GRE Biology Practice Test

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July 21, 2020

1 Hydrogen Bonds

E - A hydrogen bond will form between a lone pair on an O, N or F atom, and the antibonding orbital of a bond between a hydrogen and a more electronegative atom. Sulphur is another good atom for forming hydrogen bonds. In this case, all of the examples can form hydrogen bonds, except for I, because the bond between the C-H bond and the oxygen lone pair just isn't strong enough. A good trick here: Remember that water forms hydrogen bonds (hence why we get surface tension, the boiling point of water is so high, etc). From this, the answer can only be C or E. Then II is clearly an answer as well, noted by the N-H and O-H bond pairing. Hence the answer is E.

2 Protein Secretion

B - remember that translation takes place in the rER (rough - you can remember this by thinking of the image of the rER covered in ribosomes/tRNA). Then we move straight to the Golgi for further processing. The sER (smooth) is not involved here; that's involved with lipids and steroids.

3 DNA Structure

A - remember that the alpha helix just refers to a feature of the basic, secondary structure of a protein: the local 3-D structure. This yields two main structures to be learnt, the alpha helix and the beta-plated sheet (plus a few more that I've never seen come up on the GRE). For the alpha helix, every N-H group hydrogen bonds to the C=O group four residues behind it. This of course means that the answer is A. Here's a quick trick: remember that a helix has a regular, repeating structure: it twists the same amount per unit height. As such, we are looking for a common type of intermolecular bond to cause long helices. B is out, because cystine isn't that common. C is out, because you can probably guess that carbohydrate moieties would make the protein a bit too bulky to form a regular helix, and additionally that would form a general quaternary structure anyway. D is out, because you should realise that this is an intramolecular

interaction, not a covalent one. E isn't a bad guess, but it just isn't the answer here (ionic/polar interactions help form the ternary structure).

4 DNA Structure

D - be careful with these questions when thinking about direction. First of all, the complements for DNA are G-C, A-T (or A-U in the case of an RNA strand). Thus, the complement of 5' CGA TTG 3' becomes:

GCT AAC OR GCU AAC.

However, because this is a complementary strand, the strand is running in the opposite direction from 3' to 5'. To get the correct form given in the answers, flip the direction:

5' CAA TCG 3' or 5' CAA UCG 3'.

This gives answer D. A major hint about direction was given in this question due to the fact that if we hadn't flipped the direction, two of the answers would have been correct.

5 Cell Structure

E - The fundamental role of the nucleus is to store the DNA. Additionally, it is the site of transcription, hence mRNA enters the nuclear pores and exists in the nucleus. Looking at the answers, these facts alone tell us that the answer must be E. For completeness, you should remember that the structure of chromatin includes these giant protein complexes called histones.

6 Genetics: Phenotype

A - the answer is A, because when a mutation occurs, a nucleotide in the DNA is changed. In some cases, this means that a different amino acid(s) is used for constructing the protein in translation. To be honest, the other answers make absolutely no sense here; E doesn't even seem to give a cogent answer to the question!

7 Lab Techniques

D - Recall that Polymerase Chain Reaction (PCR) is a method for making more copies of DNA. Additionally, Northern Blotting is used to detect a particular RNA sequence in an RNA sample, and Southern Blotting is the same thing but for DNA. These all have nothing to do with proteins. Western Blotting is used to detect specific proteins, and so may seem like a tempting answer. However, this is not unique to specific DNA sequences. An Electrophoretic mobility shift assay is able to detect if a protein can bind to a DNA/RNA sequence, and thus is the correct answer.

	dw	dw	dw	dw
DW	DdWw	DdWw	DdWw	DdWw
Dw	Ddww	Ddww	Ddww	Ddww
DW	DdWw	DdWw	DdWw	DdWw
Dw	Ddww	Ddww	Ddww	Ddww

Table 1: The Punnett square for Question 9.

8 Biology Experiments

D - a common fact that should be known, the genomes of all somatic cells are equivalent. To see why this is true, consider that a nuclei from one somatic cell has been substituted into another somatic cell, and this has successfully yielded normal frogs (e.g: with the same genotype). Do not be misled by the small success rate; this can be quite common in biology due to experimental error and further complications. Alternatively, note that A is false (this is true for totipotent stem cells only). B should naturally seem wrong, and additionally you should know anyway that this experiment would work for other animals. C could be a true statement, but it has nothing to do with this experiment. E could also be a true statement, but again, this was not tested for in the experiment.

9 Genetics: Phenotype

D - first note that because the alleles for tall plants (D) and violet colour (W) are dominant, a white dwarf plant must have all recessive alleles (ddww). This allows us to construct a Punnett square, as follows:

Half of the offspring are (DdWw - tall, violet), and half are (Ddww - tall, white). This gives D as the answer.

10 Enzyme Activity

D - Enzymes are just biological catalysts, which operate by lowering the activation energy of a reaction. Enzymes don't alter the temperature (A) or donate energy (E), and very importantly they do not affect K_{eq} (the equilibrium constant - this is a common question in chemistry).

11 Targeting

D - the chloroplast is a double membraned organelle, and so will (likely) need two different signal peptides to pass through each membrane. This was the hardest question on the test (with only 11% correctly answering it).

12 Cell Replication

A - a surprisingly low number of 2%. Remember that there is a lot of 'junk' (non-coding) DNA in the human genome including regulatory sequences that control the rate of gene expression, LINEs, etc.

13 Human Genome

B - the answer is centromeres, which attach to the spindle fibres during mitosis/meiosis and split the chromosomes during anaphase.

14 Ion Transport Kinetics

D - the graph should plateau to an equilbrium rate.

15 Photosynthesis: ETC

A - I honestly find this question to be deeply confusing. My understanding is that PS1 uses light to move electrons from plastocyanin to ferredoxin, which is then used to produce NADPH from NADP+ (i.e: NADP+ is reduced). However, this also results in a proton-motive force that draws H+ through the ATP synthase that leads to the generation of ATP. This is a cyclical process, as the H+ will then enter through the plastoquinone to be returned to the thylakoid lumen. Given that this question emphasises the cyclical nature of electron flow, the answer it wants is A. However, I don't think this is an obvious question.

16 Enzyme Activity

A - if one were looking at a standard enzyme kinetics graph, one would see the reaction rate plateau as the substrate concentration increased. This is characteristic of answer A: all of the enzymes are 'busy' with acetaldehyde molecules and so the enzyme amount is the limiting factor. Other acetaldehyde molecules just have to wait for an active site to become free.

17 Virology

C - generally speaking, a virus will enter a cell and seek to reproduce before destroying the cell. This means that E is out. D is incorrect because influenza is not a retrovirus (and so does not use reverse transcriptase). Destroying the transcriptional machinery wouldn't be a sensible thing to do - the virus can use this for its own advantage! That leaves A and C. Some viruses do incorporate viral DNA into the host cell's chromosome, but influenza does not. That leaves C.

18 Enzyme Activity

B - an inhibitor that binds to the active site of an enzyme is a competitive inhibitor (i.e: it competes with the actual substrate for the active site). The other common inhibitor is an allosteric inhibitor - it binds to a site on the enzyme that is not the active site, and thus is non-competitive. These types of inhibitors affect V_{max} and K_m in different ways.

