

## 1 Mark Questions

- Both birds and bats fly have wings. Wings of birds and bats represent
  - analogous structures
  - homologous structures
  - vestigial structures
  - phylogenetically conserved structures
- Which one of the following would you qualify as a holometabolous insect?
  - Cockroach
  - Grasshopper
  - Mosquito
  - Human body louse
- All of the following statements about heterochromatin are true except one. Which one?
  - Heterochromatin stains more darkly with DNA dyes than euchromatin
  - Heterochromatin contains more highly condensed DNA than euchromatin
  - Heterochromatin is associated with inactive genes
  - Heterochromatin is more susceptible to DNase-I than euchromatin
- In human, the cardiac sphincter surrounds the cardiac orifice in the digestive tract. The failure of this sphincter's normal function with result in the
  - regurgitation of food into the oesophagus
  - loss of control of defecation
  - movement of the bolus into the trachea rather than the oesophagus
  - rapid emptying from the stomach to the small intestine
- Stroke occurs when
  - the pacemaker becomes defective, producing an irregular heartbeat
  - a blood clot enters and blocks one of the coronary arteries
  - a blood clot dislodges from a vein and moves into the lung where it block a pulmonary artery
  - a blood clot enters the cerebral circulation blocking an artery and causing the death of brain tissue
- Which one of the following statements is true with regard to tissue macrophages?
  - They have short life spans because they self-destruct after engulfing foreign invaders
  - They originate from monocytes that leave the circulation and enter the tissues
  - They are most effective against parasites
  - They do not attack microorganisms directly; instead, they destroy virus-infected body cells
- Which of the following cell types does HIV preferentially infect?
  - cytotoxic T-cells
  - natural killer cells
  - helper T-cells
  - memory cells
- Trichinella spiralis* infection is most commonly contracted from
  - beef products
  - eating infested, undercooked pork
  - undercooked vegetables
  - non-pasteurised milk
- In three of the four types of animals listed below colonies can be initiated by a single individual. However, the fourth one would need at least a pair (a male and a female) to set up, a colony. Identify which one?
  - Sea anemones
  - Frogs
  - Tapeworms
  - Whiptail lizards
- The synthesis of ATP by chemiosmosis
  - is endergonic and is coupled to exergonic electron transport
  - is exergonic and is coupled to endergonic electron transport
  - is due to electrons shuttles down the electron transport chain to the final electron acceptor, which is  $\text{NAD}^+$
  - produces less ATP than Kreb's cycle and glycolysis combined



## 2 Marks Questions

11. Presume that you can measure DNA content in a single cell throughout its cell cycle. After measuring the DNA content during  $G_1$  phase, at what other points during the remainder of the cell cycle would you find changes in DNA per cell?
- Prophase and metaphase
  - S-phase and prophase
  - S-phase and  $G_2$
  - Interphase

12. Frequency of individuals with darkly coloured wings in the moth species *Biston bistullaria* went up during the early days of industrialisation in England. This change in the moth population coincided with the darkening of the barks of the trees around the factories. This phenomenon, also referred to as industrial melanism, represents
- speciation
  - genetic drift
  - natural selection
  - allelic variations

13. Consider an island population where a majority of the individuals display hexadactyly of their hands. Evolutionary biologists would readily explain this phenomenon based on
- dominance of the hexadactyl condition
  - small size of the founder population
  - novel mutations
  - improved fitness and adaptation of the hexadactyl individuals

14. Marsupials are naturally found in Australia. The hallmark of the marsupials is
- ovoviviparity
  - prolonged placental development
  - parturition before completion of embryonic development
  - incomplete adaptive radiation

15. Imagine that you are examining eosin-haematoxylin stained cross section of a mammalian stomach. Beginning from the outermost to the innermost layers, which of the following description accurately describes the different cell layers of the stomach?
- Mucosa—Submucosa—Serosa—Muscularis
  - Serosa—Mucosa—Submucosa—Muscularis
  - Serosa—Muscularis—Submucosa—Mucosa
  - Muscularis—Submucosa—Mucosa—Serosa

16. Animals belonging to the Phylum—Chordata are unambiguously classified based on only one of the four sets of characteristics described below. Which one?

- Notochord, Central nervous system, Circulatory system and Segmented muscle
- Notochord, Dorsal hollow nerve cord, Pharyngeal slits and Postnatal tail
- Notochord, Dorsal hollow nerve chord, Gills and Segmented muscles
- Notochord, Peripheral nervous system, Pharyngeal slits and Segmented muscles

17. A female fruit fly, *Drosophila* of the genotype  $RrSs$  was mated to males with the genotype  $rrss$ . The progeny obtained in four different situations are displayed on the left column while their probable explanations are displayed on the right. Match the genotypic frequency with the most appropriate explanations.

