SET: 1

DURATION: 2 Hours

INSTRUCTION:

1. This question paper consists of 70 multiple choice questions. Answer all questions in the answer sheet provided using only 2B pencil.
2. Read the question carefully. Shade only ONE answer for every question in the answer sheet.
3. Fill all of your personal information in the question paper and answer sheet provided.
4. DO NOT open the question paper till you are inform to do so.

NAME: 
IDENTITY CARD NUMBOR:
SCHOOL/INSTITUTION:

This question paper consists of 24 printed pages not including this cover page.
1. *E. Coli* about to replicate was placed in a medium containing radioactive thymidine for five minutes. Then it was made to replicate in a normal medium. Which of the following observation shall be correct?

A. One strand will be radioactive  
B. Both strands will be radioactive  
C. Each half of the strand will be radioactive  
D. None is radioactive

2. DNA helicase, a key enzyme for DNA replication, separates double-stranded DNA into single-stranded DNA. The following describes an experiment to find out the characteristics of this enzyme.

A linear 6 kb ssDNA was annealed with a short (300 bp) complementary ssDNA that is labeled with radioactive nucleotides (a). The annealed DNA was then treated in one of three ways: with DNA helicase, boiling without helicase, or boiled helicase. Treated DNA samples were electrophoresed on an agarose gel. The gel in b shows the DNA bands that could be detected in the gel by autoradiography. (It is assumed that the ATP energy needed for this enzyme reaction was provided during the treatment of DNA helicase).

![DNA gel experiment](image)

Which of the following explanation about this experiment is CORRECT?

A. The band appearing in the top part of the gel is the 6.3 kb ssDNA only.  
B. The band appearing in the lower part of the gel is the labelled 300 bp DNA.  
C. If the annealed DNA is treated only with DNA helicase and the reaction is complete, the band pattern looks like the lane 3 in b.  
D. If the annealed DNA is treated only with the boiling without helicase treatment, the band pattern will look like lane 2 in b.  
E. If the annealed DNA is treated only with boiled helicase, the band pattern will look like lane 1 in b.
3. As shown in the picture below, microarray was used to find genes whose expression is regulated when a plant is treated with the ABA hormone.

Which of the following explanations is FALSE about the microarray experiment?

A. All cDNAs of the expressed mRNA from both the experimental group and the control group hybridizes competitively with the corresponding genes on the DNA chip.
B. Genes whose expressions are induced by ABA appear red after hybridization.
C. Because we used different colored probes with each sample, we can measure the relative amount of genes which are expressed differentially.
D. We can only know the expression profile of genes which are included on the microarray.

4. Which treatment is most effective in breaking as many hydrogen bonds as possible in an aqueous solution (pH 7.0) of 1 mg/mL DNA and 10 mg/mL protein?

A. Addition of hydrochloric acid to make the pH 1.0.
B. Addition of sodium hydroxide solution to make the pH 13.0.
C. Heating the solution to 121°C.
D. Addition of sodium dodecyl sulfate (a detergent) to a concentration of 10 mg/mL.
5. In 1961 Mitchell proposed a highly original explanation for ATP synthesis, which he called the chemiosmotic coupling model. Which of the following is correct?

A. ATP synthesis in mitochondria can be explained by the chemiosmotic model, but in chloroplasts it cannot.
B. H⁺ ions are transferred through ATP synthase both in mitochondria and chloroplasts.
C. ATP synthesis in mitochondria and chloroplasts can be explained by the chemiosmotic model only when the concentration of H⁺ ions in the cell is higher than 0.1 mmol/L.
D. The energy source for mitochondria is electrons from nutrients, but for chloroplasts the energy source is electrons from water.

6. Nucleotide sequence duplications in a gene cause severe effects on its function in some cases while they do not in other cases. Which of the following duplication events would most likely result in the synthesis of a non-functional protein?

