BIOLOGY 2020

Unit 2
Key Topic Test 3 – Genomes, genes, alleles and chromosomes

Recommended writing time*: 45 minutes
Total number of marks available: 45 marks

SOLUTIONS

SECTION A: Multiple-choice questions (1 mark each)

Question 1

Answer: A

Explanation: Deoxyribose is a 5C sugar, it is attached to both a nitrogenous base and a phosphate group and so option A is correct. Phospholipid mentioned in option C is the main constituent of the plasma membrane. The nitrogenous acid mentioned in option D is not correct and ribose sugar is the sugar found in RNA and so options B is also not correct.

Question 2

Answer: D

Explanation: Ionic bonds form between charged particles and peptide bonds form between amino acids and so options A and C are incorrect. Base pairing is responsible for which base pairs with which (complementary base pairing) but the bases are held together by hydrogen bonds, option C.

Question 3

Answer: D

Explanation: Using complementary base pairing rules, A/T and C/G then the complementary sequence would be option D. The inclusion of the base uracil - U, would only be seen in RNA.

Question 4

Answer: B

Explanation: The genome, option D is all the genetic data of an organism. A chromosome, option C is a long strand of DNA that would contain many genes. Each gene would control a characteristic and so option B is correct. Option A is an alternative form of a gene and is incorrect.

Question 5

Answer: B

Explanation: Option A refers to half the normal number of chromosomes. Option C refers to multiples of chromosome numbers and option D is when a particular chromosome has the incorrect number of copies. Two copies of each chromosome is termed diploid, option B.

Question 6

Answer: C

Explanation: Option B refers to proteomics and is incorrect. Option D is a use of genomics to clarify evolutionary relationships. Options A and C are similar but option C is the most precise definition.

Question 7

Answer: A

Explanation: A gene, option B, controls a characteristic, of which there can be different forms (alleles) and many of these are found on a chromosome, option C. Option D can cause a change in DNA and produce a new allele.

Question 8

Answer: D

Explanation: Option A and C are incorrect as the alleles can differ on each of the homologous chromosomes. Option B is incorrect as each of the homologous chromosomes will have the same genes along their length. The result of meiosis and sexual reproduction is that the offspring receives half of its genetic information from the mother and half from the father, so option D is correct.

Question 9

Answer: A

Explanation: Non disjunction is when the chromatids do not separate in meiosis during gamete formation. This leads to some gametes have more than the normal number of chromosomes. Klinefelter's syndrome is an example of this as individuals have XXY instead of XY. Options B, C and D are conditions caused in other ways.

Question 10

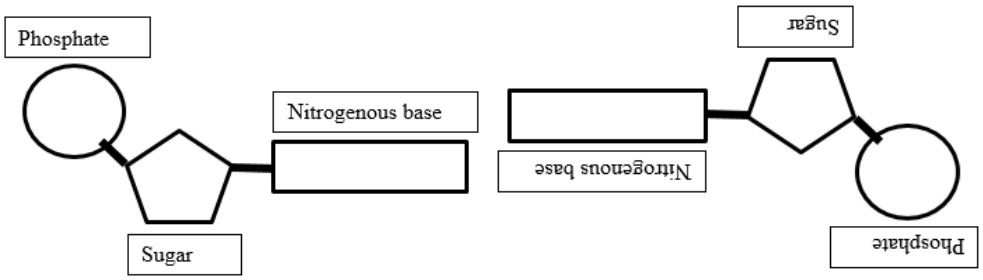
Answer: B

Explanation: The banding is indicative of where certain genes are because the banding pattern can act as a map, option B. The dark banding occurs in areas rich in A and T bases rather than cytosine, mentioned in option D but could not be used to determine the number of these bases. Option A is one feature of the structure of a chromosome but its length and position of the centromere are more indicative of structure. The banding does not relate to parental origin and so option C is incorrect.

SECTION B: Short-answer questions

Question 1

a.



One mark for each correctly named component and one mark for the correct arrangement.

4 marks

b. On diagram above…must show reverse orientation

1 mark

c. In any order:
Cytosine*
Adenine*
Guanine*
Thymine*

4 marks

d. The "rungs" of a DNA molecule are made up of two bases bonded together*. Only certain combinations of bases will bond together*.

2 marks

e. If the sequence of bases along one side of the DNA molecule is known, then the sequence along the other side can be determined.

