

PRESIDENCY COLLEGE, CALCUTTA
DEPARTMENT OF PHYSIOLOGY, UG ADMISSION TEST 2007

FULL MARKS : 100

TIME : 2 HOURS

Read the instructions carefully. All questions are to be answered in the blank spaces in question paper itself. Figure in the margin against each question indicates its full marks. **Overwriting is not permissible. For numerical problems, rough works are to be shown clearly. Extra sheet may be used for rough work only. Use of calculator is forbidden.**

I. (a) Read the following paragraphs and answer the questions as precise as possible.

The immune system responds to a variety of noninfectious foreign materials, including pollen, drugs, certain foods, bee or wasp stings, and the chemicals in such plants as poison oak and poison ivy.

An allergy is an inappropriate, overreaction of the immune system. Common allergies are hives, hay fever, asthma, and eczema. Antibodies belonging to the IgE class trigger the reaction by combining with both the antigen and the surfaces of mast cells, which are noncirculating cells that form part of connective tissue, to cause the release of large amounts of histamine into the blood stream. Histamine, a normal initiator of the inflammatory response, stimulates the dilation of arteries and increased permeability of capillaries that result in fluid buildup in the interstitial areas of the affected tissues. Sneezing, coughing, itching, difficulty in breathing, and rashes are all symptoms of an inflammatory response in a particular region of the body.

A severe allergic reaction, called anaphylactic shock, occurs when large amounts of histamine are suddenly released by the mast cells. All the peripheral arteries dilate at once, causing a precipitous drop in blood pressure, or shock. It is fatal if not immediately treated.

Allergies are treated with drugs that cause vasoconstriction – antihistamines in the case of normal allergic reactions and epinephrine in the case of anaphylactic shock.

Q: Name the substances of plant, animals and other origin to which immune system respond immediately.

2½

Q: Define allergy. Give examples.

1+1=2

Q: What are mast cells?

½

Q: What is the relation between allergy and inflammatory responses? Mention the symptoms of an inflammatory response.

2+1=3

Q: What is an anaphylactic shock? How it occurs?

½+ ½=1

Q: What should be the basic principle of treating an allergic patient?

1

2. Indicate True (T) or False (F) :

20 X ½ = 10

- (a) Olive oil is a monounsaturated fat.-----
- (b) Most immature lymphocytes are formed prior to birth.-----
- (c) Killer T-cells secrete interleukins.-----
- (d) Lysozyme kills by destroying the machinery for DNA replication.-----
- (e) The 'thermostat' in human is in its hypothalamus.-----
- (f) Glucose is removed from the filtrate at the loop of Henle.-----
- (g) Human excrete nitrogen in the form of ammonium ions.-----
- (h) The osmoregulatory tissue in all animals is epithelial.-----
- (i) Liver can convert glycerol of triglyceride into glycogen.-----
- (j) Digestive enzymes are released by the pancreas in response to the hormone insulin.-----
- (k) Mucin is a glycoprotein.-----
- (l) Most digestion and all absorption of food take place in the stomach.-----
- (m) Inactive enzyme precursors are called zymogens.-----
- (n) Humans with a diet deficient in at least one essential nutrient is said to be undernourished.-----
- (o) Another term for digestion is dehydration synthesis.-----
- (p) Breathing rate in humans is controlled by thalamus.-----
- (q) A low-protein diet may develop hypotension.-----
- (r) A polymer is formed by dehydration synthesis.-----
- (s) Transcription takes place in the cytoplasm of a cell.-----
- (t) DNA is surrounded by proteins called histones.-----

3. Give one word or one sentence answer :

- (a) Draw a water molecule. Is it a polar or nonpolar molecule ? Why?