A. A base pair is duplicated just before the translation initiation site.
B. Three base pairs are duplicated just before the translation initiation site.
C. A base pair is duplicated in the coding region near the translation initiation site.
D. Three base pairs are duplicated in the coding region near the translation initiation site.

7. A previously unknown organism that lacks nuclear membrane and mitochondria has just been discovered. Which of the following would this organism most likely possess?

A. Lysosome
B. Endoplasmic reticulum
C. Chloroplast
D. Ribosome

8. The arabinose operon of Escherichia coli is not expressed in the absence of arabinose. This is attributable to the AraC protein, which binds to the promoter of the arabinose operon and acts as a suppressor to prevent its transcription. Normally the arabinose operon is expressed in the presence of arabinose. In mutants that lack the AraC gene, however, the arabinose operon is not expressed even in the presence of arabinose. Based on this information, which of the following can be reasonably inferred with respect to AraC?

A. The transcription of the AraC gene is induced by arabinose.
B. The transcription of the AraC gene is blocked by arabinose.
C. The AraC protein is converted into an activator in the presence of arabinose.
D. The AraC protein is degraded in the presence of arabinose.
9. How do polypeptides find their way from the site of synthesis on the cytoplasmic ribosome to the place of their destination in the peroxisome?
   A. By specific amino-terminal targeting signals.
   B. By specific transport along the cytoskeleton.
   C. By specific carboxy-terminal targeting signals.
   D. By specific vesicular transport.

10. Which of the following statements corresponds to apoptosis (Programmed Cellular Death)?
    I. Enzymes known as caspases are involved
    II. Cellular swelling and plasmatic membrane lysis are observed.
    III. The product of the tumor-suppressing gene (p53 protein) activates in response to DNA damage.
    IV. It is a process that involves loss of energy.
    A. I, II, II
    B. I, III, IV
    C. I, II, III, IV
    D. II, III, IV

11. As shown in the left-hand picture below, neuron (N) receives signals directly from two separate nerve terminals (a and c). Nerve terminal (b) is synaptically connected to nerve terminal (a). The right-hand graph shows various postsynaptic potentials recorded in neuron (N) caused by input signals from the three presynaptic terminals.

![Neuron Diagram]

I. Action potentials would be generated in neuron (N) if nerve terminals (a) and (c) were stimulated simultaneously.
II. The neurotransmitter released from nerve terminal (b) is inhibitory.
III. When nerve terminal (b) is stimulated alone, an inhibitory postsynaptic potential (IPSP) would be recorded in neuron (N).
IV. When nerve terminals (b) and (c) are stimulated simultaneously, the excitatory postsynaptic potential (EPSP) recorded in neuron (N) is smaller compared to when only nerve terminal (c) is stimulated.
12. The figure shows muscle fibers, muscle spindle, and their nerve innervations of biceps of human arm.

Nerve (a) is sensitive to the stretch of muscle fibers outside of the spindle when muscle fibers within the spindle are relaxed. Choose a case when the afferent signals in nerve (a) increase?

A. Signals in(b) are increased.
B. Signals in(c) are decreased.
C. Triceps are contracted.
D. (f) are contracted.
13. The table below shows the results of experimental tests on skin graft rejection between two different mouse strains. (Strains [A] and [B] are genetically identical except for the MHC loci.)

<table>
<thead>
<tr>
<th>Exp.</th>
<th>Skin donor mouse</th>
<th>Skin recipient mouse</th>
<th>Skin rejection</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>[A]</td>
<td>[A]</td>
<td>did not occur</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>did not occur</td>
</tr>
<tr>
<td>II</td>
<td>[A]</td>
<td>[B]</td>
<td>did not occur</td>
</tr>
<tr>
<td>III</td>
<td>[A]</td>
<td>[B] mouse which had previously received strain [A] skin</td>
<td>occurred strongly</td>
</tr>
<tr>
<td>IV</td>
<td>[A]</td>
<td>[B] mouse which has received lymphocytes from a strain-[A]-skin-grafted [B] mouse</td>
<td>occurred strongly</td>
</tr>
</tbody>
</table>

Which of the following explanations for the results is FALSE?
A. Graft rejection is considered to be the result of immune responses.
B. MHC genes are mainly responsible for the graft rejection.
C. If strain [B] skin is grafted onto mouse [A], the result would be the same as the result of Exp. II.
D. If strain [A] skin is grafted onto an offspring from a mating between [A] and [B] mice (e.g. F1, [A] x [B]), the result would be the same as that of Exp. III.

