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## Theoretical test

YOU HAVE FOUR HOURS TO ANSWER ALL THE QUESTIONS

Questions in part **A** have only one correct answer which should be shown by marking (blacking out) the appropriate field in the answer list.

You' ll get one point for every correct answer in part **A**

For questions in part **B** you'll have to fill in the correct answers in the appropriate fields, build graphs, etc

The number of points you'll get for the part **B** questions varies, depending on the complexity of the question

**GOOD LUCK !**

## Part A

Find the one correct answer in each task and mark it **in the answer sheet** in this way

**The jury will check only the answer sheet!**

### Cell Biology

**A1.** In which processes microtubules could be involved?

	Beating of cilia and flagella	Movements of chromatids	Osmoregulation	Movement of organelles in living cells
<b>A.</b>	+	+	+	-
<b>B.</b>	+	-	-	-
<b>C.</b>	+	+	-	+
<b>D.</b>	-	-	+	-
<b>E.</b>	-	+	+	+

**A2.** Which of the following is an example of microfilament motion in nonmuscular animal cells?

- A. *Rigor mortis*
- B. Flagellar movement
- C. Cytokinesis
- D. Chromosome movement during meiosis
- E. Beating of cilia

**A3.** When or where it is possible to observe nucleolus?

- A. During meiosis
- B. In senescent plant cells
- C. During apoptosis
- D. In senescent animal cells

E. During the elongation of plant cells

A5. Which statement about actin microfilaments is correct?

- A. They are found only in animal muscle cells and involved in the contractions of sacromeres
- B. They are involved in the formation of the cell cleavage furrow in plant and animal cells
- C. They are found only in plant cells and involved in the movement of chloroplasts
- D. They are found in plant and animal cells and involved in the movement of vesicles
- E. They are found in all eukaryotic cells and involved in the movement of pyruvate from cytosol to mitochondrial matrix

A6. Which statement about genetic material is **incorrect**?

- A. There are viruses possessing genomes, built of RNA
- B. There are cell organelles possessing their own RNA genomes
- C. In the cells of bacteria genetic material may persist in extrachromosomal form
- D. Genetic material of eukaryotes is made of DNA
- E. Admission of foreign DNA in a cell is not necessarily lethal for the cell, especially in the case of eukaryotic cell

**A7.** Which of the following is **not** the metabolic role of tricarboxylic acid (TCA) cycle?

- A. Completion of carbohydrates oxidation
- B. Supply of metabolic precursors for biosynthesis of some amino acids
- C. Supply NADH for the respiratory chain
- D. Supply NADPH for biosynthetic reactions
- E. Production ATP or GTP

**A8.** Which statement about the chemiosmotic theory is **not** correct?

- A. While electrons in the electron transport chain are passing through the transporters located on the inner membrane of mitochondria, protons are pumped out of the matrix by the respiratory complexes I, III and IV
- B. This theory explains coupling between oxidation and phosphorylation
- C. The protons return to the mitochondrial matrix through the proton-dependent ATP synthase
- D. This theory is valid for forming of ATP in photosynthetic electron transport chains
- E. The respiratory proton transport is driven by conformational oscillations of the energy-coupling membrane bilayer

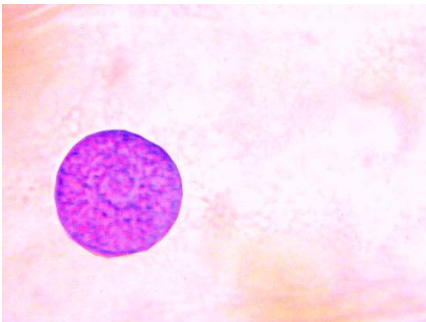
**A9.** Which three amino acids can be formed directly in one step from the following metabolic intermediates: pyruvate, oxaloacetate and  $\alpha$ -ketoglutarate ?

	<b>Pyruvate</b>	<b>Oxaloacetate</b>	<b><math>\alpha</math>-ketoglutarate</b>
<b>A.</b>	Alanine	Aspartate	Glutamate
<b>B.</b>	Lysine	Asparagine	Glutamine
<b>C.</b>	Serine	Arginine	Tyrosine
<b>D.</b>	Threonine	Glycine	Tryptophan
<b>E.</b>	Histidine	Proline	Leucine

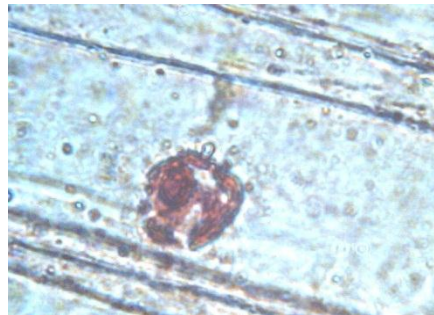
**A 10.** How many different primary structures approximately may represent a 10 residues long polypeptide, which is a random combination of 20 naturally occurring amino acids?

- A. 10
- B. 200
- C. 40 00
- D. 10 000 000 000 000
- E. 100 000 000 000 000 000 000

**A 11.** Apoptotic cell undergoes a series of changes including membrane blebbing, fragmentation of DNA creating a vacuolar nucleus and following fragmentation of nucleus forming micronuclei. Researchers used onion cells to study the cell death. Which picture corresponds to cell with nuclear fragmentation?



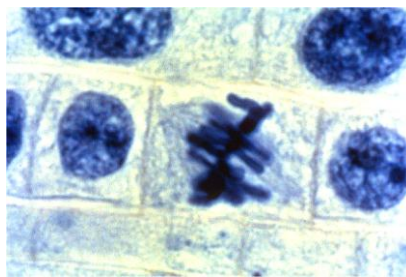
A



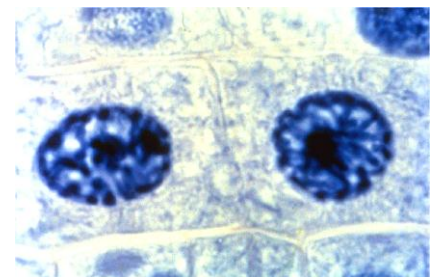
B



C



D



E

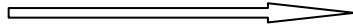
A 12. What is the correct sequence of events during immunological responses to viral infection?

Code

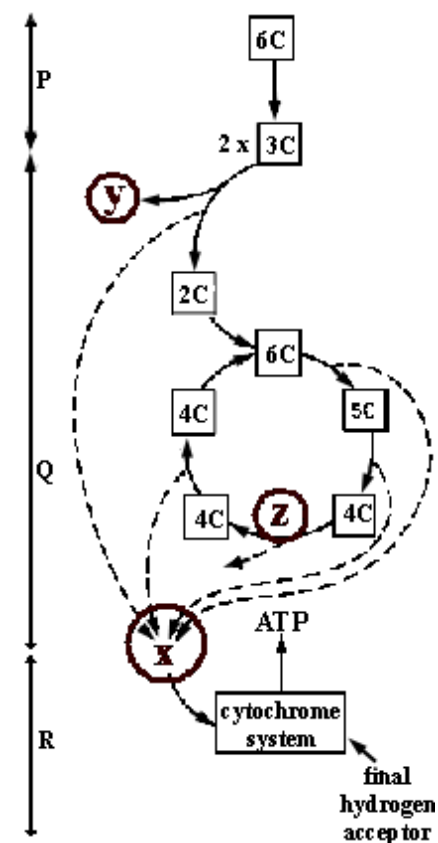
1. Natural killer cell activation
2. Antibody production
3. Cytotoxic T cell activation

Virus invasion

Time



- |    |   |   |   |   |
|----|---|---|---|---|
| A. | 4 | 2 | 3 | 1 |
| B. | 1 | 4 | 3 | 2 |
| C. | 3 | 2 | 1 | 4 |
| D. | 4 | 1 | 3 | 2 |
| E. | 4 | 3 | 2 | 1 |



A 13. The diagram shows a simplified scheme of three stages (P, Q and R) of aerobic respiration.

