KVPY-SA 2019 (BIOLOGY)

PART-I

1. Which one of the following is a CORRECT statement about primates evolution?
   (a) Chimpanzees and gorillas evolved from macaques
   (b) Humans and chimpanzees evolved from gorillas
   (c) Humans, chimpanzees and gorillas evolved from a common ancestor
   (d) Humans and gorillas evolved from chimpanzees

2. The crypts of Lieberkuhn are found in which one of the following parts of the human digestive tract?
   (a) Oesophagus
   (b) Small intestine
   (c) Stomach
   (d) Rectum

3. Removal of the pancreas impairs the breakdown of
   (a) Lipids and carbohydrates only
   (b) Lipids and proteins only
   (c) Lipids, proteins and carbohydrates
   (d) Proteins and carbohydrates only

4. Microscopic examination of a blood smear reveals an abnormal increase in the number of granular cells with multiple nuclear lobes. Which one of the following cell types has increased in number?
   (a) Lymphocytes (b) Monocytes
   (c) Neutrophils (d) Thrombocytes

5. Which one of the following genetic phenomena is represented by the blood group AB?
   (a) Codominance (b) Dominance
   (c) Overdominance (d) Semidominance

6. The mode of speciation mediated by geographical isolation is referred to as
   (a) Adaptive radiation (b) Allopatric speciation
   (c) Parapatric speciation (d) Sympatric speciation

7. Which one of the following metabolic conversions requires oxygen?
   (a) Glucose to pyruvate (b) Glucose to CO_2 and ethanol
   (c) Glucose to lactate (d) Glucose to CO_2 and H_2O

8. Where are the proximal and distal convoluted tubules located within the human body
   (a) Adrenal cortex
   (b) Adrenal medulla
   (c) Renal cortex
   (d) Renal medulla

9. In a diploid organism, when the locus X is inactivated, transcription of the locus Y is triggered. Based on this observation, which one of the following statements is CORRECT?
   (a) X is dominant over Y
   (b) X is epistatic to Y
   (c) Y is dominant over X
   (d) Y is epistatic to X

10. Which one of the following sequences represents the CORRECT taxonomical hierarchy?
   (a) Species, genus, family, order
   (b) Order, genus, family, species
   (c) Species, order, genus, family
   (d) Species, genus, order, family

11. Which one of the following organs is NOT a site for the production of white blood cells?
   (a) Bone marrow
   (b) Kidney
   (c) Liver
   (d) Spleen

12. Which one of the following anatomical structures is involved in guttation ?
   (a) Cuticle
   (b) Hydathodes
   (c) Lenticles
   (d) Stomata

13. Which one of the following parts of the eye is affected in cataract?
   (a) Cornea
   (b) Conjunctiva
   (c) Retina
   (d) Lens

14. Which one of the following organisms is a bryophyte?
   (a) Liverwort
   (b) Volvox
   (c) Chlamydomonas
   (d) Fern

15. During oogenesis in mammals, the second meiotic division occurs
   (a) Before fertilization
   (b) After implantation
   (c) Before ovulation
   (d) After fertilization

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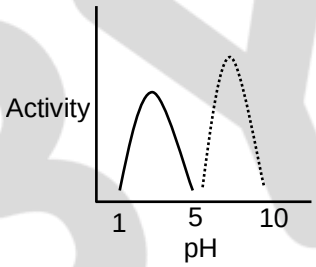
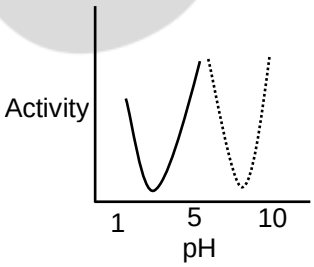
PART-II

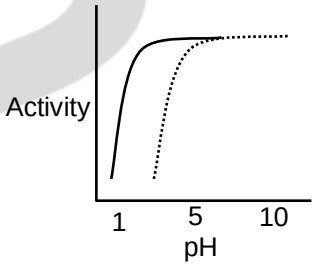
16. A cell weighting 1 mg grows to double its initial mass before dividing into two daughter cells of equal mass. Assuming no death, at the end of 100 divisions what will be the ratio of the mass of the entire population of these cells to that of the mass of the Earth? Assume that mass of the Earth is 10^{24} kg and 2^{10} is approximately equal to 1000.
    (a) 10^{-28} (b) 10^{-3}
    (c) 1 (d) 10^{3}