1 mark

f. A with T and C with G

1 mark

g. DNA in prokaryotes is a circular double strand whereas in eukaryotes it is a linear double strand*.
DNA in prokaryotes is free in the cytoplasm whereas in eukaryotes it is in the nucleus*.

2 marks

Total 15 marks

Question 2

a. The Human Genome Project aimed to sequence the precise order or sequence of bases in the DNA of humans*. It mapped the position of all genes on the chromosomes*. It also aimed to store the sequences in an accessible database for all to use the information*. Or any other reasonable responses.

3 marks

b. Any two of or any reasonable responses:

- Diagnosis by identifying mutated genes
- Prevention when certain predispositions are noted
- Better understanding of human development
- Better understanding of human evolution

2 marks

c. Base pairs or accept MBPs (mega base pairs)

1 mark

d. Not necessarily* as rice has a large number of coding genes (51,000) and yet has a relatively small genome (470 million bp)* whereas humans have a much larger genome (2.9 billion bp) and only about half the number of coding genes (20-25,000)*. Any reasonable response but must show data from the table for evidence that supports student's view.

3 marks

Total 9 marks

Question 3

a. TRUE

1 mark

b. Humans have 23 pairs of chromosomes*. 22 pairs of these chromosomes are autosomes which control all characteristics except gender*. The last pair are the sex chromosomes and they determine gender*. Therefore not all chromosomes are autosomes*.

4 marks

Total 5 marks

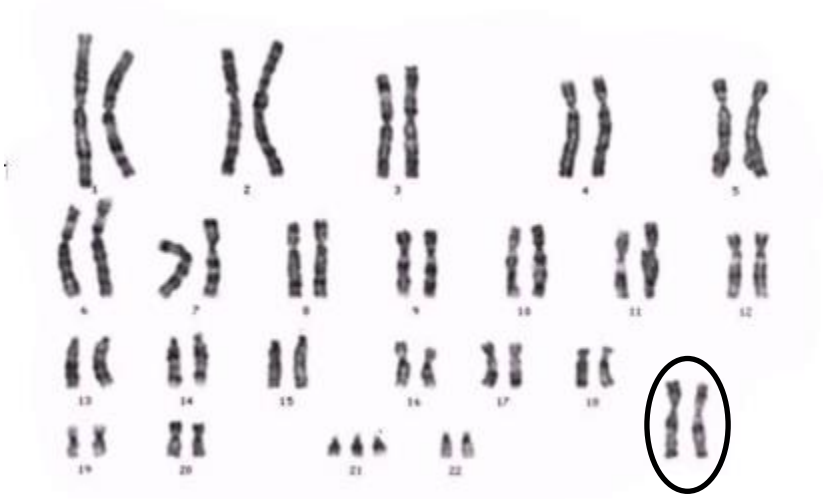
Question 4

a. The 23rd pair of chromosomes are a pair and so they must be showing XX* and the gender of the foetus is female*.

2 marks

b. On diagram

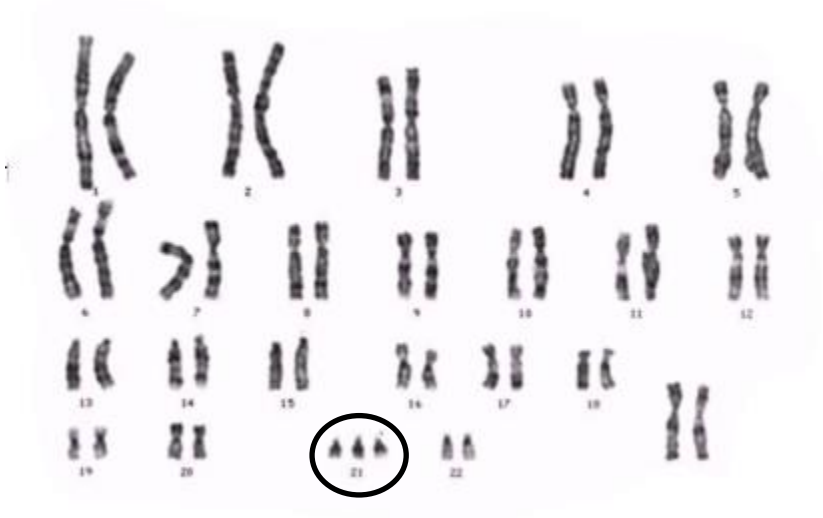
1 mark



c. The karyotype shows that there are three copies of chromosome 21*. This means that the foetus has Down's syndrome*.

2 marks

d. On diagram



1 mark
Total 6 marks