What substances are X, Y, Z?

	X	Y	Z
A.	Acetyl CoA	NADH <sub>2</sub>	Lactic acid
B.	Water	CO <sub>2</sub>	Dehydrogenase
C.	NADH <sub>2</sub>	CO <sub>2</sub>	Dehydrogenase
D.	NADH <sub>2</sub>	Water	Peroxidase

<b>E.</b>	Pyruvate	CO <sub>2</sub>	NADH <sub>2</sub>
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**A 14.** Some genes in the genome of bacteria are organised in operons. Which statement about such operons is correct?

- A.** Genes of the operon are arranged in mosaic structures of introns and exons
- B.** Translation of all genes of one operon starts at the same initiation codon
- C.** All genes of the same operon are not expressed simultaneously
- D.** Proteins encoded in the genes of the same operon are translated from one common mRNA molecule
- E.** Translation of all genes from the same operon is terminated at the same common STOP codon

**A 15.** Which of the given components is **not** needed for DNA replication *in vivo*?

- A.** Single stranded DNA template
- B.** Deoxy-nucleoside monophosphates (dAMP, dCMP, dGMP, dTMP)
- C.** RNA polymerase – primase
- D.** Single-strand DNA binding proteins
- E.** DNA polymerase

**A 16.** For numerous groups of organisms genes are split in exons and introns. Which statement about gene expression is correct?

- A.** The genetic information of only some introns is used for synthesis of proteins
- B.** A separate promoter induces the transcription of each exon
- C.** During RNA processing the sequences of introns are removed as a result of splicing of the pre-mRNA
- D.** Translation of each exon starts with its own initiation codon (AUG)
- E.** During the translation ribosomes are jumping over the intronic part of mRNA





**A 17.** Human hormone insulin is synthesised as pre-protein and modified before secretion in extracellular space. It contains two polypeptide chains. Which statement about these chains is correct?

- A.** They are synthesised on cytosolic ribosomes and modified in Golgi apparatus
- B.** They are synthesised on ER ribosomes and modified in Golgi apparatus
- C.** One chain is synthesised on cytosolic ribosomes, another on ER ribosomes and modified in cytosol and Golgi apparatus
- D.** They are synthesised on cytosolic ribosomes and modified in the lumen of lysosomes
- E.** They are synthesised on cytosolic ribosomes and modified in cytosol

**A 18.** Which statement regarding the amount of genomic DNA per cell ( $M$ ) during the cell cycle is correct?

- A.**  $M_{\text{DNA}}[\text{G}_1] = M_{\text{DNA}}[\text{meiosis prophase II}]$
- B.**  $M_{\text{DNA}}[\text{meiosis prophase II}] = 2 \times M_{\text{DNA}}[\text{meiosis prophase I}]$
- C.**  $M_{\text{DNA}}[\text{G}_1] = M_{\text{DNA}}[\text{G}_2]$
- D.**  $M_{\text{DNA}}[\text{G}_2 \text{ after mitosis}] < M_{\text{DNA}}[\text{G}_2 \text{ after meiosis}]$
- E.**  $M_{\text{DNA}}[\text{telophase of mitosis}] > M_{\text{DNA}}[\text{telophase I of meiosis}]$

## Plant Anatomy and Physiology

**A 19.** Which of the following is closer to the centre of a woody stem?

- A. Vascular cambium
- B. Primary phloem
- C. Secondary phloem
- D. Secondary xylem
- E. Primary xylem

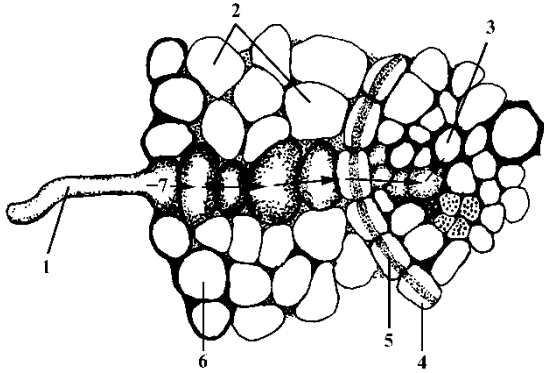
**A 20.** Carnivorous plants trap insects. What do they obtain from the insects? What do they primarily use this substance for?

- A. They obtain water, because they live in a dry environment
- B. They obtain nitrogen to make sugar
- C. They obtain phosphorus to make protein
- D. They obtain sugars, because they can't produce enough in photosynthesis
- E. They obtain nitrogen to make protein

**A 21.** The diameter of woody stems is continually increasing. What structure ensures that there is always enough bark to cover the outside of the stem?

- A. Vascular cambium
- B. Epidermis
- C. Phellogen
- D. Endodermis
- E. Pericycle

**A 22.** The drawing shows a cross-section of a plant root. The lines (1-6) indicate parts and the arrow (7) indicates a pathway in the root. Which of the statements (A-E) provides a correct explanation of the drawing?



- A.** 1 – trichome, 2 – cortex, 3 – phloem, 4 – pericycle, 5 – endodermis, 6 – epidermis,  
7 – pathway of water and sugars
- B.** 1 - root hair, 2 – cortex, 3 – xylem, 4 – endodermis, 5 – Casparian strip, 6 - epidermis,  
7 – pathway of water and minerals
- C.** 1 - root hair, 2 – cortex, 3 – xylem, 4 – Casparian strip, 5 -pericycle, 6 – epidermis,  
7 – pathway of water and minerals
- D.** 1 – root hair, 2 – periderm, 3 – phloem, 4 – endodermis, 5 – Casparian strip,  
6 – epidermis, 7 – pathway of phytohormones
- E.** 1 – root hair, 2 – endodermis, 3 – xylem, 4 – epidermis, 5 – Casparian strip, 6 - periderm,  
7 – pathway of water and minerals

**A 23.** Which cell is **incorrectly** paired with its tissue?

- A.** Root hair – dermal tissue
- B.** Palisade parenchyma – ground tissue
- C.** Guard cell – dermal tissue
- D.** Companion cell – excretory tissue
- E.** Tracheid – vascular tissue

**A 25.** A plant biochemist received a specimen from a fellow scientist who noticed that the plant's stomates are closed during the day. The biochemist observed that radioactive carbon in the form of carbon dioxide, fed to the plant at night, was first found in organic acids that accumulate in the vacuole. During the day it moved to sugars being manufactured in the chloroplast. What was the conclusion of the biochemist?

