BIOLOGY

BOOKS - KVPY PREVIOUS YEAR

QUESTION PAPER 2020

Part I Biology

1. Which ONE of the following chemicals serves as a substrate for carbonic anhydrase ?

A. O_2

B. CO_2

C. NO_2

D. CO

Answer: B

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2. Which ONE of the following is NOT a function of the small intestine ?

A. Absorption of end products of digestion

B. Digestion of proteins

C. Digestion of lipids

D. Acidification of ingested food

Answer: D

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3. Insulin stimulates the conversion of glucose to

A. fructose

B. glycogen

C. sucrose

D. starch

Answer: B

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4. Which ONE of the following statements about ecosystem energetics is INCORRECT ?

A. The metabolic requirements of poikilotherms are higher than that of homeotherms.

B. Autotrophs form the base of the food chain in natural ecosystems.

C. In terrestrial ecosystems, most of the primary production is consumed by detritivores and not herbivores.

D. Approximately 10% energy of one trophic level is transferred to the next

level.

Answer: A

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5. Proton motive force is created by pumping protons across the

A. trans-Golgi network

B. endoplasmic reticulum

C. mitochondrial inner membrane

D. early endosomal membrane

Answer: C

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6. Which ONE of the following Mendelian diseases is an example of X-linked recessive disorder ?

A. Haemophilia

B. Phenylketonuria

C. Sickle cell anaemia

D. Beta-thalassemia

Answer: A

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7. Which ONE of the following pairs gives rise to fruit and seed, respectively, in a typical angiosperm plant ?

A. Ovule and ovary

B. Ovary and pollen

C. Pollen and anther

D. Ovary and ovule

Answer: D

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8. The concept of vaccination arose from Edward Jenner's observation that

A. injecting inactivated anthrax spores in sheeps protected them from anthrax.

B. injecting humans with tuberculosis-infected lung extracts protected them from tuberculosis.

C. milk-maids previously infected with cowpox did not contract small pox.

D. injecting inactivated rabies virus in humans protected them from rabies.

Answer: C

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9. A plant with genotype AABBCC is crossed with another plant with aabbcc genotype. How many different genotypes of pollens is possible in an F1 plant if these three loci follow independent assortment ?

A. 8

B. 4

C. 2

D. 1

Answer: A

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10. Which ONE of the following sequences of events CORRECTLY represents mitosis ?

A. Metaphase, telophase, prophase, anaphase

B. Anaphase, prophase, metaphase, telophase

C. Prophase, anaphase, metaphase, telophase

D. Prophase, metaphase, anaphase, telophase

Answer: D

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11. The amount of air that is left behind in lungs after expiratory reserve volume has been exhaled is

A. inspiratory reserve volume

B. tidal volume

C. residual volume

D. vital capacity

Answer: C

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12. Match the species in Column-I with their respective feature of body organisation in Column-II.

	Column-I	Column-II
P.	Mollusca	i. Pseudocoelom
Q.	Annelida	ii. Radula
R.	Nematoda	iii. Radial symmetry
S.	Echinodermata	iv. Segmentation

Choose the CORRECT combination.

A. P-ii, Q-i, R-iv, S-iii

B. P-ii, Q-iv, R-i, S-iii

C. P-iii, Q-iv, R-i, S-ii

D. P-iv, Q-iii, R-ii, S-i

Answer: B

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13. Who among the following scientists proposed the theory natural selection independently of Charles Drawin ?

A. Alfred Russel Wallace

B. Carl Linnaeus

C. Georges Cuvier

D. Jean-Baptiste Lamarck

Answer: A

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Part Ii Biology

1. Anthropocene refers to the geological age during which

A. the earliest hominids radiated from their ancestral forms.

B. human activity significantly influenced climate and environment.

C. arthropod radiation was highest.

D. arthropod radiation significantly influenced climate and environment.

Answer: B

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2. Match the vitamins listed in Column I with the diseases caused due to their deficiency in Column II.

Column I	Column II
P. Vitamin A	i. Pellegra
Q. Vitamin B_2	ii. Rickets
R. Vitamin D	iii. Ariboflavinosis
S. Vitamin B_{12}	iv. Night blindness
	v. Pernicious anaemia

Choose the CORRECT combination

A. P-iv, Q-ii, R-iii, S-v

B. P-i, Q-ii, R-iv, S-iii

C. P-iv, Q-iii, R-ii, S-v

D. P-iii, Q-iv, R-v, S-i

Answer: C

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3. An adult mammal with 50kg body weight has the following functional parameters of its lungs. Inspiratory reserve volume = 40ml/kg body weight Expiratory reserve volume = 15ml/kg body weight Vital capacity = 60ml/kg body weight Breathing rate = 20/min

The volume (in litre) of air that its lungs displace in 24 hours is-

A. 72000

B. 7200

C. 3600

D. 1200

Answer: B

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4. In a breed of dog, long-haired phenotype is recessive to short-hair. In a litter , one pup is short-haired and its sibling is long-haired.