1+1+1= 3

- (b) Name the energy available for doing work from glucose.----- 1
- (c) What is accomplished by the last two steps of alcohol fermentation?----- 1

- (d) What are monoclonal antibodies? How these can be produced? Why these are called 'magic bullets'?
Why is this such an exciting development?----- 1+1+1+2=5

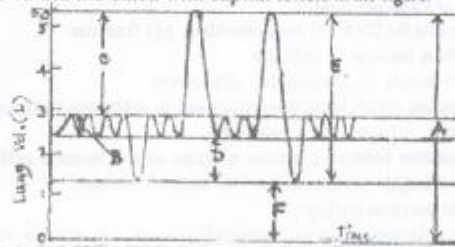
- (e) How do kidneys contribute to homeostasis?

2

- (f) Which chamber of the heart has the thickest muscular walls? ----- 1
- (g) What is indicated by a heart 'murmur'?----- 1
- (h) Where does exchange of materials between blood and interstitial fluid occurs?----- 1
- (i) Who are the chief regulators of human blood composition?----- 1
- (j) What are the major homeostatic centers of human brain?----- 1
- (k) Which type of tissue changes the diameter of a blood vessel?----- 1
- (l) What is called a rhythmic phenomenon that occurs about every 24 hours?----- 1
- (m) What are the monomers that are common to RNA, ATP and NAD?----- 1
- (n) What makes cell apoptosis different from necrosis?----- 2

4. Match the respiratory air volumes with the values indicated with capital letters in the figure. $6 \times \frac{1}{2} = 3$

- 1. Total lung capacity
- 2. Expiratory reserve volume
- 3. Vital capacity
- 4. Residual volume
- 5. Tidal volume
- 6. Inspiratory reserve volume



5. Indicate the correct answer by underlining (Overwriting will deduct marks): $40 \times \frac{1}{2} = 20$

- (i) In order to water become vapour, there must be sufficient heat energy to
 (a) break its hydrogen bonds (b) break its covalent bonds (c) lower its specific heat (d) raise its specific heat.
- (ii) The enormous diversity of protein molecules is due mostly to the diversity of
 (a) amino groups on the amino acids (b) R groups on the amino acids (c) amino acid sequences within protein molecules (d) peptide bonds.
- (iii) DNA is unique among molecules in that it can
 (a) form multipolymer complexes (b) come apart and re-form (c) withstand very high temperatures (d) replicate itself.
- (iv) A molecule of ATP is structurally most similar to a molecule of
 (a) RNA nucleotide (b) DNA nucleotide (c) amino acid (d) fatty acid.
- (v) In most metabolic pathways, all needed enzymes are arranged together, in a multienzyme complex, with a
 (a) solution of ATP (b) membrane (c) quaternary protein (d) co-enzyme.
- (vi) Which of the following is a type of intercellular junction between animal cells?
 (a) middle lamella (b) plasmodesma (c) desmosome (d) glycocalyx.
- (vii) The most abundant lipid in a cell membrane is
 (a) phospholipid (b) steroid (c) cholesterol (d) cutin.
- (viii) The osmotic pressure of pure water is
 (a) 0 (b) 1 (c) 10 (d) 100
- (ix) An input of energy is required for which one of the following?
 (a) diffusion (b) osmosis (c) facilitated diffusion (d) active transport.
- (x) Which of the following substances does not pass across membranes by simple diffusion?
 (a) O_2 (b) CO_2 (c) H^+ (d) H_2O
- (xi) Each chemical reaction in cellular respiration requires
 (a) a molecule of ATP (b) a molecule of FAD (c) a molecule of NAD^+ (d) a specific enzyme.
- (xii) How many molecules of oxygen gas are used during the glycolysis of one glucose molecule?
 (a) 0 (b) 1 (c) 16 (d) 38.
- (xiii) In the conversion of pyruvic acid to acetyl coenzyme A, NAD^+ is
 (a) oxidized (b) reduced (c) broken to one-carbon units (d) isomerized.
- (xiv) Coenzyme A, which combines with acetyl group, is formed in part from
 (a) zinc (b) iron (c) vitamin A (d) one of the B vitamins.
- (xv) At the end of the Krebs citric acid cycle, most of the energy removed from the glucose molecule has been transferred to
 (a) $NADH$ and $FADH_2$ (b) ATP (c) oxaloacetic acid (d) citric acid
- (xvi) Within the mitochondrion, the proton gradient develops across the
 (a) inner membrane (b) outer membrane (c) intermembrane space (d) matrix.
- (xvii) DNA replication occurs in which phase of the cell cycle?
 (a) prophase (b) interphase (c) anaphase (d) telophase.
- (xviii) The experiment in which it was shown that DNA is the genetic material in the bacteriophage is the
 (a) Meselson-Stahl expt (b) Franklin-Wilkins expt (c) Hershey-Chase expt (d) Delbrück-Luria expt.
- (xix) In the double-helix model of DNA, each base pair is how far from the next base pair?
 (a) 0.034 nm (b) 0.34 nm (c) 3.4 nm (d) 34 nm
- (xx) The growth of human populations is most rapid in
 (a) tropical and subtropical regions (b) temperate regions (c) Asia (d) North America
- (xxi) Proportion of young individuals is highest in case of
 (a) declining population (b) stable population (c) both (a) and (b) (d) expanding population
- (xxii) Which of the following organs develops first?
 (a) liver (b) heart (c) notochord (d) kidneys