19 Intracellular Messengers

C - an intracellular messenger is a second messenger in response to a first, extracellular messenger. This may be required due to hydrophilic molecules like peptide hormones which can't cross the phospholipid bilayer of the cell membrane. cAMP is a common secondary messenger involved in the cAMP system. It was in fact the first one discovered. Calcium ions are another messenger system, used for example in muscle contraction (in response to acetylcholine). Inositol 1,4,5-triphosphate is better known as I3P, used as a secondary messenger to regulate calcium. 1,2-diacylglycerol is a glyceride used as a secondary messenger, particularly in the activation of Protein Kinase C. Acetylcholine is not a secondary messenger. If you didn't know all of the above information, a big clue is that it is a neurotransmitter involved as a primary messenger (e.g: at the neuromuscular junction).

20 Cell Structure

C - first, the protein crosses through the nuclear pore of the nucleus (through the nuclear bilayer). Then it enters the chloroplast (passing through the chloroplast envelope - another bilayer). Finally, it enters the lumen of the thylakoid (passing through a third bilayer). The trick is to realise that a bilayer is referring to a double membrane here, so don't get confused. The nucleus is a double-membraned structure, but that means it has one bilayer.

21 Cell Structure

E - the correct answer is E. Recall that photosynthesis occurs in the chloroplast, and respiration in the mitochondria. All organisms need to respire, and so animals, plants and fungi all have mitochondria. Plants of course have chloroplasts, but remember that fungi notably do not. Instead, fungi are heterotrophic, observing nutrients from their environment.

22 Lab Techniques

B - low-speed centrifugation can be used to separate compounds with a large mass difference. All of the answers except B have a low mass difference.

23 Anatomy

C - actin is the primary constituent of microfilaments. Microtubules are made up of tubulin, and intermediate filaments are made up of a variety of proteins, including keratin. Collagen and keratin fibres are of course made of collagen and keratin respectively, not actin.

24 pH Buffers

D - recall that the electron transport chain (ETC) sees the pumping of H+ out of the matrix and into the intermembrane space for complex I, III and IV, and the ATPase pumps H+ back into the matrix. A low pH means a higher [H+] (conc. of H+). This creates a concentration gradient that results in diffusion from the intermediate space to the matrix. Both A and B are incorrect because this process does not involve OH-.

25 Chloroplast

A - the Calvin cycle occurs in the stroma of the chloroplast. The Krebs cycle is for respiration, and occurs in the mithochondria. Fermentation occurs in the cytoplasm (not requiring oxygen). Decarboxylation (of pyruvate) occurs in the mitochondria. The Urea cycle (for ammonification) takes place in the cytoplasm and the mitochondria. An easier way: note that the Calvin cycle is the only reaction here related to photosynthesis.

26 Cell Genetics

B - when thinking of a typical somatic cell, there are 23 pairs of chromosomes (46 total). In other words, it is a diploid cell as it contains pairs (di = two). This is equivalent to the entire genetic information contained in the zygote (i.e: the cell formed after the fusion of the sperm and the egg cell). Males have the XY sex chromosomes, leaving 44 autosomes (non-sex chromosomes). Finally, all of these chromosomes should be active in somatic cells, even the sex chromosomes. From this, B is the correct answer: the X chromosome is active. Additionally, note that females have XX sex chromosomes. This would make B and E incorrect.

27 Polyteny

C - Polyteny is the cause where multiple copies of a chromosome are replicated without separation, resulting in a giant, long chromosome. Hundreds of copies can occur and remain joined. This means that the answer is C: chromosomes have replicated, but cell division has not followed.

28 Genetic Disorders

A - one of the most common causes of DNA damage by UV light is the absorption of UVB radiation. This causes adjacent thymine base pairs to bond together to form thymine/pyrimidine dimers. These will accrue in individuals with conditions like XP. Perhaps surprisingly, D and E are wrong. Take note of this, as there are a lot of inaccurate/misleading diagrams out there regarding DNA damage.

29 Genetic Disorders

C - beta-thalassemia is a disorder where beta-globin is incorrectly synthesised (either reduced or not at all). Even if you didn't know that though, the big clue to this question is that the mutation occurs in the intron, not the exon. Recall that the introns are sometimes referred to as 'junk' DNA - they are removed from the DNA sequence before transcription and translation occur. This is a huge giveaway: A is wrong because the codon in this intron won't be coding for an amino acid; the same logic applies for E. B doesn't work, as it again wouldn't affect the production of the protein if this intron was cut in two. D makes no sense, ignoring the fact that the intron has no effect on transcription, increasing the transcription would likely increase the amount of beta-globin anyway, not reduce it. This leaves C as the logical choice: not splicing the intron correctly will add new codons to the remaining exon section, which is transcribed and translated incorrectly.

30 Oncogenes/Enzymes

D - Tyrosine kinase is encoded by the src oncogene. Additionally, a better clue is that kinases by definition catalyse the addition of a phosphate group (unlike phosphases, which remove a phosphate group).

31 Genes and Development

B - homeotic genes are genes that regulate the development of anatomical structures. Drosophila is a model organism, and is a commonly studied example for homeotic genes. The antennapedia complex of homeotic genes results in the formation of the head and the body, while the bithorax complex develops the back of the embryo (parts of the thorax). A mutation in any of these will result in one segment becoming another.

32 Antibodies

C - this is a straight-forward definition. Monoclonal antiserum contains antibodies from descendants of one B lymphocyte, polyclonal antiserum contains

antibodies from descendants of multiple lymphocytes.

33 DNA sequences

C - a retrotransposon is a component of DNA which is transcripted and transcribed into a ribonucleoprotein complex, which is undergoes reverse transcription and integration back into the DNA. The two main types are long terminal repeats (LTRs) and non-LTRs. Following this process, the answer is C - it is a DNA sequence that replicates via an RNA intermediate.

34 Immune System

E - the humoral response just refers to the response of body fluids (e.g: antibody production). All of the cells listed are important for the maximal immune response, including dendritic cells which process antigen materials and present them to T-cells.

35 DNA analysis

B - the fact that X and X' has the same segment length shows that the EcoR1 has no effect, so you expect there to be no EcoR1 restriction sites. Y and Y' is different though - Y' is Y sliced once. This suggests that there is one EcoR1 restriction site. A is wrong, there could be different restriction sites unaffected by EcoR1. C is wrong, this would lead to X' being two fragments, and Y' being three fragments. D and E are both wrong - X and Y both have 720 base pairs.

36 Enzyme Activity

D - recall that pH is simply a measure of the concentration of H+ ions in a solution. This charged particle will affect ionising groups, and will affect them more strongly the more charged the solution is. As such, for the constant activity over a broad pH range, ionising groups shouldn't participate.

37 Embryonic Development

D - the appearance of the yolk plug shows that gastrulation has just taken place.

38 Plant Cells

B - recall that of all of the examples listed, xylem cells are the only dead cells. The cells are lignified to be able to withstand changes in water pressure, as the xylem draws water up from the roots of the plant.

39 Meiosis

D - recombination is the process where pieces of DNA are broken and recombined to produce new combinations of alleles. During recombination, we observe chiasmata - the crossing over point of two different chromosomes.

40 Plant Groups

C - the best way to answer these types of questions is almost always by exclusion. The 'no seed' criteria excludes pines and flowering plants which do use seeds. The xylem criteria excludes mosses and the very similar liverworts. This leaves ferns as the answer.

