PART I
Total Value: 75%

Instructions: Shade the letter of the correct answer on the computer scorable answer sheet provided.

1. Which part of the brain controls muscle coordination?

   (A) cerebellum
   (B) cerebrum
   (C) medulla oblongata
   (D) midbrain

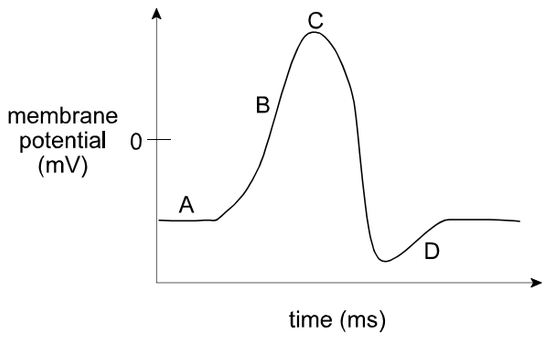
2. Which part of the nervous system includes the parasympathetic nervous system?

   (A) central
   (B) peripheral
   (C) somatic
   (D) sympathetic

3. Which part of the nervous system is responsible for the body returning to a normal state of homeostasis after a frightening event?

   (A) central
   (B) parasympathetic
   (C) peripheral
   (D) sympathetic

4. Which indicates that the sodium-potassium pump is repolarizing the membrane?



   (A) A
   (B) B
   (C) C
   (D) D

5. A hydra is a fresh water invertebrate. If adding one drop of dilute hydrochloric acid to the water surrounding the hydra causes it to contract, what role does the acid play in the response?

   (A) impulse
   (B) neurotransmitter
   (C) response
   (D) stimulus

6. Which neurotransmitter has an excitatory effect on skeletal muscle, but an inhibitory effect on cardiac muscle?

(A) acetylcholine
(B) glutamate
(C) noradrenaline
(D) seratonin

7. Which pathway illustrates a reflex arc?

(A) brain → spinal cord → hand → sensory neuron
(B) hand → sensory neuron → spinal cord → motor neuron
(C) interneuron → stimuli → sensory neuron → motor neuron
(D) motor neuron → interneuron → stimuli → sensory neuron

8. What symptoms are shown by a person with low levels of cerebral cortex dopamine?

(A) blurred vision, seizures, slurred speech
(B) headache, fever, stiff neck
(C) memory loss, confusion, impaired judgement
(D) tremors, stiffness in limbs, slow movements

9. Which sequence describes the path for the conversion of sound waves to nerve impulses?

(A) auditory nerve → cochlea → eardrum → ossicles
(B) cochlea → auditory nerve → ossicles → eardrum
(C) eardrum → ossicles → cochlea → auditory nerve
(D) ossicles → eardrum → auditory nerve → cochlea

10. Which type of hormones penetrate target cells to combine with genes to produce proteins?

(A) ACTH
(B) carbohydrates
(C) non-steroids
(D) steroids

11. Which disease is caused by an excessive production of thyroxine by the thyroid gland?

(A) diabetes mellitus
(B) gigantism
(C) hyperthyroidism
(D) hypothyroidism

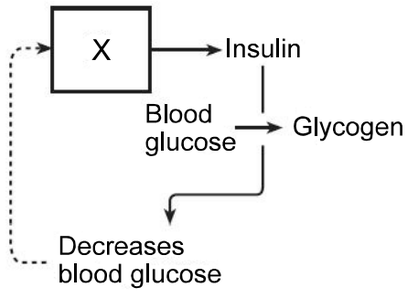
12. Which is directly involved in the action of most non-steroid based hormones?