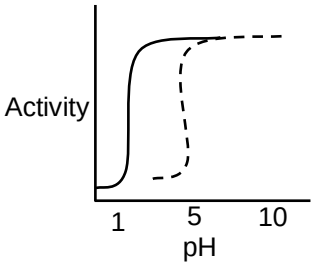
17. Papaya is a dioecious species with XY sexual genotype for male and XX for female. What will be the genotype of the embryos and endosperm nuclei after double fertilization?
    (a) 50% ovules would have XXX endosperm and XY embryo, while the other 50% would have XXY endosperm and XX embryo
    (b) 100% ovules would have XXX endosperm and XY embryo
    (c) 100% ovules would have XXY endosperm and XY embryo
    (d) 50% ovules would have XXX endosperm and XX embryo, while the other 50% would have XXY endosperm and XY embryo

18. Solid and dotted lines represent the activities of pepsin and salivary amylase enzymes of the digestive tract, respectively. Which one of the following graphs best represents their activity vs pH?

(a)


(b)


(c)


(d)


19. If the gene pool of the locus X in the human genome is 4, then what would be the highest possible number of genotypes in a large population?

(a) 6 (b) 8
(c) 10 (d) 16

20. Match the plant hormones in Column I with their primary function in Column II.

Column I	**Column II**
P. Abscisic acid	(i) Promotes disease resistance
Q. Ethylene	(ii) Maintains seed dormancy
R. Cytokinin	(iii) Promotes seed germination
S. Gibberellin	(iv) Promotes fruit ripening
	(v) Inhibits leaf senescence

Choose the CORRECT combination.

(a) P-iii, Q-iv, R-i, S-ii (b) P-ii, Q-iv, R-v, S-iii
(c) P-v, Q-iii, R-ii, S-i (d) P-iv, Q-ii, R-iii, S-v

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ANSWER KEY

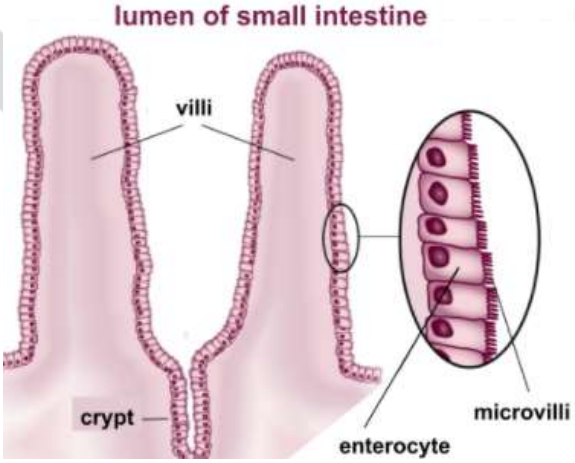
1. (c)	2. (b)	3. (c)	4. (c)	5. (a)	6. (b)	7. (d)	8. (c)	9. (b)	10. (a)
11. (b)	12. (b)	13. (d)	14. (a)	15. (d)	16. (c)	17. (d)	18. (a)	19. (c)	20. (b)

SOLUTIONS

PART-I

1. (c)
Chimpanzees are genetically closest to humans, and in fact, chimpanzees share about 98.6% of human DNA.
A study has shown that across 15% of their genetic code, or genome, gorillas are more like humans than chimpanzees. As well as fossils study shows humans, chimpanzees, and gorilla shared an ancient ancestor or common ancestor.

2. (b)
In histology of alimentary canal an crypt of Lieberkühn (also intestinal gland or intestinal crypt) is a gland found in between villi in the intestinal epithelium lining of the small intestine in humans.



3. (c)
Pancreas secretes pancreatic juice that acts on all type of foods. It is the important gland that is present behind the stomach it secretes pancreatic juice in the duodenum this juice is responsible for digestion of carbohydrates, proteins, fats. It consists of pancreatic lipase, pancreatic trypsin and pancreatic amylase. Pancreatic lipase is responsible for breakdown of fat into fatty acid and glycerol.
Pancreatic trypsin is responsible for the breakdown of protein into peptides and lastly these peptides converted into amino acids.
Pancreatic amylase is responsible for breakdown of sugar into glucose.

