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Some questions may have been altered or removed compared to the version of this paper used during the competition period.

Answers are not provided at this time.

Students are not expected to have memorised all the facts assessed, or be familiar with all the topics presented. Their biological intuition and problem solving is being assessed.

Intermediate Biology Olympiad 2020

You will have 60 minutes to complete this paper of 68 questions.

You may use a calculator.

It is recommended that you have pen and paper to hand for rough work.

No marks are subtracted for incorrect answers.

Medal	Mark	Pupils
Gold	68%	6%
Silver	59%	11%
Bronze	51%	17%
High Commended	47%	14%
Commended	43%	15%

The Variety of Life

Q1

Which is the correct classification of the organism in this photograph?



- A. Domain: Eukarya, Kingdom: Plantae
- B. Domain: Archaea, Kingdom: Plantae
- C. Domain: Eukarya, Kingdom: Animalia
- D. Domain: Eukarya, Kingdom: Protista
- E. Domain: Plantae, Kingdom: Archaea

Q2

Some scientists argue that viruses are truly living.

Here are some facts about viruses; which of these suggests viruses are living?

- A. Viruses cannot replicate outside of host cells
- B. Viruses cannot generate their own energy
- C. Viruses cannot produce proteins outside of host cells
- D. Viruses can evolve
- E. Viral particles are not made of cells

Q3

What makes plants and animals different?

- A. Only plants have a cell nucleus
- B. Only plants can make fats (lipids)
- C. Only plants have chloroplasts
- D. Only animals have mitochondria
- E. Only animals reproduce sexually

Q4

How could you accurately tell eukaryotes apart from bacteria?

- A. Only bacteria can be single-celled (unicellular)
- B. Only eukaryotes have cells
- C. Only eukaryotes have ribosomes
- D. Only eukaryotes have RNA
- E. Only eukaryotes have mitochondria

Q5

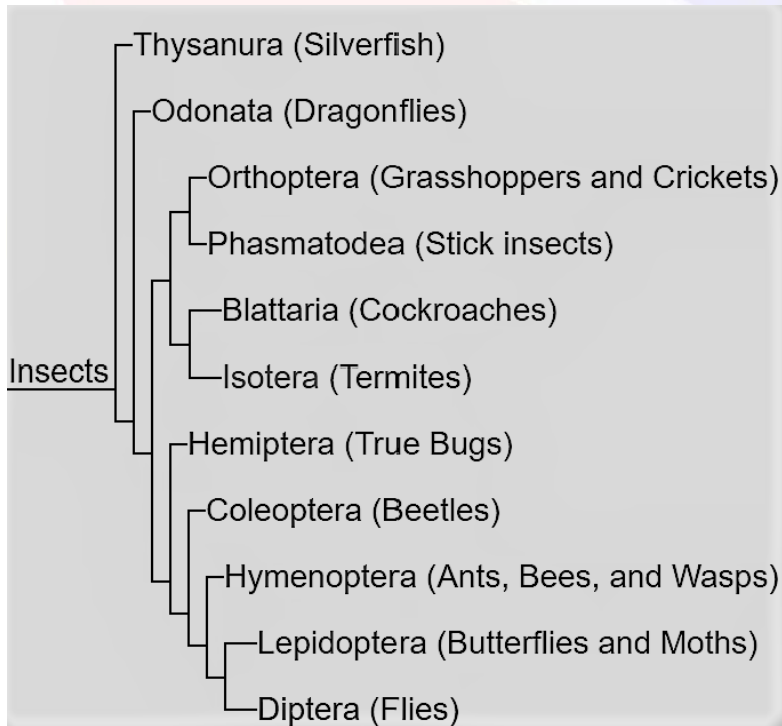
Most viruses can only infect one host species.

Why is this?

- A. Non-host species do not make the proper proteins from the genes of the virus
- B. Non-host species have antibodies against the virus
- C. Non-host species do not have the same cell types
- D. Non-host species have proteins which do not fit together well with virus proteins
- E. Non-host species already have other better adapted viruses which outcompete the virus

Q6

The majority of all species on Earth are insects (contained within the class Insecta). In turn, a large majority of all insect species are beetles (contained within the order Coleoptera). This is shown in the phylogenetic tree.



What does this phylogeny show?

- A. Flies are a type of beetle
- B. Beetles evolved from bugs
- C. Cockroaches are the most ancient kind of insect
- D. Flies are more closely related to moths than beetles
- E. Dragonflies are more closely related to silverfish than beetles

Q7

Consider a unicellular photosynthesising algae, and a multicellular plant.

Which is an advantage algae have over plants?

- A. Algae can more easily move to stay in sunlight
- B. Algae can grow taller to compete for light
- C. Algae can develop specialised organs to carry out tasks more effectively
- D. Algae can store more nutrient reserves
- E. Algae can grow thick protective coatings to survive on land

Q8

Evolution is fastest when

	Heritable variation	Migration into the population	Difference in fitness between individuals
A	Is high	Is low	Is high
B	Is low	Is low	Is low
C	Is low	Is high	Is high
D	Is high	Is high	Is low

- A. A
- B. B
- C. C
- D. D

Q9

The DNA sequences from 4 organisms have been aligned for comparison.

	Amylase gene sequence
Organism 1	C A G G T C A G T T
Organism 2	C C G G T C A G G T
Organism 3	C A G G A C A T T T
Organism 4	C C G G T C A C G T

Which two organisms are most closely related?

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

Ecology & Behaviour

Q10

Bees pollinate flowers and are given nectar in return. Some orchid flowers mimic other species, so are pollinated, but do not produce any nectar.

