IB · SL · Biology

32 mins 6 questions

Structured Questions

Diversity of Organisms

Biological Species Concept / Chromosome Number / Karyograms: Skills / Genomes / Comparing Genome Sizes: Skills / Uses of Genome Sequencing

Easy (1 question)	/6
Hard (5 questions)	/26
Total Marks	**/32**

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Easy Questions

1 (a) The following diagram shows the karyogram of an individual.

(i) Identify the sex of this individual.

[1]

(ii) State a reason for your answer in part i).

[1]

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(2 marks)

(b) Cells in metaphase of mitosis were used to construct the karyogram from part a).

Explain the reason for this.

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(1 mark)

(c) List **two** characteristics of the chromosomes that are used to arrange them in a karyogram.

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(2 marks)

(d) Apart from sex determination, state **one other** use of studying the karyotype of an individual.

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(1 mark)

Hard Questions

1 (a) The table below shows the genome size and haploid chromosome number of different organisms.

Organism	Genome size / base pairs	Chromosome number / n
Polychaos dubium (single celled eukaryote)	6.7×10^{11}	> 100
Trumpet lily (plant)	9.0×10^{10}	12
Mouse	3.5×10^{9}	20
Human	3.2×10^{9}	23
Carp (fish)	1.7×10^{9}	49
Chicken	1.2×10^{9}	39
Housefly	9.0×10^{8}	6
Tomato plant	6.6×10^{8}	12

Calculate the percentage difference in the chromosome number found in the zygotes of chickens compared to those of humans.

Show your working and give your answer to three significant figures.

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(2 marks)

(b) The diploid number in an organism is always an even number.

Using your knowledge on the behaviour of chromosomes during meiosis, explain the importance of the diploid number in an organism.

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(2 marks)

(c) Scientists hypothesised that a high chromosome number leads to the development of a more complex organism.

Discuss this hypothesis using the data provided in part a).

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(3 marks)

(d) Based on your knowledge of chromosomes, suggest a reason why the genome size of a species does not always seem to correlate with the chromosome number.

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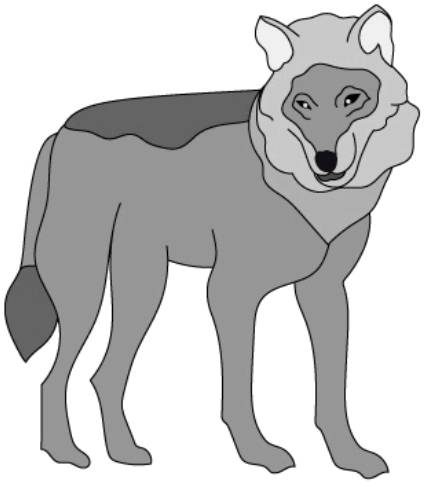
(1 mark)

2 (a) The images show two organisms from the genus *Canis*.

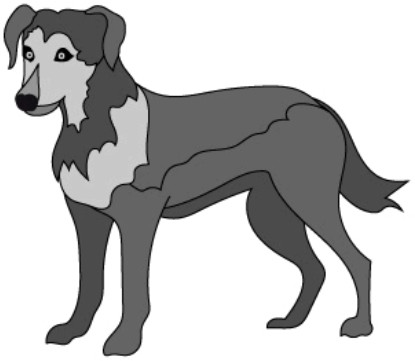
Grey wolves, *Canis lupus,* are wild animals native to Eurasia and North America.

Domestic dogs, *Canis familiaris,* descended from wolves and became domesticated over many years.

Canis lupus



Canis familiaris



A wolfdog is a hybrid produced when a domesticated dog (*Canis familiaris*) breeds with a wolf (*Canis lupus*). Genetically, dogs and wolves are very similar and the resulting offspring are fertile. Wolfdog hybrids are rare as natural habitats and territorial behaviours isolate wolves from domestic dogs.

Using the information provided, discuss the validity of the claim that wolves and dogs are the same species.