- A.** The plant fixes carbon by crassulacean acid metabolism (CAM)
- B.** The plant is a C<sub>4</sub> plant
- C.** The plant is a C<sub>3</sub> plant
- D.** The plant is using mitochondria as chloroplasts
- E.** The carbon fixation reactions occur in different cells

**A 26.** Red algae grow at depths beyond those to which red and blue light can penetrate in the ocean. What could account for this?

- A.** Red algae have accessory pigments that absorb wavelengths of light available at these depths
- B.** Red algae use infrared energy to power photosynthesis
- C.** Red algae have a more efficient light-absorbing system for red and blue light
- D.** Red algae are heterotroph organisms
- E.** The "red algae" must be identified incorrectly

**A. 27.** Sections are cut from a willow branch and planted in pots of soil in a greenhouse with the shoot end of the section exposed and the root end in the soil. Roots sprout from the root end and shoots sprout from the shoot end. Which statement about the sections is true?

- A.** The sections lacks the property of polarity
- B.** The concentration of auxin in the sections is the same in all their length
- C.** The root end will produce shoots
- D.** Dedifferentiation will be the first step in the process of root and shoot formation

E. The root end has special structures forming roots which the shoot ends lack

**A 28.** Plants have developed many adaptations to maximize the benefits of available water.

Which of the following is one of these adaptations?

- A. Reorientation of leaves in order to increase leaf temperature
- B. Decreasing the amount of water lost for each gram of fixed carbon
- C. Increasing the leaf surface area
- D. Decreasing the thickness of the cuticle
- E. Growing more leaves during drought

**A 29.** You need pears for a large party after three days but they are not ripe enough to use.

What is the best way to hasten the ripening process?

- A. To place the pears in the dark
- B. To place the pears in a refrigerator
- C. To place the pears on the windowsill
- D. To place the pears in brown paper bags together with ripe apples

## Animal Anatomy and Physiology

**A 30.** Which statements concerning human respiratory muscles are true?

1. During inspiration, the external intercostal muscles contract and the diaphragm moves downwards
2. Internal and external intercostal muscles act in inspiration, and the diaphragm acts only in expiration
3. During inspiration, only the internal intercostal muscles contract and the diaphragm moves downwards
4. During expiration external intercostal muscles contract and the diaphragm moves downwards
5. During gentle expiration, the thorax passively contracts, and then deep expiration can be finished by contraction of the internal intercostal muscles
6. During inspiration, the internal intercostal muscles contracts and then strong inspiration can be finished when the diaphragm moves upwards

- A. 2 and 4
- B. 1 and 5
- C. 4 and 6
- D. 3 and 5
- E. 2 is the only correct answer

**A 31.** Which of the following are characteristics for animals with an open circulatory system?

- A. Haemoglobin, haemocoel, lymph
- B. Haemocyanin, haemocoel, haemolymph
- C. Haemoglobin, absence of haemocoel, haemolymph
- D. Haemocyanin, absence of haemocoel, lymph
- E. Haemocyanin, haemocoel, lymph

**A 32.** Which metabolic changes in the cytoplasm of skeletal muscle cells are characteristic of skeletal muscle fatigue?

1. Increase of creatine phosphate concentration
2. Decrease in the amount of glycogen
3. Increase of H<sup>+</sup> - ion concentration
4. Increase of ATP concentration
5. Decrease in lactate concentration

- A. 1 and 2
- B. 1 and 4
- C. 2 and 3
- D. 4 and 5
- E. 3 and 4

**A 33.** Which of the following is characteristic for a physically trained person in comparison with an untrained person?

- A. The heart rate can reach a higher level
- B. Stroke volume is greater
- C. The activity of vagus nerve (*nervus vagus*) is lower
- D. Mechanical resistance of blood vessels is higher
- E. Left ventricular and diastolic volume is smaller



**A 34.** Which statements regarding the differences of a compound eye compared with a vertebrate's eye is **not** correct?

1. Has chromatic aberration
2. The absorption of ultra-violet radiation is lesser
3. Acuity of vision (visus) is lesser
4. The ability to detect movement is lesser
5. The visual field is wider

- A. 1 and 5
- B. 2 and 3
- C. 1 and 4
- D. 4 and 5
- E. 2 and 5

**A 35.** Which statement concerning a laboratory animal (white mouse) that lacks a thymus gland congenitally is true?

- A. Cellular immunity does not develop and the antibody synthesis is impaired
- B. Only humoral immunity does not develop
- C. Only cellular immunity does not develop
- D. The immune system is not affected
- E. This animal is resistant to viral infections but sensitive to bacterial infections

**A 36.** The numbers in the first column correspond to human, elephant, bat, mouse and carp.

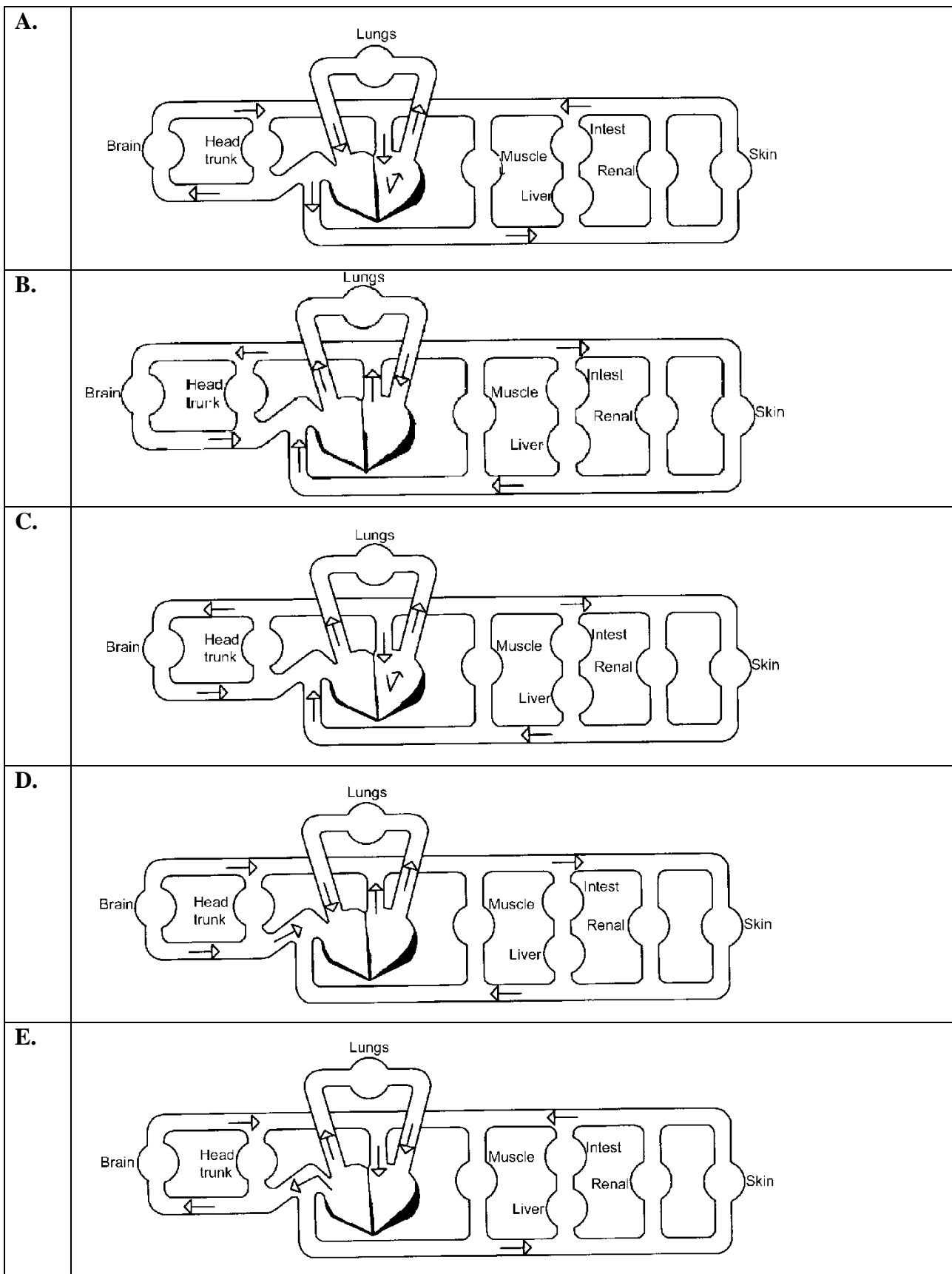
Which number indicates each organism?

