2020 British Biology Olympiad

British Biology Olympiad Question Paper

90 minutes

78 marks

Write your name, school and exam centre details on the top of the answer sheet.

You may use a calculator.

You may use a dictionary to translate words from English. (Scientific dictionaries may not be used.)

You may use spare paper for rough work or calculations.

Use black ink or black ball-point pen.

The paper consists of 78 questions. One mark per question.

Some questions have more than one answer you need to choose. For some questions, you need to put the answers in the correct order.

No marks are subtracted for incorrect answers.

At the end of the exam when you have completed the test and have checked your answers, return all test materials to the invigilator.

Section 1: Quickfire

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1. In which of the following polymers would you find alpha glucose joined only by 1,4 glycosidic bonds?

A. Amylopectin
B. Amylose
C. Cellulose
D. Glycogen

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2. Four different concentrations of glucose solution were each tested using Benedict's solution. The same volume of glucose and Benedict's solution was used in each case. After 5 minutes the colour of the precipitate was noted:

A. Sample 1: orange
B. Sample 2: yellow
C. Sample 3: green
D. Sample 4: brick-red

Place the samples in increasing order of concentration.

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3. Which of the following statements about clones is true?

A. Human twins are always clones
B. Only bacteria can form clones
C. Their DNA is identical
D. They will always show identical phenotypes

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4. Which of the following diseases may be treated with a course of antibiotics?

A. AIDS
B. Cholera
C. Common cold
D. Influenza

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5. Put the stages of meiosis in the correct order.

A. Chiasmata form
B. Homologous chromosomes separate
C. Non-identical sister chromatids separate
D. Homologous chromosomes pair up
E. DNA replicates

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6. The transpiration rate of a plant may vary during the day. Which of the following would result in an increase in transpiration?

A. A decrease in temperature
B. Closure of stomata
C. Humidity increasing
D. Wind speed increasing

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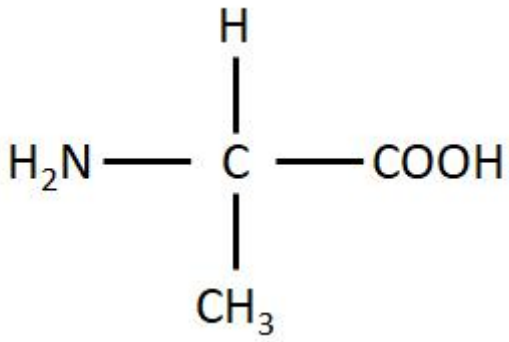
7. **The amino acid alanine is shown below.**



Which of the following parts of the molecule are the amino group, the carboxyl group and the R (variable) group?

	Amino Group	**Carboxyl Group**	**R Group**
A.	CH_3	COOH	NH_2
B.	CH_3	NH_2	COOH
C.	COOH	CH_3	NH_2
D.	NH_2	COOH	CH_3

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8. **Which of the following organelles is surrounded by a double membrane?**

A. Lysosome
B. Nucleus
C. Peroxisome
D. Smooth endoplasmic reticulum

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9. The wave of depolarisation across the walls of the atria in the heart is initiated by:

A. Atrioventricular bundle
B. Atrioventricular node
C. Bundle of His
D. Sinoatrial node

---

10. Sufferers of DiGeorge syndrome may not develop a thymus gland correctly. Which leucocytes (white blood cells) would be present in lower numbers in these individuals?

A. B lymphocytes
B. Dendritic cells
C. Helper T lymphocytes
D. Macrophages

---

11. Titin is the largest known protein and is a component of muscle. In humans the protein is 34,350 amino acids long.

What is the minimum length of the human gene for titin?

A. 34,350 bases
B. 68,700 bases
C. 103,050 bases
D. 137,400 bases

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12. Which of the following levels of organisation represents a <u>decrease</u> in hierarchy?

A. Community, population, ecosystem
B. Ecosystem, community, species
C. Population, community, organism
D. Species, community, population

Section 2: Biochemistry and Cell Biology

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13. In which of the following would ribosomal RNA be found?

1. Chloroplast
2. Lysosome
3. Mitochondrion
4. Nucleus

A. 1 and 3 only
B. 2 and 4 only
C. 1, 2 and 3 only
D. 1, 3 and 4 only

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14. Which factor impedes the movement of water molecules across a cell membrane?

A. Water molecules and the phospholipid fatty acid tails are both non-polar
B. Water molecules and the phospholipid fatty acid tails are both polar
C. Water molecules are non-polar but the phospholipid fatty acid tails are polar
D. Water molecules are polar but the phospholipid fatty acid tails are non-polar

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15. Tannins are chemicals produced by plants to defend themselves against herbivores, pathogens and UV radiation. They are found in grapes and help wine age.

In 2013 a group of scientists discovered that tannins are formed in separate organelles inside plant cells which they termed tannosomes. Tannosomes originate in chloroplasts as smaller vesicles and ultimately end up in the vacuole. Which of the following statements must be true of tannosomes?

A. Tannosomes are able to convert light energy to chemical energy
B. Tannosomes are bound by a phospholipid bilayer
C. Tannosomes contain DNA and can replicate independently of the cell
D. Tannosomes can only be present in green plant cells

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16. The coenzymes NAD and NADP are used in the processes of respiration and photosynthesis. They can exist in oxidised or reduced forms.

What is the most likely ratio of the oxidised : reduced form in the mitochondrial matrix and in the stroma of chloroplasts?

(A high ratio of oxidised : reduced indicates that most of the coenzyme is in its oxidised form).

	Mitochondrial Matrix	Chloroplast Stroma
A.	high ratio of oxidised : reduced	high ratio of oxidised : reduced
B.	high ratio of oxidised : reduced	low ratio of oxidised : reduced
C.	low ratio of oxidised : reduced	high ratio of oxidised : reduced
D.	low ratio of oxidised : reduced	low ratio of oxidised : reduced

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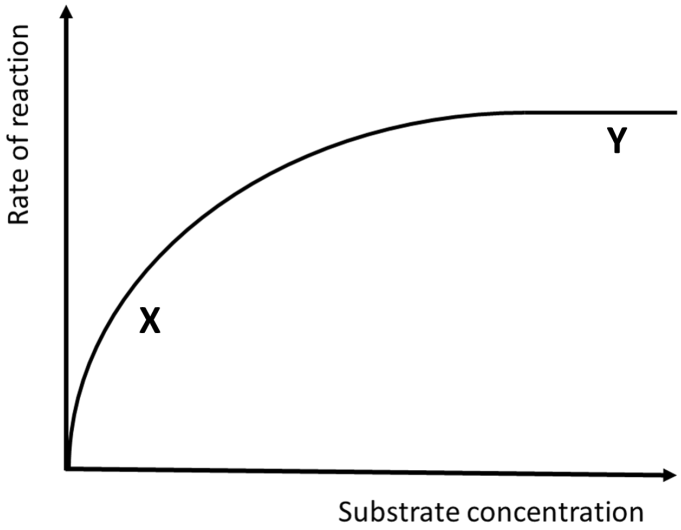
17. The graph below shows the rate of an enzyme controlled reaction at different substrate concentrations.



Which of these statements are correct?

1. At X, the rate of reaction is limited by the concentration of enzyme.

2. At Y, all of the enzyme active sites are occupied by substrate molecules.

3. At X, the rate of reaction is limited by the concentration of the substrate.

4. A competitive inhibitor would not affect the maximum rate of reaction.

A. 1 and 2 only
B. 1, 2 and 4 only
C. 1 and 3 only
D. 2, 3 and 4 only

18. What volume of 125 mmoldm^{-3} $MgCl_2$ stock solution would you need to use in order to give a final concentration of 20 mmoldm^{-3} in a total volume of 25 µl?

A. 0.25 µl
B. 4.0 µl
C. 5.0 µl
D. 6.25 µl

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19. 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

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20. How many different dipeptides can be made from 12 different amino acids?

A. 24
B. 48
C. 144
D. 288

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21. Which of these methods <u>cannot</u> be used to transport large molecules across the cell surface membrane?