14. Which of the following statements is CORRECT concerning gas exchange organs in animals?
A. In starfish, the gill plays a role in gas exchange, but the tube feet do not play a role in that process.
B. In grasshoppers, well-developed muscles surrounding the tracheae control movement of air inward and outward through an external opening.
C. In fish, blood flows through the gill-filament capillaries in the same direction as that of water exiting from the mouth and pharynx to the outside.
D. In birds, during exhalation both air sacs deflate, forcing air to the outside, whereas the lung is filled with air.
15. Select the correct combination of the temperature regulating mechanisms activated by cold:

A. perspiration - cutaneous vessel constriction - increased breathing.
B. cutaneous vessel constriction - piloerection - increased adrenalin secretion.
C. cutaneous vessel expansion - increased breathing – shivering.
D. increased adrenalin secretion – perspiration - piloerection.

16. If the corpus luteum of a pregnant woman is removed before the eleventh week of pregnancy:

A. the pregnancy proceeds because there is no connection between the corpus luteum and pregnancy during this period of gestation.
B. the placenta has already secreted enough progesterone and estrogen to sustain the pregnancy.
C. the embryo is spontaneously aborted.
D. none of the given answers is correct.

17. The diagram shows a simplified kidney tubule and associated blood vessels, and the table shows the presence or absence of substances (X, Y, Z) in each part (1–6) of the diagram.

Identify the substances X-Z

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
</tr>
<tr>
<td>2</td>
<td>Present</td>
<td>Present</td>
<td>Present</td>
</tr>
<tr>
<td>3</td>
<td>Absent</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>4</td>
<td>Absent</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>5</td>
<td>Present</td>
<td>Present</td>
<td>Absent</td>
</tr>
<tr>
<td>6</td>
<td>Present</td>
<td>Present</td>
<td>Absent</td>
</tr>
</tbody>
</table>
18. The three embryonic layers established during gastrulation in mammals subsequently differentiate into specific tissues and organs. Select the correct pair:

A. Ectoderm – crystalline lens.
B. Mesoderm – liver.
C. Endoderm - dental enamel.
D. Mesoderm - thyroid.

19. Which one of the following statement is FALSE about intestinal villi?

A. A multitudinous finger-like projections having many microvilli
B. Increase the internal surface area of the intestinal wall
C. Supplied with capillaries and the lacteal vessels
D. Participate only in digestion of fats

20. Which of the following hormones synchronizes circadian rhythms and may be involved in onset of puberty?

A. Thyroxin
B. Melatonin
C. Thymosin
D. Thymopoietin

21. Which of the following statements about the stomatal opening is TRUE?

A. Higher \(K^+\) concentrations give guard cells a negative water potential.
B. The concentration of abscisic acid in the guard cells increases.
C. The level of carbon dioxide in the spaces inside the leaf increases.
D. Lower \(K^+\) concentrations give guard cells a negative water potential.

22. Cell walls of vessels and tracheids of vascular plants contain a phenolic polymer called "lignin", which together with cellulose confers mechanical strength to these water-conducting tissues. If vessels/tracheids are deficient in lignin, they:

A. burst outward when transpiration is very active.
B. burst outward when transpiration is very inactive.
C. collapse inward when transpiration is very active.
D. collapse inward when transpiration is very inactive.
23. To examine the effect of phytohormones P1 and P2 in plant tissue culture, leaf segments were excised from plants grown under the light, placed on medium that contained P1 and/or P2, and cultured in the dark. As a control experiment, leaf segments were cultured without P1 or P2 in the dark.