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(4 marks)

(b) A taxonomist suggested that the wolf and the domestic dog should be re-categorised as follows:

- *Canis lupus familiaris*
- *Canis lupus lupus*

Identify the genus name and the species name for the wolf and the domestic dog under this re-categorisation.

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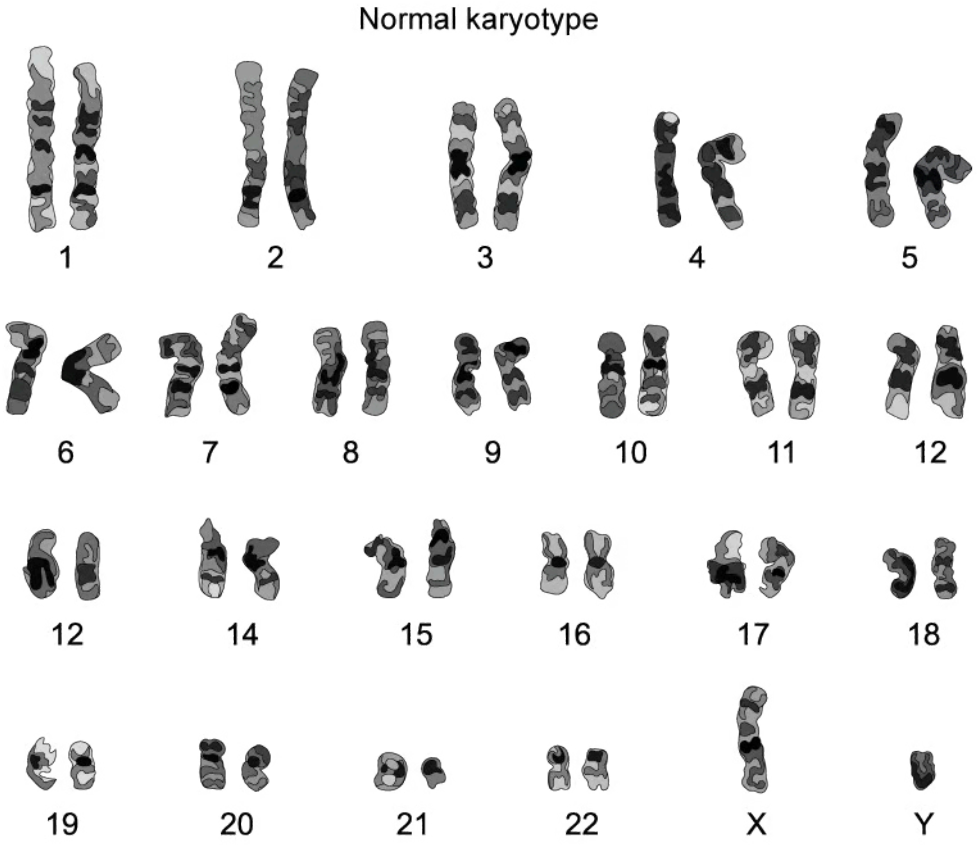
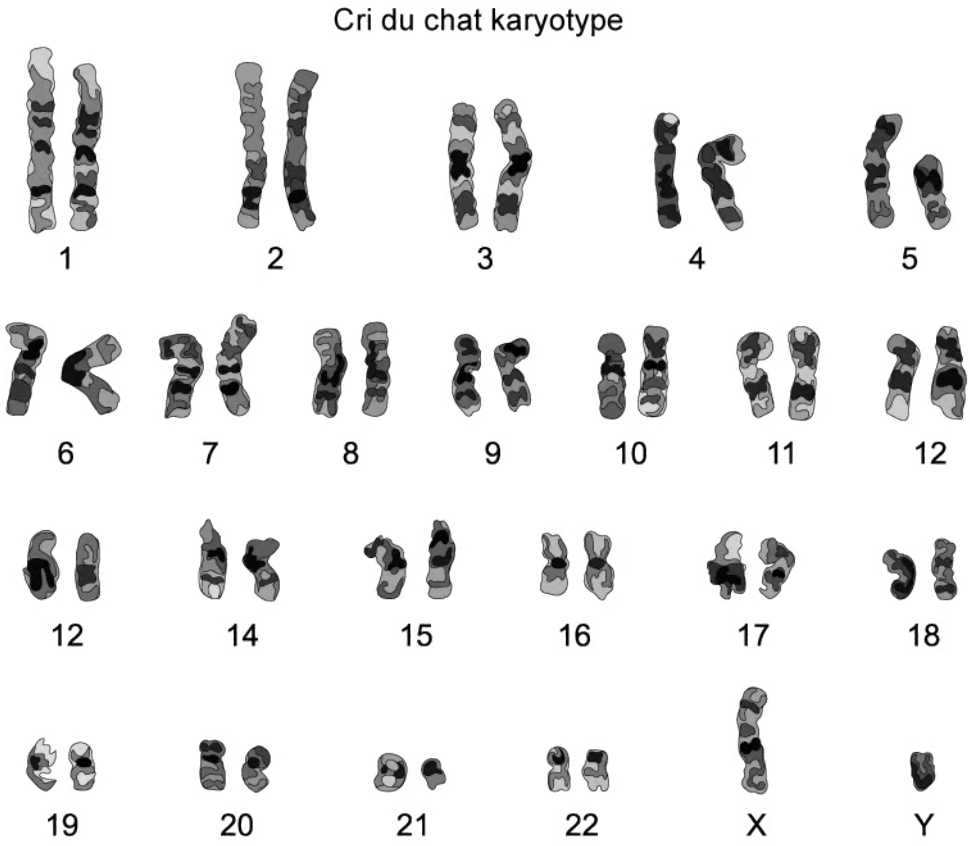
(2 marks)