41 Central Nervous System

C - the amplitude of the action potential and the threshold potential are always the same (+40mV and -55mV respectively). The final destination should of course be the same, and so should the synapsed crossed (in other words, the action potential is still taking the same path). It is the frequency that determines the intensity here.

42 Classification of Life

C - Cyanobacteria (aka. blue-green algae) are a phylum of photosynthetic bacteria. They are prokaryotes - and do not have a nuclei. However, they do have thylakoids where photosynthesis occurs. Green unicellular algae are proper algae in the Plantae kingdom, and thus are eukaryotes. They do have a nuclei. Note that both cyanobacteria and green algae have cell walls.

43 Animal Behaviour

C - the fact that the song lacks certain characteristics implies that the song is learnt to some degree. However, this statement also implies that some characteristics are the same as its species, showing there is also an instinctive element. Put another way, if the song were entirely learnt, you would expect the song to be completely different from the song of its own species.

44 Cell Division

B - a big clue to this question is that there are v-shaped chromosomal units in this image, which occurs in meiosis but not mitosis. The only gamete cell type listed here is the anther. (Incidentally, just noticing that the anther undergoes

meiosis while the others undergo mitosis is a big clue, if you had to make an educated guess).

45 Reproductive System

C - - looking at the answer options, note that we are going from the inside towards the outside. Note first of all that the epididymis is part of the male reproductive system only (connecting the testes to the vas deferens). As such, B and E are wrong. A rete is a network of blood vessels and nerves. In this case, it refers to the rete ovarii in the medulla of the ovary. As such, A and D don't make sense either. Note for completeness that there is the rete testes in men. Looking at option C, and knowing that the oviduct connects the ovary to the uterus, this order makes sense. (The oviduct is more commonly referred to as a fallopian tube).

46 Trees

C - the primary source of the dry mass of a tree is the carbon content of it. Don't be misled by the inclusion of water (which seems contradictory to the concept of dry mass) - the answer is C. Note that even not knowing this, we can still narrow down the answer. Light is a massless particle (the photon), and so adds no mass when absorbed. Mineral nutrients make up a minimal amount of the mass of a tree/plant/cell/etc. The acorns also make up a small amount of the mass of the tree in comparison to the trunk, so it isn't going to be the endosperm. This leaves A and C. Ultimately, you can guess that the addition of CO2 and H2O by photosynthesis adds more mass than organic matter taken up by the roots, as photosynthesis is a more prominent process.

47 Blastomeres

B - in amphibians, the grey crescent later forms Spemann's organiser, which directs tissue development. Removing the grey crescent will halt the formation of the embryo, so the answer is B.

48 Types of Photosynthesis

B - a simple fact-based question, the answer is B. Note that both C4 and CAM plants fix CO2 at night.

49 Double Fertilisation

D - the second sperm will fuse with the polar nuclei to form the endosperm - which acts as a food reserve (full of starch).

50 Behavioural Ecology

B - for this question, the age of the birds is important. As they are described as 'very young', we can assume that not enough time has passed for behaviour to be learnt. As a result, this cannot be a conditioned response or a learned behaviour, and A and D is out. (also note that a conditioned response is a learned behaviour, so it can't be these two answers anyway). The behaviour is not imprinted, because it occurs in very young animals. Habituation is a behaviour where an animal stops responding to a stimulus over time. Not only will this not occur in very young birds, it is not even what is happening here. A fixed action pattern describes an instinctive behavioral sequence, and so this is the answer.

51 Hyperventilation

B - If a person is breathing too quickly, then more oxygen is being breathed in (more oxygen than needed). Conversely, more CO2 is being exhaled, resulting in a drop of CO2 in the blood. This means that the partial pressure of O2 [p(O2)] in the blood has increased, while the p(CO2) has decreased.Now recall how the bicarbonate buffer in the blood works:

$$CO_2 + H_2O <=> H_2CO_3 <=> H^+ + HCO_3^- \quad (1)$$

If $[CO^2]$ decreases, then the equilibrium shifts to the left to compensate for this. In other words, H^+ is used up to try and produce more CO_2 to replace the lost CO_2. Therefore $[H^+]$ decreases. This makes sense if we remember that exercise causes an increase in CO_2 and a decrease in pH/increase in $[H^+]$. This is just the opposite.

52 Anatomy - Respiratory

C - recall Fick's Law of diffusion. Increasing the concentration gradient will increase the rate of diffusion. Decreasing the partial pressure will decrease the conc. gradient, as will decreasing the rate of blood flow. Decreasing the solubility of the gas will reduce the amount of diffusion that can occur, reducing the rate. Increasing the thickness of the diffusion surface also decreases the rate. The answer is C, increasing the total surface area gives a greater area for the gas to move through per unit time, increasing the rate.

53 Embryos/Evolution

E - echinoderms and chordates are both deuterostomes, the anus is the first opening that forms (forming before the mouth). The answer is thus E.

54 Graph Analysis

C - note first of all that ATP is unaffected by the herbicide. This means that the ETC is operating normally, so A is out. Then note that NADPH drops upon application of the herbicide. This shows that the herbicide acts to inhibit the reduction of NADP+ (to NADPH), causing a drop in NADPH.

55 Muscle Contraction

D - recall how the sliding filament theory works. Calcium ions bind to troponin causing the movement of tropomyosin. This exposes the myosin-binding site on actin, causing them to bind. Most notably, calcium does not bind to tropomyosin, making it incorrect.

56 Fertilisation

A - be careful here, injecting the eggs with a ZP3 antibody would only block the ZP3 receptors on the sperm after the acrosomal reaction had occurred (i.e: after the sperm had broken through the zona pellucida to release the antibodies).

57 Osmolarity

C - the birds want to remove as much salt as they can, but little water (if they removed too much water, they would have to keep drinking seawater to replace it, entering a vicious cycle. This is incidentally why it is so dangerous for stranded people to drink seawater). Ultimately C is the only answer that retains water significantlyand makes general sense.

58 Stem structure

E - the pith is the inner most structure of the stem while the cortex is the outer most. Unfortunately, that doesn't help for this question. The answer must be learnt, and that is E. Just note that the primary-secondary order is a bit unintuitive.

59 Cardiac Cycle

D - the effect on venous pressure is always minimal because it is further from the heart (and thus part of the reason why values and the venous return system by muscle contraction are so important). Arterial pressure, being near the heart, is strongly affected though.

60 Plant Tissues

B - the palisade mesophyll is the area of cells just below the upper epidermis of the leaf cells (and above the spongy cells). They are well-adapted for photosynthesis, resulting in the highest rate of oxygen production. For completeness, the cortex consists of unspecialised cells in the stems and roots and may store carbohydrates. The epidermis is just a single-cell layer to protect the leaf and reduce water loss. The vascular cambium is involved in producing the xylem/phloem, not photosynthesis. The endodermis is usually only present in roots to facilitate water movement.

61 Transpiration

A - the answer is A: evaporation occurs pulling more water up through the xylem. B doesn't really make sense given that movement in the xylem is unidirectional. C doesn't answer the question (what do air bubbles have to do with moving water upwards?). D is wrong, the cells of the xylem are dead and lignified. This in turn prevents the collapse of xylem cells, not turgor pressure.

62 Transpiration

B - - potassium ions are used to control the guard cells which in turn regulate whether the stomata are open. If they are open, transpiration occurs.