(A) permeable membrane
(B) prostaglandins
(C) second messenger
(D) testosterone

13. Which hormones have antagonistic effects?

(A) epinephrine and ADH
(B) insulin and glucagon
(C) thyroxine and calcitonin
(D) thyroxine and parathyroid hormone

14. Which gland is represented by X?



(A) adrenal medulla
(B) pancreas
(C) posterior pituitary
(D) thyroid

15. Which describes the blood hormone concentration of a person who has not eaten for 24 hours?

(A) high insulin, high glucagon
(B) high insulin, low glucagon
(C) low insulin, high glucagon
(D) low insulin, low glucagon

16. Which phase of mitosis is characterized by the arrangement of all chromosomes along the equator of the cell?

(A) anaphase
(B) metaphase
(C) prophase
(D) telophase

17. When does separation of the homologous chromosomes occur?

(A) fertilization
(B) meiosis I
(C) meiosis II
(D) mitosis

18. Which is true of oogenesis and spermatogenesis?

	Oogenesis	Spermatogenesis
(A)	equal cell division	unequal cell division
(B)	occurs in males	occurs in females
(C)	one egg cell produced	four sperm cells produced
(D)	produces motile cells	produces non-motile cells

19. A biologist successfully fertilized an egg cell with two sperm cells forming a zygote. Later study of the zygote showed that it contained 27 chromosomes. How many chromosomes should normally be found in diploid cells of this organism?

(A) 9
(B) 18
(C) 27
(D) 36

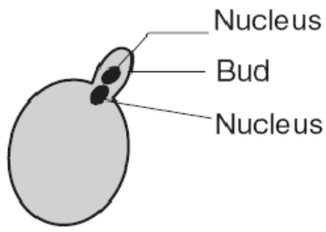
20. Which part of human sperm contains high numbers of mitochondria that provide the energy for movement?

(A) acrosome
(B) flagellum
(C) middle piece
(D) nucleus

21. A tree produces only seedless oranges. A small branch cut from this tree produces roots after it is planted in soil. What type of fruit will most likely be produced when this tree matures?

(A) a majority of oranges with seeds
(B) a majority of seedless oranges
(C) only oranges with seeds
(D) only seedless oranges

22. The diagram below represents a yeast cell in the process of budding. Which best describes the bud?

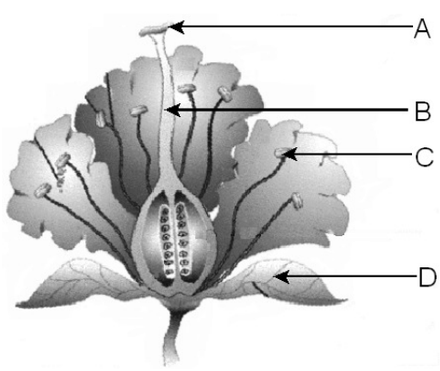


(A) It will contain genetically identical chromosomes as the parent.
(B) It will contain half the number of chromosomes as the parent.
(C) It will develop into a zygote.
(D) It will divide by meiosis.

23. Which structures aid in the transport of sperm nuclei to egg nuclei in most flowering plants following pollination?

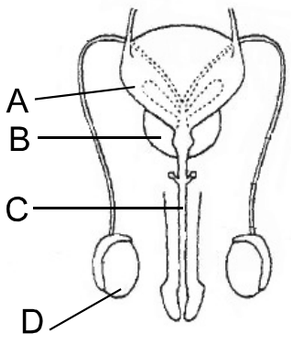
(A) anthers
(B) filaments
(C) pollen tubes
(D) sepals

24. Which structure is part of the male sex organ?



(A) A
(B) B
(C) C
(D) D

25. Which structure is located in a sac outside the body?



(A) A
(B) B
(C) C
(D) D

26. In which structure are human sperm cells matured and stored until release?

(A) accessory glands
(B) epididymis
(C) prostate
(D) seminiferous tubules

27. The data below indicates the presence of specific reproductive hormones in the blood sample of an individual. Which reproductive process(es) could occur in this individual?

Hormones Present		
Testosterone	Progesterone	Estrogen
high	none	low

(A) embryonic development only
(B) production of eggs and embryonic development
(C) production of eggs only
(D) production of sperm only

28. Which sexually transmitted infection can be effectively treated with antibiotics?

(A) AIDS
(B) genital herpes
(C) gonorrhea
(D) hepatitis

29. What is the most likely cause of infertility in a woman who has experienced a pelvic inflammatory disease?

(A) blocked oviduct
(B) damaged eggs
(C) endometriosis
(D) failure to ovulate

30. Birth control pills contain substances similar to progesterone and estrogen. How do these compounds prevent pregnancy?