A. Active transport
B. Endocytosis
C. Facilitated diffusion
D. Osmosis

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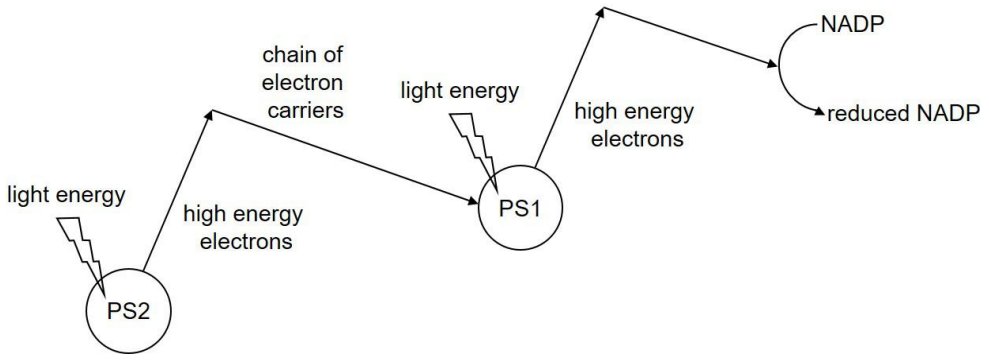
22. The flow diagram shows some of the light dependent reaction (LDR) processes in photosynthesis.



For the LDR to continue, photosystem 2 (PS2) must gain electrons. Where do these electrons come from?

A. ATP production
B. Photolysis
C. Photosystem 1
D. Reduced NADP

Section 3: Physiology

23. Which of the following would lead to the resting potential of a neurone becoming more negative?

A. A decrease in the concentration of potassium ions inside the cell
B. A decrease in the permeability of the membrane to potassium ions
C. An increase in the concentration of potassium ions inside the cell
D. An increase in the permeability of the membrane to sodium ions

24. The following table gives the volume of oxygen stored in humans and seals per kilogram of body mass.

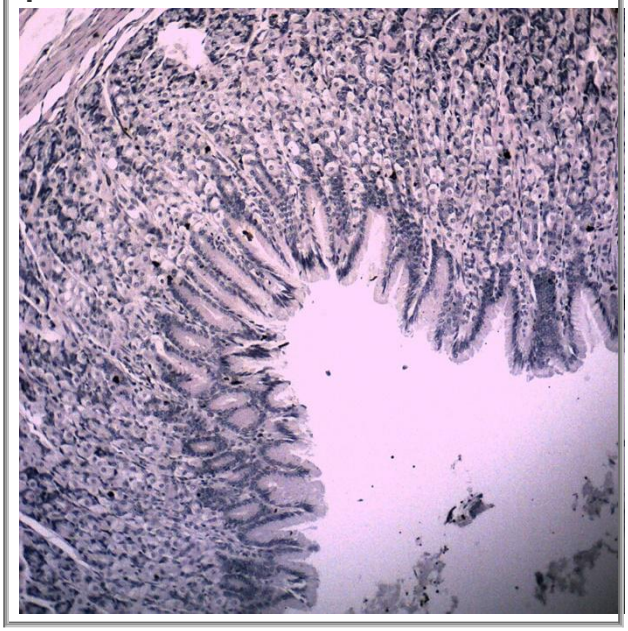
	Volume of oxygen / ml kg^{-1}	
	Human	**Seal**
Lungs	10.3	1.8
Blood	11.8	37.5
Muscle	3.4	9.0
Tissue	2.9	3.3
Total	28.4	51.7

Which molecule accounts for the high oxygen content in the muscles of seals?

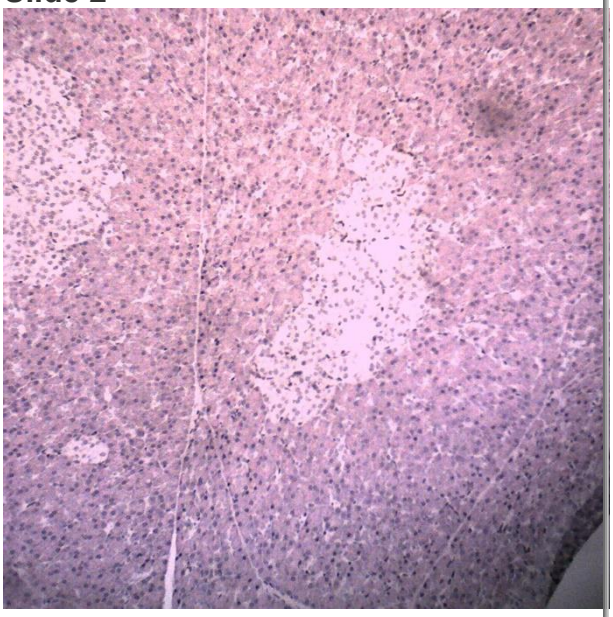
A. Actin
B. Haemoglobin
C. Myoglobin
D. Myosin

25. Which of the following organs are shown in the following images?

Slide 1

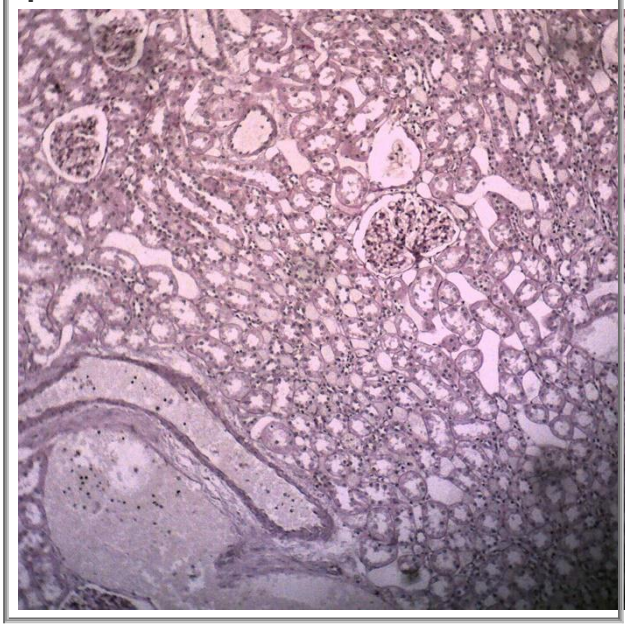


Slide 2



Slide 3

Slide 4



	Slide 1	Slide 2	Slide 3	Slide 4
A	pancreas	stomach	ovary	kidney
B	stomach	pancreas	ovary	kidney
C	kidney	ovary	pancreas	stomach

D	stomach	kidney	pancreas	ovary

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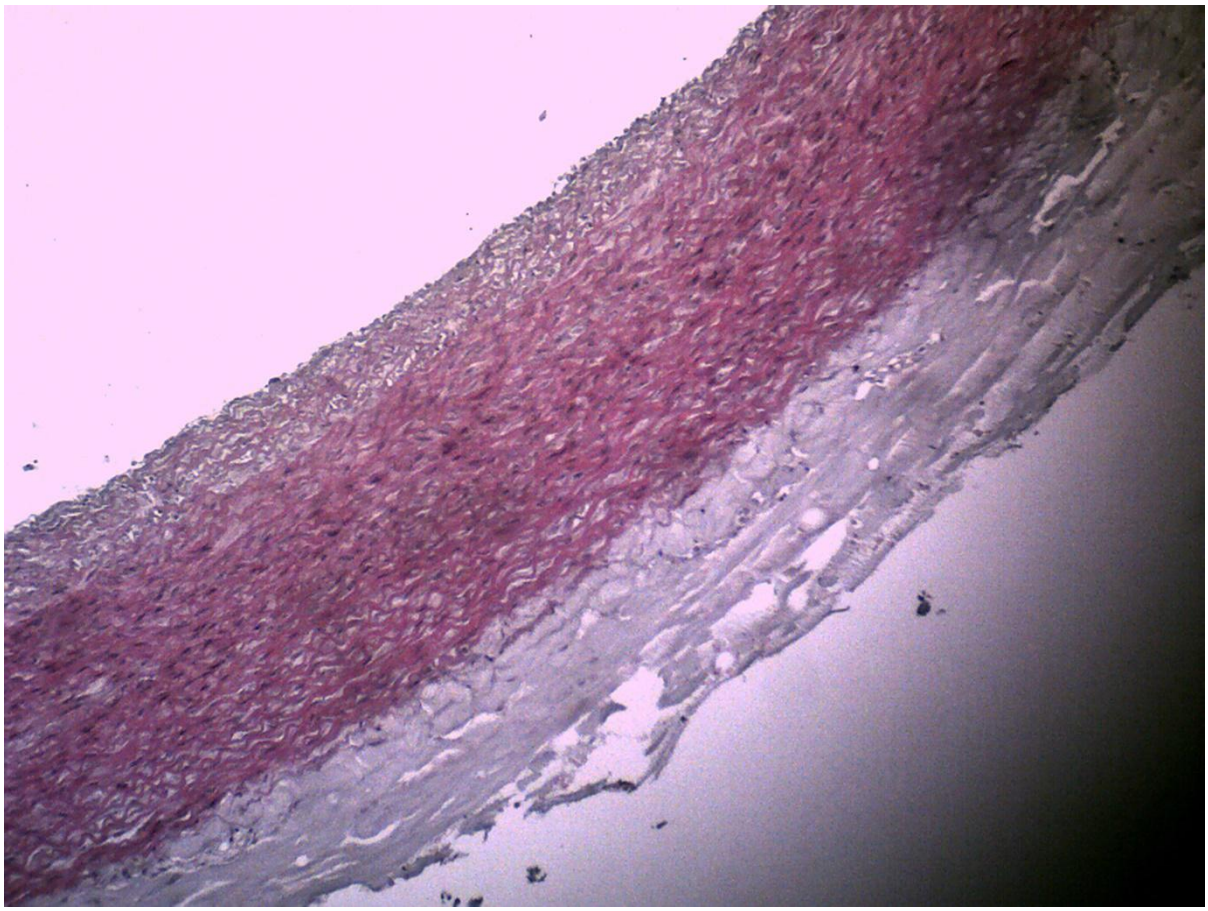
26. The image below is of the trachea. Which tissues are represented by the letters A and B?