(a) When only P1 was added to the medium, adventitious roots formed on the explants.

(b) When only P2 was added to the medium, neither organogenesis nor callus formation occurred. The explants retained green color for a longer period than the explants of the control experiment.

(c) When both P1 and P2 were added to the medium, callus formed on the explants. Based on this information, P1 and P2 were:

<table>
<thead>
<tr>
<th></th>
<th>P1</th>
<th>P2</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Auxin</td>
<td>Gibberellin</td>
</tr>
<tr>
<td>B</td>
<td>Auxin</td>
<td>Cytokinin</td>
</tr>
<tr>
<td>C</td>
<td>Gibberellin</td>
<td>Auxin</td>
</tr>
<tr>
<td>D</td>
<td>Gibberellin</td>
<td>Cytokinin</td>
</tr>
</tbody>
</table>

24. An aggregate fruit such as the blackberry is originated from:

A. a set of flowers clustered in a receptacle.
B. a flower with several carpels and a syncarpous gynoecium.
C. a flower with syncarpous gynoecium and axile placentation.
D. a flower with several separated carpels
25. As depicted in the following figure, an oat seedling was germinated in the dark. A blue light was given unilaterally to the right side of the coleoptile, and an agar block containing $\text{Ca}^{2+}$ was attached to the right side of root tip below the elongation zone.

What do you expect the bending responses of the oat seedling will be in a few days

<table>
<thead>
<tr>
<th></th>
<th>Coleoptile</th>
<th>Root</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Bending towards the light.</td>
<td>Bending towards the $\text{Ca}^{2+}$ block.</td>
</tr>
<tr>
<td>B</td>
<td>Growing upright.</td>
<td>Bending towards the $\text{Ca}^{2+}$ block.</td>
</tr>
<tr>
<td>C</td>
<td>Bending away from the light.</td>
<td>Bending towards the $\text{Ca}^{2+}$ block.</td>
</tr>
<tr>
<td>D</td>
<td>Bending towards the light.</td>
<td>Growing downwards.</td>
</tr>
</tbody>
</table>
26. Which of the following combinations are present primary walls in an adult plant?

<table>
<thead>
<tr>
<th></th>
<th>Colenchyma cells</th>
<th>Fibres</th>
<th>Sieve tube member</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Sclereids</td>
<td>Colenchyma cells</td>
<td>Sieve cells</td>
</tr>
<tr>
<td>C</td>
<td>Meristematic cells</td>
<td>Tracheary elements</td>
<td>Colenchyma cells</td>
</tr>
<tr>
<td>D</td>
<td>Sieve elements</td>
<td>Meristematic cells</td>
<td>Colenchyma cells</td>
</tr>
</tbody>
</table>

27. In a plant organ, which is covered by periderm and the stomata are absent, some gaseous exchange still takes place through:

A. pneumatophore  
B. trichomes  
C. aerenchyma  
D. lenticels

28. Water will be absorbed by root hair when

A. concentration of salts in the soil is high  
B. concentration of solutes in the cell sap is high  
C. plant is rapidly respiring  
D. they are separated from soil by a permeable membrane

29. In CAM plants, CO2 required for photosynthesis enters the plant body during

A. Daytime through the lenticels  
B. Night when the hydathodes are open  
C. Daytime when the stomata are open  
D. Night through the stomata which are kept open

30. The part of the flower that produces pollen is the

A. anther  
B. ovary  
C. carpel  
D. petal
31. Mating of *Recurvirostra avosetta*, a wading bird, is preceded by some peculiar movements. Both male and female clean their feathers nervously. After some time, the female takes a horizontal position (see picture) and this triggers the male to copulate. The horizontal position of the female corresponds to:

![Bird](image)

A. a conditioned reflex.
B. a displacement activity.
C. an innate response.
D. a sign stimulus.

32. Fixed action patterns (FAPs) are important components of behaviour. Which statement about the fixed action patterns is FALSE?

