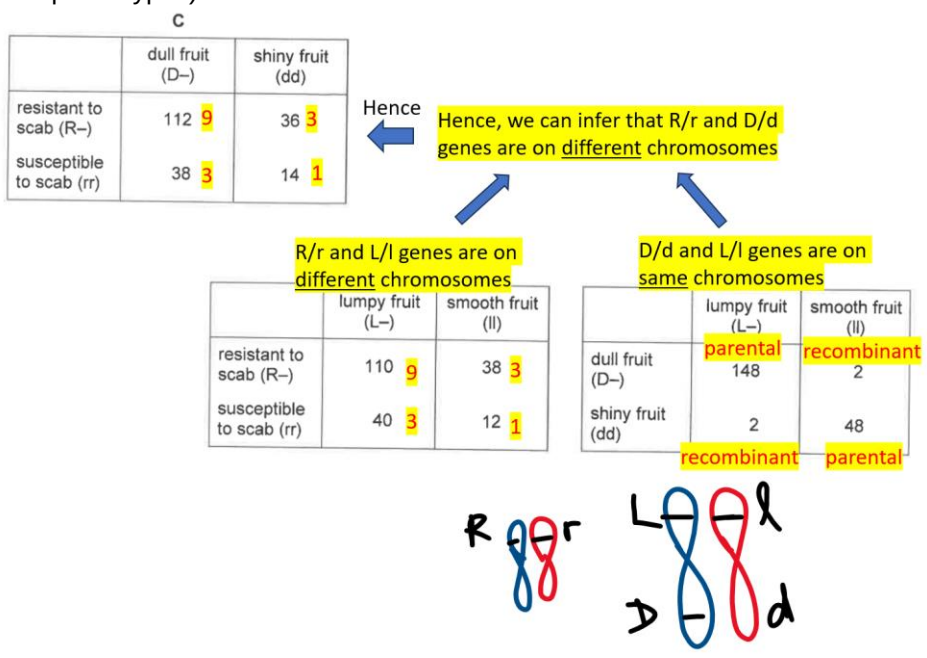
GCE A Level H2 Biology

9648 Biology November 2017

1.	**N17Q1**	A	We are told that the cell is "metabolically active". 1 is mitochondrion and the chemical inhibits oxidative oxidation in the organelle and thus it cannot carry out its role for ATP production. 2 is heterochromatin and 3 is RER. Energy in the form of ATP is needed by chromatin remodelling complexes to induce changes in conformation at the level of the nucleosome in 2 to form euchromatin, so that there is more transcription and subsequently more translation (protein synthesis). RER ribosomes would have their functions impaired due to no protein synthesis.
2.	**N17Q2**	A	T4 phage has all 3 characteristics. For phage lambda, it would be 2 and 3 only.
3.	**N17Q3**	A	Molecule A, the 1,4 glycosidic bond formed between 2 alpha-glucose are beside each other. The 1,6 glycosidic bond is formed between the second and rightmost molecule. The rightmost molecule is a beta glucose as shown by the OH on C1 being above the ring. Molecule B has both 1,4 and 1,6 glycosidic bonds formed from 3 alpha glucose. Molecule C has all 3 beta glucose. Molecule D has 2 alpha glucose and 1 beta glucose (extreme right), but has both 4,4 and 1,6 glycosidic bonds (no 1,4)
4.	**N17Q4**	C	Carbohydrate chains on the cell surface membrane are responsible for cell-cell recognition and cell to cell adhesion which allow for assembling. 2,5,6 are glycoproteins and 4 is a glycolipid.
5.	**N17Q5**	A	Z must be quaternary as it has 2 polypeptides coded by 2 genes, X and Y are coded by only 1 gene each, so tertiary structure. Y must be globular as it a great number of different aa than X, hence not many repetitive amino acids. X is fibrous as there is a high percentage of commonest amino acids, suggesting repetitive amino acids. (Remember collagen has repetitive amino acids).
6.	**N17Q6**	B	GPCR is embedded on membrane hence has hydrophobic R groups associated with the hydrophobic core of the phospholipid bilayer. GPCR is not quaternary (Option D is wrong) Option A is for fibrous protein.
7.	**N17Q7**	C	Options A, B and D apply to all enzymes whether lock-and-key hypothesis is used or induced fit hypothesis is used. Only option C applies to induced fit, where the active site of the enzyme changes conformation to fit the substrate better once the substrate approaches the active site, so the ES complex is formed. In lock-and-key hypothesis, the active site and substrate are an exact fit and there is no further conformational change after substrate binds.
8.	**N17Q8**	A	Resistant insects do not die from insecticides sprayed on them, because they have enzymes that metabolise (meaning "break down") the insecticides, and so rendering the insecticides ineffective. Synergists are non-competitive inhibitors that bind to one of the enzymes in the insect's body that metabolise (break down) the insecticides and inactivates it. Evidence 1: Resistant insects have high concentration of this enzyme but susceptible insects have low concentrations of this enzyme. Presence of synergist causes resistant insects to become susceptible. Conclusion – fewer available enzymes in resistant insects as some have been inhibited by synergist. Hence, lower concentration of enzymes (like in susceptible insects). Evidence 2: Synergists themselves have no effect on insects. Rules out options B and C.