A. A is cartilage, B is collagen
B. A is cartilage, B is smooth muscle
C. A is smooth muscle, B is collagen
D. A is smooth muscle, B is cartilage

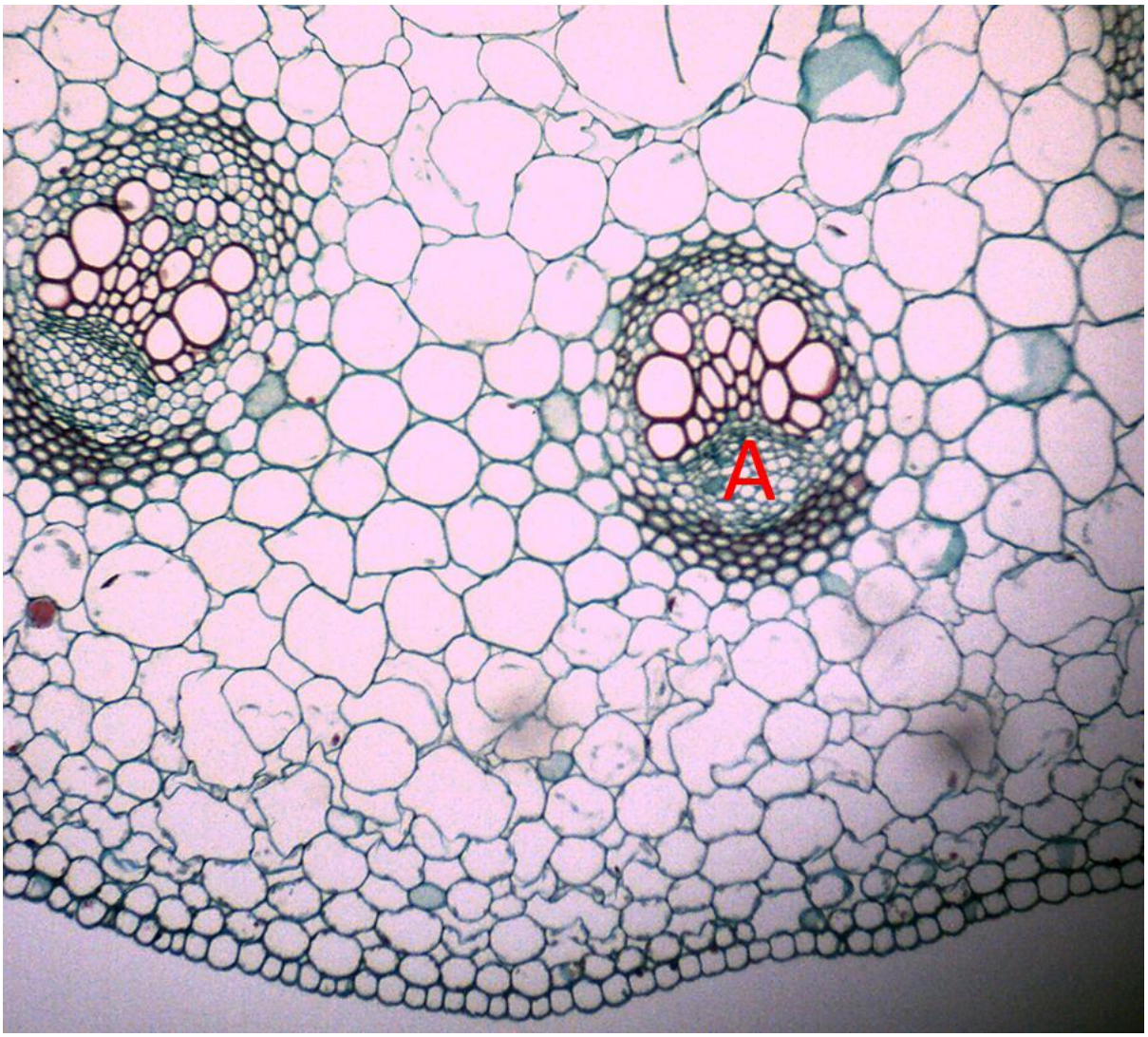
---

27. Which tubular structure is shown in the image below?



A. Artery
B. Lymph vessel
C. Oesphagus
D. Vein

28. Which carbohydrate would be found in high concentrations in the tissue labelled A in the image below?



A. Fructose
B. Glucose
C. Starch
D. Sucrose

29. In the conversion of RuBP to glycerate 3-phosphate (PGA/G3P):

A. A molecule of carbon dioxide is accepted
B. A stable six carbon molecule is formed
C. ATP is generated
D. Two x three carbon compounds are combined

Section 4: Diversity of Life

30. In which kingdom would a single-celled organism possessing a nucleus and chloroplasts be classified?

A. Fungi
B. Prokaryotae
C. Protoctista
D. Plantae

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31. The average efficiency of energy transfer between plants and herbivores is 10% but from herbivores to carnivores is about 20%.

This difference is because:

A. Carnivores egest less material than herbivores
B. Carnivores have a more specialised diet
C. Herbivores eat a lower mass of plants
D. Herbivores lose more heat energy than carnivores
E. Plant material is richer in lipids

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32. If larvae of a particular species of mosquitos are to survive to the adult stage, the eggs must be laid in a trapped pool of water of the northern pitcher plant, a carnivorous plant. The mosquito larvae do not seem to benefit or harm the pitcher plant. This type of interaction is known as:

A. Commensalism
B. Mutualism
C. Parasitism
D. Predation

---

33. When herbivores consume autotrophs, they use energy in a number of ways. Which of the following is <u>not</u> one of these:

A. Digestion
B. Heat loss
C. Movement
D. Releasing nutrients back into the food chain

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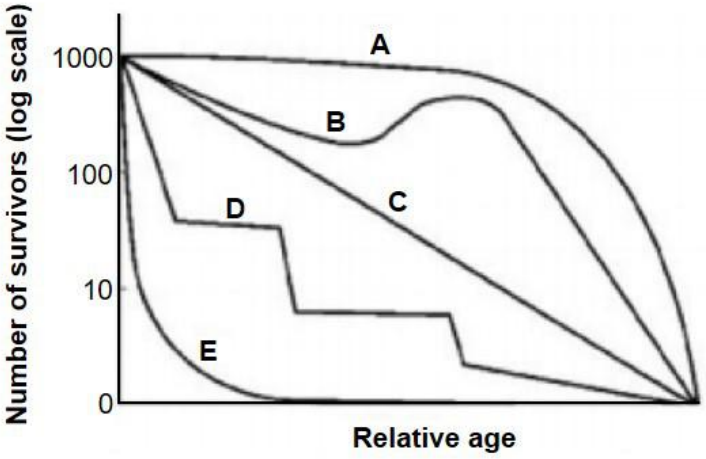
34. The graph below shows some survival curves.



Which curve best describes survival in frogs?