A. They are highly stereotypical, instinctive behaviours
B. FAPs diminish the adaptive significance of behaviour
C. FAPs are triggered by sign stimuli in the environment, and once begun, are continued to completion
D. A supernormal stimulus often produces a stronger response

33. Meerkats (*Suricata suricatta*) often have one standing guard to warn while the rest feed in case of predator attack. This is an example of:

A. agonistic
B. Territory
C. Hierarchy
D. Altruism

34. The armadillo commonly known as mataco or ball quirquincho (*Tolypeutes mataco*) adopts, sometimes, a typical position similar to a "ball" as you can see in the following figure; hence its name. In these cases, they draw in their feet and nose causing the exoskeleton plates of the body and head to fit tightly to each other.

A. sure hiding place.
B. food source.
C. possible predator.
D. companion or a baby.
35. Courtship behaviors in animals involve:

A. visual cues  
B. acoustic signal  
C. chemical signal  
D. all of the above

36. Eusocial honeybees have a specific system of sex determination. Females are diploid (2n) and develop from fertilized eggs; males are haploid (n) and develop from unfertilized eggs. Assuming that the queen copulated with a single male, which of the following is/are most likely true for this social group?

I. The males have mothers but not fathers.  
II. A female should foster her brothers to increase her inclusive fitness rather than trying to increase her direct reproduction.  
III. It is advantageous to females' (workers”) fitness if the queen produces sons and daughters in equal proportions.  
IV. A female should remove the eggs of other females (workers) from the nest to increase her fitness.

A. Only I and II  
B. Only I and III  
C. Only I and IV  
D. Only II and III

37. Which of the following descriptions is NOT an example of social learning?

A. chimpanzees using stones to crack nuts  
B. mate choice copying in guppies  
C. alarm calls of vervet monkeys  
D. garter snakes from coastal areas eating slugs

38. In operant conditioning,

A. an animal improves its performance of a fixed-action pattern  
B. an animal learns as a result of associating a benefit or harm with an action  
C. an animal learns a behavior by watching others  
D. a bird can learn the song of a related species if it hears only that song
39. A female cat in heat urinates more often and in many places. Male cats congregate near the urinedeposits and fight with each other. Which of the following would be an ultimate cause of the male cats' response to the female's urinating behavior?

A. The males have learned to recognize the specific odor of the urine of a female in heat.
B. When the males smelled the odor, various neurons in their brains were stimulated.
C. Responding to the odor means locating reproductively receptive females.
D. Male cats' hormones are triggered by the odor released by the female.

40. A guinea pig loves the lettuce kept in the refrigerator and squeals each time the refrigerator door opens. What term best applies to this behavior?

A. Classical conditioning
B. Operant conditioning
C. Imprinting
D. Sign stimulus

41. Two male specimens of the rodent Akodon molinae belonging to the same population were analyzed cytogenetically: One of them had 43 and the other 42 chromosomes. The Fundamental Number (number of chromosome arms in a somatic cell) was 44 in both of them. This may be due to:

A. Robertsonian translocation
B. chromosome loss.
C. an inversion.
D. polyploidy.

42. Which of the following statements is NOT true with respect to an X-linked recessive inheritance?

A. It affects mainly males.
B. There is no male-to-male transmission in the pedigree.
C. Females may be affected if the father is affected and the mother is a carrier.
D. It affects either sex, but females are more affected than males.
43. Some fruit flies (Drosophila melanogaster) have a mutation that makes them shake. These fruit flies are called „shakers”.

An experimental cross is shown below:

\[
\begin{align*}
P & \text{ a shaker male } (\sigma) \times \text{ a normal homozygous female } (\varphi) \\
F_1 & \text{ All males were normal.} \\
& \text{ All females were shakers.} \\
F_2 & F_1 \times F_1 \\
& 136 \text{ shaker males, 131 normal males} \\
& 132 \text{ shaker females, 137 normal females}
\end{align*}
\]

What kind of inheritance best explains the inheritance pattern for the shaker gene?