Consider the following possible phenotypes of the parents.

i. both parents are short-haired

ii. Both parents are long-haired

iii. One parent is short-haired , and one is long -haired

Choose the CORRECT combination of the possible parental phenotype.

A. i only

B. ii only

C. iii only

D. i or iii

Answer: D

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5. In medical diagnostics for a disease, sensitivity (denoted by a) of a test refers to the probability that a test result is positive for a person with the disease, whereas specificity (denoted by b) refer to the probability that a person without the disease tests negative. A

diagnostic test for COVID-19 has the values of a = 0.99 and b = 0.99. If the prevalence of COVID-19 in a population is estimated to be 10%, what is the probability that a randomly chosen person tests positive for COVID-19 ?

A. 0.099

B. 0.1

C. 0.108

D. 0.11

Answer: C

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Part I Biology

1. Species with high fecundity, high growth rates, and small body sizes are typically

A. endangered species

B. keystone species

C. K-selected species

D. r-selected species

Answer: D

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2. When RNase enzyme is denatured by adding urea, which ONE of the following combinations of bonds would be disrupted?

A. Ionic and disulphide bonds

B. Ionic and hydrogen bonds

C. Hydrogen and peptide bonds

D. Peptide and disulphide bonds

Answer: B

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3. The function of aposematic colouration is to

A. attract mates.

B. camouflage

C. scare off competitors

D. warn predators

Answer: D

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4. Maize and rice genomes have diploid chromosome number of 20 and 24, respectively. In the absence of crossing over and mutations, which ONE of the following is CORRECT about the genetic variation among their offspring?

A. maize lt rice

B. maize = rice gt 0

C. maize = rice = 0

D. maize gt rice

Answer: D

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5. The exponent z of the species-area curve measured at continental scales is

A. smaller than the value of z at regional scales

B. equal to the value of z at regional scales

C. greater than the value of z at regional scales

D. unrelated to the value of z at regional scales

Answer: C

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6. The pH of an aqueous solution of $10^{-8} MHCl$ is

A. 6.0

B. between 6.9 – 7.0

C. between 7.0 – 7.1

D. 8.0

Answer: B

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7. Which ONE of the following can NOT cause eutrophication of lakes?

A. Introduction of invasive floating plants

B. Discharge of fertilizer-rich agricultural waste

C. Natural ageing of lakes

D. discharge of industrial waste

Answer: D

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8. Which ONE of the following polymerases transcribes 5S rRNA?

A. RNA Pol I

B. RNA Pol III

C. RNA Pol II

D. RNA Pol IV

Answer: B

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9. Which ONE of the following statements about rennin is CORRECT?

A. It is secreted by adrenal glands.

B. It converts angiotensinogen to angiotensin.

C. It is secreted by peptic cells of gastric glands into the stomach.

D. It is a hormone.

Answer: C

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10. When one goes from a brightly lit area to a dimly lit room our eyes adjusts slowly, thereby regaining the clarity of vision. Which ONE of the following explains this process?

A. Regeneration of rhodopsin in the rod cells

B. Bleaching of rhodopsin

C. Constriction of the pupil

D. Increase in the number of rod cells

Answer: A

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11. In a diploid population at Hardy-Weinberg equilibrium, consider a locus with two alleles. The frequencies of these two alleles are denoted by p and q, respectively. Heterozygosity in this population is maximum at

A. $p = 0.25, q = 0.75$

B. p = 0.4, q = 0.6

C. p = 0.6, q = 0.4

D. p = 0.5, q = 0.5

Answer: D

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12. An enzyme with optimal activity at pH 2.0 and $37^{\circ} C$ is most likely to be

A. lysozyme from hen egg white

B. trypsin from cattle

C. DNA polymerase from Thermus aquaticus

D. pepsin from humans

Answer: D

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13. While adjusting to varying environmental temperature, plants incorporate in their plasma membrane

A. more saturated fatty acids in cold and more unsaturated fatty acids in hot environment.

B. more unsaturated fatty acids in cold and more saturated fatty acids in hot environment

C. more saturated fatty acids in both cold and hot environment

D. more unsaturated fatty acids in both cold and hot environment.

Answer: B

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14. Which ONE of the following terms is NOT used while describing human vertebra?