A.
B.
C.
D.
E.

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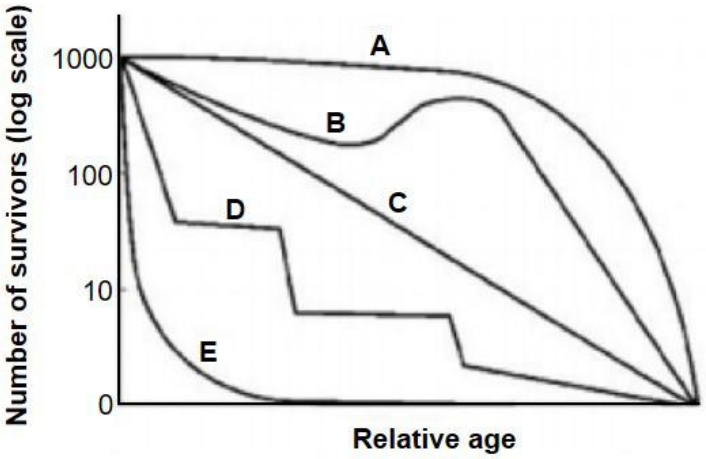
35. The graph below shows some survival curves.



Which curve best describes the survival of a marine crustacean?

A.
B.
C.
D.
E.

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36. Cell walls of xylem vessels and tracheids of vascular plants contain a phenolic polymer called lignin, which together with cellulose gives mechanical strength to these water conducting tissues.

Which of the following is the correct response if vessels and tracheids are deficient in lignin?

A. They burst outward when transpiration is very active
B. They burst outward when transpiration is very inactive
C. They collapse inward if transpiration is very active
D. They collapse inward if transpiration is very inactive

37. **Detritivores play an important part in the recycling of nutrients in the soil.**

Select the line which shows the correct classification of detritivores and the product formed in the soil.

A. Bacteria - ammonium ions
B. Bacteria - humus
C. Invertebrates - ammonium ions
D. Invertebrates - humus

Section 5: Genetics

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38. **In the fruitfly *Drosophila* the dominant allele *Cy* causes curly wings when heterozygous, but is lethal when homozygous. A fly homozygous for the recessive allele, *cy*, forms normal, straight wings.**

In a cross between a curly-winged fly and a straight-winged fly, how many of the offspring would have straight wings?

A. 0%
B. 25%
C. 50%
D. 75%
E. 100%

---

39. **In the *lac* operon, which of the following proteins have DNA binding sites?**

beta-galactosidase
galactose
RNA polymerase
repressor protein

A. beta-galactosidase and galactose only
B. galactose and repressor protein only
C. RNA polymerase and repressor protein only
D. RNA polymerase and galactose only

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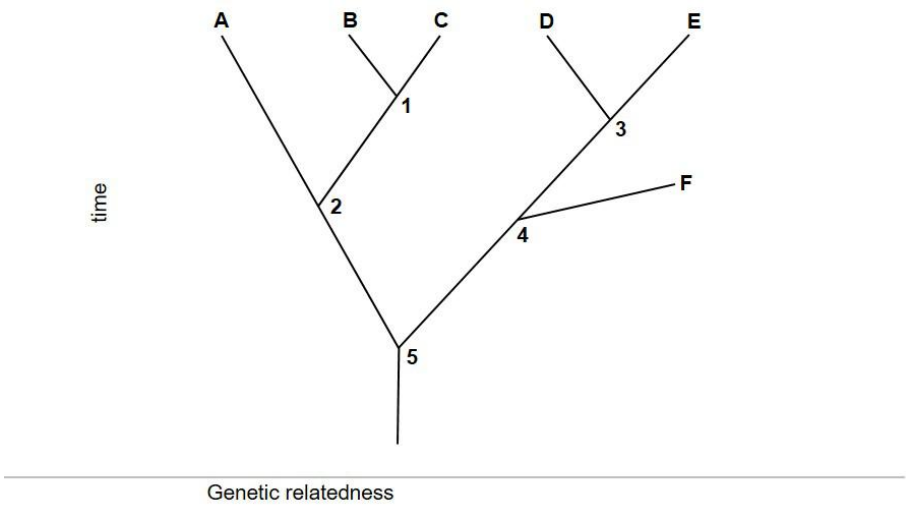
40. Consider the following diagram:



Which two species are most closely related?

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

---

41. In a population of 200 small mammals, there were 72 albinos. Assume that the gene for albinism is recessive to the gene for coloured hair and that there is random mating with no mutation occurring.

How many mammals in the population were homozygous for brown hair?

A.16
B. 32
C. 64
D. 128

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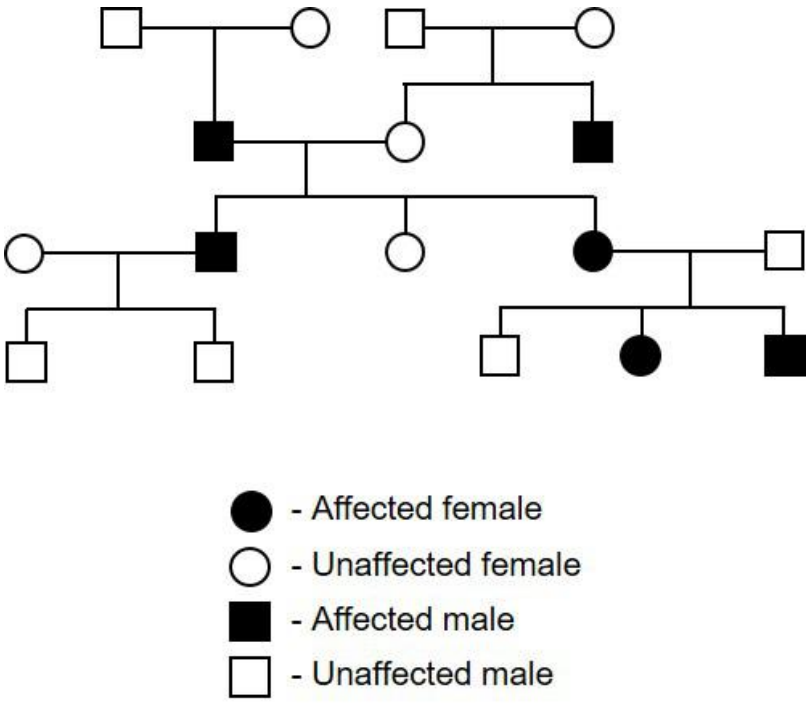
42. The diagram shows the pedigree of a family tree affected by a particular disease.



Which is the most likely explanation of the way the disease is inherited?

A. Sex linkage on the X-chromosome
B. Sex linkage on the Y-chromosome
C. Autosomal dominant allele
D. Autosomal recessive allele

---

43. Domestic rabbits were introduced to the Farne Islands and isolated for several generations. Amongst this population were black rabbits whose coat colour was due to a recessive gene. If 9% of the population were black, what proportion (%) heterozygous?

A. 58
B. 48
C. 42
D. 21

---

44. In humans, identical twins occur in about one in 300 births. Assuming that dark hair is dominant to red hair, what are the chances of a dark haired couple, each of whom had a red haired parent, having red haired identical twin boys?

A. 1/600
B. 1/1,200
C. 1/2,400
D. 1/4,800

Section 6: Quickfire II

45. The principle of competitive exclusion states that two species cannot occupy the same niche in the same habitat. Why?

A. Members of one species will kill members of the other
B. One species will already be established before the other arrives
C. One species will be better adapted to the niche than the other
D. The two species will interbreed
E. There is not enough food for two species to share

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46. Sometimes animals need to move quickly away from predators; however, digesting food takes time.

Which is <u>not</u> a store of energy that can be used in a 100 meter sprint?

A. ATP
B. Fat
C. Glucose
D. Glycogen
E. Phosphocreatine

---

47. Which of the following does not need to use transporter proteins to cross cell membranes?

A. ATP
B. Glucose
C. mRNA
D. Proteins
E. Testosterone

---

48. **A neurone conveys information with an electrical signal. How does the electrical signal change when the stimulus becomes stronger?**

A. Different frequency
B. Greater amplitude
C. Opposite charge
D. Smaller amplitude
E. Travels in a different direction

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49. **Keystone species have a disproportionate effect on other species in a habitat and increase the overall diversity of an ecosystem.**

Which of these is <u>least</u> likely to be a keystone species?