			Evidence 3: When mixed with a synergist, less insecticide can be used without reducing the number of insects killed. Rules out option D. Also implies enzyme inhibition because at lower substrate concentration, same number of insects killed → less insecticide destroyed → less available enzymes.
9.	**N17Q9**	B	The E, P and A sites on the ribosomes will need to be larger to accommodate 4 nucleotides (on anticodon) instead of the usual 3. The anti-codon on tRNA will have to consist of 4 nucleotides instead of 3. mRNA, RNA polymerase and nucleotides can remain the same because the RNA polymerase just read the DNA template nucleotide bases (no need to read in threes during transcription, unlike translation), and make complementary mRNA bases.
10.	**N17Q10**	D	Since RNA polymerase I is involved in rRNA synthesis and RNA polymerase III is involved in tRNA synthesis and synthesis of some rRNA, RNA polymerase II must be involved in normal mRNA productions. mRNA is first transcribed as pre-mRNA and the introns are later removed and exons joined together to produce mature mRNA during post-transcriptional modification.
11.	**N17Q11**	D	1 genes widely separated – *genome is usually small and has very little noncoding sequences, hence genes are not widely separated.* 2 code almost entirely for proteins – *yes, mostly coding sequences, very few noncoding sequences* 3 include small circular sequences of DNA – *yes, plasmids* 4 simultaneous transcription of related genes – *yes, related genes arranged in operons under the control of a single promoter to make polycistronic mRNA.*
12.	**N17Q12**	A	1 prevent degradation of chromosomes by nucleases – *yes, by forming the loops at the ends of the linear chromosomes, it prevents nucleases from attaching and hydrolyzing the DNA* 2 prevent the ends of chromosomes fusing to each other – *yes, by forming the loops at the ends of the linear chromosomes, the 3' single-stranded sticky ends are not exposed and cannot complementary base pair with another sticky end from another chromosome.* 3 prevent the loss of genetic information during DNA replication – *yes, the shortening of DNA with each round of replication will cause the telomeres (found at the ends of linear chromosomes) to be shortened instead of genes found further in.*
13.	**N17Q13**	B	Lac repressor is a protein (1), the enzymatic protein RNA polymerase (5) binds to lac promoter (non-coding DNA); the repressor protein (8) binds to operator (non-coding DNA); Lac Z gene (on DNA) is where RNA polymerase (11) reads and codes for protein beta-galactosidase enzyme (12).
14.	**N17Q14**	C	Fact 2 and 3 affect the half-life (stability) of mature mRNA. 1 and 4 deal with protein (or enzyme) after protein is made by translation. For 5: repressors bind to silencers, and for 6: activators bind to enhancers.
15.	**N17Q15**	A	During independent assortment, the arrangement of 1 pair of homologues is independent of the other pairs. Independent assortment results in different combination (and hence proportions) of paternal and maternal chromosomes to each pole (and to each gamete eventually). Hence the proportion of nuclear DNA from the maternal parent being passed on to the daughters is variable. B is incorrect. It will not be exactly 50%. C is incorrect. Each daughter will get one X chromosome from their father and one X chromosome from their mother.

			D is incorrect: Keyword here is “proportion of nuclear DNA”. Both daughters will get 50% of their nuclear DNA from the mother and 50% of their nuclear DNA from their father. Hence, it is incorrect to say they have different proportion inherited from the mother. All of the DNA in an egg cell is derived from the woman producing that egg cell, whether or not crossing over in prophase I has occurred. Crossing over only affects the proportion of DNA in the egg cell that is derived from the maternal and paternal DNA of the previous generation (i.e. the grandparents of the mother’s daughters).
16.	**N17Q16**	B	Fact A is incorrect: Centromeres would have already bound to spindle microtubules earlier during metaphase. Picture A appears to show early telophase. Some students might consider this to be late anaphase. However, between options A and B, B seems to be a stronger answer, as it clearly shows metaphase (alignment along equator, and the microtubules ***begin*** to pull). C is incorrect. Picture 3 does not show condensed chromatin. The chromosomes are not visible. It is actually interphase. 4 is prophase as the chromosomes are condensed.
17.	**N17Q17**	B	Excess cyclin D will bind to Rb and prevent Rb from binding to E2F. Thus overproduction of E2F will result in E2F binding to the promoter more than usual and can cause the excessive production of the synthesized protein that causes S phase to begin. This stimulates the cell cycle, and hence more rounds of mitosis subsequently. This could lead to tumour formation.
18.	**N17Q18**	D	1. Genes (only genes are found at different loci, alleles of the same gene will be found at the same locus of homologous chromosomes). 2. Epistasis (since 1 already gives you the clue it is about gene interaction) 3. Phenotype (outward appearance or protein) 4. Alleles (different alleles of two or more genes interact to give different phenotypes)
19.	**N17Q19**	C	 We observed 9:3:3:1 whenever double heterozygote x double heterozygote (involving two unlinked genes).