63 Symplastic Pathway

D - moving into the phloem, the order is bundle sheath, parenchyma, companion cell, sieve tube. Looking at a diagram of the phloem will make this clearer.

64 Protein Pumps

C - pumps tend to require energy, and so require ATP. Note that answers A and C contradict each other.

65 Phloem

B - nutrients can move in the phloem due to the pressure-flow hypothesis, which occurs through the movement of water from the xylem into the phloem, generating pressure.

66 Plant embryogenesis

C - in plant embryogenesis, the seed is formed and then in the heart stage, the shoot apical meristem is formed.

67 Biology Experiments

D - note that the intracellular concentration is lower than expected, showing that calcium is transported out of the cell. The Nernst equation gives a relationship between the electric potential and the diffusion potential, but ultimately is related to passive diffusion. The fact that the Nernst equation yields an incorrect result indicates that active transport must be occurring.

68 Fungi

D - Recall that fungi are a kingdom. In the same vein as animalia and plantae, they are eukaryotes. They all have rigid cell walls - you should recall that for fungi they are made of chitin. Rather amusingly, if you don't remember this, question 76 will tell you that (at least some) fungi have cell walls. Almost every phyla of fungi exhibits sexual reproduction in addition to asexual reproduction. Often this works by the use of spores. Also recall that most fungi contain hyphae, which are long, filamentous structures. This leaves D as the answer. It is a defining difference between plants and fungi that fungi do not photosynthesise. The obvious evidence of this is that fungi lack chloroplasts. However, you may also remember learning that fungi are heterotrophics, absorbing nutrients/energy from the surrounding environment rather than producing their own.

69 Biology Experiments

C - note that the experiment is being undertaken to develop a calibration curve - which is just a graph showing the relationship between the gibberellin and the amount of reducing sugars produced. This would fail if for some reason the amount of gibberellin or reducing sugars were varied. This hints that C or E could be feasible answers. Given that practically all of the glucose in the seed is stored as starch in the endosperm, E doesn't really make sense. This leaves C as the answer. Note that even if you had no idea what gibberellins were, you could still think through the question.

70 Plant Regulation

B - In this question, we are effectively looking for a signal that reliably indicates when a certain month/season is reached. A makes no sense - the circadian

rhythm is to do with sleep cycles over the course of a day, not a year. E also makes little sense - precipitation does change over the year but is still highly variable. You might be tempted to pick C given knowledge that global warming is resulting in a change in various ecological patterns, including flowering. However, air temperature is still too variable to be a reliable metric. The photoperiod is defined as the period of time each day during which an organism receives illumination. This varies depending on the month with highly predictable accuracy. This is thus the correct answer.

71 Mutualism

C - first of all, note that mycorrhiza just refers to a symbiotic (positive-positive) relationship between fungi and plants - it does not refer to a specific genus or anything like that. Typically plants provide sugars to fungi, and fungi provide phosphorus to the plant. Nitrogen fixation is done by bacteria around the roots of the plant. Carbon naturally enters plants as CO2. Producing toxins to kill plants doesn't seem very symbiotic, even if it is 'other plants'.

72 Auxins

B - recall how phototropism works. If light is incident on the left side of a stem, auxins will move away from the light to the right. These auxins cause the stem wall to stretch on the right, bending the stem towards the light. In other words, auxins cause increased extensibility, and the answer is B.

73 Classification of Organisms

D - the biggest clue here is the presence of isoprenylglycerol ethers in the membrane - remember that ether lipids in the membrane is a distinguishing feature of archaea. If you didn't know that, observe that all the other answers are types of bacteria. As such, picking the archaeon makes the most sense here.

74 Antibiotics

D - antibiotics do not affect reverse transcriptase.

75 Plant Types

D - recall that an angiosperm is also known as a flowering plant, whereas a gymnosperm has no flowers or fruits. As such, the key defining difference is that angiosperms have seeds enclosed in ovaries (usually a fruit), while in gymnosperms, the seeds are often bare (e.g: as cones). I would note here that

gymnosperms do tend to exhibit perennial growth and angiosperms tend not to, but this is not a defining difference between them.

76 Kingdoms/Cell Types

A - one of the key features of fungi is that they have cell walls made of chitin.

77 Ferns

A - in the alternation of generations, the fern has two different stages; sporophyte, which releases spores, and gametophyte, which releases gametes. For ferns, the sporophyte is mostly independent, whereas for liverworts, mosses and hornworts, the sporophyte is less well developed than the gametophyte and is mostly dependent on it. The answer is then A.

78 Homeostasis

D - homeostasis is simply the maintenance of something within a certain range. For example, the body temperature of humans must remain between 35^oC and 40^oC or hypo/hyperthermia will occur. The body has mechanisms to maintain this range, including sweat to cool down and shivering to warm up. A is then out. For B, recall that insulin acts to absorb glucose from the blood (e.g: after eating) by converting it to glycogen, while glucagon acts in reverse (e.g: during exercise). Thus B is out. For C, blood pH is maintained between 7.35 and 7.45 by the bicarbonate buffer. For E, blood calcium level is controlled by PTH and calcitonin. This leaves D, the metabolic rate. This makes sense, there isn't really a limit on how high the metabolic rate can be in mammals - e.g: the fatter you are, the higher your basal metabolic rate, and your metabolic rate can go up without a problem during exercise.

79 Properties of Water

B - a curious question, but one that is easy enough to work through if you're not sure. Just think of common, everyday examples, as well as the fact that molecules are more compact in a liquid than a gas. A is incorrect, as organisms (insects, even humans) can float on water due to its surface tension, and the upward buoyancy force produced by water. C is false, trying running the 100m in water! D is false, it is easier to heat up air than water (in part because in water, there are more molecules to heat). E is false, you would expect a gas to have a higher rate of gas diffusion than a liquid. That leaves B. Whilst O2 is soluble in water, there is little compared to the air (21%). This in part helps explain why more energy-intensive organisms like humans live on land rather

than in water, because there is more oxygen in the air (although this is a vast oversimplification and ignores many other factors).

80 DNA

B - the clue here is that this question is about studying the relatedness of populations. As such, you want to capitalise on the fact that mitochondrial DNA remains relatively unchanged when passed to the next generation.

81 Ecology

E - in r/K theory, r refers to the maximum rate of growth of a population, while K refers to the carrying capacity of the local environment. From this, an r-selected species is one that emphasises a high growth rate (typically high r, low K). As such, we favour traits that tend to a high reproductive rate. A is thus true by definition, B is true as small body size both correlates with a quicker offspring production rate, and also favours the low K scenario. C is true because unstable environments favour species that can adapt/evolve rapidly, and this includes r-selected species. D is also true; a higher the number of offspring favours an earlier onset of maturity and less parental care. E is hence false; r-selected species tend to occupy less-crowded ecological niches, so competitive ability is less useful when compared to K-selected species.

82 Carbon Cycle

E - a huge amount of carbon is stored in deep ocean sediment, at about 45000 billion tons compared to 10000 billion tons of fossil fuels. The air-sea gas exchange is also a significant part of the carbon cycle.

83 Ecology

B - the answer is B as one excepts a high ratio of primary production to standing-crop biomass, given that the standing-crop biomass will be close to zero to begin with (as succession is occurring). We can exclude the other answers as follows: C is wrong because early-successional communities have high growth rates (i.e: favour r-selected species). It then follows that A is wrong (because high niche divergence is more common for K-selected species). D and E are also wrong for early-successional communities.

