

Biology, 2013 EC, entrance exam, round 1, booklet 12

Grade 12 · Biology · 2013 E.C.

MARKING KEY — CONFIDENTIAL

Time allowed: 120 minutes

Questions: 95

Total marks: 95

1. Which one of the following is true about the importance of Lucy in resolving debates about human evolution? (1)
- A. Big brains came before bipedalism.
 - B. Lucy had a brain size of 1.8% of her body mass.
 - C. ✓ **Bipedalism came before big brains.**
 - D. Lucy was partially an arboreal primate.

Answer: C

The discovery of Lucy (*Australopithecus afarensis*) was pivotal because she had a small, ape-like brain but walked upright, proving that bipedalism evolved before large brains in human evolution.

2. Which one of the following can best explain behavior? It is (1)
- A. ✓ **the co-ordinated response of an organism to an internal or external stimuli.**
 - B. the tendency for parts of plants to grow towards light.
 - C. the actions or reactions of a person or animal in response to external or internal stimuli.
 - D. a cell or group of cells that receives and processes stimuli.

Answer: A

In biology, behavior is best defined as the coordinated response of an organism to an internal or external stimulus.

3. The quick withdrawal of your hand from a hot plate is an example of (1)
- A. fixed action pattern
 - B. ✓ **innate behavior**
 - C. biological clock
 - D. key stimulus

Answer: B

The rapid withdrawal of a hand from a hot surface is a reflex arc, which is a type of innate (inborn) behavior that does not require learning or prior experience.

4. Which one of the following processes describes a biological clock? (1)
- A. Removal of one's thumb from hot objects quickly
 - B. The growing of plants towards light
 - C. ✓ **Circannual migration of birds from temperate to tropical areas**
 - D. Kinesis and taxes of woodlice and other simple animals

Answer: C

A biological clock regulates rhythmic biological processes; circannual migration is driven by an internal annual biological clock that prompts birds to migrate seasonally.

5. Identify learned behavior from the following. (1)
- A. ✓ **Dog trained to hunt.**
 - B. Honey bee making honey.
 - C. Child withdraws hand from hot things.
 - D. Ants making nest.

Answer: A

A dog trained to hunt represents a learned behavior because it is acquired through training and experience, unlike the innate behaviors listed in the other options.

6. Which one of the following features is unique to bacteria? (1)
- A. Presence of permeable membrane B. Being unicellular
C. ✓ **Absence of nuclear membrane** D. Having flagella for locomotion

Answer: C

Bacteria are prokaryotes, and the defining feature of prokaryotes is the absence of a membrane-bound nucleus (nuclear membrane).

7. This item is based on the diagram which shows the different shape of bacteria below. What is the correct name of the shape of bacteria represented by letters A, B and C, respectively? (1)

[Figure: A scanned drawing showing three groups of bacterial cells side by side, each with a leader line and a bold capital letter label. Left group, labelled A: three long, thin, wavy corkscrew-like filaments drawn with several regular waves each, lying loosely parallel (spiral / spirochaete form). Middle group, labelled B: about ten small round cells scattered across the field, some single, several joined in pairs and one short chain of two or three touching cells (spherical / coccus form). Right group, labelled C: six short, thick, blunt-ended rod cells drawn at various angles, most of them joined end to end in pairs (rod / bacillus form). The cells are coloured grey, dark red and olive; the scan carries a faint bleed-through of text from the reverse of the page and a small 'Scanned with CamScanner' watermark at bottom left. No scale, no other text or values appear in the figure.]

- A. Rod, spirochaete, sphere B. Sphere, rod, spirochaete
C. Flagellated bacilli, clusters, spirilla D. ✓ **Spirochaete, sphere, rod**

Answer: D

Letter A shows spiral/corkscrew-shaped bacteria (spirochaete), B shows spherical bacteria (coccus/sphere), and C shows rod-shaped bacteria (bacillus/rod).

8. It is possible to produce human insulin in a bacterial strain. The insulin gene should be inserted in a plasmid and the recombinant DNA plasmid should be inserted into a bacterium. What is the role of the bacterium in this process? (1)
- A. The source of insulin and modification
B. The source of plasmid and insulin production
C. ✓ **Multiplying the recombinant DNA molecule**
D. Joining the gene of insulin with the gene of plasmid

Answer: C

When the recombinant plasmid is introduced into the host bacterium, the bacterium's primary role is to replicate and multiply the recombinant DNA molecule as it reproduces.

9. Bacteria can cause diseases in all of the following mechanisms EXCEPT (1)
- A. ✓ **changing the genetic structure of host cells.**
B. entering living cells and disrupting metabolic systems.
C. releasing toxins as they multiply.
D. invading and growing on the tissues of organs.

Answer: A

Changing the genetic structure of host cells is characteristic of viruses (like retroviruses), whereas bacteria cause disease by tissue invasion and releasing toxins, not by altering host DNA.

10. Functional diseases differ from infectious diseases in that they (1)
- A. are caused by microorganisms.
 - B. occur in the brain and heart.
 - C. are common in females than males.
 - D. ✓ **show no signs of damage on the organ.**

Answer: D

Functional diseases are characterized by abnormal functioning of an organ or body system without any detectable structural damage or organic changes in the tissue, unlike infectious or structural diseases.

11. This item is based on the drawing of a bacteriophage given below. In the above diagram of a bacteriophage, DNA (1)

[Figure: A scanned drawing of a T-even bacteriophage standing upright, with three numbered leader lines. The virus has an elongated six-sided (hexagonal) head drawn as a grey shell whose wall is shown as a row of small repeating subunits; inside the hollow head a single dark red and grey coiled thread winds up and down. Below the head is a straight vertical tail: a narrow collar, then a longer sheath drawn with a beaded or ridged edge, ending in a base plate. Six long, thin, sharply bent legs (tail fibres) splay out from the base plate, three to each side, each bending at a knee roughly halfway down. Label 1 is at the top left, its line running down into the head to touch the coiled thread inside it. Label 2 is at the top right, its line running down to the wall of the head. Label 3 is at the bottom right below the legs, its line running up to one of the bent tail fibres. No other text, units or values appear in the figure; the scan shows faint bleed-through from the reverse of the page.]