A. Lumbar

B. Sacral

C. Thoracic

D. Tarsal

Answer: D

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15. Assume a population that has reached herd immunity for an infectious disease. If an infected individual is introduced to this population. Which of the following is most likely to occur?

A. The infection will spread exponentially across the population

B. The infection will spread linearly across the population

C. A few individuals may get infected, but the infection will not spread across the population

D. No other individual will be infected by the disease

Answer: C

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16. Match the type of cells in Column I with the organs they are part of, listed in Column II:

Column I	Column II
P. Chondroblast	i. Bone
Q. Osteoclast	ii. Brain
R. Microglia	iii. Cartilage
S. Pneumocyte	iv. Lung

Choose the CORRECT combination

A. P-iii, Q-i, R-ii, S-iv

B. P-ii, Q-i, R-iii, S-iv

C. P-iv, Q-iii, R-ii, S-i

D. P-iii, Q-ii, R-iv, S-i

Answer: A

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17. A bacterial culture was started with an inoculum of 10 cells. What will be the number of cells at the end of 10 cycles of division, assuming that every progeny cell undergoes division in each cycle?

A. 100

B. 1024

C. 2048

D. 10240

Answer: D

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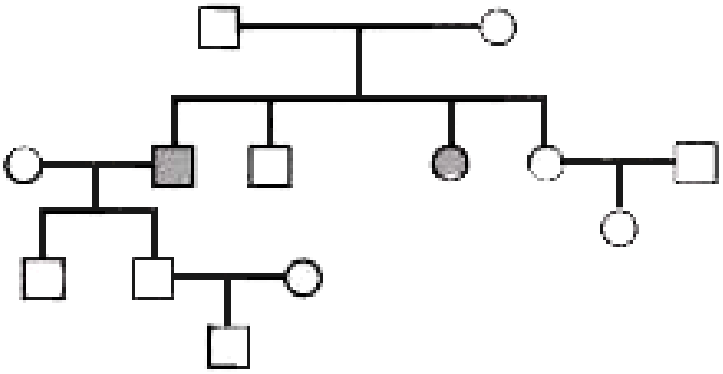
18. The following family tree traces the occurrence of a rare genetic disease. The filled symbols signify the individuals with the disease, whereas the open symbols signify healthy individuals



Based on this information, the disease is most likely to be

A. autosomal, dominant

B. autosomal, recessive

C. X-linked, recessive

D. X-linked, dominant

Answer: B

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19. Which ONE of the following statements is CORRECT about the mechanism of action of penicillin?

A. It inhibits transcription

B. It hydrolyses cell wall

C. It inhibits cell wall biosynthesis

D. It inhibits translation

Answer: C

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20. Leaf extract from an infected plant was passed through a filter with a pore size of 0.05 mm diameter. The infectious agent was detected in the filtrate. Which ONE of the following is the likely infectious agent?

A. Bacteria

B. Virus

C. Nematode

D. Fungus

Answer: B

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Part Ii Biology

1. Which ONE of the following is the most likely ratio of blood groups (A: B: AB) among the

progeny from heterozygous parents with B and AB blood groups?

A. $0.5 : 0.25 : 0.25$

B. $0.25 : 0.25 : 0.5$

C. $0.25 : 0.5 : 0.25$

D. $0 : 0.25 : 0.75$

Answer: C

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2. Match the plants in Column I with their features listed in Column II ,III & IV

Column I	Column II	Column III	Column IV
Types of plants	Types of photosynthesis	Site of Calvin cycle	Time of stomata opening
Rice	CAM	Mesophyll	Day
Pineapple	C4	Bundle sheath	Night
Sugarcane	C3		

Choose the CORRECT combination .