Which word best describes the relationship between bees and the mimic orchids?

- A. Mutualism
- B. Pathogenic
- C. Parasitism
- D. Commensalism
- E. Predation

Q11

After being tricked by the mimic orchids, bees will stop visiting both the orchids and the flowers they mimic.

What type of behaviour is this?

- A. Instinct
- B. Habituation
- C. Imprinting
- D. Reasoning
- E. Conditioning

Q12

Pine martens are a British predator which hunt squirrels. Grey squirrels, which were introduced from America, have replaced red squirrels in most of Britain. Recently, the marten population has been growing because, unlike red squirrels, grey squirrels are not afraid of martens so are easier to catch.

Why do the red and grey squirrels behave differently?

- A. Conditioning
- B. Teaching
- C. Instinct
- D. Play
- E. Altruism

Q13

In very polluted areas, camouflaged animals tend to have many darkly coloured individuals in their population. When pollution is stopped, more lightly coloured individuals tend to become more common.

What type of evolution explains this?

- A. Genetic drift
- B. Sexual selection
- C. Natural selection
- D. Artificial selection
- E. Inheritance of acquired characteristics

Q14

In a food chain, the energy, carbon, nitrogen and oxygen fixed into molecules, often comes from different sources.

Which class of organism can fix all of these by themselves?

- A. Plants
- B. Animals
- C. Fungi
- D. Bacteria
- E. None can

Q15

Scientists estimate up to 10^{30} bacterial cells live inside rocks deep within the earth. They may survive by very slowly metabolising hydrogen produced by the decay of radioactive elements.

What type of organisms are they?

- A. Consumer (heterotroph)
- B. Producer (auto/lithotroph)
- C. Decomposer (detritivore/saprophage)
- D. Omnivore
- E. Herbivore

Q16

Historically, lawns were made from a variety of small herbs. These were re-branded as weeds by grass seed companies, and have become rare. We counted the number of some animals in a herb lawn versus a grass lawn. The table includes the partial results of some calculations you will need to use.

	Grass lawn			Herb lawn		
	Number of individuals	(n-1)	n(n-1)	Number of individuals	(n-1)	n(n-1)
Woodlice	21	20	420	18	17	306
Ladybirds	1	0	0	11	10	110
Earwigs	8	7	56	8	7	56
Worms	1	0	0	3	2	6
Ants	12	11	132	7	6	42

The Simpson index of diversity is $D = 1 - [\sum n(n-1) / N(N-1)]$, where

n = the total number of organisms of a particular species

N = the total number of organisms of all species

Calculate D for the herb lawn. Pick the nearest answer.

- A. 0.5
- B. 0.6
- C. 0.65
- D. 0.7
- E. 0.75
- F. 0.8

Q17

If you replaced a grass lawn with a herb lawn, what would you most notice?

- A. Ants become more common
- B. Woodlice become more common
- C. The number of animals increases
- D. The variety of animals increases
- E. No obvious differences

Q18

The characteristic smell of rain after long dry spells is caused by a type of bacteria releasing scents. These attract insects which feed on the bacteria. Whilst feeding, the insects are coated in bacterial spores.

The insect shows:

- A. Phytotaxis/phototaxis
- B. Gravitropism
- C. Chemotaxis
- D. Kinesis
- E. Chemotropism

Q19

What benefit do the scent producing bacteria get from this process?

- A. Population control
- B. Fertilisation
- C. Dispersal
- D. Nutrition
- E. Protection

Q20

Scottish wildcats are Britain's only surviving indigenous cat species. Motion-sensitive cameras in 347 Scottish locations captured 200 000 images, and volunteers used these to identify wildcats by their markings.

In one year, they found 10 different wildcats. In the next year, they found 9 different Scottish wildcats, one of which 1 had the same markings as a cat photographed in the preceding year.

Use the mark recapture method to estimate, to the nearest 50, the number of wildcats in Scotland.

- A. 50
- B. 100
- C. 150
- D. 200
- E. 250

Genetics

Q21

In Harry Potter, children are more likely to have magical ability if their families do. However, some children have magical ability even though their parents do not.

What mechanisms of inheritance **cannot** explain this pattern?

- A. Magical ability is a recessive allele
- B. Magical ability is controlled by many genes (polygenic)
- C. Magical ability is a consequence of cultural/environmental factors in childhood
- D. Magical ability is a dominant allele
- E. Magical ability is spread by an infectious organism

Q22

In flu viruses, each gene is encoded on 8 separate pieces of RNA. The H and N genes determine the virulence of flu. The pieces of RNA are packaged together to make a viral particle. If two different strains of flu infect the same cell, a random mix of RNA from each strain is packaged into new viral particles.

If a H1 N2 flu virus from birds, and a H5 N9 flu virus from pigs, infect the same cell, how many different H and N combinations will be present in the resulting viral particles?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 8
- F. 12

Q23

How many different combinations of all 8 genes will the new viral particles contain?

- A. 8
- B. 16
- C. 64
- D. 256
- E. 512

Q24

Scientists want to modify an organism so it can incorporate an unnatural amino acid with special properties into proteins encoded by artificial genes.

What steps should they take to achieve this most easily?

1. Identify the rarest codon, and replace it in all the organism's existing genes with an alternative encoding the same amino acid
2. Modify tRNA synthesis so it adds the unnatural amino acid to the appropriate tRNA
3. Alter RNA polymerase so it incorporates different bases at some codons
4. Alter ribosomes so they read codons differently
5. Alter tRNAs so they bind four mRNA bases.
6. Alter all genes so they use a quad code rather than triplet code
7. Add genes encoding enzymes to synthesise the unnatural amino acid

- A. 1,2,7
- B. 1,2,3,7
- C. 2,4,7
- D. 4,5,6,7
- E. 2,4,5,6,7

Q25

You want to create rose flowers which are both whorled and large. Therefore you cross a plant producing small whorled flowers with a plant producing large open (not whorled) flowers.