<b>Number</b>	<b>Body temperature (°C)</b>	<b>Heart rate (beats/min)</b>	<b>Maximal speed of locomotion (m/s)</b>
<b>1</b>	1-30	30-40	1.5
<b>2</b>	38	450-550	3.5
<b>3</b>	31	500-660	14
<b>4</b>	36.2	22-28	11
<b>5</b>	36.6	60-90	10

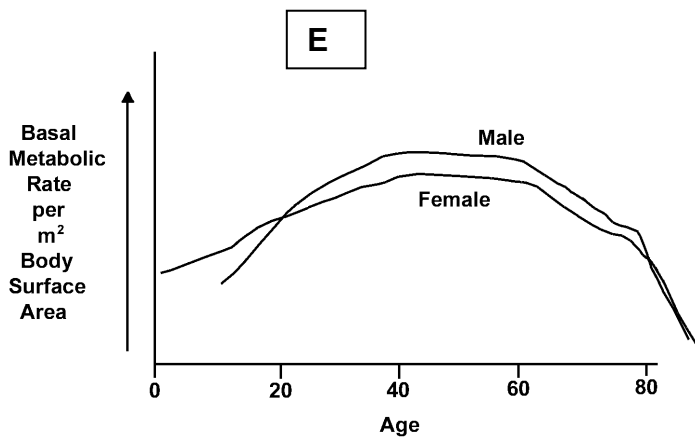
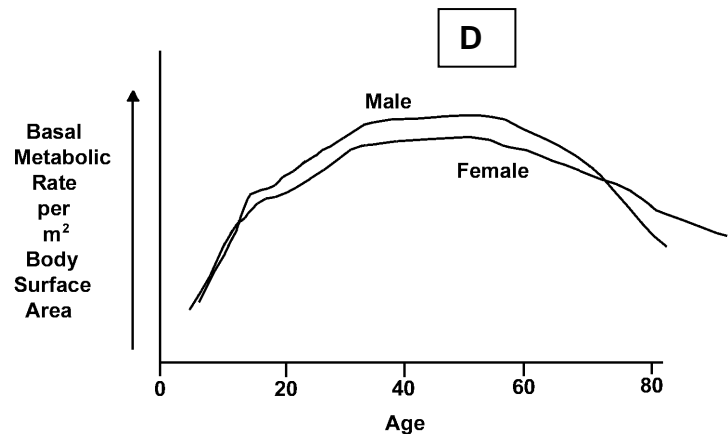
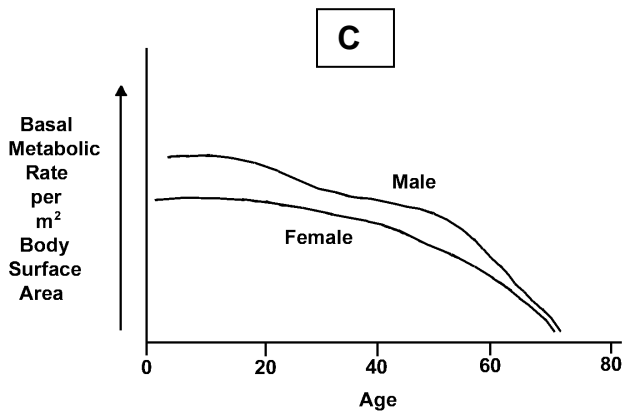
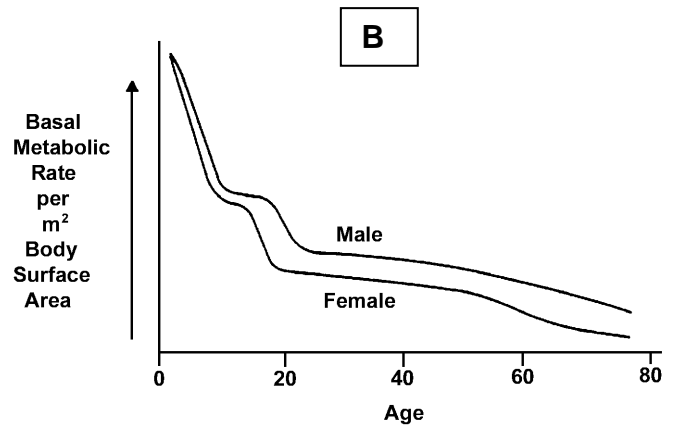
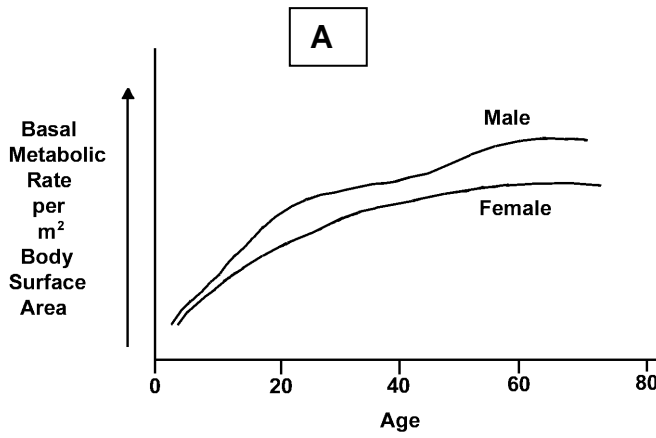
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>A.</b>	Human	Elephant	Bat	Mouse	Carp
<b>B.</b>	Mouse	Bat	Elephant	Human	Carp
<b>C.</b>	Carp	Mouse	Bat	Elephant	Human
<b>D.</b>	Carp	Mouse	Elephant	Bat	Human
<b>E.</b>	Bat	Mouse	Carp	Human	Elephant