(A) cause the corpus luteum to decrease in size
(B) enhance the effects of FSH
(C) inhibit follicle growth so no egg is produced
(D) initiate several surges of LH rather than just one

31. Which may be caused by the use of fertility drugs?

(A) artificial insemination
(B) cryopreservation
(C) in vitro fertilization
(D) superovulation

32. During embryonic development what is the name given to the hollow ball of several hundred cells?

(A) blastula
(B) fetus
(C) gastrula
(D) morula

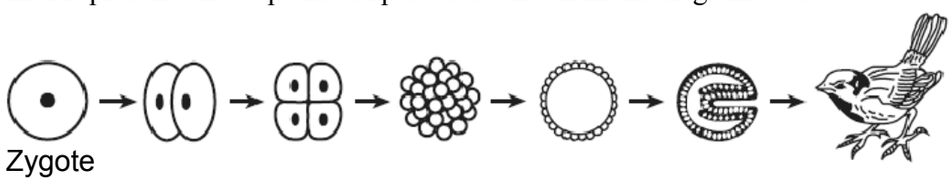
33. Which procedure is recommended to screen for fetal genetic disorders in pregnant women?

(A) amniocentesis
(B) cryopreservation
(C) pedigree
(D) ultrasound

34. Which structure is ruptured when a pregnant woman's "water breaks" during early labour?

(A) allantois
(B) amnion
(C) gastrula
(D) yolk sac

35. Which represents the sequence of processes shown in the diagram below?



(A) meiosis → differentiation → growth
(B) meiosis → growth → differentiation
(C) mitosis → differentiation → growth
(D) mitosis → growth → differentiation

36. What is another term for a hybrid?

(A) hemizygous
(B) heterozygous
(C) homozygous dominant
(D) homozygous recessive

37. What is an alternate form of a gene?

(A) allele
(B) hybrid
(C) trait
(D) unit

38. What would be the likely genotypes of the parents if the children's genotypes were Rr and rr?

	Parent 1	Parent 2
(A)	heterozygous	heterozygous
(B)	heterozygous	homozygous dominant
(C)	homozygous dominant	homozygous dominant
(D)	homozygous dominant	homozygous recessive

39. Lupin flowers exhibit incomplete dominance. The heterozygous condition produces an intermediate colour. When pure purple flowers are crossed with pure white flowers, what will be true of the offspring?

(A) all pink
(B) all purple
(C) 2 purple: 2 pink
(D) 3 purple: 1 white

40. Two parents have three boys in a row. What is the probability that their next child will be a girl?

(A) $\frac{1}{16}$
(B) $\frac{1}{8}$
(C) $\frac{1}{4}$
(D) $\frac{1}{2}$

41. What is a convenient graphical method for determining all of the possible combinations of gamete alleles in a cross?

(A) karyotype
(B) pedigree chart
(C) phenogram
(D) Punnett square

42. In horses, chestnut fur and white fur are incompletely dominant, producing palimino (tan). What is the phenotypic ratio of a cross between two palimino horses?

(A) 25% palimino, 50% chestnut, 25% white
(B) 50% palimino, 25% chestnut, 25% white
(C) 50% palimino, 50% white
(D) 75% palimino, 25% white

43. Why are males affected more often than females with respect to sex-linked disorders?

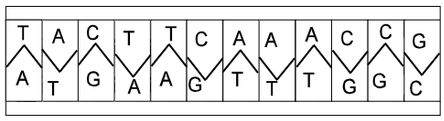
(A) Females do not carry the Y chromosome and therefore cannot inherit the disorder.
(B) Males need only to inherit one recessive trait on the X chromosome.
(C) Males receive the recessive trait on both the X and Y chromosome.
(D) The recessive trait is found only on the Y chromosome.