- (xxiii) The acrosome of a sperm contains
 (a) hydrolytic enzymes (b) DNA (c) mitochondria (d) fructose
- (xxiv) A cell formed from cleavage is called a
 (a) blastomere (b) morula (c) blastula (d) blastopore
- (xxv) External fertilization occurs almost exclusively in habitats that are
 (a) tropical (b) moist (c) warm (d) crowded.
- (xxvi) The neurotransmitter between a motor neuron and a muscle cell is
 (a) serotonin (b) endorphin (c) dopamine (d) acetyl choline.
- (xxvii) An oxygen debt develops during
 (a) tetanus (b) sarcoplasmic release (c) anaerobic work (d) aerobic work.
- (xxviii) A muscle cell is a muscle
 (a) bundle (b) fibre (c) fibril (d) filament.
- (xxix) The neurons of a person with diabetes mellitus do not produce sufficient
 (a) ATP (b) fatty acids (c) enzymes (d) steroids.
- (xxx) All the hormones of the adrenal cortex are synthesized from
 (a) tyrosine (b) glycoproteins (c) cholesterol (d) fats.
- (xxxi) The pineal gland is located
 (a) on the kidneys (b) in the brain (c) beneath the thymus gland (d) beneath the thyroid gland
- (xxxii) Hypothalamic releasing hormones reach the anterior pituitary gland by way of
 (a) the posterior pituitary gland (b) lymphatic vessels (c) blood vessels (d) axons.
- (xxxiii) Which of the following hormones is a modified amino acid?
 (a) prostaglandin (b) estrogen (c) epinephrine (d) progesterone.
- (xxxiv) Animal tissues that synthesize hormones are closely associated, and sometimes resemble, cells of the
 (a) immune system (b) embryonic mesoderm (c) circulatory system (d) nervous system.
- (xxxv) Most of what we 'taste' in food is actually
 (a) imagined by our cerebral cortex (b) a memory from childhood (c) odours (d) normal components of saliva.
- (xxxvi) Sound is amplified by the
 (a) pinna (b) tympanic membrane (c) bony ossicles (d) round window.
- (xxxvii) The structures in a human that provide balance are located in the
 (a) outer ear (b) middle ear (c) inner ear (d) Eustachian tube.
- (xxxviii) Before environmental information can be transmitted to the brain, it must always be
 (a) transduced (b) integrated (c) amplified (d) modulated.
- (xxxix) Which of the following is a structure in the mesencephalon?
 (a) inferior colliculus (b) cerebellum (c) thalamus (d) mammillary body.
- (xxxx) The virus that causes AIDS parasitizes
 (a) B cells (b) cytotoxic T cells (c) helper T cells (d) the membranes of lymph nodes.

