KVPY-SA_2017 (BIOLOGY)(05-11-2017)

PART-I

1. The major excretory product of birds is
(A) urea
(B) uric acid
(C) nitrates
(D) ammonia

2. Codon degeneracy means that
(A) several of the amino acids are coded by more than one codon
(B) one codon can code for many amino acids
(C) one amino acid can be coded by only one codon
(D) The codons are triplet nucleotide sequences

3. In cell cycle, during interphase,
(A) two daughter cells are produced
(B) the nucleus is divided into two daughter nuclei
(C) the chromosome condenses
(D) the DNA is replicated

4. Transfer of genetic material between populations is best defined as
(A) gene flow
(B) genetic drift
(C) genetic shift
(D) speciation

5. Which ONE of the following statements is CORRECT about the tobacco mosaic virus?
(A) It affects all monocotyledonous plants
(B) It affects photosynthetic tissue of the infected plant
(C) It does not infect other species belonging to the Solanaceae
(D) It infects gymnosperms

6. Which ONE of the following statements is CORRECT about placenta?
(A) Placenta is permeable to all bacteria
(B) Oxygen and carbon dioxide cannot diffuse through the placenta
(C) Waste products diffuse out of placenta into maternal blood
(D) Placenta does not secrete chorionic gonadotropins

7. The respiratory quotient of the reaction given below is

$$2(C_{51}H_{98}O_6) + 145O_2 \longrightarrow 102CO_2 + 90H_2O + \text{energy}$$

(A) 0.703
(B) 0.725
(C) 0.960
(D) 1.422

8. Which ONE of the following statements is INCORRECT about nucleosomes?
(A) They contain DNA
(B) They contain histones
(C) They are membrane-bound organelle
(D) They are a part of chromosomes

9. The immediate precursor of thyroxine is
(A) Tyrosine (B) Tryptophan
(C) Pyridoxine (D) thymidine

10. The maximum number of oxygen molecules that can bind to one molecule of hemoglobin is
(A) 8 (B) 6
(C) 4 (D) 2

11. Which ONE of the following biomolecules is synthesized in smooth endoplasmic reticulum?
(A) Proteins (B) Lipids
(C) Carbohydrates (D) Nucleotides

12. The products of light reaction during photosynthesis include
(A) ATP and NADPH (B) O_2 and $NADP^+$
(C) O_2 and H_2O (D) $NADP^+$ and H_2O

13. Hypothalamus directly controls the production of which of the following hormones?
(A) glucocorticoid and insulin
(B) insulin and glucagon
(C) atrial natriuretic factor and gastrin
(D) glucocorticoids and androgens

14. Which ONE of the following drugs is NOT obtained from fungal or plant sources?
(A) Penicillin (B) Reserpine
(C) Acetaminophen (D) Quinine

15. Jean-Baptiste Lamarck explained evolution based on
(A) natural selection
(B) survival of the fittest
(C) mutations
(D) inheritance of acquired characteristics

16. The nucleus of a diploid organism contains 3 ng of DNA in G_1 phase. Which ONE of the following statements describes the state of the cell at the end of S phase?
(A) The nucleus divides into two, and each nucleus contains 3 ng of DNA
(B) The nucleus does not divide, and it contains 3 ng of DNA
(C) The nucleus divides into two, and each nucleus contains 1.5 ng of DNA
(D) The nucleus does not divide and it contains 6 ng of DNA

17. Three cellular processes are listed below. Choose the Correct combination of processes that involve proton gradient across the membrane.
(i) Photosynthesis (ii) Aerobic respiration (iii) Anaerobic respiration
(A) ii and iii (B) i and ii
(C) i, ii and iii (D) i and iii

18. The concentration of OH^- ions in a solution with the H^+ ions concentration of 1.3×10^{-4} M is

(A) 7.7×10^{-4} M
(B) 1.3×10^{-4} M
(C) 2.6×10^{-8} M
(D) 7.7×10^{-11} M

19. Given that tidal volume is 600 ml, inspiratory reserve volume is 2500 ml, and expiratory reserve volume is 800 ml, what is the value of vital capacity of lung?