44. Which inheritance pattern controls a trait that shows continuous variations, such as height in humans?

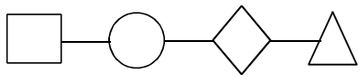
(A) co-dominance
(B) incomplete dominance
(C) polygenic inheritance
(D) sex-linked traits

45. In the diagram provided, molecule 2 represents a protein that is determined by the code in molecule 1. What will likely happen if there is a change in the first 3 nucleotides in molecule 1?

Molecule 1



Molecule 2



(A) A portion of molecule 2 may be different.
(B) Molecule 1 will become denatured.
(C) Molecule 2 will form a double helix.
(D) The remaining nucleotides in molecule 1 will also change.

46. Which scientist was known for using X-ray crystallography?

(A) Barbara McClintock
(B) Erwin Chargaff
(C) Oswald Avery
(D) Rosalind Franklin

47. Which is true of a tRNA molecule?

(A) contains a double helix
(B) contains thymine rather than uracil
(C) has equal amounts of cytosine and guanine
(D) transfers amino acids to the ribosome

48. Which is contained in both DNA and RNA?

(A) a nitrogenous base uracil
(B) double stranded polymers
(C) genetic codes
(D) the same sugar

49. During transcription what structures transfer the DNA code from the nucleus to the ribosomes?

(A) mRNA molecules
(B) polypeptides
(C) proteins
(D) tRNA molecules

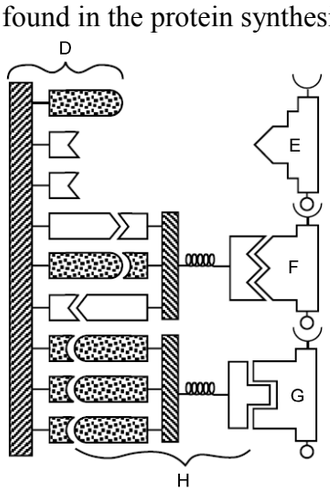
Amino Acids coded by mRNA Codons (5' to 3')

First Letter	Second Letter				Third Letter
	U	C	A	G	
U	phenylalanine	serine	tyrosine	cysteine	U
	phenylalanine	serine	tyrosine	cysteine	C
	leucine	serine	**STOP**	**STOP**	A
	leucine	serine	**STOP**	tryptophan	G
C	leucine	proline	histidine	arginine	U
	leucine	proline	histidine	arginine	C
	leucine	proline	glutamine	arginine	A
	leucine	proline	glutamine	arginine	G
A	isoleucine	threonine	asparagine	serine	U
	isoleucine	threonine	asparagine	serine	C
	isoleucine	threonine	lysine	arginine	A
	START/ methionine	threonine	lysine	arginine	G
G	valine	alanine	aspartate	glycine	U
	valine	alanine	aspartate	glycine	C
	valine	alanine	glutamate	glycine	A
	valine	alanine	glutamate	glycine	G

50. Using the mRNA codon table above, which is the amino acid sequence produced by tRNA molecules with anticodons 3' CAG UUC AUU 5' arriving in that order?

(A) valine - asparagine - glycine
(B) valine - asparagine - tyrosine
(C) valine - lysine - stop
(D) valine - lysine - tyrosine

51. How many codons are found in the protein synthesis diagram below?



(A) 3
(B) 5
(C) 6
(D) 9

52. Which best describes a frameshift mutation?

(A) does not create a change in the polypeptide produced
(B) results from non-disjunction
(C) results from the addition or deletion of a single nucleotide
(D) results only in silent mutations

53. A hockey player develops a better shot as a result of practice. Why will this ability not be passed on to her offspring?

(A) Base sequences in DNA are not affected by this activity.
(B) Gametes do not carry complete sets of genetic information.
(C) Muscle cells do not carry genetic information.
(D) Mutations that occur in body cells are not inherited.

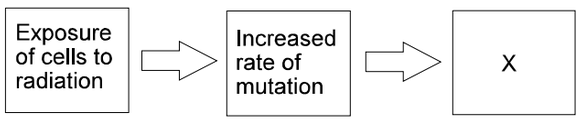
54. Which is an illustration or a photograph of chromosomes in a somatic cell?

