Credit: Written by the collective effort of our tutors at ThatBioTutor. You are welcome to share these with anyone you'd like! Just don't sell them for profit :)

TYS Answers 2020 (ThatBioTutor Edition)

IMPT NOTE:

- *For differences between 2023 and 2024 syllabus, see this list here.*
- **Shaded black = out of syllabus from 2024 onwards*

Question	Ans	Question	Ans
~~1 *~~	~~D~~	21	C
2	B	~~22 *~~	~~D~~
3	B	23	B
4	D	24	A
5	C	25	D
6	A	~~26 *~~	~~B~~
7	C	27	B
8	A	28	A
9	B	29	C
10	D	30	D
11	C	31	D
12	B	32	D
13	A	~~33 *~~	~~A~~
14	C	34	C
15	A	35	B
16	A	36	C
~~17 *~~	~~D~~	37	B
18	B	38	D
19	D	39	A
20	D	40	D

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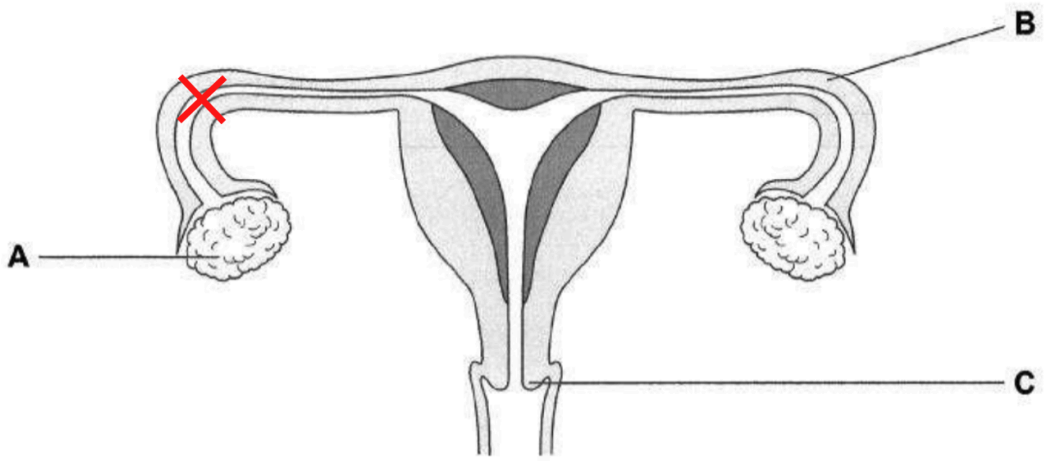
Q1.

(a)

- A: Ovary
- B: Oviduct~~/Fallopian tube~~
- C: Cervix

(b)



(c)

Choose 3:

- After fertilisation, the zygote is moved from the oviduct towards the uterus, by peristaltic action of the oviduct walls and the sweeping action of cilia.
- Meanwhile, the zygote divides by mitosis into an embryo,
- Which embeds itself into the uterine lining during implantation, where it develops into a foetus,
- Finger-like projections called villi, containing the blood vessels from the embryo, grow into the uterine lining, forming the placenta.

(d)

(i)

- As the ovum is not motile, the sweeping action of the cilia move ovum from the ovary towards the uterus.

(ii)

- Respiratory system.

Q2.

(a)

- D: DNA replication is occurring in the nucleus during interphase, doubling the amount of DNA
- E: Cytokinesis occurred, splitting the parent cell into two daughter cells, hence halving the amount of DNA per cell.

(b)

(i)

- Anaphase

(ii)

- Before: Metaphase
- After: Telophase

(iii)