(A) 3900 ml
(B) 3300 ml
(C) 3100 ml
(D) 1400 ml

20. Which of the following organisms produce sperm without involving meiosis?

(A) Sand fly and fruit fly
(B) House fly and grasshopper
(C) Honeybee and ant
(D) Zebra fish and frog

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ANSWER KEYS

1. (b)	2. (a)	3. (d)	4. (a)	5. (b)	6. (c)	7. (a)	8. (c)	9. (a)	10. (c)
11. (b)	12. (a)	13. (d)	14. (c)	15. (d)	16. (d)	17. (b)	18. (d)	19. (a)	20. (c)

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Solution

1. (b)
Nitrogenous wastes in the body tend to form toxic ammonia, which must be excreted. Mammals such as humans excrete urea so are ureotelic organisms, while birds, reptiles, and some terrestrial invertebrates (arthropods) produce uric acid as waste so are uricotelic organisms

2. (a)
Some amino acids are coded by more than one codon, hence the code is degenerate. So when genetic code is degenerate it is known as Codon degeneracy.

3. (d)
Interphase of cell cycle represents the phase between two successive M phases (mitosis phase). The interphase lasts more than 95% of the duration of cell cycle. The interphase is divided further into three phases: G1 phase (Gap 1), S phase (Synthesis) and G2 phase (Gap 2)

G1 phase corresponds to the interval between mitosis and initiation of DNA replication. S or synthesis phase marks the period during which DNA synthesis or replication takes place.

4. (a)
Transfer of genetic material from one population to another is called Gene flow. Gene flow can take place between two populations of the same species through migration, and is mediated by reproduction and vertical gene transfer from parent to offspring.

5. (b)
Tobacco mosaic virus (TMV) is a positive-sense single-stranded RNA virus species. It infects a wide range of plants, especially tobacco and tomato plants (dicotyledonous) and other members of the family Solanaceae.
The infection causes characteristic patterns, such as mosaic like mottling and discoloration on the leaves. It affects the photosynthetic tissue or leaves of the infected plant.

6. (c)

When chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit between developing embryo (foetus) and maternal body is called placenta.

The placenta facilitates the supply of oxygen and nutrients to the embryo and also removal of carbon dioxide and excretory/waste materials produced by the embryo into maternal blood. It also acts as an endocrine tissue and produces several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens, progestogens, etc.

7. (a)

The respiratory quotient (RQ) is the ratio of the volume of CO_2 evolved to the volume of O_2 consumed in respiration.

RQ = CO_2 eliminated/O_2 consumed

$2(C51H98O6) + 145\ O_2 \longrightarrow 10^2\ CO_2 + 90\ H_2O$ + energy

So RQ = $10^2 / 145 = 0.703$

8. (c)

A nucleosome is the basic structural unit of DNA packaging in eukaryotes. The structure of a nucleosome consists of a segment of DNA wound around eight histone proteins. The nucleosome is the fundamental subunit of chromatin. They are important part of chromosomes. So they are not membrane-bound organelle.

9. (a) Thyroxine is the hormone secreted by the thyroid gland and is made from iodine and tyrosine. The immediate precursor of thyroxine is tyrosine. Tyrosine is one of the nonessential amino acids of the body, uses to synthesize polypeptides or proteins.
Tyrosine is essential in the production of several neurotransmitters such as epinephrine, dopamine, and norepinephrine.

10. (c)

Binding of Oxygen to Haemoglobin is shown by Oxygen Saturation (Dissociation) Curve.
Haemoglobin molecules consist of four heme groups. Each heme group contains an iron atom which binds to one oxygen molecule.
So maximum 4 oxygen molecules can bind to one molecule of haemoglobin

11. (b)

Eukaryotic cells show the presence of a network or reticulum of tiny tubular structures scattered in the cytoplasm called the endoplasmic reticulum (ER)
The endoplasmic reticulum bearing ribosomes on their surface is called rough endoplasmic reticulum (RER). In the absence of ribosomes they appear smooth and are called smooth endoplasmic reticulum (SER).
The smooth endoplasmic reticulum is the major site for synthesis of lipid. In animal cells lipid-like steroidal hormones are synthesised in SER.