(A) amniocentesis
(B) CAT scan
(C) chorionic villi sampling
(D) karyotype

55. Why might clones produced from the same organism be physically non-identical?

(A) Differentiated cells have different genes.
(B) Events in meiosis result in variation.
(C) Gene expression can be influenced by the environment.
(D) Genetic information comes from both parents.

56. Which statement best completes box X?



(A) decrease in the number of altered genes
(B) decreased chance of genetic variability of offspring
(C) increase in the production of gametes
(D) increased chance of cancer

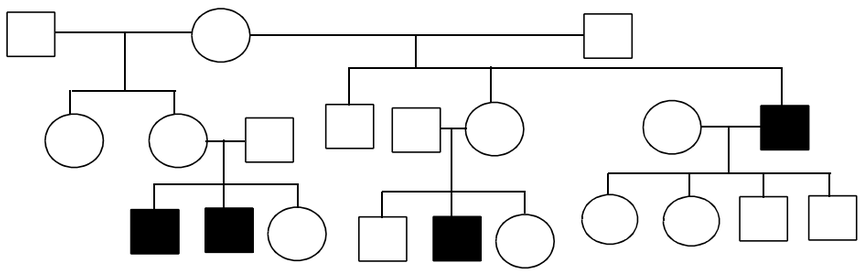
57. Which scientist(s) discovered that short strands of DNA may be capable of moving from one location to another?

(A) Alfred Hershey and Martha Chase
(B) Barbara McClintock
(C) Erwin Chargaff
(D) James Watson and Francis Crick

58. Which are caused by nondisjunction of the sex chromosomes resulting in an individual who has too many X or Y chromosomes?

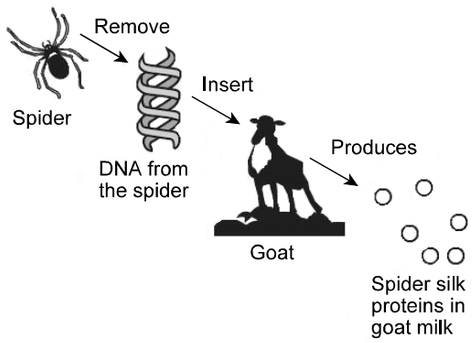
(A) Down syndrome and Jacobs syndrome
(B) Down syndrome and Turner syndrome
(C) Klinefelter syndrome and Jacobs syndrome
(D) Klinefelter syndrome and Turner syndrome

59. What is the genotype of the mother in the P generation of the pedigree below?



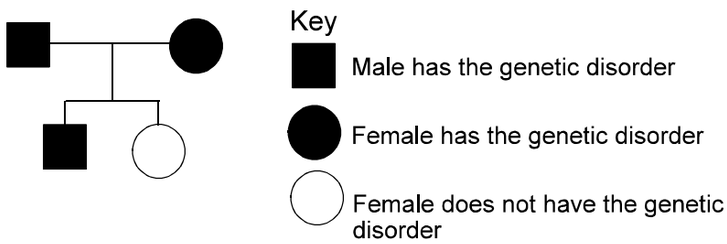
(A) bb
(B) Bb
(C) X^bX^b
(D) X^BX^b

60. Which process is illustrated in the diagram below?



(A) gel electrophoresis
(B) karyotyping
(C) polymerase chain reaction
(D) recombinant DNA

61. Which best describes the gene that caused the condition in the pedigree below?

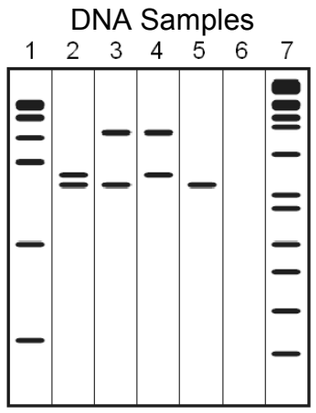


(A) codominant
(B) dominant
(C) recessive
(D) sex-linked

62. What is the function of a vector in genetic engineering?

(A) carry the gene into the host cell
(B) cut DNA into many fragments
(C) enhance the accuracy of a genetic marker
(D) link DNA fragments together

63. Which process produces the diagram shown below?



(A) gel electrophoresis
(B) karyotype
(C) protein synthesis
(D) recombinant DNA

64. What is the most likely set of effects if human intestinal bacteria are genetically engineered to feed on organic pollutants, converting them to inorganic compounds?