- A. 2 and 3.
- B. 1 and 3.
- C. ✓ **1 and 2.**
- D. 2 and 1.

Answer: C

Label 1 points to the nucleic acid (DNA) inside the bacteriophage head, and label 2 points to the outer protein capsid (protein coat).

12. The social impact of AIDS can be mainly revealed by (1)
- A. ✓ **fear of stigmatization**
 - B. loss of appetite
 - C. reduced labor force
 - D. loss of body weight

Answer: A

Fear of stigmatization and discrimination is a direct social impact of HIV/AIDS, whereas reduced labor force is an economic impact, and weight/appetite loss are physical symptoms.

13. Which one of the following is a DNA virus? (1)
- A. ✓ **Herpes complex**
 - B. HIV
 - C. Hepatitis C
 - D. H1N1

Answer: A

Herpes simplex (referred to here as 'Herpes complex') is a double-stranded DNA virus, whereas HIV, Hepatitis C, and H1N1 are all RNA viruses.

14. Which one of the following is a correct comparison of lytic and lysogenic cycles of virus multiplication? (1)
- A. Lysogenic cycle releases new viruses using only chronic cycle.
 - B. Lytic cycle involves incorporation of viral DNA into the host DNA.
 - C. ✓ **Lytic cycle releases new viruses only by splitting the host cell.**
 - D. Both cycles damage the host cell DNA following infection.

Answer: C

The lytic cycle of viral replication concludes with the lysis (splitting) of the host cell to release newly synthesized viral particles, whereas the lysogenic cycle involves integrating viral DNA into the host genome without immediately destroying the cell.

- 15.** In an HIV/AIDS community screening, students were asked to take part in voluntary testing. The following discussion presents the views of four grade 12 students named A, B, C and D towards HIV testing. Student A: I should not take the testing; it is simply boring. Student B: We should take the testing, since we are educated; we should be exemplary. Student C: If we get tested and got positive, what should we do? So, let us not get tested. Student D: You know, this HIV/AIDS testing is simply a business. We should not be cheated. Which student do you think is correct?

A. ✓ Student B

B. Student A

C. Student D

D. Student C

Answer: A

Student B shows a responsible and educated attitude towards HIV testing, recognizing the importance of being tested to set a positive example for the community.

- 16.** Which event of cellular respiration takes place in the cytoplasm eukaryotic cells? (1)

A. ✓ Production of pyruvate from glucose

B. Reaction of acetyl CoA with oxaloacetate

C. Production of ATP through chemiosmosis

D. Reaction of pyruvate with coenzyme A

Answer: A

Glycolysis, which is the process of breaking down glucose into two molecules of pyruvate, takes place in the cytoplasm of eukaryotic cells. The other options occur within the mitochondria.

17. Suppose two moles of glucose is burned aerobically. How many moles of ATP can be produced by substrate level phosphorylation in Krebs cycle? (1)

A. ✓ 4

B. 6

C. 10

D. 8

Answer: A

One mole of glucose yields two turns of the Krebs cycle, with each turn producing 1 ATP through substrate-level phosphorylation (total of 2 ATP per glucose). Therefore, two moles of glucose will produce 4 moles of ATP.

18. During alcoholic fermentation, CO_2 is released when (1)

A. acetaldehyde is reduced.

B. pyruvate is oxidized.

C. ✓ pyruvate is decarboxylated.

D. ethanol is oxidized.

Answer: C

During alcoholic fermentation, pyruvate (3C) is decarboxylated by the enzyme pyruvate decarboxylase to produce acetaldehyde (2C) and carbon dioxide.

19. During anaerobic respiration, reduced NAD is required to (1)

A. split pyruvate to CO_2 and acetaldehyde.

B. ✓ reduce pyruvate to lactate.

C. convert lactate into pyruvate.

D. reduce pyruvate to acetyl CoA.

Answer: B

During anaerobic lactic acid fermentation, reduced NAD (NADH) is oxidized to NAD⁺ to reduce pyruvate into lactate, regenerating the NAD⁺ needed for glycolysis to continue.

- 20.** Why do we get tired and fatigued during heavy exercise such as long distance running? It is due to (1)

A. accumulation of CO₂.

B. ✓ accumulation of lactic acid.

C. high rate of aerobic respiration.

D. shortage of glucose.

Answer: B

During intense exercise, oxygen supply to muscles is limited, causing them to undergo anaerobic respiration. This leads to the accumulation of lactic acid, which causes muscle fatigue and soreness.

21. If one base in the six triplets of the gene coding for one of the four polypeptides in the haemoglobin molecule alters the triplet from GAG to GTG, which one of the following biological terms best describes the above phenomenon? (1)

- A.** ✓ Mutation **B.** Cloning
C. Translation **D.** Transcription

Answer: A

A change in a single base pair of a DNA sequence (such as GAG to GTG in the beta-globin gene, which causes sickle-cell anemia) is defined as a point mutation.

22. Which one of the following is the basic characteristic of mutation? It is (1)

- A. ✓ spontaneous. B. planned.
C. regular. D. expected.

Answer: A

Mutations are primary sources of genetic variation and are characterized as spontaneous, random, and unpredictable changes in the genome.

23. The theory that suggests "life can evolve autonomously from non-living objects" is known as (1)

- A. cosmozoan theory.
- B. ✓ **spontaneous generation theory.**
- C. biochemical theory.
- D. eternity theory.

Answer: B

The theory of spontaneous generation (abiogenesis) states that living organisms can arise spontaneously and autonomously from non-living matter.

24. Which one of the following is true about neo-Darwinian theory? (1)

- A. There is a natural variation in features and variations which are heritable.
- B. All species tend to produce more offspring than can possibly survive.
- C. ✓ **It takes into account genetics and animal behavior to understand evolution.**
- D. Development of new feature is important for survival.

Answer: C

Neo-Darwinism (or the modern evolutionary synthesis) integrates Darwin's theory of natural selection with modern genetics, population dynamics, and behavior to explain how evolution occurs.