A. Beaver
B. Coral
C. Great white shark
D. Oak tree
E. Zebra

---

50. **Which of the following is an animal hormone?**

A. Auxin
B. Cytokinin
C. Glucose
D. Glucagon
E. Glyphosate

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51. **Which pair of organelles has internal membranes?**

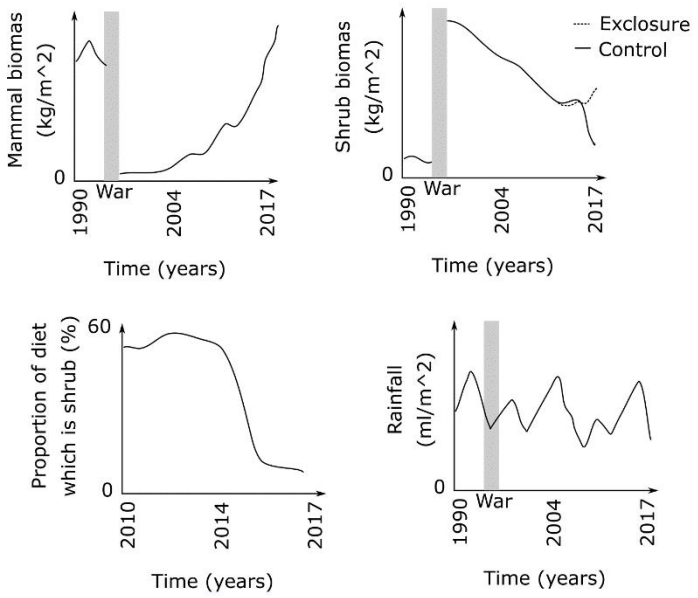
A. Ribosomes and mitochondria
B. Mitochondria and chloroplasts
C. Nuclei and chloroplasts
D. Nuclei and ribosomes

Section 7: Plants

52. **It is not known whether conservation programs for large mammals also benefit other organisms in the habitat.**

In Mozambique, a war severely disrupted the habitat. The biomass of large mammals, the biomass of an invasive shrub, the diet of large mammals, and rainfall, were measured.

In 2015, ecologists erected exclosures, which are fences around some areas to keep out large mammals.



Which of the following hypotheses is supported by these data?

A. Rainfall had a greater impact on shrub biomass than herbivory
B. Preventing poaching of large mammals could help conserve a habitat
C. Large mammals died during the war mostly because their food supply was destroyed
D. Large mammals do NOT like to eat the shrub if other options are available
E. Large mammal populations cannot recover easily once a habitat is degraded
F. Rainfall determined the diet of large mammals

53. **Atmospheric carbon dioxide is increasing rapidly from its long-term average of ~ 280 parts per million to around 415 parts per million today.**

Ignoring the effect of weather and climate, what effect will this have?

A. Faster rate of anaerobic respiration
B. Faster rate of breathing
C. Faster rate of photosynthesis
D. Oceans become more alkaline
E. Plants using C4 photosynthesis become more common

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54. **The development of each part of a flower is determined by whether three transcription factors (A, B or C) are turned on. The table shows which parts of the flower A, B and C are turned on in.**

Sepal	A
Petal	A & B
Stamen	B & C
Carpel	C

Which of these predictions is true?

A. Flowers lacking gene A have petals
B. Flowers lacking gene B have petals
C. Flowers lacking gene C have stamens
D. Flowers lacking gene B have sepals and carpels
E. Flowers lacking gene C can be pollinated

---

55. **Plants do not have a skeleton like animals.**

How do they maintain their structure?

A. Plants are lightweight so do not need structural support
B. Plants lean on each other in forests
C. Proteins hold cell walls together making them rigid
D. The xylem is a strong rod down the middle of stems
E. Water pressure pushing against cell walls

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56. **Recently, there have been large fires in Australia.**

Which characteristic will the plants which replace burnt woodland most likely possess?

A. Grow best in shade
B. Long lifespans
C. Part of climax community
D. Rapidly growing
E. Slow to set seed

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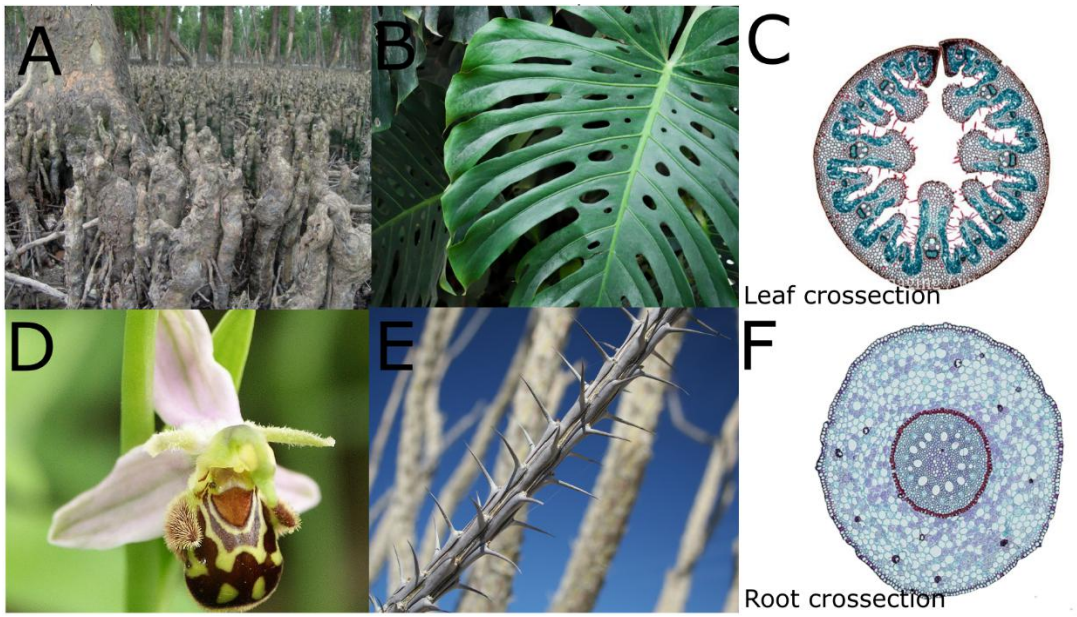
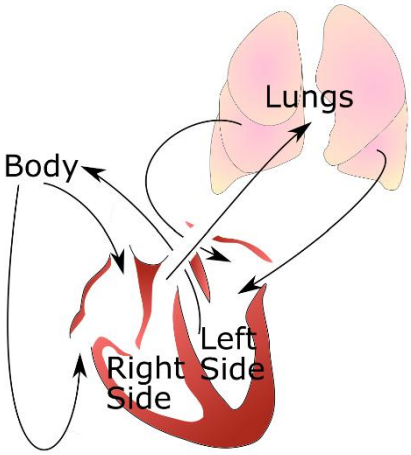
57. Which plant shows adaptations for living in dry environments?



A.
B.
C.
D.
E.
F.

Section 8: Animals

58. The route blood flows around humans is shown.



In a rare disease, the veins of the lungs become blocked and constricted.

What is a symptom of this disease?

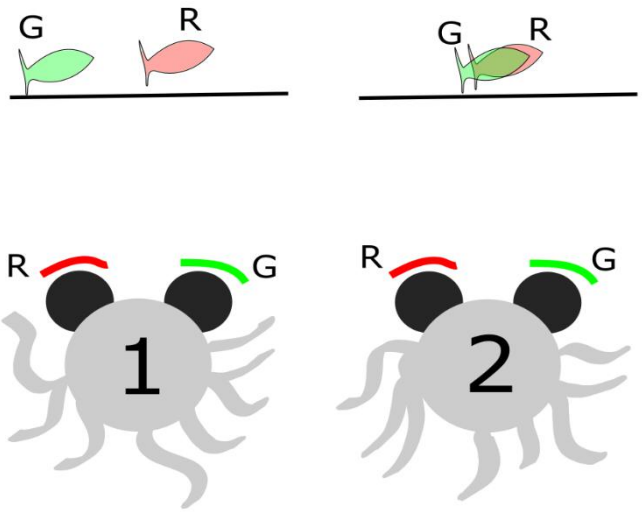
A. Ability to do physical activities and exercise increases
B. Arterial blood pressure in the body increases
C. Cardiac output (volume of blood pumped by the heart per minute) increases
D. Less fluid is found within the lungs
E. Right side of the heart swells

59. Which of the following is true of human metabolism?

A. Fats are not needed except as an energy store
B. Fats can be used in anaerobic respiration
C. Proteins cannot be used as an energy source
D. Storing sugar results in more retention of water than storing fat
E. Sugars provide more energy than fat because they are less oxidised

60. **Stereopsis is a way the brain uses the angle between images seen with each eye to calculate how far away an object is.**

To test whether cuttlefish use stereopsis, they were fitted with red (R) and geen (G) filtered eyeglasses and red and green images of prey were projected on a screen. The distance the cuttlefish reached with their tentacles to grab the virtual prey was measured.



Which of these ideas is true?