- Haploid number = 3

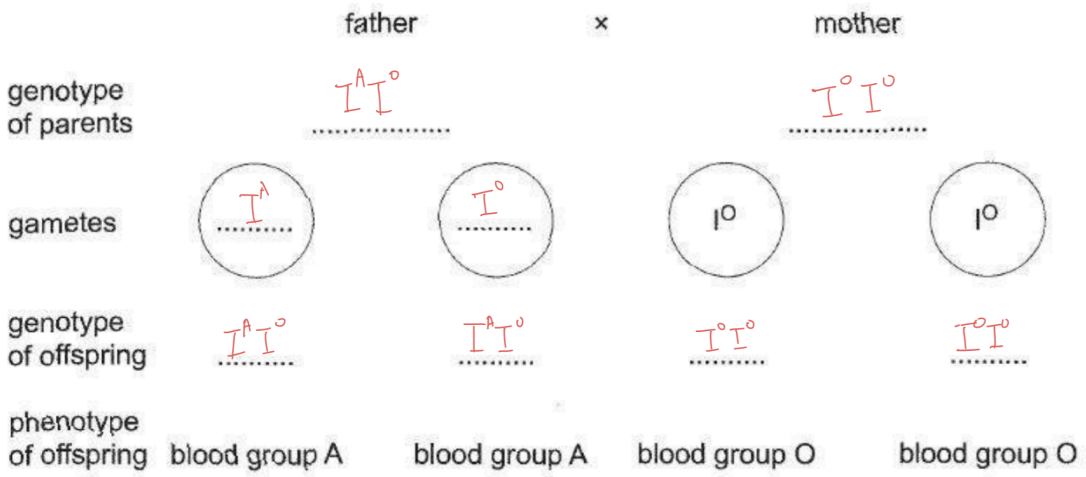
- In this stage of anaphase, there are 12 daughter chromosomes in total. After telophase and cytokinesis, there will be 6 chromosomes in each daughter cell.
- Since mitosis occurs in diploid cells, and preserves the chromosome number of the original parent cell, the original cell had six chromosomes.
- Haploid number would be half of the diploid number = 6 x 0.5 = 3.

(c)

- Due to independent assortment of chromosomes during Metaphase I, maternal and paternal chromosomes could be segregated into either daughter cell in different combinations.
- During Prophase I, crossing over may occur, resulting in new combinations of alleles and forming chiasmata, increasing the genetic variation of the gametes.
- Random fertilisation of a random sperm and egg further increases the genetic variation of the zygote formed, increasing the number of offspring variants.

Q3.

(a)



(b)

- Codominance: When the two different alleles for a trait are both expressed and influence phenotype, such as the I^A and I^B allele both being expressed hence type AB red blood cells have both the A antigen and B antigen on their plasma membranes.
- Multiple alleles: When more than two alleles exist for a certain trait, such as the presence of I^A I^B I^O alleles, which are responsible for blood groups A, B and O respectively.

(c)

- Discontinuous variation is when there are few and distinct phenotypes, such as the 4 blood groups A, B, AB, O, and phenotypes are not affected by the environment.

(d)

- A gene is a sequence of DNA nucleotides that codes for a specific polypeptide, while an allele is an alternative form of a gene.
- Individuals of the same species have the same genes, but they may have different alleles.

Q4.

(a)

- As the age men started smoking tabacco increased from 10-14 to 20-24 years old, the relative death rate decreased gradually from 2 to 1.7,
- Then decreased sharply to 1.25au at 25-29 years old.
- All smokers in the study had a higher death rate compared to non-smokers which is at 1au.

(b)

- Occlusion of coronary arteries due to atherosclerosis narrows the lumen, reducing bloodflow to the cardiac muscles.
- The heart muscles lack oxygen and nutrients for them to release energy via aerobic respiration, they may start dying, which can result in chest pain.
- If the fatty deposit ruptures in the artery, a blood clot that forms may get stuck and completely block the already narrowed lumen, which would then lead to a heart attack.

(c)

- Cigarette smoke contains carbon monoxide, which binds irreversibly to the foetus' haemoglobin,
- such that it cannot transport oxygen anymore, reducing the ability of blood to transport oxygen.
- Foetal cells are deprived of oxygen, less aerobic respiration occurs to release energy for mitosis and metabolic reactions,
- Hence the foetus grows slower than it should during pregnancy, resulting in a higher chance of having low body mass when born.

Q5.

(a)

- 40.00 / 0.04 = 1000

(b)

- As the insecticide is not easily excreted from organisms' bodies, it accumulates in them via bioaccumulation.
- Each small fish feeds on many water plants, large amounts of insecticide enters them, biomagnification has occurred.
- The process repeats up the food chain, hence the top consumer, fish-eating birds, has the highest concentration of it in their bodies, and get the most poisoned, hence a higher proportion of them die compared to the lower trophic levels.

(c)

- If all fish-eating birds die, there will be no predator to feed on large fishes, hence their population will increase.
- This results in more small fishes being fed on by the large fishes,
- hence small fish population will decrease significantly.