25. Which one of the following statements describes the evolutionary theory of Lamarck? (1)

- B. ✓ Structures commonly used become more developed.**

Answer: B

Lamarck's evolutionary theory is based on the ideas of use and disuse, where structures that are used frequently become more developed, and the inheritance of these acquired characteristics.

26. The behavior which trainers look, if modified, could lead to the desired behavior and reward such a behavior is (1)
- A. innate.
 - B. instinct.
 - C. reflex.
 - D. ✓ **operant.**

Answer: D

An operant is a behavior that is actively emitted by an organism and operates on the environment; in training, operant behaviors are reinforced with rewards to shape the desired outcome.

27. Which one of the following examples of behavior describes when an animal stops responding to stimulus or cue after a period of repeated exposure? (1)
- A. Imprinting
 - B. Reflex
 - C. ✓ **Habituation**
 - D. Conditioning

Answer: C

Habituation is a form of learning in which an animal decreases or stops its response to a repetitive stimulus that is neither rewarding nor harmful.

28. Which one of the following behaviors is a courtship behavior? (1)
- A. ✓ **Touch**
 - B. Scent marking
 - C. Ritual fighting
 - D. Defending a den

Answer: A

Touch is a key tactile communication signal used in the courtship behaviors of many animals, whereas scent marking and defending dens are territorial behaviors, and ritual fighting is agonistic.

29. The Ethiopian wolf (*Canis simensis*) lives and hunt in packs. During patrolling their habitat, both male and female wolves of the group maintain their area with urine containing pheromone. This pattern of behavior best exemplifies (1)
- A. courtship behavior.
 - B. ✓ **territorial behavior.**
 - C. operant behavior.
 - D. learned behavior.

Answer: B

Marking territory using urine containing pheromones to exclude other individuals of the species is a classic example of territorial behavior.

30. The terrestrial biome characterized by cold temperature, dry precipitation, frozen soil and inhabited by migrating birds is (1)
- A. boreal forests.
 - B. deserts
 - C. tropical montane forests.
 - D. ✓ **tundra.**

Answer: D

The tundra biome is characterized by very cold and dry conditions, permanently frozen soil (permafrost), and serves as a summer nesting ground for many migratory birds.

31. This item is based on the table below. | Biome | Soil | Animals | | Desert (hot) | L | M | | Tropical montane forest | N | O | Select the correct representatives for L, M, N and O, respectively (1)
- A. Fertile, many animals, poor, few animals
 - B. ✓ **Poor, sparse, fertile, many animals**
 - C. Fertile, migratory animals, poor, drought and fire adapting animals
 - D. Medium, ants and spiders, poor, polar bears

Answer: B

Hot deserts are characterized by poor, sandy soils and sparse animal life, whereas tropical montane forests typically have fertile soils and high animal diversity.

32. Which one of the following explains biodiversity? (1)
- A. ✓ **The variability among living organisms, within species, and of ecosystem**
 - B. The large number of human races in the world
 - C. The similarity and difference of organisms which live in different ecosystems
 - D. Large number of organisms in the same ecosystem

Answer: A

Biodiversity is defined as the variability among living organisms from all sources, encompassing diversity within species, between species, and of ecosystems.

33. This item is based on the table below which shows an 'invented' ecosystems. Number of organisms of each species | Species | Area 1 | Area 2 | Area 3 | | A | 86 | 16 | 23 | | B | 5 | 17 | 25 | | C | 2 | 16 | 27 | | D | 3 | 17 | 5 | | E | 1 | 17 | 12 | | F | 3 | 17 | 8 | In which area of the above table does all of the species are more or less equally successful? (1)
- A. ✓ **Area 2**
 - B. Area 1
 - C. Area 1 and 3
 - D. Area 1 and 2

Answer: A

In Area 2, all species have almost equal abundance (around 16 or 17 individuals), representing high species evenness, which indicates they are more or less equally successful.

34. What is the major difference that viruses have with free living cells? Viruses (1)
- A. reproduce only asexually.
 - B. lack genetic material of their own.
 - C. ✓ **do not function outside of a living cell.**
 - D. lack locomotary structure.

Answer: C

Unlike free-living cells, viruses lack metabolic machinery and are obligate intracellular parasites, meaning they cannot replicate or carry out metabolic processes outside of a living host cell.

35. Why is nutrient recycling important in an environment? Because (1)
- A. ✓ **the amount of nutrients in the environment is limited.**
 - B. it adds new types of molecules into the environment.
 - C. nutrients in an environment will be depleted if recycled.
 - D. nutrients should be exchanged between the earth and other planets

Answer: A

Nutrient recycling is essential because the earth has a finite and limited supply of nutrients. Unlike energy, which flows through ecosystems from the sun and is lost as heat, nutrients must be continuously recycled to remain available for living organisms.

36. Which one of the following orders of life processes correctly illustrates occurrence of the nutrient cycle? (1)
- A. feeding → death and decomposition → excretion → respiration and breathing
 - B. ✓ **feeding → excretion → respiration and breathing → death and decomposition**
 - C. death and decomposition → feeding → excretion → respiration and breathing
 - D. respiration and breathing → feeding → excretion → death and decomposition

Answer: B

This sequence represents the logical order of nutrient processing through an organism's life history: starting with feeding (nutrient intake), followed by excretion of metabolic waste, continuous respiration to release energy, and finally death and decomposition, which returns the remaining nutrients back to the environment.

37. Which of the following processes in the phosphate cycle DOES NOT return phosphate ions to the soil? (1)
- A. Weathering of rocks
 - B. Use of fertilizers
 - C. Decomposition of dead animals
 - D. ✓ **Cellular respiration**

Answer: D

Cellular respiration is a process that releases carbon dioxide and water into the environment, playing a key role in the carbon and water cycles. It does not release or return phosphate ions to the soil, unlike weathering, fertilizer use, and decomposition.