A. If cuttlefish use stereopsis, cuttlefish 1 will reach further than cuttlefish 2
B. If cuttlefish use stereopsis, they do NOT need adjustable lenses in their eyeball to focus objects at different distances
C. Stereopsis is better at determining the distance of near objects than objects very far away
D. The conclusions of this experiment are more robust if different cuttlefish are shown one projection each, than if the same cuttlefish are shown both projections in a random order
E. This experimental technique only works for animals which can see colour

61. **Insulin can be given to diabetics, but the effect it has depends on various factors.**

What will <u>not</u> affect how a cell responds to insulin?

A. Concentration of insulin
B. The number of insulin receptors the cell expresses
C. The presence/absence of other hormones
D. Whether the insulin was produced in yeast or animals
E. Which genes are silenced in that cell type
F. Which type of insulin receptors the cells express

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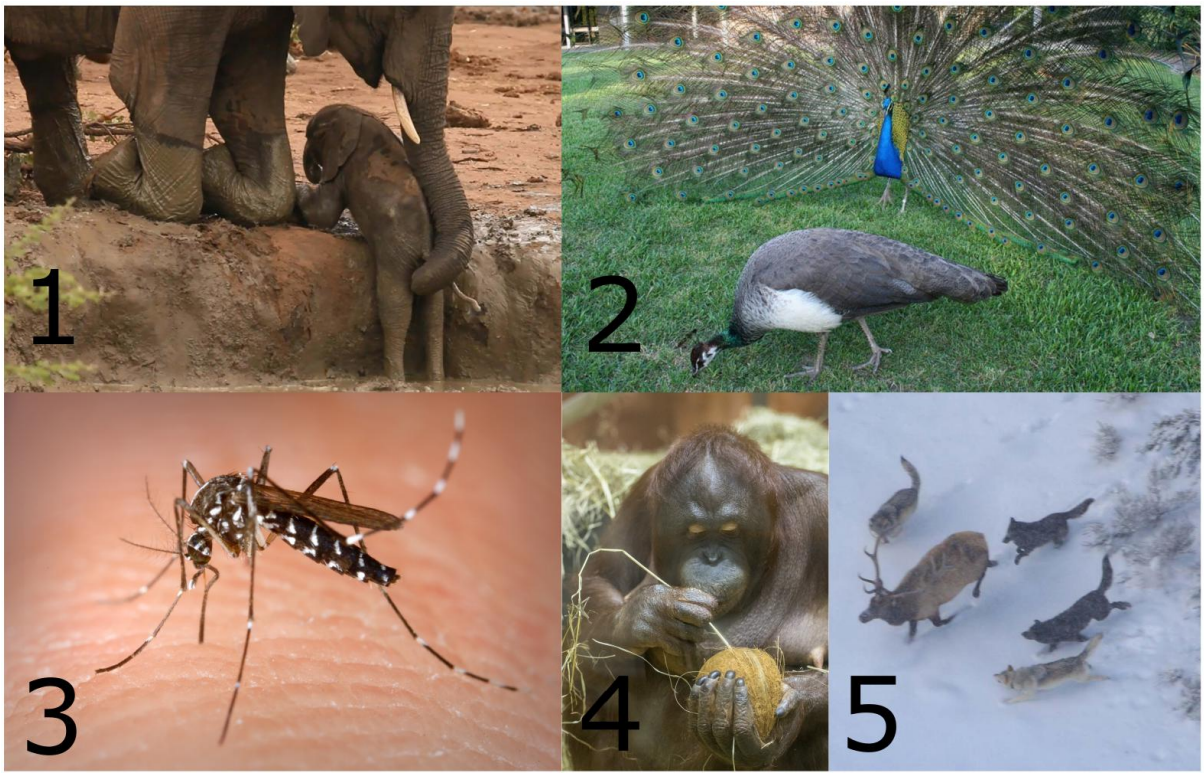
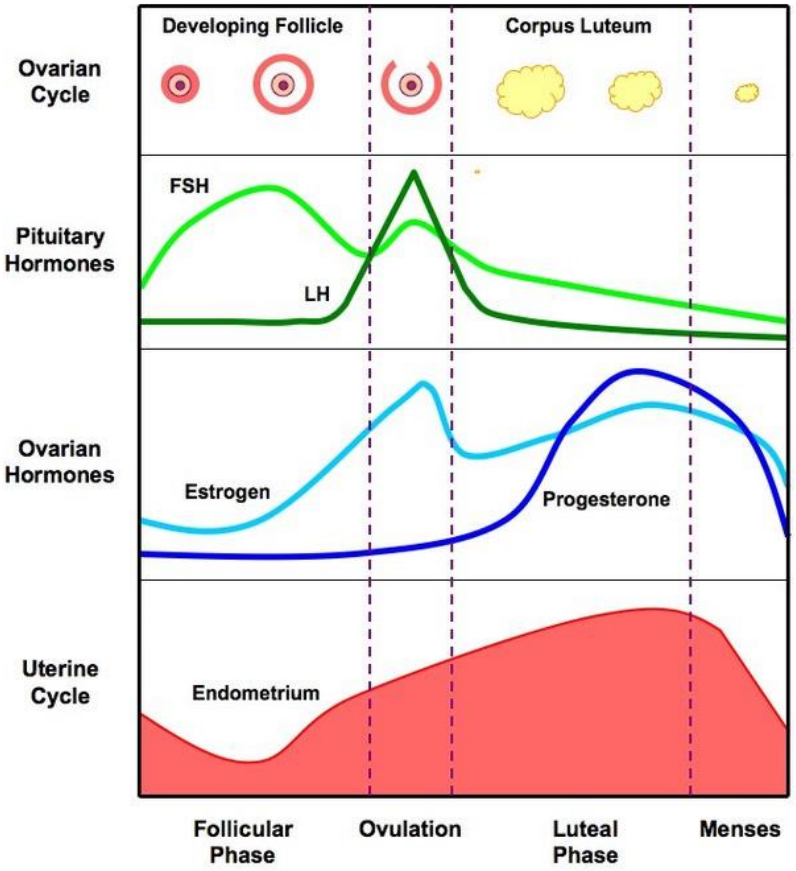
62. **Which animal is behaving altruistically?**



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

63. During the menstrual cycle, changes within the ovary and uterus are coordinated by hormones.



Which of the following is true?

A. An LH tablet would work well as a contraceptive
B. LH stimulates the release of the egg
C. Progesterone stimulates the thickening of the uterine lining
D. The most likely time to get pregnant is when progesterone is high
E. You cannot get pregnant when FSH is high

Section 9: Data handling

64. **There are different kinds of clinical study:**

1) Case-control study: A group of diseased people are compared to a group of similar healthy people to see what is different between the diseased and healthy people.

2) Longitudinal Study: Two groups of healthy people who are similar except for one factor (e.g. smoking) are studied over time to see who develops disease.

3) Controlled trial: A group of similar people are randomly administered an intervention or a placebo to see if the intervention has an effect.

4) Mendelian randomisation: People who have alleles which cause them to be exposed to a certain factor (e.g. alleles which cause obesity) are compared to similar people who do not have those alleles to see if the factor causes disease.

Different kinds of study have different disadvantages:

A) Very expensive to setup and carry out
B) Often unethical
C) Provides weakest evidence
D) Not practical for rare diseases
E) Results cannot be understood without prior knowledge of biology

Match the study to the disadvantage(s).

A. 1-C, 2A, 3-BE, 4-D
B. 1-C, 2-BD, 3-A, 4-E
C. 1-C, 2-D, 3-AB, 4-E
D. 1-A, 2-D, 3-BE, 4-C
E. 1-A, 2-C, 3-DB, 4-E
F. 1-EA, 2-B, 3-C, 4-D
G. 1-E, 2-C, 3-AD, 4-B
H. 1-B, 2-ED, 3-A, 4-C
I. 1-B, 2-AE, 3-C, 4-D
J. 1-DE, 2-A, 3-B, 4-C
K. 1-D, 2-E, 3-C, 4-BA

65. **There are several related theories of how bones sense forces:**

1) Flexing of the bone forces fluid through micro channels in the bone

2) Bone is piezoelectric, so when it is bent, electrical charges separate between the inside and outside of the curve

3) Bone growth is stimulated by hormones known as bone morphogenetic proteins

4) High forces stimulate cells which deposit calcium compounds in bone

Several pieces of evidence support the importance of these theories for regulating bone strength:

A) Applying a potential difference across a bone can strengthen it

B) Exercise routines with elasticated equipment prevents bone weakening in astronauts

C) High frequency flexing of bone increases strength more than low frequency flexing

D) Injecting viruses carrying certain genes can turn muscle into bone

Match the theory to the evidence

A. 1-D, 2-C, 3-B, 4-A
B. 1-D, 2-B, 3-A, 4-C
C. 1-A, 2-A, 3-D, 4-B
D. 1-A, 2-D, 3-B, 4-C
E. 1-A, 2-B, 3-D, 4-C
F. 1-B, 2-D, 3-C, 4-A
G. 1-B, 2-A, 3-D, 4-C
H. 1-B, 2-C, 3-D, 4-B
I. 1-C, 2-D, 3-A, 4-B
J. 1-C, 2-A, 3-B, 4-D
K. 1-C, 2-A, 3-D, 4-B

66. **Piezo proteins are cell-surface proteins which allow cells to sense mechanical force (e.g. touch). Unexpectedly, people with mutant Piezo proteins have been found to have shrivelled red blood cells, which look like those of Sickle cell anemia patients.**

What is <u>not</u> a sensible hypothesis regarding Piezo proteins?