Q6.

(a)

(i)

- Arteries need a thick elastic layer to withstand the high pressure of blood within them,
- As well as to effectively stretch and recoil with enough force, to push blood forward in spurts.

(ii)

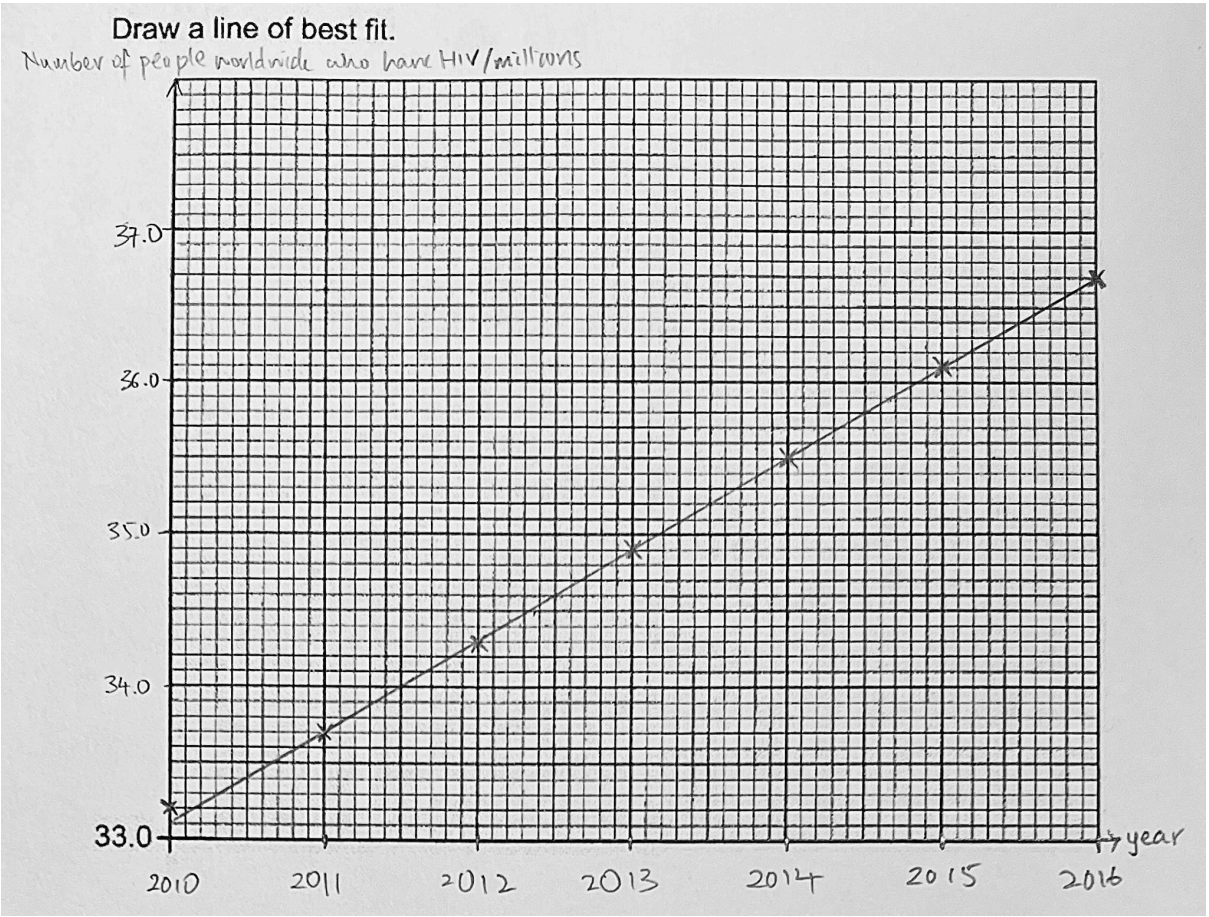
- The muscle fibres allow for the regulation of bloodflow to the tissues they are connected to,
- By contracting during vasoconstriction to reduce bloodflow, and relaxing during vasodilation to increase bloodflow.

(b)

- Veins have semi-lunar valves.

Q7.