Frequency of Progeny	Explanation
A. 50% $RS$ and the rest $rs$	1. The two loci are not linked
B. 50% $RS$ and $rs$ , the rest $RS$ and $rs$	2. The $r$ and $s$ gametes in the female were not formed
C. 90% $RS$ and $rs$ , the rest $R_s$ and $r_S$	3. The two loci are 10 mu apart
D. All the progeny are $RS$	4. The two loci are tightly linked

### Codes

	A	B	C	D		A	B	C	D
(a)	4	1	3	2	(b)	1	4	2	3
(c)	2	4	3	1	(d)	4	1	2	3

18. Diploid chromosome number in human is 46. However, if you count chromatids which are visible during mitotic or meiotic cell divisions, you would be able to count different sets of chromatid numbers depending on the stage and the type of the cell division in question. Match the chromatid numbers given on the left with cell division stage shown on the right.

Group I	Group II
A. 46	1. Mitotic metaphase
B. 23	2. Aneuploid meiotic telophase-II
C. 92	3. Meiotic telophase-I
D. 24	4. Meiotic anaphase-II

### Codes

	A	B	C	D		A	B	C	D
(a)	3	4	1	2	(b)	2	4	1	3
(c)	1	4	2	3	(d)	1	2	3	4



19. The transport of molecule of a particular solute from inside an animal cell across the cell membrane to the extracellular fluid always requires energy when the
- concentration of the solute is higher inside the cell than outside it
  - concentration of the solute is lower inside the cell than outside it
  - a transport protein is involved in the movement of the molecules
  - the cytoskeleton blocks all available channels
20. Different cell types respond to the same signalling molecule (for example, a hormone like glucagon) in different ways because
- different cells possess different receptors, which produce signals unique to each cell type
  - different cells possess identical receptors, however, ultimately different sets of targets are activated
  - different cells have membrane receptors that bind to different sides of the signal molecule
  - the signal transduction pathway in cells has a variable length
21. Indicate the order in which the following steps occur in the production of a mature mRNA.
- Initiation of transcription, splicing, addition of 5' cap, addition of poly A tail transport to cytoplasm
  - Initiation of transcription, addition of 5' cap, splicing, addition of poly A tail, transport to cytoplasm
  - Initiation of transcription, addition of poly A tail, addition of 5' cap, splicing, transport to cytoplasm
  - Initiation of transcription, addition of 5' cap, addition of poly A tail, splicing, transport to cytoplasm
22. All your cells contain protooncogenes, which can change into cancer-causing genes. Why do cells possess such potential time bombs?
- Protooncogenes protect cells from infection by cancer-causing viruses
  - Protooncogenes are genetic junk that has not yet been eliminated by natural selection
  - Protooncogenes are unavoidable environmental carcinogens
  - Protooncogenes are necessary for normal control of cell division
23. Researchers have found homeotic genes in humans, but they are not yet certain how these genes shape the human phenotype. Considering the functions of homeotic genes are comparable in *Drosophila* and humans, which one of the following statements is most likely to be their function in humans?
- Determining skin and hair colour
  - Regulating the cellular metabolic rate and growth
  - Determining that arms come off the upper portion of the torso and legs from the lower half of the body
  - Regulating the rate and timing of cell division
24. Which one of the pairs of answers provided below will correctly fill blanks in the statements, "In lakes and ponds, eutrophication occurs when (i) ..... leading to (ii) .....?"
- (i) levels of dissolved CO<sub>2</sub> rise;  
(ii) bicarbonate levels too high to support life
  - (i) too much nutrients flow into the water body;  
(ii) anaerobic conditions in deeper water
  - (i) pesticides are washed off agricultural land;  
(ii) decreased aquatic biodiversity
  - (i) primary producers are killed by pollution;  
(ii) starvation of organisms at higher trophic levels
25. In ecological parlance, which of the following can be defined as a population?
- All the insects that are trapped in a spider web
  - All the plants in a forest
  - All the earthworms that live in a grassland plus those in the forest
  - All the sandalwood trees in a given forest
26. Which one of the following activities does not increase the concentration of greenhouse gases in the atmosphere?
- Increasing the number of cows and sheep to help feed a growing human population
  - Burning tropical rainforests to clear land for grazing
  - Leaving leaks in natural gas pipelines unchecked
  - Spreading salt on roads to prevent ice formation
27. Organism X can see colours we cannot and sense traces of chemicals we cannot. However, if organism X cannot hear very well, then which one of the following statements would be the ultimate explanation for their poor hearing?
- Organism X is too small to have functional auditory organs
  - Hearing may not contribute much to the reproductive success of organism X



- (c) If organism X could hear well, its brain would be swamped with unnecessary information
- (d) This is an example of altruism

28. Every morning, a research student turns on the light in a laboratory aquarium to feed the fish. After a couple of weeks of this routine, the student noticed that the fish come to the surface to feed as soon as the lights are turned on. The behaviour of the fish is a result of

- (a) habituation
- (b) positive phototaxis
- (c) imprinting
- (d) classical conditioning

29. If an individual were to raise a set of relatives, which one of the following sets would result in a maximal continuation of his own gene pool through successive generations?

- (a) Eight first cousins
- (b) One offspring and two nieces
- (c) One sibling, one grandchild, and two first cousins
- (d) One offspring, one nephew, and two grandchildren

30. You label a few cells at the tip to the animal pole of a gastrulating frog embryo with a fluorescent dye. At the end of embryogenesis, where would you find the fluorescing cells?

- (a) The cardiac cells
- (b) The pancreatic cells
- (c) The neural cells
- (d) The intestinal cells