20.	**N17Q20**	A	At X from Glyceraldehyde-3-phosphate (aldehyde) to glycerate (acid), there is oxidation resulting in reduced NAD formed because NAD+ removes H from glyceraldehyde-3-phopshate, and at the same time a Pi is added. At Y and Z, these steps are substrate level phosphorylation where Pi is transferred from substrates glycerate 1,3 bisphosphate and subsequently glycerate 3 phosphate to 2ADP to form 2 ATP.
21.	**N17Q21**	D	1 is wrong as NAD can be regenerated by the alcohol fermentation. Oxygen is also the final electron acceptor. 2 is wrong as oxidation of ethanol is exothermic (releasing heat) 3 is correct because net 2 ATP is produced during glycolysis through the process of substrate level phosphorylation. Link reaction, Krebs cycle and oxidative phosphorylation does not occur.
22.	**N17Q22**	C	1 They can be linked to a protein kinase cascade to amplify the signal. (True; think of cAMP and how it causes the phosphorylation cascade) 2 They are activated only when they bind to extracellular signaling molecules. (Second messengers are found inside the cells and do not come in contact with the extracellular ligand) 3 They always cross cell surface membranes to initiate cellular processes. (Second messengers are found inside the cells and do not have to cross the cell surface membrane) 4 Membrane-bound receptors often trigger their release or synthesis. (True, e.g. adenylyl cyclase, which is membrane bound synthesises cAMP)
23.	**N17Q23**	D	Fact.
24.	**N17Q24**	A	Fact. Phylogeny is grouping organisms based on evolutionary relationships. To construct phylogeny, many evidences are used, including fossil records, DNA sequences, homologous structures, etc.
25.	**N17Q25**	C	*From lecture notes:* **microevolution** - is change in allele frequency within a population or species over **shorter periods of time**. It **does not give rise to a new species**. **macroevolution** - is gradual changes in allele frequencies usually over **longer periods of time** and may eventually **give rise to a new species**. The defining feature of macroevolution is speciation. This is an example of microevolution as the changes within each frog population have only resulted in changes in colouring, mating calls and toxicity within the population and have not yet led to the formation of a new species within the population itself.
26.	**N17Q26**	B	A – True, different genotypes in different strains of the bacteria can result in some strains being more toxic/ cause more severe form of disease than others. B – False, if bacteria have same DNA sequence, they will interact with the human host in the same way during infection and the severity of the disease will be the same. C – True, human hosts and bacteria strains co-evolve over the years which explains the different severity of the disease. D – True, as plasmids replicate independently of the bacterial genome, they may or may not be inherited by the daughter bacteria → hence, some cells will have plasmids that contain DNA sequences that cause a more severe disease compared to other cells.
27.	**N17Q27**	B	Although the X4 strain mainly uses the CXCR4 receptor on T helper cells and a reduction in T helper cells would mean a reduction in infection by the X4 strain, it also means that the immune system is more compromised as the T helper cells are needed for activation of naïve B cells. If the immune system is more compromised due to fewer helper T cells, disease (including secondary infections) will progress more quickly in these individuals

			because fewer T cells mean fewer activation of naïve B cells to form plasma cells. So fewer T cells will not mean more resistance to the infection, but instead the reverse is true! Hence, statement 3 is wrong.
28.	**N17Q28**	D	The number of circulating B lymphocytes will be greatest during the peak of antibody production. This is when the number of plasma cells be greatest. Memory B cells are low in proportions compared to plasma cells.
29.	**N17Q29**	C	Statement 1 is incorrect as use of antibiotics is to treat bacterial diseases but measles is a viral disease. Statement 2 – a successful vaccination programme can explain a drop in the number of people getting measles as there is less people to people transmission. Statement 3 – antigenic drift may cause a mutation in the viral glycoproteins on the surface, hence the antibodies produced against the original virus does not recognize the mutated antigens and it will not destroy the virus, allowing the virus to infect the cells. Statement 4 – A drop in the number of people vaccinated will mean there are more susceptible people in the population allowing for more people to people transmission.
30.	**N17Q30**	B	1. Likely – Earlier migration and nesting (which happens in breeding habitats) will result in a mismatch between timing of breeding seasons and maximum food availability. Migration and reproduction of many avian (bird) species are controlled by mechanisms that have been under intense selection over time to ensure that arrival to and departure from breeding grounds is synchronized with peak food availability and availability of nesting sites. In the Northern Hemisphere, this could mean arrival of birds before summer. 2. Likely – Population is the number of individuals of a particular species in an area. Limiting factors like the availability of food, water, and shelter can impact an organism's population. Other limiting factors, like competition for resources, predation, and disease also impact populations. This is evidenced by the examples given. 3. Likely – Increases in global temperatures will cause and increase in the range of boreal forest and thus invading the tundra grassland and reducing the area of tundra grassland. 4. Unclear – While it is stated that warm water fish may move to rivers inhabited by cold water species, the overall change in the available habitat is unclear. While there may be some competition, cold water species may be able to persist or even adapt to colder regions of the river (e.g. in deep water caves, or higher elevated regions).