All the plants from this cross had small open flowers - the opposite of what you wanted! However, you allowed these plants to set seed anyway. If 1 gene controls whorled versus open flowers and 1 gene controls flower size, what proportion of the seeds will grow into plants with large whorled flowers?

- A. $\frac{1}{20}$
- B. $\frac{1}{16}$
- C. $\frac{1}{14}$
- D. $\frac{1}{12}$
- E. $\frac{1}{8}$
- F. $\frac{1}{4}$
- G. $\frac{1}{2}$

Q26

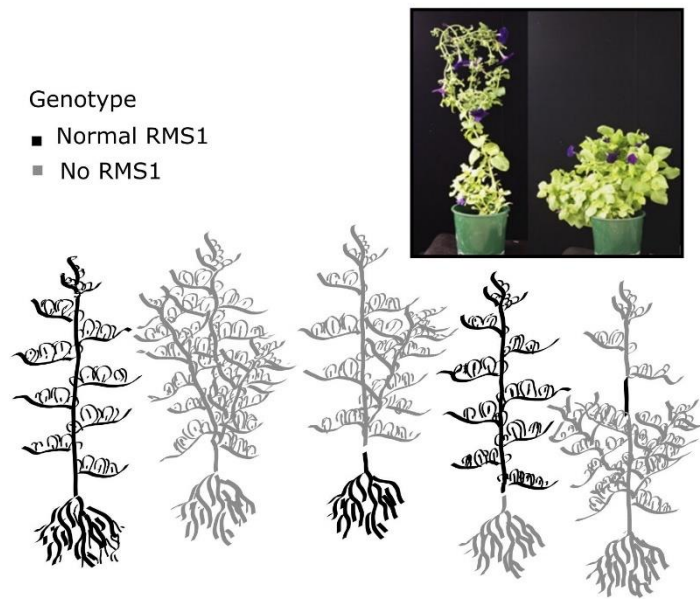
A cell contains an amount of DNA, X, in G2 phase. How much DNA will a cell contain after anaphase 2 of meiosis?

- A. $x/4$
- B. $x/2$
- C. x
- D. $2x$

Q27

The gene RMS1 controls how branched plants become, and it was altered in modern crops as part of the 'green revolution'.

Parts of seedlings with normal RMS1 were grafted onto seedlings which have no RMS1 to study how the gene works.

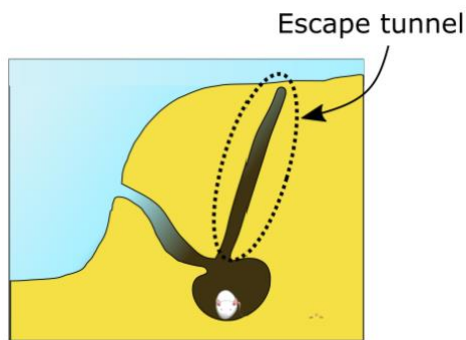


Which of the following is true?

- A. RMS1 increases shoot branching
- B. The signal produced by RMS1 travels towards the shoot tip, rather than towards the roots
- C. RMS1 in the roots alone is enough to give normal shoot branching
- D. Shoots cannot branch normally unless RMS1 is in the roots
- E. The signal produced by RMS1 only travels a short distance

Q28

Complex behaviour can be genetically controlled by a single gene. Burrowing mouse burrows of species A have an escape tunnel.



Burrows of species B do not have escape tunnels.

When species A and B interbreed, the hybrids always dig an escape burrow.

What is correct?

- A. Alleles for digging an escape tunnel are recessive
- B. If the hybrids breed with species A (backcross), half the offspring dig an escape tunnel
- C. If the hybrids breed with species B (backcross), half the offspring dig an escape tunnel
- D. If the hybrids breed with each other, half of the offspring dig an escape tunnel
- E. Offspring of hybrids will never build an escape tunnel

Q29

People with pale eyes are more likely to get skin cancer. What is a plausible explanation for this correlation?

- A. The same genes control the amount of pigment in skin and eyes, and pigment in skin protects against skin cancer
- B. People with pale eyes are more likely to grow up in cultures that do not take adequate steps to prevent skin cancer
- C. Genes for pale eyes and increased risk of skin cancer tend to be inherited together
- D. All of the above
- E. None of the above

Q30

It is not possible to predict accurately whether a mutation is likely to be harmful, but you can make a reasonable guess based on your knowledge of biology.

Which is most likely?