A. Rice-C3-Mesophyll-Day, Pineapple-CAMMesophyll-Night, Sugarcane-C4-Bundle sheath-day

B. Rice-C3-Mesophyll-Day, Pineapple-CAMMesophyll-Night, Sugarcane-C4-Mesophyll-Day

C. Rice-C4-Mesophyll-Day, Pineapple-C3-Bundlle sheath-Night, Sugarcane-CAMBundle sheath-Day

D. Rice-CAM-Mesophyll-Day, PineappleCAM-Mesophyll-Day, Sugarcane-C4- Bundle sheath-Day

Answer: A

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3. A bacteriophage T2 particle contains within its head a double-stranded B-from DNA of molecular weight 1.2×10^8 Da. Assume that the head of a T2 Phage particle is of 210 nm in length and the average molecular weight of a nucleotide is 330 Da. The length of the T2 genome is in the range of

A. $6 \times 10^5 \text{to } 6.4 \times 10^5 \text{nm}$

B. $40 \times 10^4 \text{ to} 41 \times 10^4 \text{nm}$

C. 1.8×10^5 to 2×10^5 nm

D. 6×10^4 to 6.4×10^4 nm

Answer: D

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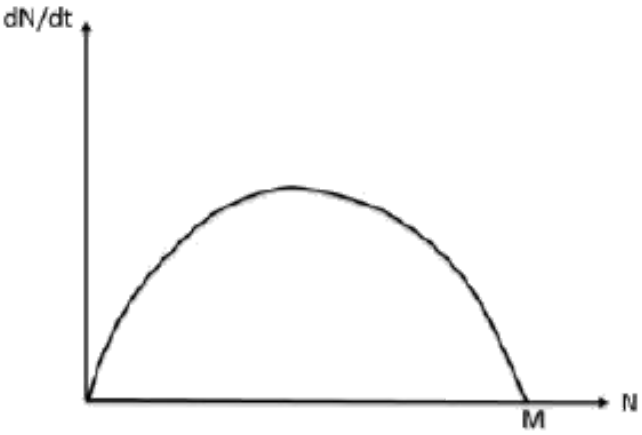
4. In the graph below. where N is population size and tis time. M represents



A. specific growth rate.

B. Median population size

C. carrying capacity

D. minimum population size without going extinct.

Answer: C

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5. Match the metabolic pathways in Column I with their corresponding intermediate molecules listed in Column II

Column I	Column II
P. Krebs cycle	i. Dihydroxy acetone phosphate
Q. Glycolysis	ii. Succinate
R. Electron transport chain	iii. Cytochrome c
S. Nitrogen fixation	iv. Glutamate
	v. Glyoxylate

Choose the CORRECT combination.

A. P-ii, Q-i, R-iii, S-iv

B. P-i, Q-v, R-iv, S-ii

C. P-v, Q-i, R-iii, S-iv

D. P-ii, Q-i, R-iii, S-v

Answer: A

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6. By comparing mitosis and meiosis occurring in the same organism, which ONE of the following options is CORRECT regarding the DNA content per cell ?

A. Mitotic anaphase gt Meiotic anaphase I =

Meiotic anaphase II

B. Mitotic anaphase = Meiotic anaphase I gt

Meiotic anaphase II

C. Mitotic anaphase lt Meiotic anaphase I =

Meiotic anaphase II

D. Mitotic anaphase = Meiotic anaphase I lt

Meiotic anaphase II

Answer: B

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7. Which ONE of the following is likely to occur upon heating a solution of eukaryotic protein from $20^{\circ} C$ to $95^{\circ} C$

A. Breakage of disulphide bonds

B. Change in primary structure

C. Hydrolysis of peptide bonds

D. Change in tertiary structure

Answer: D

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8. Which ONE of the following statements is INCORRECT about the hexokinase-catalysed reaction given below ? Glucose + ATP $\rightarrow$ Glucose-6-phosphate+ADP

A. This reaction takes place in the cytoplasm

B. This is an endergonic reaction

C. Folding of hexokinase to fit around the glucose molecule excludes water from

the active site

D. This reaction involves an induced fit mechanism in hexokinase

Answer: B

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9. An ecologist samples trees in multiple forest plots to determine species richness. Which ONE of the following can help determine the adequacy of sampling effort ?

A. Graph the number of new tree species in each successive sampling plot.

B. Graph the total number of tree species per total area for all plots combined.

C. Graph the number of individuals per tree species in each successive sampling plot.

D. 30 sampling plots are sufficient, irrespective of the forest area.

Answer: A

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10. In medical diagnostics for a disease, sensitivity (denoted a) of a test refers to the probability that a test result is positive for a person with the disease whereas specificity (denoted b) refers to the probability that a person without the disease test negative. A diagnostic test for influenza has the values of a = 0.9 and b = 0.9. Assume that the prevalence of influenza in a population in 50%. If a randomly chosen person tests negative, what

is the probability that the person actually has influenza ?

A. 0.01

B. 0.02

C. 0.05

D. 0.10

Answer: D

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