	Negative Effect	Positive Effect
(A)	Engineered bacteria may out-compete native bacteria.	The organic pollutants are removed.
(B)	Inorganic compounds interfere with cycles in the environment.	Human bacteria are added to the environment.
(C)	Only some of the pollutants are removed.	Bacteria will make more organic pollutants.
(D)	The bacteria will cause disease in humans.	The inorganic compounds are buried in the soil.

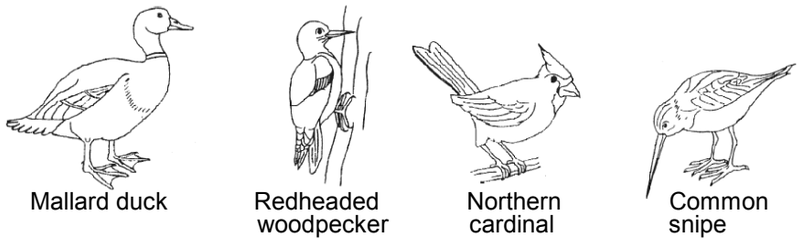
65. Which statement represents the concept of the biological theory of evolution?

(A) As a species becomes extinct a new species takes its place.
(B) Every biome on Earth has its own unique group of organisms.
(C) Every era of the geological time scale has its own group of species which is different from any other era.
(D) Relative change in the characteristics of populations occurs over successive generations.

66. What is the error in Lamarck's theory of acquired characteristics?

(A) Acquired traits do not change the genetic makeup of the individual.
(B) Individuals in a population compete against each other for resources.
(C) Organisms best suited to their environment survive.
(D) Organisms change over a period of time.

67. The diagram below represents four different species of wild birds, each having feet with different structural adaptations. Which explains the success of these adaptations?



(A) acquired characteristics
(B) natural selection
(C) selective breeding
(D) use and disuse

68. How are the human, moose and the coyote gene pools on the island of Newfoundland similar?

(A) They show a limited gene pool because of the bottleneck effect.
(B) They show a limited gene pool because of the founder effect.
(C) They show a varied gene pool because of the bottleneck effect.
(D) They show a varied gene pool because of the founder effect.

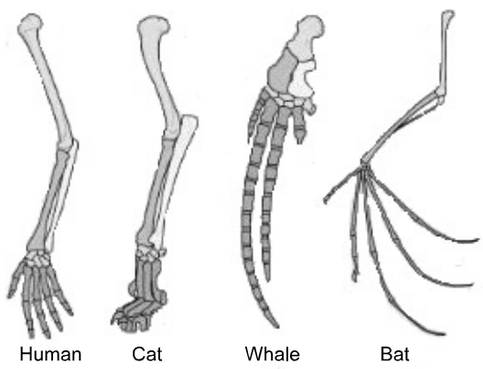
69. Who, along with Charles Darwin, developed the theory of natural selection?

(A) Alfred Wallace
(B) George Cuvier
(C) Gregor Mendel
(D) Jean-Baptiste Lamarck

70. How is natural selection best described?

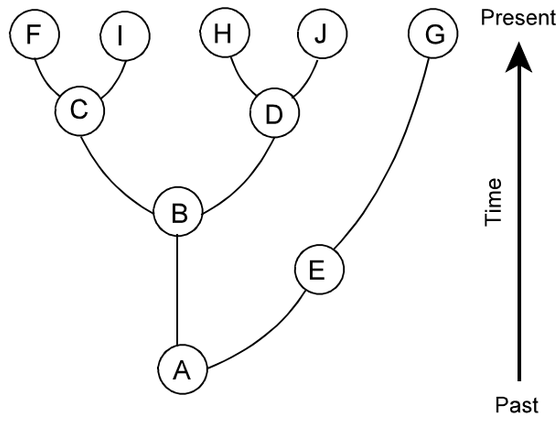
(A) changing of the gene pool of a population through mutations
(B) greater reproductive success of individuals better suited to the environment
(C) increased life span of individuals with favourable characteristics
(D) process by which favourable characteristics are inherited

71. Which hypothesis is supported by similarities in the bone arrangements of the four specimens shown below?



(A) adapted to survive in the same environments
(B) are members of the same species
(C) contain the same genetic information
(D) descended from the same ancestor

72. The diagram below shows some evolutionary pathways with each letter representing a different species. Which is the most recent ancestor of both D and F?