- A. Deleting a base in an intron is worse than deleting a base in an exon
- B. Deleting 3 bases in an exon is worse than deleting 1 base
- C. Deleting 1 base near the start of an exon is worse than deleting 1 base near the end
- D. Deleting 3 bases in the middle of an intron is worse than deleting 3 bases at its start
- E. Swapping 1 base for another is worse than deleting 1 base

Q31

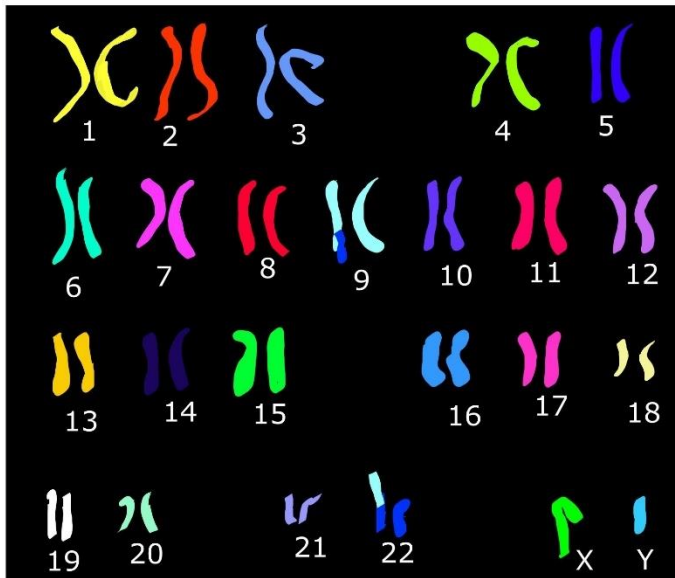
What is different between meiosis and mitosis?

- A. Sister chromatids are separated
- B. DNA is replicated
- C. Chromosomes condense
- D. Homologous chromosomes pair up

Q32

A certain kind of blood cancer (leukemia) is always caused when pieces of two chromosomes are swapped, which causes two genes to be stuck together. This new fusion gene produces a protein which forces cells to divide.

DNA from different chromosomes can be stained different colours, and seen down a microscope. Chromosomes from a person with this blood cancer are shown.



Which of the following is true?

- A. This mutation is recessive
- B. Pieces of chromosome 8 and 3 are swapped
- C. This person is female
- D. This person has Down syndrome (an extra copy of chromosome 21)
- E. This person is heterozygous for the mutation

Q33

A complementary strand of DNA, formed by semi-conservative replication has the base sequence 5'-TAGGCATT-3'.

5' refers to the phospho end of the nucleotides, and 3' the OH group, hence the orientation of the strand.

What is the base sequence on the original DNA strand?

- A. 5'-AAUGCCUA-3'
- B. 5'-ATCCGTAA-3'
- C. 5'-AATGCCTA-3'
- D. 5'-AUCCGUAA-3'

Physiology

Q34

What is true of **both** the animal cardiovascular system and the plant transpiration system?

- A. Fluid is pushed along vessels
- B. Fluid is water based
- C. Fluid circulates in a loop
- D. Fluid movement is mostly active (requires energy generated by the organism)
- E. Fluid has the same osmolarity as cells (isosmotic/isotonic)

Q35

Which of the following processes does not occur during digestion in animal guts?

- A. Active transport of glucose into the body
- B. Facilitated diffusion of water into the body
- C. Hydrolysis of proteins
- D. Secretions of salts into the gut
- E. Excretion of urea

Q36

Light harvesting proteins are embedded in the internal membranes of chloroplasts.

Consider:

1. A primitive chloroplast where the internal membrane simply lines the outside of the chloroplast
2. A modern chloroplast where the internal membrane is invaginated and stacked to fill much of the volume of the chloroplast

How much more light will the primitive chloroplast harvest if it grows to double its radius?

- A. The same amount of light
- B. 1.5 times
- C. 2 times
- D. 4 times
- E. 8 times

Q37

How much more light will a modern chloroplast harvest if it grows to double its radius?

- A. The same amount of light
- B. 1.5 times
- C. 2 times
- D. 4 times
- E. 8 times

Q38

Fick's law models the rate of diffusion across a surface, such as oxygen travelling from air sacs into blood in the lungs.

$$Q = K (C_1 - C_2) A / d$$

Q = rate of transfer

K = diffusion constant. For Oxygen in air at body temperature, K = 0.3. For Oxygen in water at body temperature, K = 0.00002

($C_1 - C_2$) = the concentration difference of Oxygen between air and blood

A = surface area of airsacs

d = distance (or thickness) the Oxygen moves

What is **not** an adaptation of lungs to increase exchange of oxygen according to Fick's law?

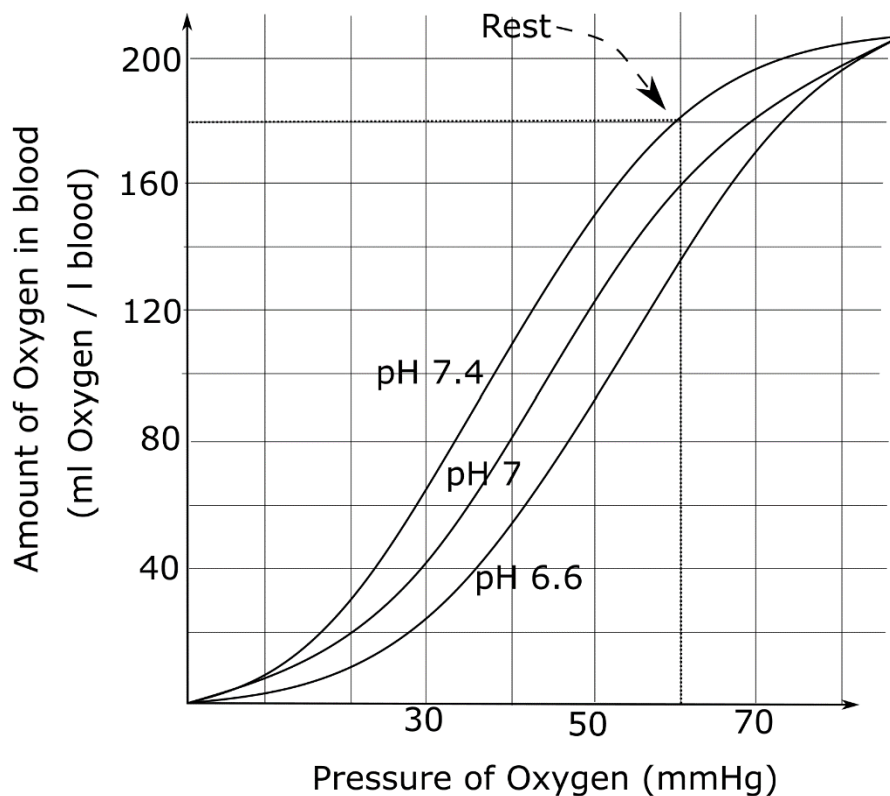
- A. Fast rate of blood flow to keep C_2 low
- B. Fast rate of breathing to keep C_1 high
- C. Minimum thickness of cells lining air sacs
- D. Air sacs lined with a layer of water
- E. Red blood cells bind most oxygen to keep C_2 in blood low