84 Early World

A - the answer is an O2-rich atmosphere, produced by photosynthesis (a biological process). CO2 can be produced by numerous geological processes (including

volcanic activity). The water cycle exists primarily as the evaporation and precipitation, with the biologically-facillated process of transpiration being a less major part of the cycle. Seasonality is caused by the Earth's axial tilt and tectonic processes are caused by the movement of tectonic plates. Neither of these are biological processes.

85 Photosynthesis

C - A straightforward graph deduction question. Looking at graph X, the only time the photosynthesis rate is higher than the other plants is for low light intensity. This means X is more competitive in the shade. Answers A, D and E cannot be deduced from the graph, and B is wrong (it's actually the other way around, Z outcompetes Y).

86 Hardy-Weinberg

B - the Hardy-Weinberg equilibrium states that genetic variation in a population will remain constant from one generation to the next in the absence of disturbing factors. This assumes five factors: no mutation, random mating, no gene flow (or migration), infinite population size, and no selection. As such, genetic drift is not an assumption here.

87 Biomes

E - the primary cause of the world's deserts is the existence of atmospheric cells that result in circulation, better known as Hadley cells. Be careful when reading answers, 'global climate changes' sounds like a compelling answer, but certainly not 'in the last century' (deserts have been here far longer than the 1900s!)

88 Interactions

E - note that both species have a greater number of individuals when they are grown together. This means A is positive for B, and B is positive for A (a positive-positive relationship). Reviewing our terminology in the answers: A - negative-negative; B - positive-neutral; C - positive-negative; D - positive-negative; E - positive-positive. Thus the answer is E.

89 Ecology

D - a pioneer species takes root in an ecosystem in succession. When the ecosystem is being colonised for the first time, it is primary succession, and when living organisms already are present there, it is secondary succession.

90 Natural Enemies

D - lekking behaviour is where males perform courtship displays. This has probably developed to improve the reproductive potential of the species, not as a consequence of natural enemies.

91 Gene Flow

A - recalling the definition of a population, gene flow between populations is the transfer of alleles between different species. If this occurs, the two species become more similar. This in turn makes the meta-population more homogeneous.

92 Keystone Species

E - keystone species tend to be defined by their disproportionate impact on an ecosystem to the point that their presence defines it. Usually, this occurs because the keystone species is a dominant predator, and keeps other competitors at bay. The classic analogy is an animal which preys on a particular herbivore, thus protecting plant species in the area. As a clue, note that B and C imply each other (as both answers are indicative of organisms at the bottom of the food web).

93 Primates

B - sexual dimorphism is where the same species exhibits differences between the sexes (consider male lions having manes when the females do not). Among primates, this is typically due to competition amongst the males for a mate. (this is generally a good guess for a lot of animals if you're not sure).

94 Offspring

B - high parental investment is linked to small litter sizes. This is better explained by the converse: large litter sizes mean that the parents have less time to spend with each offspring. Another way to remember this is that humans usually have a 'litter size' of one, and that baby requires a huge amount of investment compared to, say, a puppy from a litter size of 6.

95 Predator-Prey Relationship

C - an increase in mites means an increase in fox deaths (a decrease in the fox population). Because the fox is a predator, a decrease in the fox population will cause an increase in the hare population.

96 Population Growth

D - all three experiments tend over time to the same point. This immediately discounts A and B - the growth is clearly non-random and there is an equilibrium. There is no evidence here that interspecific competition (between different species) is stronger than intraspecific competition (between members of one species). The answer is D. The decrease in the graphs indicates that there is a strong density dependence (e.g: species 2 tends to decrease around 300), rather than an interaction between the two species.

97 Ecology Experiments

A - to test that the ants are defending the plant from insects, simply remove the ants. If this is true, the leaf-feeding insects will damage the plant, and if this is false, then there will be no damage to the plant.

98 Linkage Disequilibrium

E - linkage disequilibrium is the non-random association of alleles at different loci. In other words, linkage disequilibrium is showed by the difference in the frequency of alleles. It is caused by factors including selection, mutation rate, population subdivision, and genetic drift. It is notably not caused by random mating, as this shuns selection.

99 Adaptive Evolution

B - for cliff nesting to be adaptive, it needs to confer an advantage to the species that makes up for the increased death rate. This is given in B by the increased fitness rate.

100 Hardy-Weinberg

D - this is a trinomial expansion rather than the standard two-allele binomial expansion. It is solved by:

$$(a+b+c)^2 = a^2 + b^2 + c^2 + 2ab + 2ac + 2bc \tag{2}$$

The heterozygous terms are the terms with two factors rather than one (2ab, 2ac, 2bc). This gives the total frequency as:

$$2ab + 2ac + 2bc = 2 * 0.28 * 0.17 + 2 * 0.28 * 0.55 + 2 * 0.17 * 0.55) = 0.59 \tag{3}$$

101 Distribution factors

E - cosmopolitan just means more widespread/more worldwide. Long-distance dispersal would obviously result in the species developing over a larger area, resulting in this cosmopolitan distribution. If you didn't know the definition of cosmopolitan, just note that A,B,C and D all restrict the species and its distribution in some way. E does the opposite, so it should stand out as a probable answer.

102 Hybrids

E - this is a case of hybrid speciation, where descendants of hybrids can reproduce. This excludes A. It also excludes C if you know that backcrossing isn't needed. The correct answer here is E.

103 Punctuated Equilibrium

D - punctuated equilibrium effectively states that evolution happens in sudden jumps. This is consistent with the definition in D.

104 Pollination

B - Figure 2 shows a narrowing of the range of petal lengths - they are no longer extremely short or long. This occurs when these are selected against, such as island pollinators avoid these petals. The answer is thus B.

105 Genetic Drift

B - generally speaking, genetic drift causes slower evolution when the selection of organisms is completely random and with no inequalities. Thus the answer is B. Consider for D and E, this would encourage evolution towards the standard of the dominant sex. With A and C, the inequality in the number of the sexes would encourage evolution by, e.g: the same male mating with numerous females, leading to an increased spread of his genes.

106 Domains/Evolution of Life

A - this scenario suggests that organisms have evolved to have TBP and TFIIB. From this, bacteria are the earliest organisms. Then, a common ancestor of Archaea and Eukarya evolved similar transcription factors. This evolution continued with Eukarya evolving with TBP and TFIIA, and Archaea evolving with similar factors. The clue is to realise that Eukarya and Archaea are more similar here than Bacteria - implying that they evolved more closely from one another.

107 Hamilton's Rule

A - r is a coefficient of relatedness (typically speaking, it is the probability that at a random locus, the alleles will be identical by descent). This coefficient should make sense, as we want the altrustic genes to increase in frequency.

108 Phylogenetic Tree

B - this is a paraphyletic group - they are descended from a common ancestor, but does not include all of the descendants.

109 RNA

E - RNA was not abundant on early Earth, in fact it was still quite difficult to form (consider that if RNA was highly abundant on early Earth, we might expect it to be abundant on other planets). RNA can self-replicate, and did as part of the hypothesised RNA world. Ribozymes are RNA catalysts. The correct options are II and III.