A. Somatic dominant.
B. Somatic recessive.
C. X-linked dominant.
D. X-linked recessive.

44. You carry out a cross between homozygous purple-eyed flies with vestigial wings, and wild-type flies. The resulting F₁ flies are all phenotypically wild-type. In the progeny of the testcross of F₁ females you observe the following phenotypes:

<table>
<thead>
<tr>
<th>Phenotype</th>
<th>Progeny</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purple-eyed, vestigial wings</td>
<td>1193</td>
</tr>
<tr>
<td>Purple-eyed, normal wings</td>
<td>159</td>
</tr>
<tr>
<td>Red-eyed, vestigial wings</td>
<td>161</td>
</tr>
<tr>
<td>Red-eyed, normal wings</td>
<td>1129</td>
</tr>
</tbody>
</table>
What is the map distance between these two loci?

A. 12.2 map units.
B. 48.2 map units.
C. 6.2 map units.
D. 24.4 map units.

45. In cats, there is a genetic locus with two alleles (A, a). In a population, 1300 cats have genotype AA, 7400 are heterozygous and 1300 individuals carry the recessive genotype aa. What is the allele frequency of allele A in the population?

A. 0.87
B. 1.0
C. 0.5
D. 0.25

46. What's the difference between genetic drift and change due to natural selection?

A. Genetic drift does not require the presence of variation.
B. Genetic drift does not involve competition between members of a species.
C. Genetic drift never occurs in nature, natural selection does.
D. There is no difference.

47. Which of the following is evidence for Darwin's theory of common descent?

I. There are patterns in the fossil record that suggest other species have diverged from a single ancestor species.
II. There are biogeographic patterns in the distribution of species, for instance distinct bird species on an island tend to resemble one another, suggesting a common ancestor.
III. There are common stages in the early embryological development of organisms representing several distinct vertebrate groups.
IV. Anatomical structures, such as forelimbs, in different groups appear to be modified versions of structures that might have been present in a common ancestor.

A. I, II, III only
B. I, III, IV only
C. II, III, IV only
D. I, II, III, IV
48. How might an evolutionary biologist explain why a species of species of salamander becomes blind after colonizing a cave?

A. There could be a source of pollution in the cave that increases the mutation rate for a gene that makes salamanders blind. Over time, due to exposure to this chemical, the members of the population lose their sight.

B. Members of the ancestral population that colonized the cave differed in their ability to see. If maintaining the ability to see in the cave was a waste of energy, blind salamanders might actually have more offspring than those who could see.

C. There is no way to explain this in terms of natural selection.

D. The members of this salamander species no longer needed to use their eyes. Over time, due to lack of use, they lost the ability to see.

49. Stabilizing selection acts to ________ in a species' population.

A. maintain a certain phenotype

B. alter traits

C. push for directional change

D. elaborate new traits

50. Which of the following represents a testcross?

A. Ww x Ww

B. WW x Ww

C. WW x ww

D. None of the above

51. In the photic zone of freshwater and marine environments, where light penetrates, cyanobacteria are found in the upper part of the zone, and purple and green bacteria are in the lower part of the zone. Which of the following statements best explains the vertical distribution of the photosynthetic bacteria?

A. Green and purple bacteria are anaerobic, while cyanobacteria are aerobic.

B. Green and purple bacteria are better able to use light wavelengths that cyanobacteria do not use as efficiently.

C. Habitat isolation develops due to competition for nutrient and oxygen.

D. Cyanobacteria are better able to use oxygen as an electron donor for photosynthesis.
52. The following figure shows nitrogen cycling in an ecosystem. Numbers I~V represent different chemical conversion steps in the cycle.

Which process (I ~ V) is CORRECTLY paired with the organismal group performing that step?