4. (c)

This granulocyte has very tiny stained granules with low visibility. The nucleus is frequently multi-lobed with lobes connected by thin strands of nuclear material. These cells are capable of phagocytizing foreign cells, viruses. This type of cell is the most commonly found, accounting for 50-70% of all leukocytes. If the count exceeds this amount, it is usually caused by an acute infection such as appendicitis, smallpox, or rheumatic fever.

5. (a)

Codominance means that neither allele can mask the expression of the other allele. An example in humans would be the ABO blood group, where alleles A and alleles B are both expressed. So if an individual inherits allele A from mother and allele B father, they have blood type AB (IA & IB).

6. (b)

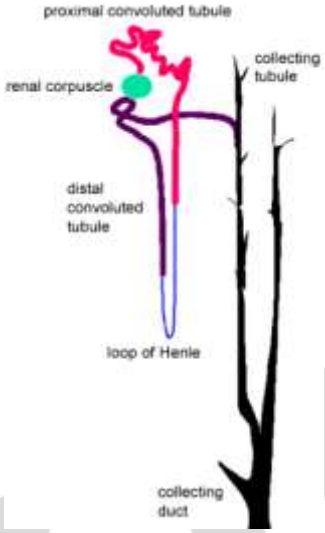
When biological populations of the same species are found in different places or isolated by geographical or physical barriers and changes for example social changes like emigration, mountain building etc.

7. (d)

Option A Glycolysis is the process by which one molecule of glucose is converted into two molecules of pyruvate, two hydrogen ions and two molecules of water. Through this process, the 'high energy' molecules of ATP and NADH are synthesised. So, there is no oxygen requirement. Option B and C are Ethanol fermentation, also called alcoholic fermentation, is a biological process which converts sugars such as glucose, fructose, and sucrose into cellular energy, producing ethanol and carbon dioxide as by-products and these reactions are conducted in the absence of oxygen. Last option D breakdown of glucose in which glucose molecule is broken down into $C_6H_{12}O_6+6O_2$……$6CO_2+6H_2O+ATP(Energy\uparrow)$.

8. (c)

The proximal tubule is the segment of the nephron in kidneys which is located in the renal cortex of loop of Henle's and distal convoluted tubule is another segment of nephron it is found in renal cortex.

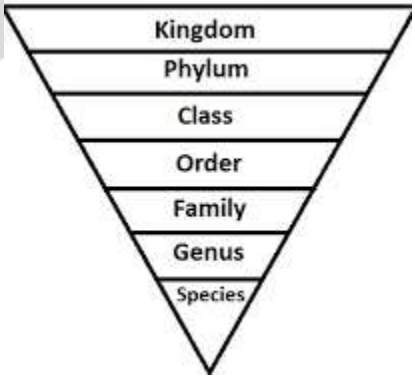


9. (b)

The masking of the phenotypic effect of alleles at one gene by alleles of another gene. A gene is said to be epistatic when its presence suppresses the effect of a gene at another locus. Epistatic genes are sometimes called inhibiting genes because of their effect on other genes which are described as hypostatic. So, in option B X is epistatic to Y.

10. (a)

Taxonomic category hierarchical arrangements



Or

Species → genus → family → order → class → division → kingdom

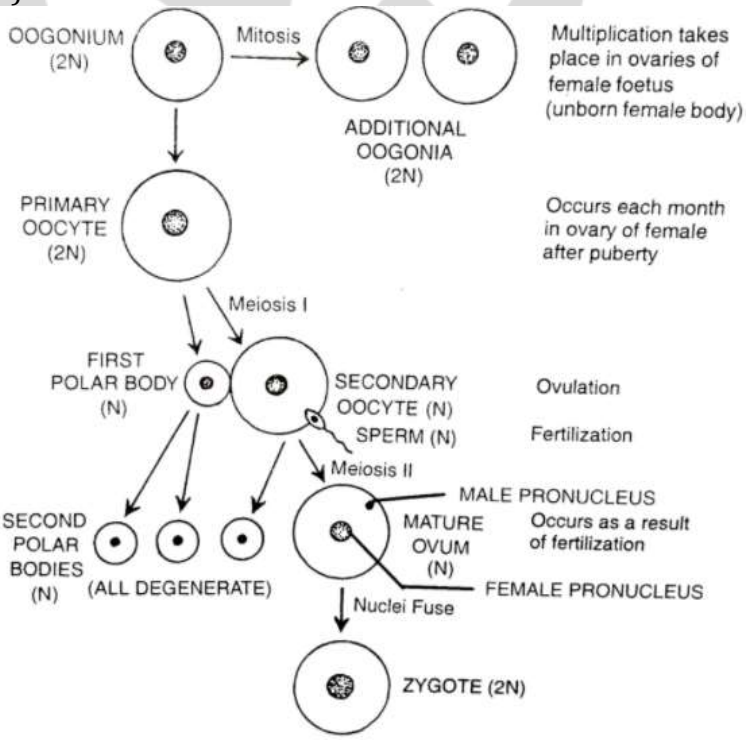
11. (b)
White blood cells begin in the bone marrow in a process called hematopoiesis.
The kidneys are essential for homeostasis (maintaining a constant internal environment) of the body's extracellular fluids.