110 Hardy-Weinberg

D - the standard Hardy-Weinberg equation is given by a binomial expansion for two alleles:

$$a^2 + 2ab + b^2 \tag{4}$$

The allele is completely recessive, so the people with cancer have both alleles. Therefore:

$b^2 = 1/400 \Rightarrow b = 1/20$

Then as $a + b = 1$ (by rules of probability), $a = 19/20$.

The proportion of people with an allele b, but no cancer is then $2ab = 2 * 19/20 * 1/20 = 38/400$.

The answer is then D.

111 Continential Drift

A - the splitting of Panagea lead to the formation of Laurasia (north) and Gondwana(land) (south). The creation of the modern-day continents followed afterwards.

112 Evolutionary History

E - fossils were already discovered long before 1859, and would form part of the evidence of evolution. Darwin rather notably did not know what mechanism

would cause natural selection, with Mendel only just starting his pea pods experiments at the same time. All of the other answers involve more modern scientific techniques and methods.

113 Chemical Elements

D - the clearest statement here in my opinion is the second statement: banded iron deposits are linked to atmospheric oxygen as it causes rust formation (which is red). This is incidentally one of the main pieces of evidence for the Snowball Earth. For the third statement, you should be aware that Fe-S groups are important in the ETC. For example, electrons move from Complex I through the Fe-S groups to co-enzyme Q, etc. Additionally, heme is very important in the Q-cycle and Complex IV. For the first statement, this appears to be true for Fe(III)-reducing prokaryotes.

114 Net Primary Productivity

C - remember that NPP = GPP - R, where GPP is gross primary productivity, and R is respiration. As such, we are looking for factors that increase NPP or decrease R. A would do this by increasing GPP, but the logic makes no sense. B would do this by decreasing R, except it is false: the metabolic costs should remain the same. For D, herbivory affects neither GPP nor R, so NPP is unchanged. E could make sense - the tropics do see increased weathering, but it is unlikely to make a sizable difference to GPP/NPP. This leaves C, the clearest abiotic factors that increase towards the tropics that affect GPP.

115 Pollination

C - recall that most bee-pollinated plants tend to have UV patterns, while most bird-pollinated plants tend to completely absorb UV. Additionally, bees need an area on which to land, whereas birds do not. Upright petals would make it difficult for a hummingbird to hover and position its beak for the nectar. Finally, it seems likely that hummingbirds would favour higher nectar amounts than bees. From these points we can also reason correctly as to why C is the answer: the red flowers are unlikely to reflect much UV light for bees, and the hanging nature doesn't provide a good landing space.

116 Cell Evolution

B - separating molecules from the outside world is essential so that they can continue to undergo reactions (e.g: amino acids forming and then building up into proteins). Remember that eukaryotes evolved later than prokaryotes, so

double-membraned structures like the nucleus and the mitochondrion are not sensible answers here.

117 Kidneys

D - Juxtamedullary nephrons have very long loops that extend deep into the medulla. By making the greatest contribution to the osmotic gradient of the medulla, they allow for the production of hypertonic urine. Whilst the answers to this question may contain a lot of niche information, understanding the human kidney is all that is needed to realise the correct answer.

118 Cell Cycle

E - most mature neurons are in the G0 cell stage, a stage outside of the regular cell cycle where replication does not occur. As such, there are 23 pairs of chromosomes in the G0 stage. A mature spermatozoan is a haploid cell (it contains half the genetic information of a standard somatic cell, because the other half of the genetic information comes from the ovum cell). Thus there is 0.5X DNA.

119 Cell Cycle

B - a skin cell is a somatic (non-gamete cell), so typically we think of it has having 23 pairs of chromosomes. The G2 phase in the cell cycle is the growth and preparation for mitosis. The S phase (DNA synthesis for mitosis) precedes the G2 phase, so this cell has double the number of chromosomes. There is 2X DNA.

120 Biological Molecules

B - a prohormone is the inactive precursor to a hormone. Because it is a precursor, you should realise that it has little biological activity. Alternatively, all of the other compounds listed are very active.

121 Biological Molecules

E - in cell signalling, active G protein binds to adenylate cyclase to cause the activation and release of cAMP.

122 Biological Molecules

D - recall from the fluid mosaic model that cell membranes are made up of amphipathic phospholipids - with a hydrophobic taii and a hydrophilic head. As such, small non-polar molecules can readily traverse. In this case, the only option is steroid hormones. Peptide hormones have polar amino acids and so often interact with receptors on the surface of the cell.

123 lac Operon

B - the operator is bound by the repressor protein.

124 lac Operon

C - the promoter contains the binding site for RNA polymerase.

125 lac Operon

E - lac I encodes the repressor protein (lac Z cleaves lactose).

126 Population Growth

C - the rate of population growth with respect to time is the gradient of this graph. For the highest rate, you want the steepest positive slope. That occurs at C.

127 Population Growth

A - we are now looking at the rate of population growth per person. These are higher when the population growth is high, but the total population is low. The answer is A.

128 Population Growth

D - ultimately, you are looking for an area for which the population is still increasing, but that increase is getting smaller with time. This corresponds to a curve with a positive gradient that is tending to a zero gradient. The answer is thus D. For completeness, note that A and B are the cases where the rates are positive, and those rates are accelerating. C has positive rates but sees no acceleration (it is a point of inflection).

129 Population Growth

E - the carrying capacity is effectively the maximum size of a population that can live on a specific land area. The plateau suggests that the population is reaching its maximum, so the answer is E. Another tip, answers A, B, C, and D are all smaller than the reached population size at E, so they can't be the answer.

130 Anatomy

B - to form microtubules, the dimers of α- and β-tubulin bind to GTP. The answer is thus tubulin.

131 Anatomy

A - the answer is actin - it is a major cytoskeletal protein that forms microfilaments. Cross-linked actin is found in the microvilli, etc.

132 Anatomy

E - the reference to vertebrae skeletal fibres is a clue to think of the sliding filament theory. The calcium-binding protein is troponin, which then causes tropomyosin to move and reveal the myosin-binding sites.

133 Invertebrate Anatomy

D - the radula of molluscs is a small tongue-like structure used for feeding. It slices up food before it enters the oesophagus.

134 Invertebrate Anatomy

B - spicules are crystalline structures found in sponges that provide support.

135 Invertebrate Anatomy

D - the nematocyst of a cnidarian is a cell that can propel a stinger to capture prey. As such, it is involved with feeding.

136 Invertebrate Anatomy

A - just like humans, the trachaea is the structure through which oxygen enters the lungs/body.

137 Ecology Terminology

E - don't get confused, the population always refers to a group of interbreeding individuals in an area (usually we simplify this as members of the same species, which is effectively the same thing). A helpful hint, we think of the Earth's population as around 7.5 billion, but this obviously refers to the human population, not the total number of organisms on the Earth.

138 Ecology Terminology

B - a community is an interaction of populations. To remember this, you might be aware of the term 'community ecology' that looks at these interactions.

139 Ecology Terminology

A - common biomes include tundra, rainforest, desert, etc.

140 Ecology Terminology

C - an ecosystem is a mixture of abiotic and biotic factors. Think of a documentary on a rainforest - it will mention the animals, the vegetation, and factors such as the temperature and precipation rates when describing the ecosystem in this biome.

141 DNA Replication

A - a replication fork is the location at which DNA replication takes place. As a quick review, the progression of replication is going from top to bottom. The RNA primer is located at A.

