Thiamine is a cofactor for all of the following enzymes except:

a. Alpha Ketoglutarate dehydrogenase
b. Branched-chain keto-acid dehydrogenase
c. Succinate dehydrogenase
d. Pyruvate dehydrogenase

Ans. c. Succinate dehydrogenase

Ref: Harper: Illustrated Biochemistry 30/e p555

Thiamine is the coenzyme for these multienzyme complexes that catalyze oxidative decarboxylation reactions, while succinate dehydrogenase is involved in a redox reaction which is catalyzed by FMN and FAD.

JAYPEE BROTHERS

for detailed information on PGMEE books, visit our website **www.jaypeebrothers.com,** for detailed info

AIIMS November 2015

With Explanatory Answers

Key Features

- Includes colored Image-based questions
- A section entailing how to study for PG entrance examinations
- Tips to tackle difficult questions from toppers of the exam
- All genuine questions
- Authentic answers with clear references from various latest standard textbooks
- Explicit explanation of each question incorporating high-yielding facts
- Only relevant information about each topic
- Includes useful tables and figures
- Highlights the likely source of errors by the candidates.



Rituraj Upadhyay MBBS is a graduate from All India Institute of Medical Sciences and is currently doing MD in Radiation Oncology from the same place. He started with his endeavor of helping PG aspirants by writing up a book on AIIMS November 2014 paper with the sole aim of coming up with a timely book containing authentic questions and genuine explanations. This is the third book of the series. It is really important for students to be thorough with the recently asked questions in the exams. Hope this book meets the requirements like the previous one. All the best!!

Available at all medical bookstores
or buy online at www.jaypeebrothers.com

JAYPEE BROTHERS
Medical Publishers (P) Ltd.
www.jaypeebrothers.com

Join us on facebook.com/JaypeeMedicalPublishers

ISBN 978-93-85891-57-1

9 789385 891571