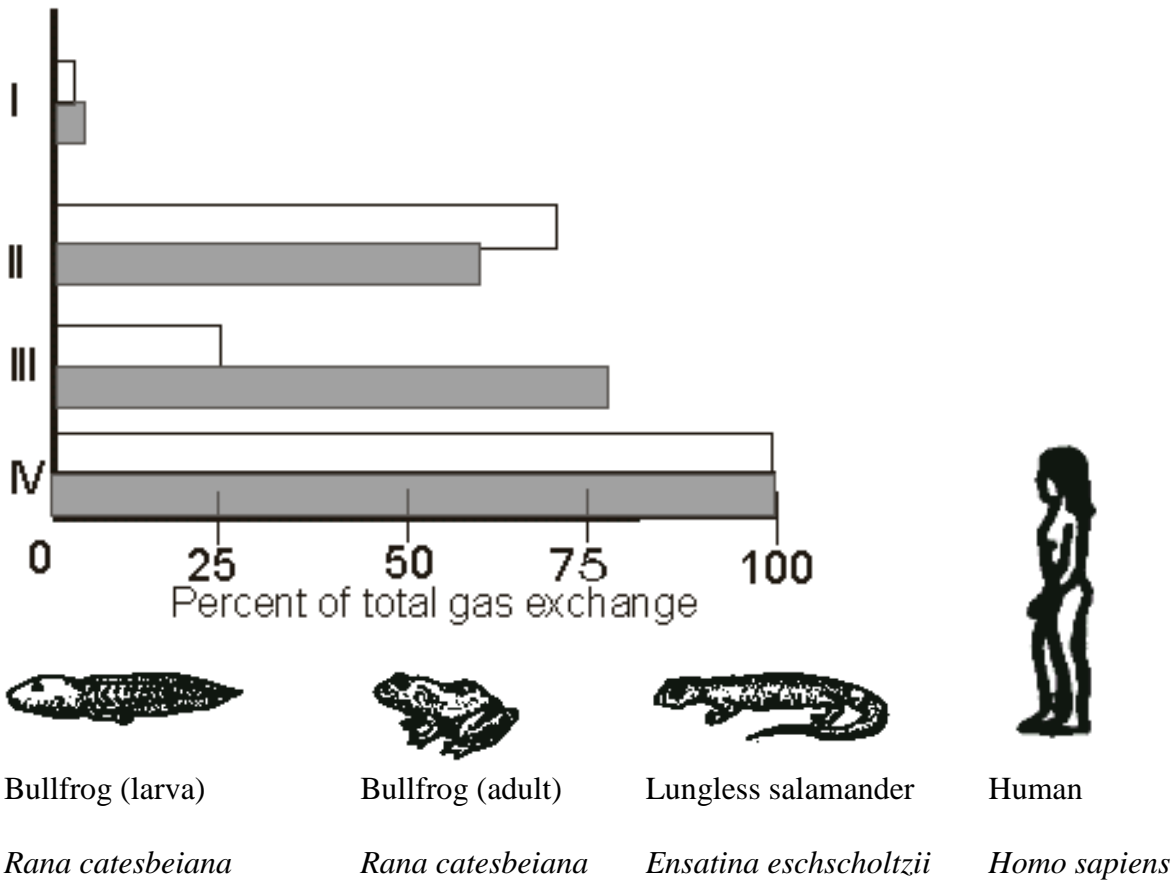
A 38. Which figure shows the correct blood flow direction in a human?



A 39. Which of the figures shows the correct relations between basal metabolic rate per  $m^2$  body surface area and age (in years) of human male and females?



**A 40.** The Figure shows cutaneous respiration among different vertebrates: excretion of carbon dioxide (solid bars) and uptake of oxygen (open bars). Which of the version about cutaneous respiration is true?



	I	II	III	IV
<b>A.</b>	Bullfrog (larva)	Bullfrog (adult)	Lungless salamander	Human
<b>B.</b>	Human	Bullfrog (adult)	Bullfrog (larva)	Lungless salamander
<b>C.</b>	Lungless salamander	Bullfrog (larva)	Bullfrog (adult)	Human
<b>D.</b>	Bullfrog (adult)	Bullfrog (larva)	Lungless salamander	Human
<b>E.</b>	Bullfrog (adult)	Human	Bullfrog (larva)	Lungless salamander

## Ethology

**A 41.** Fixed action patterns (FAPs) are important components of behaviour. Which statement about the fixed action patterns is **not** true?

- A.** They are highly stereotypical, instinctive behaviours
- B.** FAPs are triggered by sign stimuli in the environment, and once begun, are continued to completion
- C.** A supernormal stimulus often produces a stronger response
- D.** FAPs diminish the adaptive significance of behaviour
- E.** FAPs are often released by one or two simple cues associated with the relevant object in an organism

**A 42.** Which feature correctly describes the return of salmon to their native stream to spawn?

- A.** Insight
- B.** Olfactory imprinting
- C.** Habituation
- D.** Classic conditioning
- E.** Positive taxis

**A 43.** Why did psychologists fail in teaching chimpanzees to talk like humans?

- A.** Chimpanzees have a different location and structure of larynx
- B.** They have weakly developed cerebrum
- C.** They have thin tongue
- D.** They have too large teeth
- E.** They have bad memory

**A 44.** Why do territorial birds, which are territory owners tend to win when they meet intruder birds?

- A.** They are more aggressive and better fighters
- B.** They have more to gain from a fight and so they are prepared to fight harder. The higher benefit associated with territory, the harder they fight for it
- C.** Ownership is simply a conventional settlement
- D.** Owners always have a larger body size
- E.** Both A and D are correct answers



## Genetics and evolution

**A 45.** What is the probability for exactly three children to have a dominant phenotype in a family with four children of heterozygous parents ( $Aa \times Aa$ )?

- A. 42%
- B. 56%
- C. 36%
- D. 44%
- E. 60%

**A 46.** Mouse hair colour is determined by two unlinked loci – **C** and **B**. Mice with genotype **CC** or **Cc** are agouti, and with genotype **cc**-albino because pigment production in hair is blocked. At the second locus, the **B** allele is dominant to the **b**, and the **B** allele determines black agouti coat colour, but **b** - brown agouti coat colour.

A mouse with a black agouti coat is mated with an albino mouse of genotype **bbcc**. Half of the offspring were albino, one quarter - black agouti, and one quarter were brown agouti.

What was the genotype of the black parent?

- A. **BBCC**
- B. **BbCc**
- C. **BbCC**
- D. **Bbcc**
- E. **BBcc**

**A 47.** After graduation, you and 19 friends (sex ratio close 1:1) build a raft, sail to a deserted island, and start a new population, totally isolated from the world. Two of your friends carry (that is, are heterozygous for) the recessive **c** allele, which in homozygotes causes cystic fibrosis.