Q39

In a resting muscle, the pressure of oxygen 60 mmHg and the pH is 7.4.

When exercising, the muscle consumes oxygen, so the pressure of oxygen drops to 30 mmHg, and the muscle produces carbon dioxide and other acids, so the pH drops to 6.6.

These changes affect how much oxygen is bound to hemoglobin according to the curves shown below.



Calculate how much more oxygen the muscle extracts from blood when exercising than resting.

- A. 180 ml/l
- B. 160 ml/l
- C. 140 ml/l
- D. 120 ml/l
- E. < 120 ml/l

Q40

Tissue fluid is extruded from capillaries and bathes cells. The amount of tissue fluid produced depends on the balance of pressures and osmolarities in blood versus tissues.

Excess tissue fluid accumulates in several diseases. What would **not** cause excess tissue fluid?

- A. High blood pressure
- B. Blockage in veins
- C. Blockage in lymph vessels
- D. Reduced protein concentration in blood
- E. Kidneys unable to concentrate urine (unable to absorb fluid)

Q41

Vaccines aim to stimulate an adaptive immune response.

What is involved in stimulating the adaptive immune system?

- A. Antibodies bind to things on the pathogen, stopping them from working
- B. Cytotoxic cells kill other cells infected with the pathogen
- C. Phagocytic cells ingest the pathogen
- D. An inflammatory response increases immune system activity
- E. All of the above

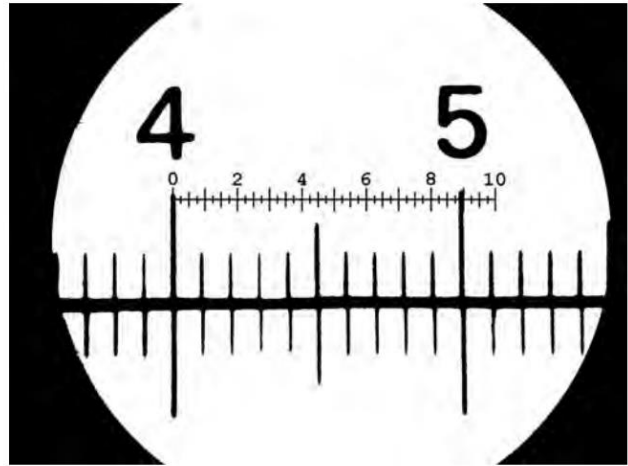
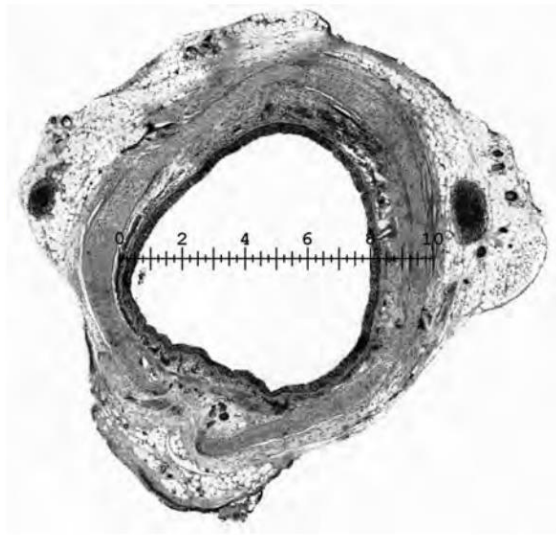
Q42

What feature of a pathogen is most likely to make it difficult to vaccinate against?

- A. Causes very severe illness
- B. Usually causes very mild illness
- C. Lives inside host cells
- D. Mutates rapidly
- E. Has genes which suppress immune responses

Q43

A blood vessel was observed using a microscope with a ruler etched into the eyepiece. Without changing the magnification, a micrometer was also observed through the microscope. Each small division on the on the micrometer is 100 μm .



Estimate the diameter of the blood vessel lumen (inside) in μm . Choose the nearest answer.

- A. <700
- B. 700
- C. 780
- D. 800
- E. 830
- F. 1500
- G. 8000

Q44

When trees are transpiring, the diameter of their trunks decreases because:

- A. Less water is present in xylem vessels
- B. More water is present in xylem vessels
- C. Tension in xylem vessels increases
- D. Tension in xylem vessels decreases

Q45

Put the stages of the cardiac cycle in order

- a. Ventricular systole begins
- b. Atrial systole begins
- c. Atrioventricular valves shut
- d. Semilunar valves shut

- A. $a > c > d > b$
- B. $a > b > c > d$
- C. $a > d > b > c$
- D. $a > d > c > b$
- E. $a > c > b > d$

Biochemistry & cell biology

Q46

Animals generate more energy from glucose in the presence of oxygen, than in the absence of oxygen. This is because oxygen

- A. is needed as an oxidising agent to fully break down glucose
- B. molecules are split to make free radicals which react with glucose
- C. binds to the enzymes which break down glucose
- D. neutralises acids made by breaking down glucose
- E. is needed as a reducing agent to fully break down glucose

Q47

Many molecules (DNA, proteins, carbohydrates etc) are polymers. There are many reasons polymers are so important in biology.