38. A previously bare land was gradually occupied by lichen and mosses, annual herbs, perennial herbs, shrubs and finally by forests. Which one of the following best describes the process indicated above? (1)
- A. Afforestation
 - B. ✓ **Succession**
 - C. Climax community
 - D. Natural Selection

Answer: B

Ecological succession is the gradual process by which ecosystems change and develop over time. In this primary succession scenario, pioneer species like lichens and mosses are gradually replaced by herbs, shrubs, and eventually a climax forest community.

39. This item is based on the table below. | Condition | Population size | | Natality exceeds mortality | X | | Mortality exceeds natality | Y | | Mortality and natality are equal | Z | The population number of X, Y, and Z, respectively will (1)
- A. decrease, increase, remain the same.
 - B. ✓ **increase, decrease, remain the same.**
 - C. decrease, remains the same, increase
 - D. remain the same, increase, decrease.

Answer: B

When natality (birth rate) exceeds mortality (death rate), the population size increases (X). When mortality exceeds natality, the population size decreases (Y). When they are equal, the population size remains the same (Z).

40. This item is based on the table below which shows population growth trend. | Time period | Numbers in population X | Numbers in population Y | | 0 | 5 | 40 | | 1 | 10 | 80 | | 2 | 15 | 160 | | 3 | 20 | 320 | | 4 | 25 | 640 | | 5 | 30 | 1280 | | 6 | 35 | 2560 | | 7 | 40 | 5120 | Which one of the following is correct about X and Y? (1)
- A. X is exponential growth because the numbers increase by the same fixed amount in each time period and Y is arithmetic growth because the population doubles in each time period.
 - B. X and Y cannot be compared because each of them grow differently with incomparable proportion.
 - C. **X is arithmetic growth because the numbers increase by the same fixed amount in each time period and ✓ Y is exponential growth because the population doubles in each time period.**
 - D. Both X and Y are exponential growth since each of them increase regularly without interruption.

Answer: C

Population X grows arithmetically (linearly) because it increases by a constant amount (+5) in each time step. Population Y grows exponentially because it doubles (multiplies by 2) in each consecutive time interval.

41. *Drosophila melanogaster* are convenient experimental animals in genetics. Because they (1)
- A. have 23 pairs of chromosomes per cell.
 - B. ✓ **are small animals with a short life cycle.**
 - C. are too cheap to breed in large numbers.
 - D. have chromosomes that can't be easily detected,

Answer: B

Drosophila melanogaster (the common fruit fly) is widely used in genetic research because it is small, easy and inexpensive to culture, and has a very short life cycle (about 10 days), allowing researchers to observe many generations quickly.

42. Suppose a heterozygous brown eye father is married with a blue eye mother. What would be the proportion of homozygous children for eye color? (Hint: Brown is dominant over blue) (1)
- A. ✓ **50%**
 - B. 100%
 - C. 75%
 - D. 25%

Answer: A

A cross between a heterozygous father (Bb) and a homozygous recessive blue-eyed mother (bb) yields 50% heterozygous offspring (Bb) and 50% homozygous offspring (bb). Thus, the proportion of homozygous children is 50%.

43. The following question is based on the figure that shows the gains in productivity from hybrid vigour. In the above diagram, what best describes the breeding condition represented by letter X, and Z, respectively? (1)
- [Figure: A scanned photograph of a printed bar chart. The vertical axis is labelled "improvement in yield (%)" and is scaled 0, 5, 10, 15, 20, 25 with faint horizontal grid lines. Three positions are marked along the horizontal axis and labelled with bold capital letters X, Y and Z, left to right; the axis itself carries no title. There is no bar at X, only the value "0%" printed just above the axis at that position. A solid dark bar stands at Y reaching just above the 9 level, with "9%" printed above it. A taller solid dark bar stands at Z reaching just above the 23 level, with "23%" printed above it. Both bars are the same width and the plot area is grey. Nothing else is drawn or labelled; a small 'Scanned with CamScanner' watermark sits at the bottom left of the image.]*
- A. X involves cross breeding and Z involves inbreeding.
 - B. ✓ **X involves inbreeding and Z involves cross breeding.**
 - C. X represents natural selection and Z represents artificial selection.
 - D. Both X and Z represent inbreeding.

Answer: B

Inbreeding leads to inbreeding depression, resulting in no gain in productivity (0% improvement at X). In contrast, cross-breeding (outbreeding) produces hybrid vigour, resulting in a significant improvement in yield (23% at Z).

44. If organisms share very similar molecules such as DNA, then they must be closely related evolutionarily. Which evidence of evolution supports the above information? (1)
- A. Comparative embryology
 - B. Comparative anatomy
 - C. Comparative physiology
 - D. ✓ **Comparative biochemistry**

Answer: D

Comparing molecular structures, such as DNA, RNA, and proteins, to determine evolutionary relationships among different organisms falls under the field of comparative biochemistry.

45. Which one of the following CANNOT be used as an evidence of evolution through paleontology? (1)

- A. ✓ **Stomach**
- B. Teeth
- C. Hair
- D. Bones

Answer: A

Paleontology is the study of fossils. Soft internal organs like the stomach decay rapidly and almost never fossilize, whereas hard structures like teeth and bones, or exceptionally preserved external structures like hair, commonly serve as fossil evidence.

46. The process in which individuals with a particular heritable trait survive better than the other is (1)

- A. adaptation.
- B. evolution.
- C. selective breeding.
- D. ✓ **natural selection,**

Answer: D

Natural selection is the process by which individuals with favorable, heritable traits are more likely to survive and reproduce, passing those advantageous traits on to the next generation.

47. Which type of selection favors individuals at both extremes of a range to have some advantage over these displaying the mean value? (1)

- A. Stabilizing selection
- B. Directional selection
- C. Natural selection
- D. ✓ **Disruptive selection**

Answer: D

Disruptive (or diversifying) selection favors individuals with extreme phenotypes at both ends of the spectrum over those with intermediate (mean) phenotypes.

48. Which one of the following is true about the human evolution? (1)

- A. ✓ **Humans and chimpanzees both evolved from a common ancestor.**
- B. Humans evolved from chimpanzees.
- C. Humans evolved from different line of evolution than great apes.
- D. Humans evolved from great apes.