142 DNA Replication

B - the DNA polymerase is located at B.

143 DNA Replication

B - the DNA with a free 3' OH is also located at B.

144 Transcription Analysis

A - first of all, there is a lot of information to digest when reading the background of this question. Just breathe, digest it slowly, and I would recommend

reading the questions first so that you have a better idea of what information to hone in on. In this question, these controls check whether mutant transcription phenotypes are due to perturbation of TBP function. The other answers don't relate to the experiment at hand (e.g: this doesn't check for equivalent RNA levels or specific activity).

145 Transcription Analysis

C - looking at the Pol I genes, there is a notable difference between band 5 and band 6, showing a temperature-sensitive effect due to the P65S mutation.

146 Transcription Analysis

E - more 5S rRNA transcription would be found in extracts from the P65S mutant than the I143N one. This is shown in the pol III band, which shows no activity for I143N, but does for P65S.

147 Transcription Analysis

D - TBP is involved in transcription of genes transcribed by pol I, II and II - hence the bands (especially the high intensity for WT).

148 Experiment: Neurogenesis

D - the peak for both graphs occurs on the bar with the arrow indicating subjective dusk.

149 Experiment: Neurogenesis

C - the new neurons (represented by the mean count of labelled cells) is dependent on the light cycle. The fact that the peak is at subjective dusk shows that the clock hour is not the factor. B, D and E are not varied/measured in this experiment.

150 Experiment: Neurogenesis

C - looking at Table 1, this strongly indicates that neuronal proliferation is greater at the time of subjective dusk. Certainly A, B and E are clearly wrong, and D is also wrong.

151 Experiment: Neurogenesis

E - again, the main factor here is the light/dark cycle.

152 Experiment - Pollination

E - the answer is E, the hummingbird visitation goes up as nectar volume goes up, so it is positively correlated. In contrast, the bee visitation rate is negatively correlated with carotenoid concentration. Also note that this question provides a helpful hint to Question 115.

153 Experiment - Pollination

B - incomplete dominance is where one allele is not completely expressed over the other allele. The classic example is for flowers. If C is the dominant allele for the colour red, then you might find CC makes red, cc is white, but Cc is pink. Here, c1 and c2 exhibit incomplete dominance because c1c2 is halfway between c1c1 and c2c2.

154 Experiment - Pollination

C - given that both pollinators are equally effective, we want to maximise the total number of pollinators. This occurs at the lowest cartenoid concentration. As such, we want the genotype to be c3c3.

155 Experiment - Pollination

C - if hummingbirds are extinct but bees are not, then nectar volume is irrelevant here. Here you want to maximise bee pollination which again occurs at low carotenoid concentrations. This matches answer C. For completeness, note that answers D and E will increase carotenoid frequency.

156 Experiment - Insulin

B - simply trace a horizontal line from 50% until you reach the pig line, and trace down to the x-axis. It reads 0.5 ng/mL. An ostensibly simple question that 26% got wrong - so do be careful to check these things!

157 Experiment - Insulin

B - B would measure the effect of all four insulins on all four species. This would allow us to measure if the hormones are equally effective in the species

from which they were obtained. Note here that an assay is simply to determine the biochemical activity of something.

158 Experiment - Insulin

B - the curve being on the left shows that less insulin is needed for the same effect. For this, B makes the most sense. A and D do not make sense as the CO2 production can be the same as other animals (e.g: 100% of pig maximum) and still lie to the left, showing that an equivalent amount of glucose is used up (and so this is nothing to do with metabolism). E doesn't make sense in light of this experiment - the results involve fat cells (with no blood), not a full turkey. The idea of insulin stimulating gene activity more effectively also doesn't really make sense.

159 Experiment - Insulin

C - similar to how enzymes and substrates work, the effect of hormones is limited by the number of receptors. Additionally, none of the other answers really make sense.

160 Experiment - Metabolism

D - note that the resting metabolism is the white graph. Then the highest part of the graph is at 9 O2 ml/hr at 30C.

161 Experiment - Metabolism

C - endurance will involve the active graph, which has the highest metabolic rate at 25C.

162 Experiment - Metabolism

C - the Q10 is the rate of change of the metabolic rate as a result of a 10C temperature increase. The steeper the gradient, the greater the magnitude of the rate of change. Given this, the active graph has a steeper gradient between 10C and 20C than the resting one, so the answer is C.

163 Experiment - Alleles

D - a simple graph reading - the N=60 and N=100 see no overall change in the average number of alleles (although there is fluctuation) while the N=20 population sees a decrease.

164 Experiment - Alleles

A - this experiment is measuring genetic drift, defined as the change in the frequency of an allele in a population due to random sampling of organisms.

165 Experiment - Alleles

A - simply take the size of the population and multiply it by the egg-to-adult proportion value (which is a probability). This gives N = 20, p20 = 0.65, A = 20*0.65 = 13. This immediately gives the answer as A, but you can double check for the other populations as well.

166 Experiment - Alleles

A - density-dependent survival has affected this experiment, e.g: it affects the starting point of the average number of alleles and the egg-to-adult survival proportion. If you are confused by this, note carefully that each experiment occurs in an identical vial, meaning the areas are equal. This means that N is directly proportional to the population density.

167 Action Potential

C - note that whilst Neuron B is 'resting', relative to Neuron A it is hyperpolarised. This is because the potential difference of -100mV corresponds to a value below that of the resting potential of Neuron A -70mV).

168 Action Potential

D - do not be tricked by the stationary value of the potential difference - that value needs to be maintained! This is caused by the sodium-potassium pump and the subsequent diffusion of K^+ ions through the potassium leak channel (due to the electrochemical gradient).

169 Action Potential

C - from $t = 0$ to $t = 1$, depolarisation occurs. This is caused by the open sodium and potassium channels - the sodium channels are voltage-gated.

170 Action Potential

B - regarding action potentials, current changes will affect sodium and potassium. At the peak, sodium ions have finished entering the cell, while potassium ions have moved out of the cell. This gives answer B, as the currents are equal.

171 Heart

B - as given in the question: CO = Q / (A-V). At rest, CO = 250 / 50 = 5 and during exercise, CO = 1500 / 150 = 10. The factor is then 10/5 = 2.

172 Heart

E - rearrange the equation such that SV = CO/HR. Then at rest, SV = 5/60. During exercise, SV = 10/120. These are equivalent fractions, so the SV is unchanged.

173 Heart

A - think carefully about the implications of what we have just calculated. The stroke volume has remained constant, so II is not an option. If the stroke volume is a constant, then CO = SV * HR can be written as CO = k * HR, where k is just a number. Cardiac output is thus just a function of the heart rate. A is thus the answer.

174 Ecology

C - the answer is C; the ranges of breeding records is clearly lower for the sympatric populations in all cases compared to the allopatric ones.

175 Ecology

B - first of all, be sure to understand the difference between an allopatric population and a sympatric one. In allopatric speciation, groups become reproductively isolated and diverge due to a geographical barrier. In sympatric speciation, reproductive isolation and divergence occur without geographical barriers. Notice how in the sympatric populations, the breeding times do not overlap. This suggests that B is the right answer - this non-overlapping breeding schedule avoids interspecies breeding. Note that the overlap doesn't matter for the allopatric populations because they are already geographically separated.