Which is **not** a correct reason?

- A. Polymers give structural strength
- B. Polymers are more compact than small molecules
- C. Polymers are less soluble and have less impact on osmolarity than small molecules
- D. Polymers often require little energy to assemble/disassemble
- E. Polymers are more chemically reactive than small molecules

Q48

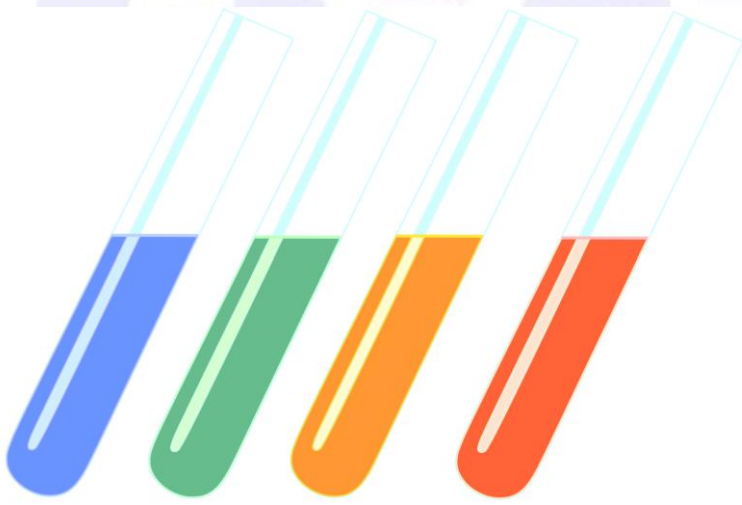
What is the key difference between lipids (fats) and carbohydrates?

- A. Molecular size
- B. Amount of carbon
- C. Amount of nitrogen
- D. Presence of closed rings versus open chains
- E. Amount of oxygen

Q49

In people with diabetes, blood sugar levels may become very high. The kidney usually reabsorbs all the sugar from blood plasma it filters into urine. However, in diabetic people, the rate of glucose reabsorption in the kidney may become saturated. A Benedict's test used to be used to test the amount of sugar in samples from diabetic people.

Which is order of samples, from left to right, giving the results shown in the test-tubes?

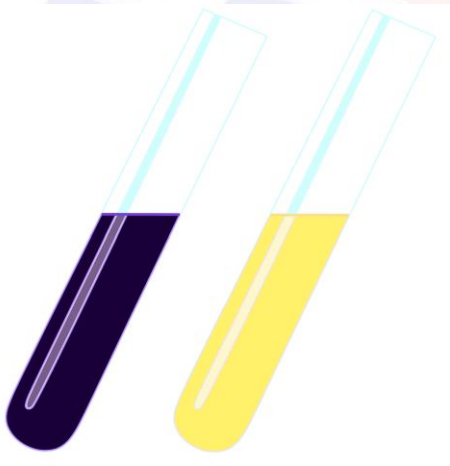


- A. Urine from healthy person; urine from diabetic; blood plasma from diabetic; positive control (glucose)
- B. Urine from diabetic person; urine from healthy person; blood plasma from diabetic; positive control (glucose)
- C. Urine from healthy person; blood plasma from diabetic; urine from diabetic; positive control (glucose)
- D. Blood plasma from healthy person; urine from healthy person; urine from diabetic; positive control (glucose)
- E. Positive control (glucose); urine from diabetic; blood plasma from diabetic; urine from healthy person
- F. Positive control (glucose); blood plasma from diabetic; urine from diabetic; urine from healthy person

Q50

Plants use underground tubers to store carbohydrates densely over the winter. Plants pack fruits with sweet tasting carbohydrates to attract animals which will disperse their seeds. Other parts of the plant contain a mix of sugars being transported and metabolised or stored.

An iodine test was used on samples from a plant. Which is order of samples, from left to right, giving the results shown in the test-tubes?



- A. Fruit; tuber
- B. Leaf; tuber
- C. Leaf; fruit
- D. Tuber; fruit
- E. Tuber; leaf

Q51

A scientist wants to analyse the cytoplasm of some cells, but not their membranes. Therefore, she separates the cytoplasm and membranes into different tubes. She performs an emulsion test to measure how effective the separation was.

What results would she expect for the cell membranes?

- A. Insoluble in ethanol; then forms cloudy layer when water added
- B. Successfully dissolves in ethanol; then forms cloudy layer when water added
- C. Insoluble in ethanol; then clear when water added
- D. Soluble in water; then forms a clear layer when ethanol added
- E. Insoluble in water; then forms cloudy layer when ethanol added

Q52

The high energy bonds of the triphosphate group of ATP are the energy source for many active processes within cells. However, DNA polymerases do not directly require ATP to extend a DNA strand.

Why?

- A. Condensation of the DNA polymer is more energetically favourable than its hydrolysis
- B. DNA polymerases use GTP instead of ATP
- C. Hydrolysis of one DNA strand provides energy for synthesising another
- D. Deoxyribonucleotides are synthesised with their own triphosphate groups
- E. Base pairing with the template strand provides energy for synthesising the new strand

Q53

Albumins are soluble proteins present at extremely high concentrations in biological fluids (such as blood). When denatured, albumins lose certain properties, which is why fluids (such as egg whites) set when heated.