A. Piezo gene mutations are more common in Africa
B. People with Piezo gene mutations are resistant to Plasmodium infections
C. People with Piezo gene mutations have poor coordination
D. The allele frequency of Piezo gene mutations is less than 50%
E. There are exactly twice as many heterozygous Piezo gene mutation carriers as homozygotes

---

67. **In the UK, there is thought to be around 1 person with an undiagnosed HIV infection for every 10 000 uninfected people. Data for two new self-testing kits are shown:**

Test A: Sensitivity = 99.9%, Specificity = 99.99%
Test B: Sensitivity = 99%, Specificity = 99.999%

<u>Sensitivity</u>: The percentage of sick people who are accurately diagnosed as being sick
<u>Specificity</u>: The percentage of healthy people who are correctly identified as being healthy.

People with a positive result are told to go to their doctor for a re-test and then treatment.

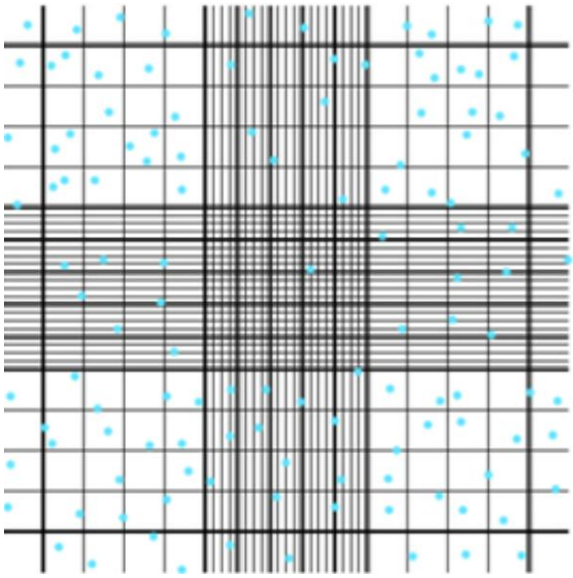
What is true about these tests when they are taken in the UK?

A. If everyone is tests themselves, Test B will give more positive results than Test A
B. Pharmacies should offer Test A rather than Test B
C. Someone with a negative result from Test B has a 1% chance of having HIV
D. Someone with a positive result from Test A is more likely to have HIV than they are to not have HIV
E. Test A is better at ruling out false positive results than Test B

---

68. **You want to estimate the number of cells in a sample.**

You take a portion of the sample, dilute it and add it to a cell chamber (haemocytometer) which contains squares of a known volume and look at it with a microscope.



What is true about the estimate you make?

A. It will be higher if you add more sample to the cell chamber
B. It will be more accurate if you count all of the cells which overlap with the borders of the squares you count
C. It will be more accurate if you count cells in more of the squares
D. It would be more accurate if the sample was diluted more
E. It would be more accurate if you use the small central squares to count larger cells

Section 10: Cell biology

69. **Phages are viruses, containing both protein and DNA, that infect bacteria. Phages were created which contained radioactive sulfur (^{35}S) and phosphorus (^{32}P), instead of normal sulfur and phosphorus.**

The phages were incubated with bacteria. The amount of radioactive sulfur and phosphorus remaining in phage particles or transferred to the bacteria was measured.

	^{35}S	^{32}P
Proportion of radioactivity remaining in phage particles	~ 75%	~ 15%
Proportion of radioactivity transferred to bacteria	~ 25%	~ 85%

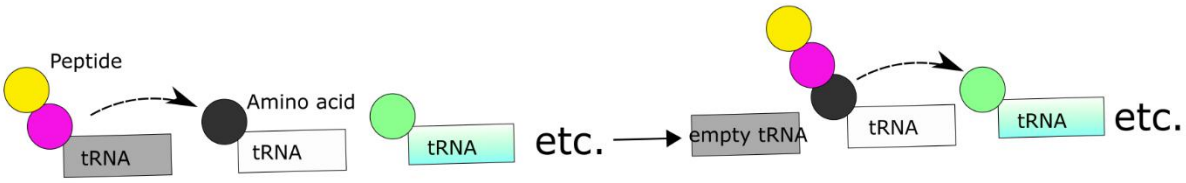
Secondly, the amount of radioactivity which was transferred to new phage particles produced by the infected bacteria was measured.

	^{35}S	^{32}P
Proportion of radioactivity transferred to new phage particles	< 1%	~ 30%

What hypothesis is consistent with these data?

A. All phage particles are able to infect bacteria
B. Phage DNA contained sulfur but no phosphorus
C. Phage DNA was NOT recycled to make new phage particles
D. Phage proteins were NOT recycled to make new phage particles
E. Phages mostly injected their protein, rather than their DNA, into bacteria

70. **Ribosomes catalyse multi-step reactions between peptide-tRNA and amino-acid-tRNA. The empty tRNA is released after each step.**



In an experiment, ribosomes and all the other factors needed for translation, are mixed with radioactive tRNAs carrying amino acids.

In the presence of the drug tetracycline, the ribosomes are only half as radioactive as they are usually, and peptide synthesis is slowed or stopped.

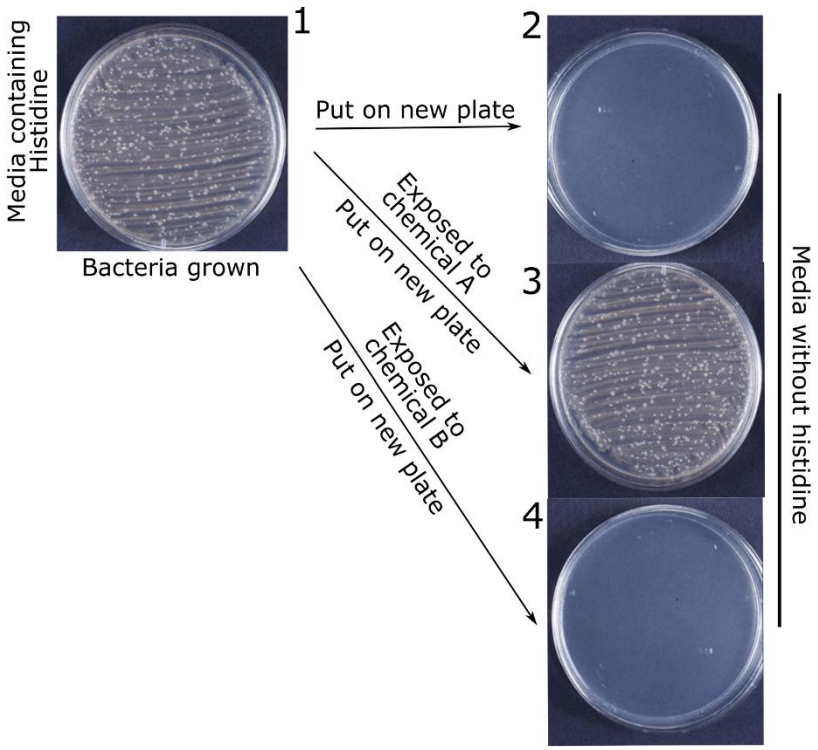
In the presence of puromycin, ribosomes produce incomplete peptides of variable length.

In the presence of both tetracycline and puromycin, the ribosomes are not radioactive.

Which of these hypotheses is consistent with this data?

A. Puromycin and tetracycline bind the same site on ribosomes
B. Puromycin prevents the binding of amino acid-tRNA to ribosomes
C. Puromycin reacts with the peptide chain, replacing the amino-acid-tRNA
D. Ribosomes can bind 3 tRNAs at any one time
E. Tetracycline prevents the release of empty tRNA

71. The Ames test is used to test whether chemicals can cause mutations in DNA. The bacteria on plate 1 have special edits in the gene used to produce the amino acid histidine.