A. I-photoautotrophs.
B. II-bacteria symbiotic with plants.
C. III- anaerobic bacteria living in conditions such as wetland ecosystem.
D. IV-eukaryotic organisms.

53. Organic matter decomposition depends in part on climatic factors such as temperature and precipitation. In the following schemes, the distribution of nitrogen in mulch, root, and soil for six different biomes is shown. Which biome is represented in each of the following figures: I, II, and III?
A. I= Tundra, II= Temperate deciduous forest, III= Tropical deciduous forest.
B. I= Tropical deciduous forest, II= Tundra, III= Temperate deciduous forest.
C. I= Temperate deciduous forest, II= Tropical deciduous forest, III= Tundra.
D. I= Tundra, II= Temperate deciduous forest, III= Tropical evergreen forest.

54. Which of the following statements are CORRECT?

I. The amount of nitrogen in living organisms is very small compared to the total quantity in the atmosphere.
II. Less than 30% of the nitrogen available for plants comes from nitrogen-fixing bacteria or algae.
III. The gaseous nitrogen cycle is global because it implies an exchange between the ecosystem and the atmosphere.
IV. The nutrient cycles can be studied introducing radioactive markers in natural or artificial ecosystems.

A. I; II; and IV.
B. II; III; and V.
C. I; III; and IV.
D. I, II, III; IV;

55. The following graph shows the relationship between the frequency or strength of disturbance and species diversity.

Which of the following statements is FALSE?

A. The low species diversity of community (a) is due to the presence of dominant species in the community.
B. The degree of competitive exclusion among species is highest in community (b).
C. In community (c), species diversity is low because there is not enough time between disturbances for a wide variety of species to colonize.
D. In community (c), late successional species will be replaced rapidly by early successional species.
56. A male guppy (*Poecilia reticulata*) with large, bright spots on the body is more likely to attract females, which increases his opportunity to reproduce. In the meantime, he is also more easily detected by the natural enemy, which increases his predation risk. Consider male guppies from three different rivers: X, Y and Z, males from X have the largest spots, males from Y have the intermediate-sized spots, and males from Z have the smallest spots. Which of the following descriptions about the guppies in the three rivers is correct? The density of

A. male guppies in X is higher than in the other rivers  
B. male guppies in Z is higher than in the other rivers  
C. natural enemy of guppies in X is higher than in the other rivers  
D. natural enemy of guppies in Z is higher than the other rivers

57. Species M had been introduced multiple times to an ecosystem outside its native distribution, but could not establish itself. Although no parameter in ecosystem changed between the different attempts, the final one introduction was eventually successful, and led to a rapid and wide-spread expansion of species M in the ecosystem. Which of the followings is the MOST plausible explanation for why species M was not natively distributed in this ecosystem?

A. There are too many competitors of species M in the ecosystem  
B. There are too many predators of species M in the ecosystem  
C. Species M is not able to disperse to the ecosystem on its own  
D. The abiotic environment in the ecosystem is not suitable for the growth of species M

58. Which factor most promotes the stability of population dynamics in a developed terrestrial ecosystem?

A. Food webs that have many trophic levels each of which consists of few species only  
B. A few species of producers with very high production rates  
C. Rapid nutrient recycling by active decomposers  
D. Food webs that have very few trophic levels and limited niche overlaps

59. In the same way as a population, a community shows several properties. Which of the following characteristics correspond to the community level?

A. Species diversity, dominance, relative abundance, and trophic webs.  
B. Species diversity, stratification, relative abundance of females, and trophic webs.  
C. Species diversity, age distribution, deaths of individuals, and trophic webs.  
D. Cohorts diversity, dominance, age distribution, and trophic webs.
60. A typical biomass pyramid is represented in the figure below.