What key property do you suppose albumins have?

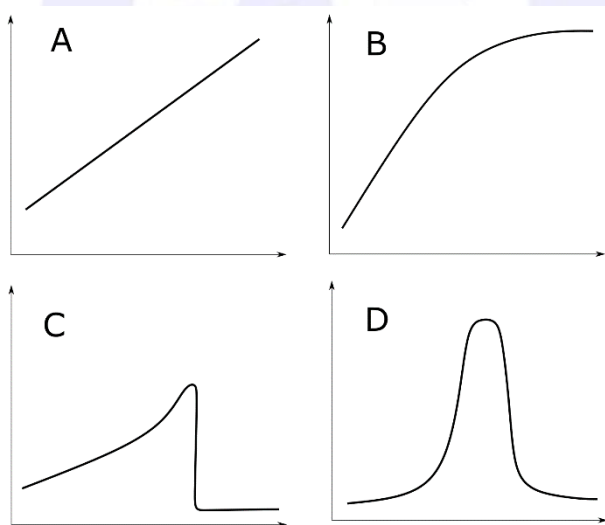
- A. Very large molecular size
- B. Hydrophobic surfaces
- C. Long, fibrous shapes
- D. Approximately neutral pH
- E. Shape mostly maintained by covalent bonds

Q54

Pineapples contain an enzyme which digests proteins (protease).

The amino acid tyrosine is aromatic, so it absorbs UV light in proportion to its concentration. When tyrosine is within a protein, it does not absorb UV.

These graphs are different measurements from a protein sample treated with pineapple extract.



Which graph shows absorbance on the Y axis, and tyrosine concentration on the X axis?

- A. A
- B. B
- C. C
- D. D

Q55

Which graph shows rate of reaction on the Y axis, and temperature on the X axis?

- A. A
- B. B
- C. C
- D. D

Q56

Which graph shows rate of reaction on the Y axis, and pH on the X axis?

- A. A
- B. B
- C. C
- D. D

Q57

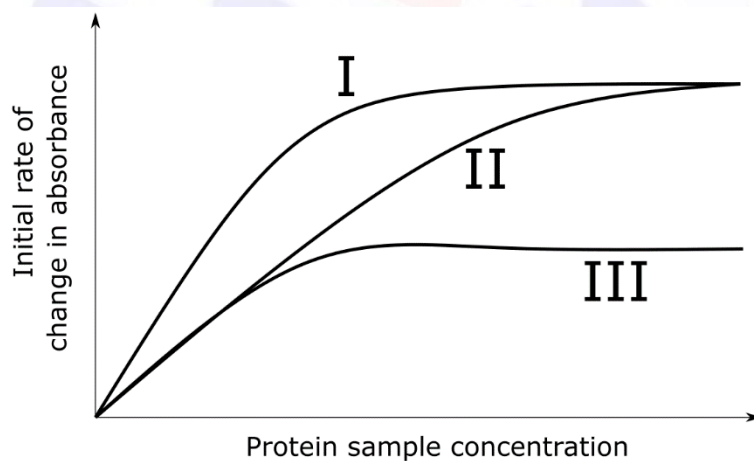
Which graph shows absorbance on the Y axis and time on the X axis?

- A. A
- B. B
- C. C
- D. D

Q58

Next, different chemicals were added to the mix of pineapple extract and protein sample. The chemicals could either

- (a) Have no effect on pineapple protease
- (b) Competitively inhibit pineapple protease
- (c) Non-competitively inhibit pineapple protease



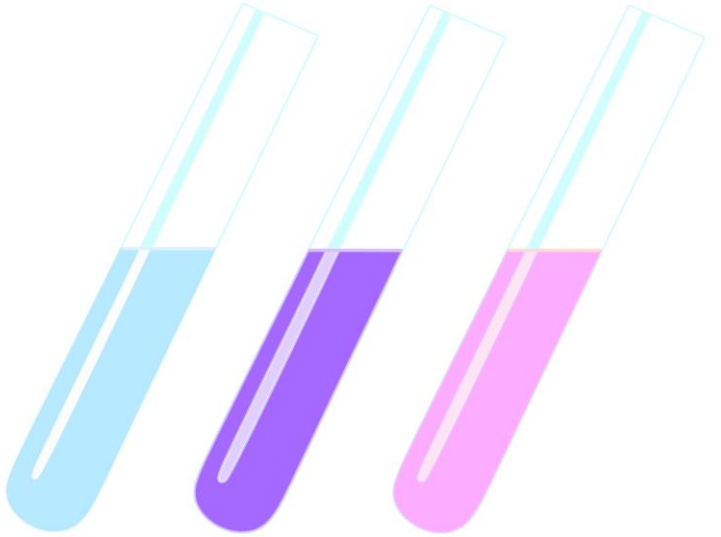
Which curve matches which chemical?

- A. I=a, II=b, III=c
- B. I=a, II=c, III=b
- C. I=b, II=a, III=c
- D. I=b, II=c, III=a
- E. I=c, II=a, III=b
- F. I=c, II=b, III=a

Q59

A Biuret test was carried out on samples from these experiments.