(a)(i)



(ii)

- The number of people worldwide who had HIV increased from 2010 at 33.2 million to 36.7 million in 2016, an increase of 3.5 million.
- From 2010 to 2011, the increase of 33.2 to 33.7 was 0.5 million, which is less steep compared to the change from 2011 to 2016,
- where there was a slightly steeper and linear increase of 0.6 million each year.

(b)

- Use condoms when engaging in sexual intercourse.
- Only engage in sexual intercourse with one partner who is known to be free of sexually transmitted diseases.
- Do not share unsterilised needles.

Q8.

(a)

- The presence of forest fires acts a selection pressure.
- As there is variation between eucalyptus trees, some of them had a fire-resistance allele,
- Which is a favourable trait as it allows them to survive fires, giving them a selective advantage.
- As a result, these individuals survived and reproduced more, passing on their favourable fire-resistance alleles to their offspring.
- Over a long period of time, accumulation of new genes by mutation and natural selection resulted in the evolution of eucalyptus trees to be resistant to fires.

(b)

(i)

- ~~The process whereby humans selectively choose which individuals to breed in order to achieve desirable traits.~~

(ii)

~~Animal: Cows~~

- ~~Feature: Sweetness of milk produced/Quantity of milk produced/Amount of meat that can be harvested per cow/Tenderness of meat.~~

~~Plant: Soybeans~~

- ~~Feature: Oil content in soybeans/Size of beans/Sweatness of beans~~

(c)

- Example: Chickens that have been genetically engineered to lay eggs that contain human proteins which are then used to make medicines.

Choose 2:

- Social implication: Medicines become more affordable to the masses
- Social implication: Companies can set patent on these medicines and financially exploit patients who need them.
- Ethical implication: It could result in unforeseen health problems for the chickens, causing suffering for chickens which is morally wrong.
- Ethical implication: Morally wrong to violate animal rights, by using chickens as biological 'factories'.
- Ethical implication: Some vegetarians/vegans/religions may object to consuming the medicinal proteins because their production involved animals.

Either Q9.
(a)

- The individual has two 'X' chromosomes, hence is a female.
- There are 3 copies of chromosome 21, hence this person has Down Syndrome,
- ~~And is likely to have symptoms such as small hands and feet, flattened face and eyes that slant upward.~~

(b)

- Radiation and chemicals are mutagens, increasing the rate of mutation in individuals, hence increasing the rate of new alleles appearing in the population.
- Some of these could give favourable traits to the organisms, allowing them to survive and reproduce more, passing these favourable alleles to offspring.
- Through mutation and natural selection, evolution is likely to occur at a faster rate.

(c)

- A restriction enzyme is used to cut a section of DNA containing the human insulin gene, creating sticky ends.
- The same restriction enzyme is used to cut a plasmid, creating sticky ends.
- Plasmid and target gene are mixed, allowing them to anneal via complementary base pairing at the sticky ends.
- DNA Ligase is added to seal them together, resulting in a recombinant plasmid.
- Mix this with the bacteria, and heat shock/electric shock treatment is applied, creating pores in the bacteria's plasma membrane to allow the recombinant plasmid to enter.
- The transgenic bacteria will then produce insulin as part of their metabolic processes.

Or Q9.

(a)

- In cities, dead honeybee colonies only contain up to 4 different insecticides, while that of farmlands can have up to 8 different insecticides.
- From 1 to 4 different insecticides found in the colonies, the number of dead colonies in farmlands always exceeds that of cities.
- For both cities and farmlands, as the number of different insecticides increases, the number of dead colonies found decreases.

(b)

Choose 3:

- In farmland areas, insecticides are frequently used on crops, hence more colonies near farmlands would get poisoned and killed by insecticides.
- Farmland areas likely use multiple types of insecticide for the different types of insects that attack the crops.
- The honeybees in cities could be more resistant to dying from insecticide than those found in the farmlands.
- The insecticides used in cities could be more eco-friendly and less poisonous to useful insects like honeybees.

(c)

- Honeybees are pollinators of crops, and their population decline means lower crop yields, hurting food security.
- Honeybees are part of food webs, and their decline affects the trophic levels above and below them, upsetting the balance of the ecosystem.
- Honeybees are pollinators of natural plant species, which would in turn decline in population, reducing biodiversity.
- These plants could be used for certain medicines/studied for obtaining useful information through biological discoveries/maintain a large gene pool for farmers to cross-breed different varieties of these wild plants with favourable traits to improve crops.