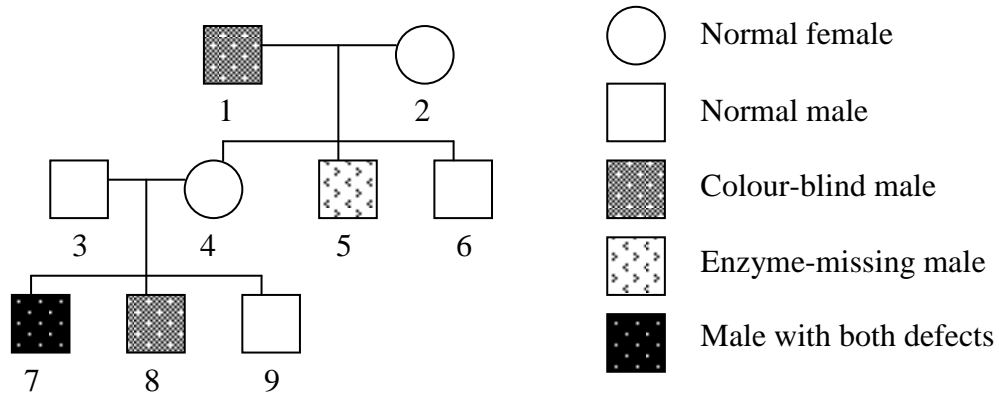
What will be the incidence of cystic fibrosis on your island, if you assume that the frequency of this allele does not change during the growth of population?

- A.** 0.05 %
- B.** 0.0025 %
- C.** 0.25 %
- D.** 0.5 %
- E.** 0.10 %

**A 48.** Suppose that allele **b** is sex-linked (located on X chromosome), recessive and lethal. It kills the zygote or embryo. A man marries a woman who is heterozygous for this gene. What would be the predicted sex ratio of the children of this couple if they have many children?

- |           | <b>Girls</b> |   | <b>Boys</b> |
|-----------|--------------|---|-------------|
| <b>A.</b> | 1            | : | 1           |
| <b>B.</b> | 2            | : | 0           |
| <b>C.</b> | 3            | : | 1           |
| <b>D.</b> | 3            | : | 2           |
| <b>E.</b> | 2            | : | 1           |

**A 49.** Two X-linked genetic defects have been studied by genealogical method (family history): colour blindness and deficiency of certain enzyme in red blood cells. The pedigree shows the results.



Which individual (-s) show (-s) that crossing over has occurred?

- A. 8 and 9
- B. 1
- C. 7 and 8
- D. 7 and 9
- E. 5

**A 50.** Which statement about the meiotic behaviour of chromosomes in a translocation heterozygote is true?

- A.** Only adjacent chromosomal segregations yield viable gametes
- B.** Chromosomes form a cross-shaped structure during prophase I
- C.** All gametes produced by a translocation heterozygote are non-viable
- D.** All gametes produced by a translocation heterozygote contain either duplications or deletions
- E.** The correct answers are A and D

**A 51.** Dihybrid crosses between tall, spherical seeded plants and short, dented-seeded plants in the F<sub>1</sub> generation produced only tall, spherical seeded plants. A testcross of F<sub>1</sub> hybrids with short, dented-seeded plants produced many more tall, spherical seeded plants and short, dented-seeded plants than tall, dented-seeded and short spherical –seeded plants. Which is the right conclusion?

- A.** Genes for tallness and seed shape are located in different chromosomes
- B.** Genes for tallness and seed shape are located in the same chromosome, and are completely linked
- C.** Genes for tallness and seed shape show incomplete linkage
- D.** Traits for tall, dented-seeded plants are dominant
- E.** Traits for short, spherical seeded plants are recessive



**A 54.** In crossing true-bred yellow and grey fruit flies *Drosophila*, the following results were obtained:

Parents	Progeny
Grey female x yellow male	All grey
Yellow female x grey male	All males – yellow All females - grey

Which statement is correct?

- A. Alleles for grey and yellow body colour are codominant
- B. The allele for grey body colour is X-linked recessive
- C. The allele for yellow body colour is X-linked dominant
- D. The allele for grey body colour is X-linked dominant
- E. The allele for yellow body colour is autosomal recessive

**A 55.** In the figure, each column represents a hypothetical haplotype for four RFLP (restriction fragment length polymorphism) loci, each with two alleles (indicated by **1** or **2**), and the disease locus, where **n** indicates normal allele and **m** the mutant allele for a X-linked locus.

Son	Mother		Grandfather	Grandmother	
1	1	2	1	2	2
2	2	2	2	2	1
m	m	n	n	n	n
1	1	1	1	1	1
2	2	1	2	1	1

(Continuation see on the next page)

Presence or absence of the mutant allele can be detected by some direct molecular assay. The data that the mutation is present in the mother but absent in both her parents does not tell us which of the parents was the source of the mutant gamete. The problem is solved by haplotype analysis using closely linked polymorphic loci. Where did the mutation, received by the son occur?

- A.** In mother's germ cells
- B.** In grandmother's germ cells
- C.** In grandfather's germ cells
- D.** In both grandfather's and grandmother's germ cells
- E.** There is insufficient information to solve this problem

## Ecology

**A 56.** Which statement (-s) is (are) correct?

1. Food chains usually have at least 7 levels
2. Food chains are limited in length by energy losses, for example in respiration
3. Most of the world terrestrial above-ground production is utilized directly by detritivores
4. Gross energy production is the remaining assimilated energy after respiration

**A.** 2, 3 and 4

**B.** Only 2

**C.** Only 1

**D.** 1 and 3

**E.** 2 and 3

**A 57.** Which statements are correct?

1. Some autotrophic bacteria obtain energy oxidizing  $\text{NH}_4^+$  to  $\text{NO}_2^-$  or  $\text{NO}_2^-$  to  $\text{NO}_3^-$
2. Some autotrophic bacteria obtain energy reducing  $\text{NO}_2^-$  or  $\text{NO}_3^-$
3. Nitrogen-fixing cyanobacteria can utilize atmospheric nitrogen ( $\text{N}_2$ )



4. *The ocean serves as a buffer, stabilizing the atmospheric CO<sub>2</sub> concentration*
5. *Coral reefs are very productive ecosystems, but they contain a minor portion of the global amount of assimilated C*
- A.** *3, 4 and 5*
- B.** *2, 3, 4 and 5*
- C.** *1, 4 and 5*
- D.** *1, 3, 4 and 5*
- E.** *Only 4 un 5*



**A 60.** Which statement (-s) is (are) correct?

1. Succession after forest logging is an example of secondary succession
2. Succession after forest fire is an example of secondary succession
3. Generally, fire is a very important ecological process, as many ecosystems depend on fire for their renewal
4. In climax forests, most of the under storey species will have high competitive ability.
5. In climax forests, most of the under storey species are stress-tolerant species

**A.** 1, 2 and 4

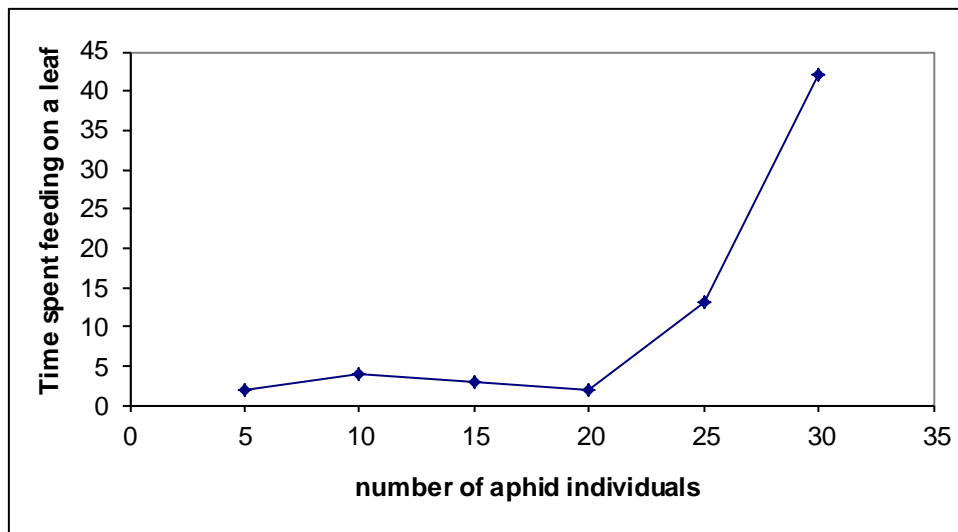
**B.** Only 1, 3 and 5

**C.** 1, 2, 3 and 5

**D.** Only 1

**E.** Only 3 and 5

**A 61.** Aphids are common prey for ladybird beetles. The figure shows the amount of time spent feeding on a leaf by ladybird beetles. What does the figure indicate?