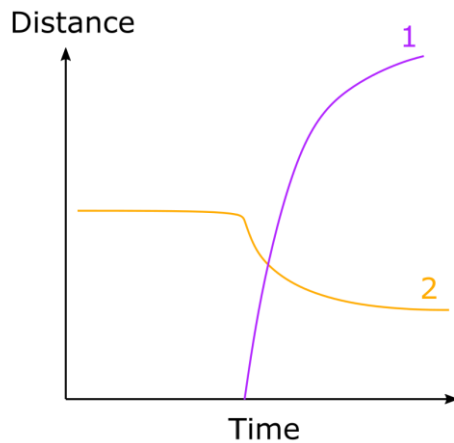
Which is order of samples, from left to right, giving the results shown in the test-tubes?



- A. Protein, protein exposed to pineapple, no protein
- B. Protein, no protein, protein exposed to pineapple
- C. Protein exposed to pineapple, protein, no protein
- D. Protein exposed to pineapple, no protein, protein
- E. No protein, protein, protein exposed to pineapple
- F. No protein, protein exposed to pineapple, protein

Q60

Two distances were measured during mitosis.



What were the distances?

	1	2
A	Distance between nuclei	Distance between centrioles and centromeres
B	Distance between centromeres of sister chromatids	Distance between centrioles and centromeres
C	Distance between centrioles and centromeres	Distance between centromeres of sister chromatids
D	Distance between centrioles	Distance between centrioles and centromeres

Q61

A student would like to film the movement of chromosomes during cell division. Their best choice for a microscope would be a

- A. light microscope, because of its resolving power
- B. transmission electron microscope, because of its magnifying power
- C. scanning electron microscope, because the specimen is alive
- D. transmission electron microscope, because of its great resolving power
- E. light microscope, because the specimen is alive

Q62

Which of the following is responsible for the high resolution of an electron microscope?

- A. Extremely thin sections
- B. High magnification
- C. The short wavelengths of the electron beam
- D. Using heavy metal stains

Q63

Which cellular structure is responsible for producing membrane bound vesicles?

- A. Golgi body
- B. Mitochondrion
- C. Nucleus
- D. Rough endoplasmic reticulum
- E. Smooth endoplasmic reticulum

Q64

Which of the following combinations of statements is correct?

1. The nuclear envelope consists of a single membrane layer.
2. The pH inside lysosomes is approximately 8.
3. Rough endoplasmic reticulum is coated with ribosomes.
4. Glycolysis takes place in mitochondria.
5. The pH in the matrix of mitochondria is higher than in the intermembrane space.

- A. 1, 3 & 5.
- B. 2, 4 & 5.
- C. 1, 2 & 3.
- D. 3 & 5 only
- E. 1 & 4 only

Q65

Which combination of the following statements concerning the fluid mosaic model of the cell membrane is true?

- i. The membrane is 6 – 10nm wide
 - ii. Phospholipid structure has a glycerol with three fatty acid groups attached
 - iii. Transmembrane proteins have a hydrophobic 'waist'
 - iv. The membrane surface has a negative charge
-
- A. all of them
 - B. i, ii and iii
 - C. i, iii and iv
 - D. ii, iii and iv
 - E. i and iii only

Q66

A scientist added a solution of positively-charged ions to a solution containing an animal cell and measured the concentration of the ions inside the cell 20 minutes later. If she repeated the experiment using a new cell and doubled the external concentration of the ions, the concentration inside the cell also was doubled. When she injected the living cell with a dye that specifically fluoresced when it bound to the ions, she saw that the cytoplasm fluoresced uniformly throughout the cell.

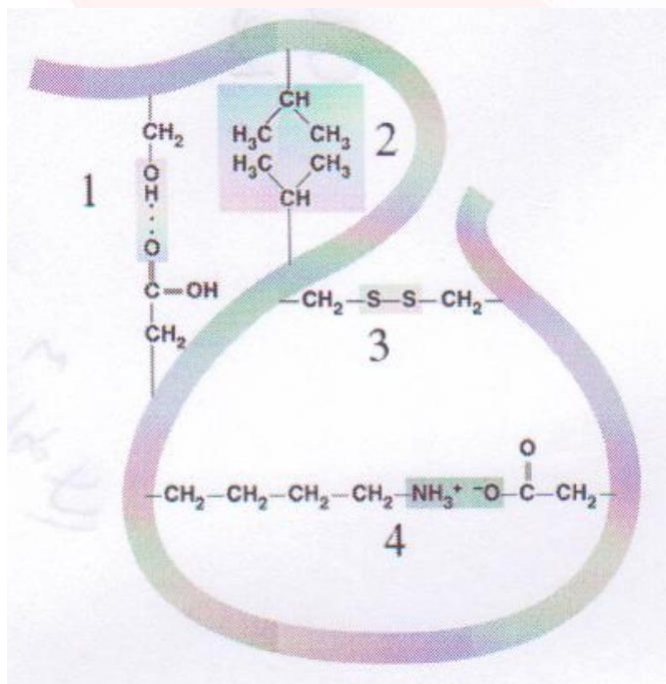
What is the most likely explanation for how the ions were taken up into the cell?

- A. Via channel proteins in the plasma membrane
- B. By active transport
- C. By simple diffusion through the membrane
- D. By endocytosis
- E. By osmosis

Q67

Various forces are important in the interactions contributing to the tertiary structure of a protein.

The figure below is a diagram showing several possible interactions.



Which of the following letters represent the correct names for each type of interaction?

	Hydrogen bond	Hydrophobic interaction	Disulphide bond	Ionic bond
A	2	3	4	1
B	1	2	3	4
C	1	2	4	3
D	3	1	2	4

Q68

A peptide six amino acids long was partially digested and the following peptides were produced:

TEY

YEG

EGG

EYE

What was the sequence of amino acids in the original peptide?

- A. TEEYGG
- B. YEGGTE
- C. EGGTEY
- D. TEYEGG

End