Answer: A

Humans did not evolve directly from modern chimpanzees; instead, both species shared a common evolutionary ancestor several million years ago.

49. Which one of the following organic molecules is used to make haemoglobin? (1)

- A. Glycogen
- B. Lipids
- C. ✓ **Proteins**
- D. Nucleic acids

Answer: C

Haemoglobin is a globular protein (consisting of four polypeptide chains bound to iron-containing heme groups) used to transport oxygen in red blood cells.

50. Which one of the following is the correct formula of maltose? (1)

- A. $C_6H_{12}O_6$
- B. $C_{12}H_{24}O_{12}$
- C. $C_5H_{10}O_5$
- D. ✓ $C_{12}H_{22}O_{11}$

Answer: D

Maltose is a disaccharide formed by joining two glucose molecules ($C_6H_{12}O_6$) through a dehydration reaction, which removes a water molecule (H_2O), yielding $C_{12}H_{22}O_{11}$.

51. A grade 11 student added Benedict's reagent on food sample and heated the mixture for 5 minutes. Then he observed a color change. Which one of the following is FALSE about the result? (1)
- A. An orange colour shows that a reducing sugar is present.
 - B. A yellow colour shows that a reducing sugar is present.
 - C. ✓ **An orange colour shows that a non-reducing sugar is present.**
 - D. A red colour shows that a reducing sugar is present.

Answer: C

Benedict's test is used to detect reducing sugars; a color change (like orange) confirms the presence of a reducing sugar, making the statement that it shows a non-reducing sugar false.

52. In a Benedict's test for sucrose, why does the test sample first boil with hydrochloric acid? (1)
- A. To reduce Benedict's solution
 - B. To neutralize the solution
 - C. ✓ **To hydrolyze non-reducing sugar**
 - D. To retest the mixture with Benedict's solution

Answer: C

Sucrose is a non-reducing sugar, so it must first be hydrolyzed with hydrochloric acid into its constituent reducing sugars (glucose and fructose) to react with Benedict's reagent.

53. Which one of the following statements explains the specificity of enzymes? Enzymes (1)
- A. ✓ **catalyze one reaction only.**
 - B. speed up a reaction without being used up.
 - C. can be destroyed by excessive heat.
 - D. can be used over and over again.

Answer: A

Enzyme specificity means that a particular enzyme will catalyze only one specific chemical reaction, or act on a very limited range of similar substrates.

54. The relevance and promise of biological sciences can be demonstrated by their contribution in (1)
- A. ✓ **finding mechanisms to feed the growing human population.**
 - B. finding solutions to ethnic conflicts.
 - C. development of housing and construction sectors.
 - D. advancement of aviation technology.

Answer: A

One of the key promises of biology lies in improving agricultural productivity, biotechnology, and genetics to ensure food security for the growing human population.

55. All are the roles of biology to combat the spread of HIV/AIDS EXCEPT (1)
- A. producing drugs that can stop the virus from reproducing
 - B. breaking the transmission pathway.
 - C. ✓ **raising fund for infected people.**
 - D. producing a vaccine against the virus.

Answer: C

While raising funds is vital for supporting infected people, it is a socio-economic and humanitarian effort rather than a direct role of biological sciences.

56. Which one of the following statements is INCORRECT about AIDS? The rate of transmission of AIDS will reduce when (1)
- A. the transmission path ways is broken.
 - B. promiscuous sexual intercourse is reduced.
 - C. the number of sexual partners is restricted.
 - D. ✓ **men and women are circumcised.**

Answer: D

While male circumcision has been shown to reduce HIV transmission, female circumcision (female genital mutilation) does not reduce transmission and is associated with severe health risks.

57. Which one of the following statements explains the property of water? It (1)
- A. takes less energy to heat water up.
 - B. has the lowest latent heat of vaporization.
 - C. ✓ **is a transparent molecule.**
 - D. is highly viscous substance.

Answer: C

Water is a transparent liquid, which is biologically crucial because it allows sunlight to penetrate aquatic environments so that phytoplankton and aquatic plants can photosynthesize.

58. Suppose there are two communities in a village. Community A actively participates in HIV/AIDS awareness creation, HIV prevention and gets blood test for HIV whereas community B frequently requests for food aid, participates only in afforestation activities and HIV positive individuals keep the secret to themselves. In which community do you think that the incidence of HIV/AIDS most probably high? (1)
- A. In both communities
 - B. ✓ **In community B**
 - C. Impossible to decide
 - D. In community A

Answer: B

Community B, which lacks active awareness campaigns, does not practice prevention, and has individuals secrecy around their status, is at a much higher risk for a high incidence of HIV/AIDS.

59. Which property of water is useful for life that it continues in relatively warm water underneath through the cold weather? (1)
- A. ✓ **High specific heat capacity**
 - B. High density in its solid form than its liquid form
 - C. High surface tension
 - D. High latent heat of vaporization

Answer: A

High specific heat capacity allows water to resist rapid temperature changes, keeping the water underneath relatively warm and stable for aquatic life during cold weather. Option B is factually incorrect because solid water (ice) is actually less dense than liquid water, which is why it floats.

60. Consider the following table which contains organic and inorganic molecules. Which rows contain the corresponding organic and inorganic molecules correctly? | No | Organic Molecules | Inorganic Molecules | | 1 | Lysine, sucrose | Salts, hydrochloric acid | | 2 | Deoxyribose, carbon monoxide | Fructose, sodium chloride | | 3 | Fatty acid, methane | Sodium hydroxide, carbon dioxide | | 4 | Water, calcium carbonate | Stearic acid, starch | Which rows contain the corresponding organic and inorganic molecules correctly? (1)

- A. 2 and 3
B. 1 and 2
C. 3 and 4
D. ✓ 1 and 3

Answer: D

Row 1 is correct because lysine and sucrose are organic, while salts and HCl are inorganic. Row 3 is also correct because fatty acids and methane are organic, while sodium hydroxide and carbon dioxide are inorganic.