176 Ecology

A - linked to question 175, the sympatric populations exhibit reproductive isolation, because they cannot breed with each other (due to the temporal division in breeding times). It is pre-zygotic because it specifically prevents the fertilisation of eggs (this is in contrast to post-zygotic, which prevents the formation of fertile offspring).

177 Virology - HIV

B - the immune system acts to eliminate most of the virus. Certainly it should be realised that A, C and D do not answer the question at all.

178 Virology - HIV

E - an individual will be infectious when HIV is present in serum. This corresponds to the entire period of infection.

179 Virology - HIV

B - first of all, note that E is not supported by the graph, and C makes no sense in light of the graphical data (as the concentration of anti-HIV antibodies continues to rise until about year 6.). The lymphoid organs include the thymus and the bone marrow, and these are certainly not destroyed 1 year into having HIV. HIV doesn't affect neurons, although it does infect astrocytes (more or less straight away, just like other cells). Either way, A and D are also wrong. This leaves B. Graphical evidence confirms a drop in CD4+ T-cells which would cause the release of HIV.

180 Biology Experiences

E - with the thyroid removed, the TSH treatment would have absolutely no effect, and no thyroid hormones would be secreted. This would yield a result that is identical to Group 8, with the metamorphosis not occurring over the course of the experiment.

181 Biology Experiences

B - prolactin causes metamorphosis to not occur over the course of the experiment, similar to Group 8. This removes A and D as answers. The answer is C, because the results of Group 8 show that the role of the thyroid gland is to produce hormones that promote metamorphosis, and prolactin does the opposite. Note that E is far too specific, to the point that whilst it could be a viable answer, it can't be inferred from the information given.

182 MacArthur-Wilson model

B - naturally one would expect the mainland to have the most bird species, because the area of the mainland is far, far greater than either of the islands. Then, the islands are both the same size but island 2 is further away from the mainland than island 1, as such island 1 > island 2. Why does more isolation

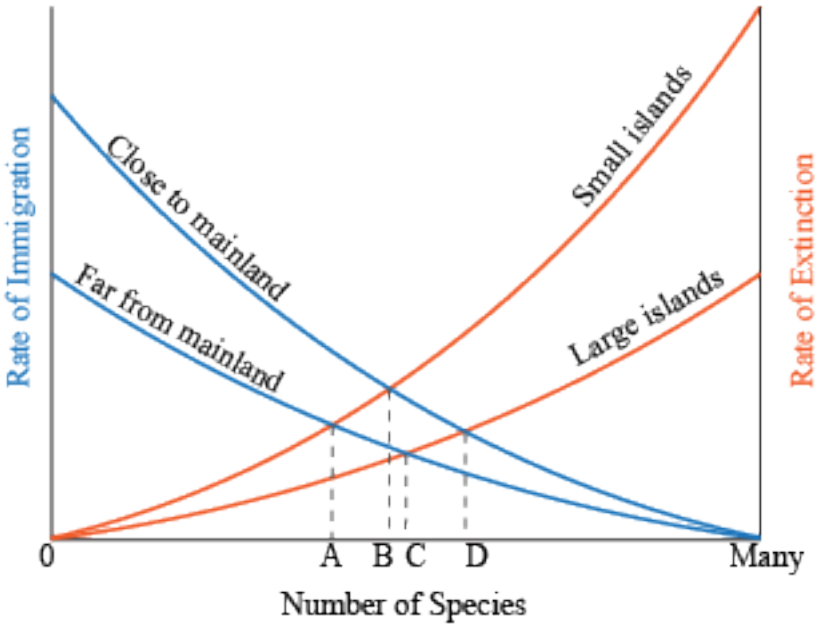

Figure 1: The MacArthur Wilson model in graphical form.

result in fewer bird species? There is less migration of new species from the mainland.

183 MacArthur-Wilson model

E - if an island is freshly formed, it starts with zero species. A, B, and C are already out. The number of species will increase due to migration, and will flatten out as the rate of species introduced through migration = the rate of extinction. Most importantly, the number of species will NOT drop back down to zero. Thus the answer is E. Note how even if you had no idea for this question, some simple logic reduced our options to two answers.

184 MacArthur-Wilson model

B - as shown in the graph below, these are the two factors that are considered in the MacArthur-Wilson model (also referenced in our answer to Question 183)
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185 MacArthur-Wilson model

D - the increased land area results in a greater carrying capacity of the land, so we would expect there to be a long-term increase in the number of bird species. This is because the rate of extinction is decreased, resulting in a new equilibrium. The answer is thus D. If confused, just think of the graph!

186 Pedigree

D - first of all, note that this effects both men and women, so it is unlikely to be X or Y-linked. However, it is most likely to be autosomal (i.e: not a sex chromosome). It is also implied that it is a dominant disease as this family tree doesn't indicate carriers.

187 Pedigree

B - III-3 has the genotype Rr. It can't be RR because otherwise II-2 would have to have an R allele (and thus would be affected). It can't be rr because III-3 is affected.

Now be careful: the question is asking for the probability of receiving the disease trait from III-3. It doesn't matter if the father is RR, Rr, or rr, either way there is a 50% chance of the R gene being passed from III-3, and so a 50% chance of receiving the disease trait from the mother. (Additionally, this still includes the case where it is received from both the mother and the father).

188 Pedigree

B - by the same logic outlined above, both III-3 and III-6 are Rr. This yields possibilities: RR, Rr, Rr, rr. There is thus a 75% chance that the son would be affected.

189 ABC Model

A - first of all, this has no effect on A, so the first whorf remains Se. There is also no effect on the second whorf, as the B class gene remains the same. Fusing the C-class gene is effectively extending the B-class gene into the fourth whorf, yielding Se, Pe, St, St.

190 ABC Model

D - there will be A and B class mutated genes. The mutation in A will cause the expression of C class genes in all whorfs, while the mutations in B will prevent a B-C combination yielding stamens.

191 ABC Model

B - a null mutation will effectively result in the absence of B. Thus petal 1 and 2 have A (Se) and petal 3 and 4 have C (Ca).

192 Ecology Model

B - to determine where the highest development of the population should be, we need to consider both of the factors: The higher the seed density, the higher the population, and the higher the seed survivorship, the higher the population. Obviously we need both factors to be optimised: consider that even if the seed density were exceptionally high at a point, if the survivorship was zero then the population there would also be zero, and vice versa. To think about this, consider the product of the two graphs. This gives us the number of seeds that grow in an area to the adult stage, and thus is want we want to maximise. This is clearly going to be at a maximum in the middle of the graph (and near zero everywhere else).

193 Ecology Model

B - there is evidently going to be some dispersion of the seeds away from the parent tree, but to a small extent so that most seeds remain close to the tree. This is more or less the answer given in B. C would likely see a greater distribution of seeds away from the parent tree, and D and E are both factors affecting seed survivorship, not seed density.

194 Ecology Model

A - A is the most logical answer here. B would affect seed density, not survivorship. C contradicts the graph; one would except that to be the worst microhabitat. D is incorrect for two reasons: Ignoring the fact that both curves show this is incorrect, the survivorship curve gives a probability that a seed will survive, and thus is (generally) independent of the number of seeds in an area. This argument has its limits though, if the number of seeds is too high, then the competition increases and you would expect seed survivorship to decrease. There is no evidence to support E.