1. Ladybird beetles become confused when stationary prey is abundant, and have to spend a longer time capturing an individual
2. The size of the ladybird population is dependent on the number of aphids available
3. Ladybirds do not waste energy searching for aphids when they are in short supply
4. Ladybird beetles have a better chance of spotting from afar a leaf with many aphids as compared to a leaf with few aphids
5. Ladybird beetles spend more time on leaves where there are more aphids, because their net energy gain is maximum due to fewer losses from searching

**A.** Only 1

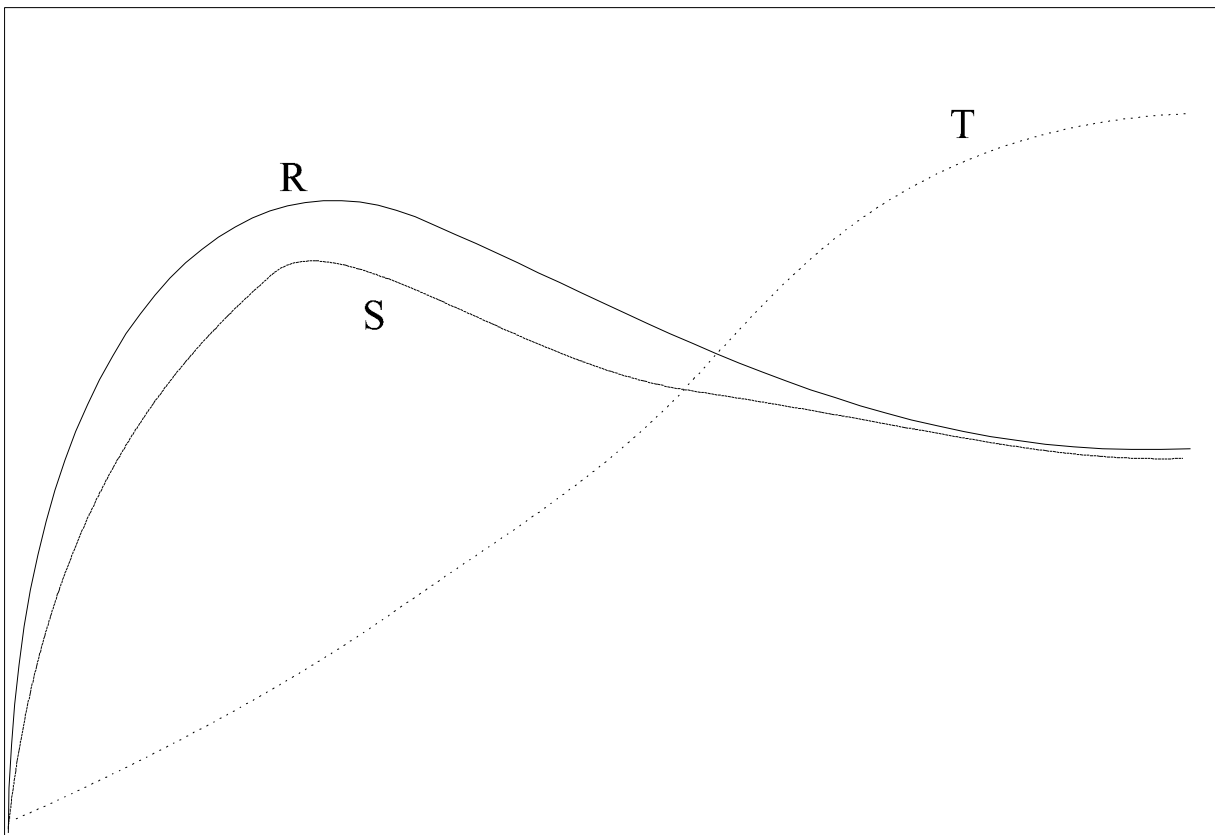
**B.** Only 2

**C.** Only 3

**D.** 3 and 5

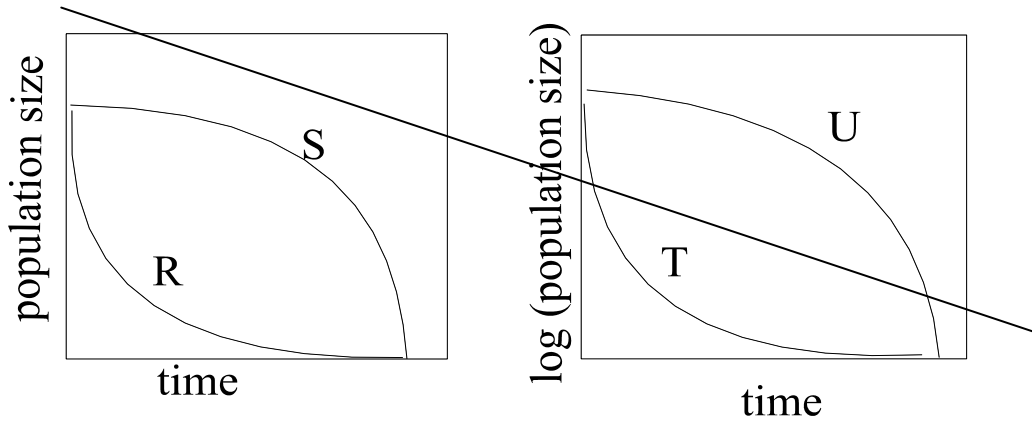
**E.** All the answers are correct.

A 62. Changes that occur in a forest developing on abandoned farmland are represented in the graph below. What do the curves R, S and T indicate?