12. (b) Hydathodes are the structures that discharge water from the interior of the leaf to its surface in a process called guttation. It is thought that guttation is a necessary process to absorb solutes when transpiration is suppressed or guttation is the exudation of drops of xylem sap on the tips or edges of leaves of some vascular plants, such as grasses etc.

13. (d)
A cataract is an opacification of the lens of the eye which leads to a decrease in vision. Cataracts often develop slowly and can affect one or both eyes. Symptoms may include faded colours, blurry or double vision, halos around light, trouble with bright lights, and trouble seeing at night.

14. (a)
Bryophytes are seedless plants without specialized water-conducting tissues. Bryophytes include mosses (phylum Bryophyta), liverworts (phylum Marchantiophyta Hepatophyta), and hornworts (phylum Anthocerophyta). Habitat is usually moist and shady places.

15. (d)



So, second meiotic division started after fertilization.

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PART-II

16. (c)

After first division in number of cells is 2 and after second division in number of cells is 4, after 100^{th} division is number of cells is 2.2^{100-1} lastly 100^{th} division in number of cells is equal 2^{100}.

Now, total number of cells is two and mass of 1 cell =1mg or equal to 10^{-6}kg

Total mass of cells is $2^{100}\times10^{-6}$ because $2^{10}=10^3$

$= (10^3)^{10}\times10^{-6}kg=10^{24}$

Finally, ratio of mass is $10^{24}/10^{24} = 1$ (ONE).

17. (d)

Dioecy is characterized by a species having distinct male and female organisms. This is opposed to hermaphroditic species, or more correctly, monoecious species, in which on one individual both male and female reproductive organs are present. Dioecious reproduction is biparental reproduction.

The embryo sac, where one fuses with the egg and forms a zygote and the other fuses with the two polar nuclei of the central cell and forms a triple fusion, or endosperm, nucleus. This is called double fertilization because the true fertilization (fusion of a sperm with an egg) is accompanied by another fusion process (that of a sperm with the polar nuclei) that resembles fertilization

So, on cross

XY × XX

50% ovules will have XXX endosperm and XX embryo, while the other 50% will have XXY endosperm and XY embryo.

OR

After double fertilization when male gametes enter in embryo sac and fused with XX of female & XY of male then the genotype of endosperm will be XXX and XXY and 50% embryo of XX and 50% embryo of XY.

18. (a)

The optimum pH for pepsin activity of 1.0–2.0 is maintained in the stomach by HCl. In the graph (a) indicating activity of pepsin at low pH (2.5).The optimum pH for the enzymatic activity of salivary amylase ranges from 6 to 7. Above and below this range, the reaction rate reduces as enzymes get denatured. It will be highest and similarly activity of salivary amylase will be highest at the pH of 6.8. Graph B shows minimum activity and C&D graph shows constant activity

19. (c)

Total number of gene for locus X is 4.

i.e. P, Q, R and S

So, possible genotype is:

PP QQ RR SS

PQ QR RS

PR QS

PS

Formula of gene alleles (total no.=n)

Therefore: $n/2(n+1)$

$4/2(4+1)$

$2(5)$

2×5

$=10$

20. (b)

Abscisic acid (ABA) is a plant hormone. ABA functions in many plant developmental processes, including seed and bud dormancy, the control of organ size and stomatal closure.

Ethylene is a gas and is known as the "fruit-ripening hormone." Every fruit has a certain level of ethylene production throughout its lifecycle.

Cytokinin $\rightarrow$ Inhibit leaf senescence

Gibberellins (GAs) are plant hormones that are essential for many developmental processes in plants, including seed germination, stem elongation, leaf expansion, pollen maturation etc.