61. Cellulose is (1)
- A. a mixture of amylose and amylopectin.
B. ✓ a polymer of β -glucose molecule.
C. a non-reducing monosaccharide sugar.
D. a polymer of α -glucose molecule.

Answer: B

Cellulose is a structural polysaccharide made of long, unbranched chains of beta-glucose molecules linked by beta-1,4-glycosidic bonds.

62. Which organic molecules are formed when two fatty acid molecules are bounded to the glycerol and the place of the third is taken by a phosphate group? (1)
- A. Waxes
B. Glycolipids
C. Triglycerides
D. ✓ Phospholipids

Answer: D

Phospholipids are lipids containing a glycerol backbone bound to two fatty acids and a phosphate group, forming a hydrophilic head and hydrophobic tails.

63. All are the function of lipids EXCEPT (1)
- A. thermal insulation.
B. water proofing.
C. respiratory substrates
D. ✓ determines a particular features.

Answer: D

The determination of particular features of an organism is the function of nucleic acids (DNA and RNA), which contain the genetic code, rather than lipids.

64. Three different cells are in the process of transporting materials across the cell membrane as indicated below: (1)
- Cell 1 = water from high concentration to low concentration
Cell 2 = Na^+ from high concentration to low concentration
Cell 3 = glucose from low concentration to high concentration
Which types of transport mechanism do the above cells use, respectively?
- A. ✓ Osmosis, facilitated diffusion, active transport
B. Osmosis, active transport, facilitated diffusion
C. Facilitated diffusion, osmosis, active transport
D. Facilitated diffusion, active transport, osmosis

Answer: A

The movement of water down its concentration gradient is osmosis, the movement of sodium ions down their concentration gradient through channel proteins is facilitated diffusion, and the movement of glucose against its concentration gradient is active transport.

65. Suppose you took a container and divided it into two halves by a membrane which is permeable to water and labeled the two halves as A and B. Finally, you added hypertonic solution in A and hypotonic solution in B. What will be the expected result of this experiment? (1)

- A. Rise of the water level in both halves
- B. Rise of the water level in B
- C. ✓ **Rise of the water level in A**
- D. No change in both halves

Answer: C

Water moves from an area of higher water potential (hypotonic solution B) to an area of lower water potential (hypertonic solution A), which results in a rise of the water level in A.

66. A student did an experiment and found out that catabolism of amino acid produces toxic ammonia in the liver cells which gradually get converted into urea and excreted through urine. What would be the result of the experiment if osmosis was blocked? The liver cells (1)

- A. gain water and become turgid.
- B. excrete more ammonia and urea.
- C. become over active and produce more energy.
- D. ✓ **become damaged and lose functionality.**

Answer: D

If osmosis is blocked, the cells cannot maintain osmotic balance and the transport/dilution of toxic metabolic byproducts like ammonia is impaired, leading to cellular damage and loss of function.

67. Consider the following key events in the study of cell biology. I. Hooke describes 'cells' in a cork. II. Leeuwenhoek discovers protozoa. III. Schleiden and Schwann propose a cell theory. IV. Jansen builds the first compound microscope. Which one of the following represents the correct order from ancient to the recent? (1)

- A. I, II, III and IV
- B. ✓ **IV, I, II and III**
- C. III, II, I and IV
- D. II, III, IV and I

Answer: B

The correct chronological order is: Jansen builds the microscope (~1590, IV), Hooke describes cells (1665, I), Leeuwenhoek discovers protozoa (1674, II), and Schleiden/Schwann propose the cell theory (1839, III). Option B contains a small typo (printing 'II' twice instead of 'III') but represents this correct sequence.

68. One of the differences of prokaryotic and eukaryotic cells is their cell wall. This is because cell wall of prokaryotic cell is (1)

- A. the site of energy production.
- B. impermeable.
- C. stronger than eukaryotic cells.
- D. ✓ **made from sugar and amino acid.**

Answer: D

The cell wall of prokaryotes is made of peptidoglycan (murein), which consists of polysaccharide chains cross-linked by short chains of amino acids.

69. Consider the following features of cells. I. have pili II. have chromosome III have circular DNA IV. have larger ribosomes Which of the above features of cells can be included in eukaryotic cells? (1)

- A. II and III
- B. I and II
- C. ✓ **II and IV**
- D. I and III

Answer: C

Eukaryotic cells are characterized by having linear chromosomes (II) and larger (80S) ribosomes (IV), whereas pili (I) are a feature of prokaryotes.

70. Which of the following is correct about the structure of the cell membrane? (1)
- A. Phospholipid molecules form a transport channel.
 - B. Protein molecules form a double layer.
 - C. ✓ **The membrane has a fluid nature that is regulated by cholesterol.**
 - D. Proteins form the outer layer while phospholipids form the inner layer.

Answer: C

Cholesterol is embedded in the cell membrane where it regulates membrane fluidity, preventing it from becoming too rigid at low temperatures or too fluid at high temperatures.

71. Which of the following is a correct match of cellular organelles and their corresponding function? (1)
- A. Vacuole strength and elasticity
 - B. ✓ **Mitochondria - ATP synthesis**
 - C. Lysosome - modification of proteins
 - D. Golgi body - digesting foreign cells

Answer: B

Mitochondria are known as the powerhouses of the cell because they are the site of aerobic respiration and ATP synthesis.

72. What structural arrangements make chlorophyll suit for its function? (1)
- A. The floating of the photosystems and the electron transport chain in the cytosol.
 - B. ✓ **The fixing of the photosystems and the electron transport chain on thylakoid membrane.**
 - C. The structural differences between Photosystem I and Photosystem II.
 - D. The long distance between Photosystem I and Photosystem I.

Answer: B

By embedding and fixing the photosystems and the electron transport chain components in the thylakoid membrane, the cell ensures they are in the precise positions and orientations required for efficient electron transport.