3 (a) Cri du chat syndrome is a rare genetic disorder caused by a chromosomal abnormality that occurs very early in embryonic development. Babies born with cri du chat syndrome suffer from a variety of symptoms and have a characteristic cry which sounds like the meowing of a cat.

The karyograms below compare the karyotype of a normal child with one that suffers from cri du chat syndrome.





Contrast the karyotype of a normal child with that of a child suffering from cri du chat syndrome.

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(1 mark)

(b) There are some individuals with cri du chat syndrome that do not differ developmentally from their peers in a significant way.

Based on the information provided in the karyograms at part a), explain this occurrence.

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(2 marks)

(c) Most of the people affected by cri du chat syndrome do not have a family history of the condition.

Suggest what this means in terms of the heritability of the syndrome.

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(1 mark)

4 (a) Polyploidy is a condition in which cells have a chromosome number that is greater than the normal diploid (2n) number. Polyploidy is considered to be a useful characteristic in crop plants as it gives rise to bigger plant organs and provides cells which contain a larger variety of alleles for breeding programmes. While polyploidy can occur naturally in plants, it can also be induced artificially using a chemical called colchicine. Colchicine works by preventing the formation of the microtubules that make up the spindle fibres inside cells.

Suggest how colchicine gives rise to tetraploid (4n) cells after **mitosis** in plants.

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(2 marks)

(b) A watermelon variety that naturally produces fewer seeds has been identified by scientists, and observation of its cells indicates that an event known as reciprocal translocation of chromosomes occurs in the cells of the watermelon variety. Reciprocal translocation of chromosomes involves the exchange of entire sections of chromosomes between non-homologous chromosomes during meiosis.

(i) Contrast reciprocal translocation of chromosomes and crossing over with each other.

[1]

(ii) Suggest how reciprocal translocation of chromosomes could result in a watermelon plant that produces fruits containing fewer seeds.

[2]

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(3 marks)

5 The binomial naming system is an important tool to facilitate cooperation and collaboration between groups of scientists.

Discuss how the binomial system will facilitate cooperation and collaboration between scientists.

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(3 marks)