If A represents a primary producer, then E is likely to be a

A. photo-litho-heterotroph  
B. chemo-organo-heterotroph  
C. chemo-litho-autotroph  
D. photo-organo-heterotroph

61. Which of the following statements about speciation is CORRECT?

A. Sympatric speciation occurs more gradually and more slowly than allopatric speciation.  
B. The divergence of two maggot fly races is an example of allopatric speciation due to mating time differences.  
C. The evolution of cultivated wheat is associated with polyploidization. This is an example of sympatric speciation.  
D. Allopatric speciation is usually associated with stronger secondary reproductive barriers than sympatric speciation.

62. Development in marine molluscs may be characterized by:

A. trochophore larva only.  
B. trochophore and veliger larva.  
C. direct development without larval state.  
D. all of them are correct.
63. Observe the following diagrams of invertebrates embryos illustrating the characteristics of the body plan.

Select the correct sequence which corresponds to the Phyla represented with I, II, III, IV and V.

<table>
<thead>
<tr>
<th>Cross</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transversal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Longitudinal</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Diploblastic</th>
<th>Triploblastic</th>
</tr>
</thead>
<tbody>
<tr>
<td>No coeloms</td>
<td>pseudocoeloms</td>
</tr>
<tr>
<td>Incomplete or blind gut</td>
<td>Complete gut (Tube-within-a-tube)</td>
</tr>
<tr>
<td>Without segmentation</td>
<td>With segmentation (metameric)</td>
</tr>
</tbody>
</table>

Select the correct sequence which corresponds to the Phyla represented with I, II, III, IV and V.

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Cnidaria</td>
<td>Plathyhelmintha</td>
<td>Annelida</td>
<td>Nematoda</td>
<td>Arthropoda</td>
</tr>
<tr>
<td>B.</td>
<td>Cnidaria</td>
<td>Plathyhelmintha</td>
<td>Nematoda</td>
<td>Arthropoda</td>
<td>Annelida</td>
</tr>
<tr>
<td>C.</td>
<td>Nematoda</td>
<td>Arthropoda</td>
<td>Plathyhelmintha</td>
<td>Cnidaria</td>
<td>Annelida</td>
</tr>
<tr>
<td>D.</td>
<td>Annelida</td>
<td>Cnidaria</td>
<td>Arthropoda</td>
<td>Plathyhelmintha</td>
<td>Nematoda</td>
</tr>
</tbody>
</table>
64. The following figure shows a hypothetical evolutionary tree of species a~e along with the variability between pairs of these species.

Choose a statement that is CORRECT

A. Species variation shows a linear relationship to evolutionary time.
B. The species pair a - b and the pair c - d shows sister group relationship.
C. The tree contains three monophyletic groups.
D. Species a can be used as an outgroup for the other four species.

65. What do scientists use to apply cladistics?

A. homologous traits
B. homoplasies
C. analogous traits
D. monophyletic groups

66. What is true about organisms that are a part of the same clade?

A. They all share the same basic characteristics.
B. They evolved from a shared ancestor.
C. They usually fall into the same classification taxa.
D. They have identical phylogenies.

67. Which of the following pairs does not show a monophyletic group - paraphyletic group relationship?

A. Monocots - Dicots
B. Tetrapods - Bony fishes
C. Echinoderms - Chordata
D. Birds - Reptiles
68. The following characteristics correspond to: unicellular organisms, eukaryotic cell with micronuclei and macronuclei, asexual reproduction by transverse binary fission and sexual reproduction by conjugation. Most are free-living.

A. Rhizopoda  
B. Apicomplexa  
C. Zoomastigophora  
D. Ciliophora

69. The Orchidaceae family presents:

A. superior ovary, three-carpellate, one loculed ovary  
B. showy labellum, pollen grains united in a mass  
C. plants with terrestrial habitat only  
D. androecium with two whorls of stamens of six stamens each

70. Which one of the following animals is correctly matched with its particular named taxonomic category?

A. Cuttlefish - Mollusca, a class  
B. Tiger - Tigris, the species  
C. Housefly - Musca, an order  
D. Humans - primates, the family

END OF QUESTION PAPER