73. Why does photorespiration take place in a hot environment? Because plants close their stomata and face (1)
- A. H₂O shortage
 - B. ✓ **CO₂ shortage.**
 - C. O₂ accumulation.
 - D. O₂ shortage

Answer: B

Under hot and dry conditions, plants close their stomata to prevent water loss, which blocks carbon dioxide from entering the leaf, leading to a CO₂ shortage that triggers photorespiration.

74. This item is based on the diagram of chloroplast given below. Which letters represent the site where photolysis and Calvin take place, respectively? (1)

[Figure: A scanned, dark greyscale photograph of a textbook drawing of a chloroplast, shown as a rounded lens-shaped body with a wedge cut away at the upper left so the interior is visible. Six bold capital letters run down the left of the picture, each with a straight leader line pointing into the drawing. A (topmost) points to the outermost of the envelope layers along the cut edge of the wedge. B, just below it, points to the next layer in along that same cut edge. C points further in, to the stacked disc-like structures (grana of thylakoids) that fill the exposed interior. E, lower on the left, points to the rim of the cut face at the level of the lower half of the organelle. F, below E, points to the pale ground substance filling the space around the stacks in the lower half of the body (stroma). D, at the bottom, points with a short line up to the smooth outer surface of the intact lower part of the chloroplast. The interior stacks are drawn as several piles of flattened discs joined by connecting sheets. The letters are the only labels; no names, scale bar or values are printed on the figure. The scan is low contrast with faint text bleeding through from the reverse of the page and a small 'Scanned with CamScanner' watermark at the bottom left.]

- A. D and F
B. ✓ C and E
C. B and A
D. F and E

Answer: B

In chloroplast diagrams, 'C' points to the grana/thylakoids where photolysis (light-dependent reactions) takes place, and 'E' points to the stroma where the Calvin cycle (light-independent reactions) occurs.

75. Which of the following is correct about the process of glucose production in the light-independent reactions of photosynthesis? (1)

- A. A total of 9 ATP molecules are synthesized.
B. CO_2 reacts with GP to form RuBP.
C. One TP is directly converted to one glucose molecule.
D. ✓ GP is reduced to TP by reduced NADP.

Answer: D

During the reduction phase of the Calvin cycle, glycerate 3-phosphate (GP) is reduced to triose phosphate (TP) using energy from ATP and electrons from reduced NADP (NADPH).

76. Which of the following is a correct description of the CAM pathway of photosynthesis? (1)

- A. ✓ CO_2 is stored in the form of malate during the night.
B. The Calvin cycle takes place during the night.
C. The Calvin cycle takes place in the bundle sheath cells during the day.
D. CO_2 is stored in the bundle sheath cells during the night.

Answer: A

CAM plants adapt to arid conditions by opening their stomata at night to capture CO_2 , converting and storing it as malic acid (malate) in their vacuoles for use during the day.

77. Which one of the following statements explains how an enzyme lowers the activation energy of a reaction? By (1)

- A. enabling the reaction to occur at lower physiological temperature
B. ✓ making the individual substrate molecules more reactive
C. lowering the kinetic energy of the reacting molecules
D. changing its tertiary structure into secondary protein structure

Answer: B

Enzymes lower the activation energy of a reaction by interacting with the substrate and making its individual molecules more reactive through bond strain or orientation.

78. Consider the following chemical reaction below. $RH_2 + A \xrightarrow{E} R + AH_2$ Based on the above chemical reaction, in which classes of enzymes can enzyme "E" be grouped? (1)

A. Transferases
B. Hydrolyases
C. Isomerases
D. ✓ **Oxidoreductases**

Answer: D

The chemical equation depicts a redox (oxidation-reduction) reaction in which hydrogen is transferred, which is catalyzed by enzymes belonging to the class oxidoreductases.

79. Which one of the following enzymes is used as washing powders? (1)

A. Biochymosin
B. ✓ **Lipase**
C. Cellulase
D. Pectinase

Answer: B

Lipases are added to biological washing powders because they break down insoluble fats and oils, helping to remove grease stains from clothes.

80. What happens when the substrate molecule binds to the active site of an enzyme? (1)

A. The substrate and the enzyme will bond permanently.
B. They form a stable intermediate substance.
C. The amino acids in the active site become unreactive.
D. ✓ **The chemical bonds of the substrate distorted.**

Answer: D

When a substrate binds to the active site of an enzyme, the interaction induces a conformational change that distorts and weakens the chemical bonds of the substrate, lowering the activation energy needed to break them.

81. How does crossing over during meiosis bring variation in species? By (1)

A. increasing the amount of genes in one of the parents during meiosis
B. ✓ **combination of genes in the gametes that are not found in either parent**
C. combining sex and somatic cell chromosomes
D. creating genes that are not found in both parents due to meiosis

Answer: B

Crossing over during prophase I of meiosis shuffles genetic material between non-sister chromatids, resulting in new combinations of alleles in gametes that are different from those of either parent.

82. How does our body synthesize some of the amino acids in our body? From (1)

A. fatty acids we consume
B. ✓ **intermediate molecules of different path ways**
C. breaking down of pre-existing proteins
D. biological breakdown of our own cells

Answer: B

Non-essential amino acids can be synthesized by our body cells using intermediate molecules from metabolic pathways like glycolysis and the Krebs cycle through processes like transamination.

83. This item is based on the following list of events during cloning of an insulin gene into plasmid. I. Obtaining insulin producing cells and plasmid from organisms II. Cutting the insulin gene and plasmid III. X IV Inserting the recombinant plasmid into bacteria V. Production of insulin by bacteria Which one of the following best represents the step listed as "X"? (1)

- A. Inserting the insulin gene into a bacterium
- B. Inserting the open plasmid into a bacterium
- C. Fusing the insulin and plasmid genes to the cell wall of bacteria
- D. ✓ **Combining the insulin gene into the opened plasmid**

Answer: D

After obtaining and cutting the insulin gene and the plasmid (Steps I and II), the next step (X) is to ligate (combine) the insulin gene into the opened plasmid to form recombinant DNA before transforming it into bacteria.