12. (a)
Light reactions of photosynthesis or the 'Photochemical' phase include light absorption, water splitting, oxygen release, and the formation of high-energy chemical intermediates, ATP and NADPH. This ATP and NADPH in turn serve as the energy source for the second phase of photosynthesis (dark reactions)

13. (d)
Hypothalamus lies at the base of the thalamus. The hypothalamus contains a number of centres which control body temperature, urge for eating and drinking. It also contains several groups of neurosecretory cells, which secrete hormones called hypothalamic hormones.
The hormones produced are Anti-diuretic hormone (ADH), Corticotropin-releasing hormone (CRH), Gonadotropin-releasing hormone (GnRH), somatostain, xytocin, Dopamine.
Corticotropin-releasing hormone (CRH) produces glucocorticoids and Gonadotropin-releasing hormone (GnRH) increases production of androgens from testes .

14. (c)
Antibiotics are chemical substances, which are produced by some microbes and can kill or retard the growth of other (disease-causing) microbes. Penicillin drug is obtained from mould Penicillium notatum, Penicillin G. Reserpine drug is obtained from the root of Rauwolfia vomitoria plants and is used for the treatment of high blood pressure. Quinine drug is obtained from bark of a cinchona tree and used in treatment of malaria and babesiosis .
Acetaminophen is a paracetamol and it is artificially formed. It is not produced by plant or fungi and is used to treat mild to moderate pain (from headaches, menstrual periods, toothaches, backaches, osteoarthritis, or cold/flu aches and pains)

15. (d)
Jean-Baptiste Lamarck explained evolution based on inheritance of acquired characteristics. He said that evolution of life forms had occurred but driven by use and disuse of organs.
He gave the examples of Giraffes who in an attempt to forage leaves on tall trees had to adapt by elongation of their necks. As they passed on this acquired character of elongated neck to succeeding generations, Giraffes, slowly, over the years, came to acquire long necks.

16. (d)

G1 phase corresponds to the interval between mitosis and initiation of DNA replication. During G1 phase the cell is metabolically active and continuously grows but does not replicate its DNA.

S or synthesis phase marks the period during which DNA synthesis or replication takes place. During this time the amount of DNA per cell doubles.

If the initial amount of DNA is denoted as 3ng then it increases to 6ng. However, there is no increase in the chromosome number and the nucleus does not divide; if the cell had diploid or 2n number of chromosomes at G1, even after S phase the number of chromosomes remains the same, i.e., 2n

17. (b)

Like in respiration, in photosynthesis too, ATP synthesis is linked to development of a proton gradient across a membrane. Within the chloroplast, protons in the stroma decrease in number, while in the lumen there is accumulation of protons. This creates a proton gradient across the thylakoid membrane as well as a measurable decrease in pH in the lumen.

This gradient is important because it is the breakdown of this gradient that leads to release of energy. So processes like photosynthesis and aerobic respiration involves proton gradient across the membrane.

18. (d)

$[H+]\ [OH-] = 10-14$

$1.3 \times 10-4 \times [OH] = 10-14$

$[OH-] = 1.3\ 1 \times 10-10$

$= 0.769 \times 10-10$

$= 7.7 \times 10-11$

19. (a)

Vital Capacity (VC) is the maximum volume of air a person can breathe in after a forced expiration. This includes ERV, TV and IRV or the maximum volume of air a person can breathe out after a forced inspiration.

VC = TV + IRV + ERV

= 600 + 2500 + 800 = 3900 ml

20. (c)

The special kind of cell division that reduces the chromosome number by half results in the production of haploid daughter cells. This kind of division is called meiosis.

In honeybee and ants sperms are produced without meiosis. In honey bee and ant sex is determined by organism's ploidy. Female is diploid and is produced from fertilised egg while male is haploid and produces sperm due to mitosis and not meiosis.