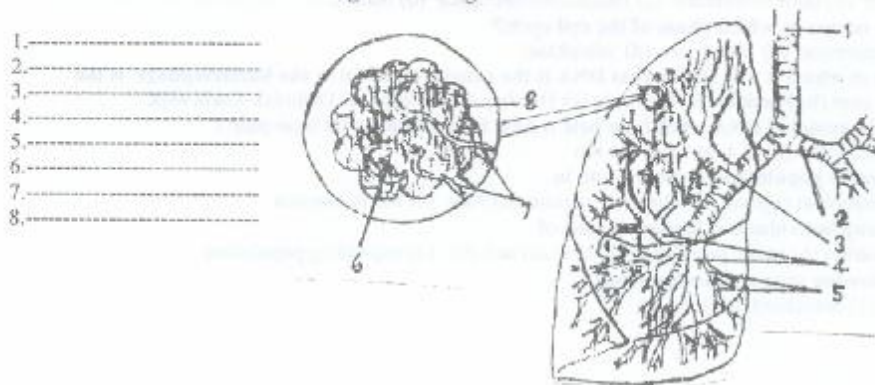
6. Match the pair :

6X½=3

- | | |
|---------------------------|---|
| ----- 1. Tarsal gland | (a) secretes ear wax |
| ----- 2. Optic radiation | (b) vibrates in response to sound waves |
| ----- 3. Ciliary body | (c) transmit sensory impulses |
| ----- 4. Basilar membrane | (d) secretes tear |
| ----- 5. Lacrimal gland | (e) secretes an oily substance |
| ----- 6. Ceruminous gland | (f) secretes aqueous humor |

7. Label the structures indicated in the figure to the right :

8 X ½ = 4



8. (a) A labour weighing 74.6 kg walks up 10 stairs of height 20 cm each in 5 seconds. Find the horse power of the labour. 2½
- (b) What would be the peripheral resistance (R), if the mean aortic pressure is 90 mmHg and the left ventricular output is 90 mL/s? 1
- (c) A lens has a principal focal distance of 0.25 m. What would be the refractive power of the lens? 1
- (d) Find the position of an object placed in front of a concave mirror of 15 cm focal length so as to get an image magnified three times. 2½
- (e) Find at what temperature the velocity of sound in air is 1½ times the velocity at 7° C. 2
- (f) 90 gm of sulphuric acid of specific gravity 1.8 is mixed with 90 gm of water. If the specific gravity of the mixture is 1.5, find the contraction of the mixed liquids. 2

9. (a) Calculate the amount of energy (in kcals) produced when 1 gm of substance is completely converted into energy. 2

(b) 0.5574 gm of a metal was converted into 0.6817 gm of oxide. The specific heat of the metal is 0.063. Find the exact atomic weight. 2

(c) Calculate the percentage composition of anhydrous sodium sulphate. Its molecular formula is Na_2SO_4 . 2

(d) 10 cc of a solution of H_2O_2 decolourised 50 cc of N/10 solution of acidified KMnO_4 . What is the strength per litre of H_2O_2 ? 3

(e) What weight of sodium carbonate is required to neutralize 50 cc of normal sulphuric acid? 2

10. Match the substance or condition with its description:

6 X ½=3

- | | |
|------------------------------|---------------------------------------|
| ----- 1. Extracellular fluid | (a) plasma or interstitial fluid |
| ----- 2. Evans blue | (b) dehydration |
| ----- 3. Diabetes insipidus | (c) 15%-20% body water |
| ----- 4. Intracellular fluid | (d) abnormal increase in fluid volume |
| ----- 5. Hypovolemia | (e) used to measure plasma volume |
| ----- 6. Hypervolemia | (f) lack of ADH |