Time (years)

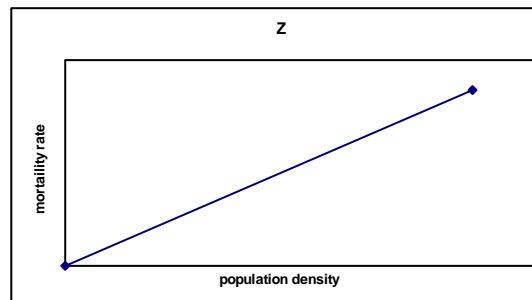
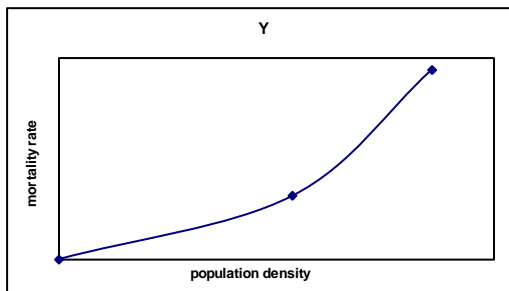
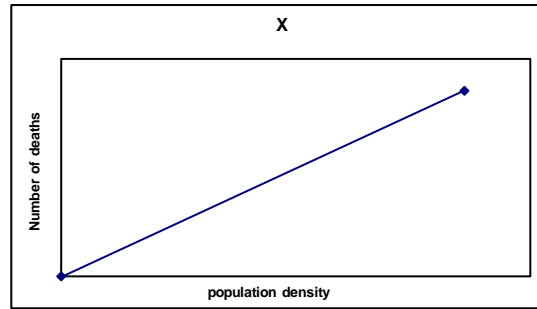
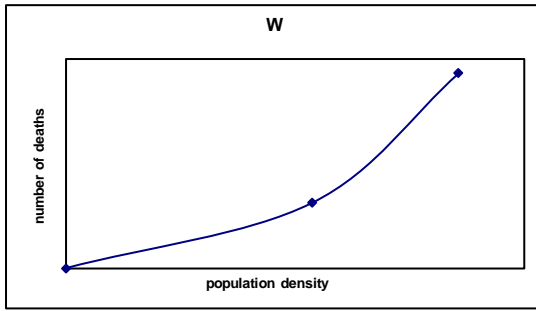
	Curve R	Curve S	Curve T
A.	Net productivity	Respiration	Succession
B.	Gross productivity	Net productivity	Heterotrophy
C.	Gross productivity	Respiration	Total biomass
D.	Community respiration	Total biomass	Net productivity
E.	Respiration	Total biomass	Gross productivity



**A 64.** In a Latvian pond, a random sample of carp fish consisted of 120 individuals. All individuals were permanently marked and released without injuring them. On the next day, 150 individuals were captured, of which 50 were marked. Assuming no change in the total population size between the two days, what is the size of the population in the pond?

- A. 3600
- B. 6000
- C. 170
- D. 360
- E. 50

A 65. Which of the figures below show density-dependent mortality that could play a role in



regulation of population size?

- A. W, X, Y and Z
- B. Y and Z
- C. W and X
- D. Only Y
- E. W, Y and Z

**A 66.** In an experiment to determine the proportion as a percent of cabbage leaf material eaten by a caterpillar that was converted to biomass, it was observed that the caterpillar ate  $2 \text{ cm}^2$  of leaf per day . In order to make an estimate of the conversion several measurements were done.

W. Average dry mass per  $\text{cm}^2$  of leaf similar to that eaten

X. Total mass of caterpillar faeces per day

Y. Dry mass of caterpillar faeces per day

Z. Mass of carbon dioxide produced per day

Which of the given equations for estimating B, the mass of cabbage leaf converted into caterpillar biomass per day, is correct?

**A.**  $B = 2W - Y - Z$

**B.**  $B = W - Y - Z$

**C.**  $B = (2W - Y - Z)/2W$

**D.**  $B = 2W - X - Z$

**E.**  $B = W - X - Z$



## Biosystematics

**A 68.** What do **all Angiosperms** have that all Gymnosperms lack?

- A. vascular cambium
- B. secondary xylem
- C. pericarp
- D. cotyledons
- E. seeds

**A 70.** Which of the following **is false** about the life cycle of mosses?

- A.** Gametophytes arise from a protonema
- B.** External water is required for fertilization
- C.** Gametes are produced by meiosis
- D.** Antheridia and archegonium are produced by the gametophytes
- E.** Sperms have flagella

**A 71.** Many benthic marine invertebrates have free-living planktonic larvae. Which of the following invertebrates all have planktonic larvae?

- A.** Nematoda, Echinodermata, Polychaeta, Turbellaria
- B.** Polychaeta, Turbellaria, Echinodermata, Corallium
- C.** Decapoda, Echinodermata, Corallium
- D.** Bivalvia, Turbellaria, Porifera, Nematoda
- E.** Cephalopoda, Gastropoda, Bivalvia, Echinodermata

**A 72.** Which statement regarding the systematics of following taxa is correct?

- A.** Phylum Platyhelminthes includes Hirudinea, Turbellaria and Cestoda
- B.** Phylum Arthropoda includes Chilopoda, Polychaeta, Crustacea
- C.** Phylum Platyhelminthes includes all the parasitic worms
- D.** Phylum Arthropoda includes water insects and water mites
- E.** Phylum Echinodermata and phylum Cnidaria are close relatives, as they possess a radial symmetric body

**A 73.** A biology student made some comments after examining Turbellaria, tapeworm (*Taenia* sp.) and trematoda (*Fasciola hepatica*). Which of his comments is **not** true?

- A.** Reduction in digestive system evolved in conjunction with passing to the parasitic life style
- B.** With passing to the parasitic life style, the reproduction capacity has increased
- C.** The total disappearance of the digestive system in the parasitic species did not cause any additional change in the body
- D.** The excretory systems of these animals basically resemble each other
- E.** The parasitic life style did not cause any change in the basic structural plan of the nervous system

**A 74.** Parasites are adapted to the host and its life cycle. Which of the following statements about parasitic species is correct?

- A.** Numerous Nematoda, Turbellaria and Cestoda are endoparasites in the intestine of fishes
- B.** Fleas, lice and most female mosquitoes are ectoparasites of warm-blooded animals
- C.** Cyclops are the intermediate hosts of Trematoda and Cestoda
- D.** The parasitic Nematoda and Turbellaria develop directly without an intermediate host
- E.** Trematodes and Turbellaria are endoparasites of cold-blooded animals

**A75.** Heterothermy is the ability to reduce body temperature during hibernation until it gets close to the environmental temperature. Which of the following animal groups include heterothermal organisms?

- A.** Rodentia, Chiroptera, Insectivora
- B.** Only Carnivora
- C.** Carnivora, Chiroptera
- D.** Penguins
- E.** All mammals living in burrows

Answer key

	A1	A2	A3	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16	A17	A18	A19	A20	A21	A22	A23			
A								■									■							A	
B					■					■				■		■						■			B
C	■	■	■									■			■						■				C
D				■		■			■		■		■											■	D
E			■				■												■	■					E

	A25	A26	A27	A28	A29	A30	A31	A32	A33	A34	A35	A36
A	■	■	■								■	
B				■		■	■	■	■			
C								■		■		■
D			■		■							
E												

A38	A39	A40	A41	A42	A43	A44	A45	A46	
					■		■		A
■	■	■	■		■		■	■	B
									C
			■						D
									E

	A47	A48	A49	A50	A51	A52	A53	A54	A55	A56	A57
A											
B				■		■					
C	■				■			■			
D			■				■			■	
E		■					■			■	

A60	A61	A62
■		■
	■	

A64	A65	A66
		■
■		
	■	

A68	
	A
	B
■	C
	D
	E

	A70	A71	A72	A73	A74	A75
A						■
B					■	
C	■	■		■		
D			■			
E						