84. Consider the DNA molecule containing: Strand 1: T A C G T A Strand 2: A T G C A T What will be the sequence of the new DNA if the DNA replicates semi-conservatively? (1)

- A. ATGCAT UACGUA
- B. TACGTA ATGCAU
- C. ATGCAT ATGCAT
- D. ✓ **TACGTA ATGCAT**

Answer: D

Semi-conservative replication produces two identical double-stranded DNA molecules, each consisting of one original template strand (such as TACGTA) and one newly synthesized complementary strand (such as ATGCAT).

85. During translation the (1)

- A. tRNA serves as a template of the DNA molecule.
- B. ribosome moves forward over two codons at a time.
- C. mRNA brings amino acids into the ribosomes.
- D. ✓ **tRNA with complementary anticodon binds on the codon of mRNA.**

Answer: D

During translation, the anticodon of a tRNA carrying a specific amino acid base-pairs with the complementary codon on the mRNA template inside the ribosome.

86. The step of scientific method which comes after analyzing results and draw conclusion is (1)

- A. doing background research.
- B. constructing hypothesis.
- C. designing and carrying out experiment.
- D. ✓ **accepting or rejecting the hypothesis.**

Answer: D

Based on the analysis of experimental data and the conclusion, a scientist determines whether to accept or reject the initial hypothesis.

87. In a group of individuals in which group A was a control and group B was an experimental group, a student gave a placebo to the control group, and an unknown drug to the experimental group. At the end, the experimental group got better. Which one of the following is true about the result? (1)

- A. ✓ **The drug has an effect.**
- B. Placebo has better effect.
- C. The experiment was wrong.
- D. Conclusion cannot be reached.

Answer: A

In a controlled experiment, comparing the experimental group (receiving the active drug) with a control group (receiving a placebo) allows researchers to determine if the drug has a real, specific therapeutic effect.

88. A biologist conducted simple experiment to investigate the effect of pH on salivary amylase. She added 5 cm^3 amylase solution into 5 cm^3 starch suspension with a neutral pH in a test tube. After ten minutes, she tested it with iodine reagent and the solution turned into blue-black color. What is the dependent variable of this experiment? (1)

- A. Applying iodine treatment
- B. pH of the solution
- C. Adding salivary amylase
- D. ✓ **Formation of blue-black color**

Answer: D

The dependent variable is the response that is measured in an experiment; in this case, the formation of the blue-black color indicates whether starch was digested by the amylase.

89. Which one of the following pairs of biological tools and their functions is FALSE? (1)

- A. Petri dish -used for culturing microorganisms
- B. Balances-used for measuring mass
- C. ✓ **Quadrat- to separate solids from liquids**
- D. Optical microscope- use beam of light to produce magnified image

Answer: C

A quadrat is an ecological tool used to isolate a standard area for studying the distribution or density of organisms, not a tool used to separate solids from liquids.

90. Grade 12 students went to a field and collected plant specimens for identification in the laboratory. They wanted to preserve the plant parts for some times and specimens can be analyzed later. Which one of the following biological tool is used for their activities? (1)

- A. ✓ **Plant press**
- B. Pitfall traps
- C. Theodolite
- D. Quadrat

Answer: A

A plant press is a biological tool used to flatten, dry, and preserve plant specimens collected in the field for long-term laboratory identification and study.

91. Some amino acids are synthesized using transamination process in the cell. This activity more describes the cell's (1)

- A. replication.
- B. catabolism.
- C. energy production.
- D. ✓ **anabolism.**

Answer: D

Anabolism refers to metabolic pathways that construct molecules from smaller units, requiring energy; the biosynthesis of amino acids through transamination is an anabolic process.

92. Identify the statement that correctly explains the factors of an enzyme activity. (1)

- A. Excessive heat breaks the ionic bonds that hold the tertiary structure of the enzyme protein.
- B. ✓ **Hydrogen ion concentration affects the ionic bonds of an enzyme.**
- C. Increasing concentration of substrates does not affect enzyme activity.
- D. Inhibitors increase enzyme activity by increasing their turnover rate.

Answer: B

Hydrogen ion concentration (pH) changes the charge of amino acid side chains, which disrupts the ionic bonds holding the tertiary structure of the enzyme. High temperatures primarily break hydrogen bonds and hydrophobic interactions rather than ionic bonds directly.

93. Which one of the following is true about allosteric regulation?

(1)

- A. Enzymes are activated when activators attached on the active site.
- B. Inhibition by competitive inhibitors when it interacts on the allosteric site.
- C. ✓ **Activation by activators when it interacts on the allosteric site.**
- D. Allosteric inhibition is occurred when inhibitors attached on the active site.

Answer: C

Allosteric regulation involves the binding of regulatory molecules (activators or inhibitors) to an allosteric site, which is a specific site on the enzyme other than the active site.

94. If an enzyme from thermophilic bacteria, which catalyses glucose 6- phosphate into fructose 6-phosphate in the process of glycolysis, is subjected to below the optimum temperature, the rate of reaction will be decreased. This is because

- A. the particles have more kinetic energy
- B. the enzyme is denatured.
- C. more collisions between enzyme and glucose 6-phosphate occurred.
- D. ✓ **less enzyme - glucose 6-phosphate complexes formed.**

Answer: D

Lowering the temperature below the optimum reduces the kinetic energy of the molecules, resulting in fewer effective collisions between the enzyme and substrate, and thus fewer enzyme-substrate complexes are formed.

95. Cyclooxygenase-2 is an enzyme that catalyzes the conversion of arachidonic acid to prostaglandins, which promote pain and fever in our body. The pain killer ibuprofen, act as non-competitive inhibitor of cyclooxygenase-2, reduces the production of prostaglandins. What would happen if the concentration of the ibuprofen increased?

(1)

- A. ✓ **Pain of the body is decreased.**
- B. Production of prostaglandin is increased.
- C. Concentration of arachidonic acid is decreased.
- D. Substrate affinity of cyclooxygenase-2 is higher.

Answer: A

Increasing the concentration of ibuprofen (an inhibitor) further reduces the activity of cyclooxygenase-2, leading to decreased production of prostaglandins and therefore a decrease in pain.

— END OF MARKING KEY —

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