Which conclusion is correct?

A. Bacteria put on plate 1 can produce histidine
B. Bacteria put on plate 2 can produce histidine
C. Bacteria put on plate 4 can produce histidine
D. Chemical A causes mutations in DNA
E. Chemical B causes mutations in DNA

72. **Genes A, B, C and D relay signals to one another in a chain, leading to the development of the vulva (reproductive organ) of worms.**

A → B → C → D → vulva

Mutant genotype	Phenotype
Loss of gene A	Multiple vulvas
Loss of gene B	No vulva
Loss of gene C	No vulva
Extra copies of gene D	Multiple vulvas

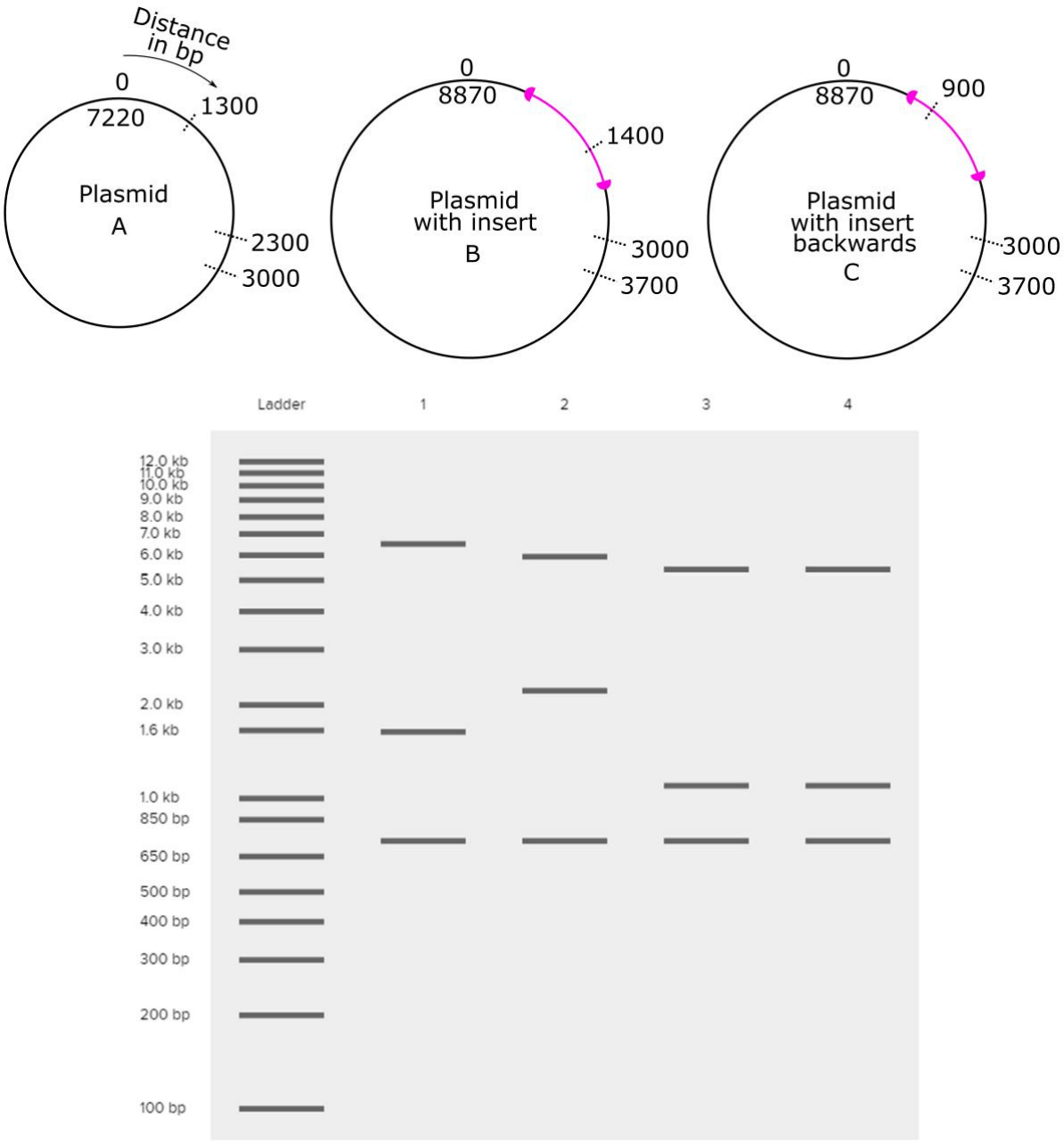
Which of these predictions is correct?

A. Combined loss of gene A and B leads to multiple vulvas
B. Extra copies of gene A leads to no vulva
C. Gene A promotes vulva development
D. Gene B inhibits vulva development
E. Gene D has no role in vulva development

73. **You want to insert a gene into a plasmid.**

You test whether the gene inserted into the plasmid correctly by performing a restriction enzyme digest, followed by gel electrophoresis.

Cut sites are shown with dashed lines. bp = base pairs, kb = kilobase pairs.



Which plasmid is in each lane of the gel?

A. 1=A, 2=B, 34=C
B. 1=A, 2=C, 34=B
C. 1=B, 2=C, 34=A
D. 1=B, 2=A, 34=C
E. 1=C, 2=B, 34=A
F. 1=C, 2=A, 34=B
G. Not possible to tell

Section 11: Quickfire III

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74. When are DNA polymerases essential?

A. During mitosis
B. During PCR reactions
C. During transcription
D. During translation
E. Only in Eukaryotes

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75. Which is a learned behaviour?

A. A bird chick pecking its mother for food
B. A turtle hatchling crawling towards the ocean
C. Ducklings following their mother in a flock of birds
D. Removing your hand from a hot stove
E. Stickleback fish attacking red fish in a shoal of fish

---

76. Which is <u>not</u> involved in making proteins from DNA?

A. Endoplasmic Reticulum
B. Nucleus
C. Nucleolus
D. Plasmodesmata
E. Ribosome
F. Spliceosome

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77. An enzyme catalyses the production of glucose from glucose-6-phosphate.

At the beginning of the experiment glucose-6-phosphate was added to the enzyme. After half an hour 60% of the glucose-6-phosphate remained.

What is true about this reaction?

A. Adding a second enzyme which breaks down glucose would speed up the reaction
B. After an hour 20% glucose-6-phosphate would remain
C. The enzyme would probably work with sucrose-6-phosphate
D. The reaction can only occur in the presence of an enzyme
E. The reaction would happen quicker at 100 degrees C

78. **Some breeds of cat can be black, yellow or tortoise shell (black and yellow patches).**

Almost all tortoiseshell cats are female. They are the offspring of either tortoiseshell females or of one black and one yellow parent. What contributes to this phenomenon?

A. Female cats have colder skin
B. Fur colour is Y-linked (carried on Y the chromosome)
C. Half the X-chromosomes are inactivated in females
D. Male tortoiseshell cats are more likely to be predated
E. The same gene controls male sterility and tortoiseshell colour
F. Tortoiseshell colouring is switched on by oestrogen

END.

2020 British Biology Olympiad

British Biology Olympiad Answers

Section 1: Quickfire

1.	B
2.	D, A, B, C
3.	C
4.	B
5.	E, D, A, B, C
6.	D
7.	D
8.	B
9.	D
10.	C
11.	C
12.	B

Section 2: Biochemistry and Cell Biology

13.	D
14.	D
15.	B
16.	B
17.	D
18.	B
19.	C
20,	C
21.	D
22.	B

Section 3: Physiology

23.	C
24.	C
25.	B
26.	B
27.	A
28.	D
29.	A

Section 4: Diversity of Life

30.	C
31.	A
32.	B
33.	D
34.	E
35.	D
36.	C
37.	A, B, C, D

Section 5: Genetics

38.	C
39.	C
40.	B
41.	B

42. D

43. C

44. C

Section 6: Quickfire II

45. C

46. B

47. E

48. A

49. E

50. D

51. B

Section 7: Plants

52. B

53. C

54. D

55. E

56. D

57. C

Section 8: Animals

58. E

59. D

60. D

61. D

62. A

63. B

Section 9: Data handling

64. C

65. K

66. E

67. B

68. C

Section 10: Cell biology

69. D

70. C

71. D

72. B

73. C

Section 11: Quickfire III

74. B

75. C

76. D

77. A

78. C