(A) A
(B) B
(C) C
(D) I

73. Which condition is necessary for Hardy-Weinberg equilibrium?

(A) gene flow
(B) immigration
(C) random mating
(D) small population size

74. Which describes the fact that the ostrich and emu look very similar and live in similar habitats, although they are not closely related?

(A) adaptive radiation
(B) convergent evolution
(C) divergent evolution
(D) geographical speciation

75. Who proposed the Serial Endosymbiosis Theory (Symbiogenesis)?

(A) Lynn Margulis
(B) Niles Eldridge
(C) Stanley Miller
(D) Stephen Gould

PART II
Total Value: 25%

Instructions: Complete all items in this section. Your responses should be clearly presented in a well-organized manner.

Value

3% 76.(a) Some cell phones have ring tones with high frequencies that can be heard by adolescents but not by older adults.

i) Explain two biological reasons for this difference.

ii) Most newer cell phones can be used as a personal listening device. Explain why the use of personal listening devices, played at high volumes for prolonged periods, should be discouraged in adolescents?

2% (b) The abuse of steroid hormones, such as testosterone, by athletes can lead to problems with homeostasis. Explain how this abuse can have a negative impact on the body.

Value

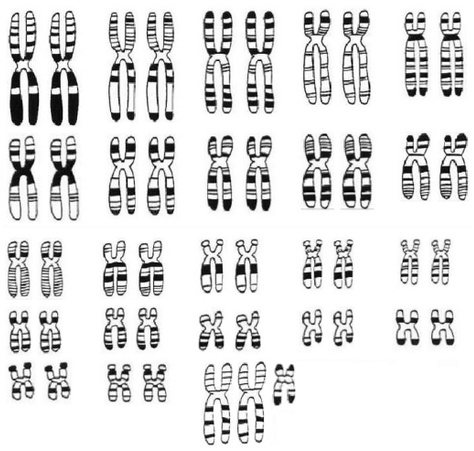
4% 77.(a) Stem cell researchers in independent labs have made great strides in creating stem cells without using embryos. One group was able to reprogram mature skin cells in mice into pluripotent cells. The reprogrammed cells were indistinguishable from embryonic stem cells. Name and explain two benefits of this new technology for science and society.

3% (b) In some cases, pelvic inflammatory disease (PID) develops when chlamydia is untreated. Although chlamydia has no permanent side effects, PID can permanently scar the fallopian tubes. Explain how this can affect a woman's fertility and list two technologies that can be used to overcome this problem.

Value

3% 78.(a) A couple has a son with muscular dystrophy and two daughters, one with the condition and one without. All three children have a widow's peak. Neither parent has a widow's peak. Muscular dystrophy is a recessive sex-linked trait and the widow's peak is an autosomal recessive trait. Use a Punnett square to determine the genotype of both parents.

2% (b) Explain which genetic disorder is shown in the karyotype below.

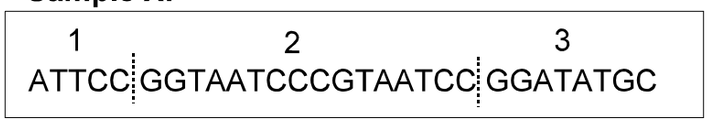


Value

4% 78.(c) Students were given two samples of DNA and asked to cut them between C and G in each CCGG sequence in sample X. In sample Y, they were asked to cut between the A's in TAAT sequences. Both sets of fragments were then arranged on a paper model demonstrating gel electrophoresis.

DNA Strip Samples

Sample X:



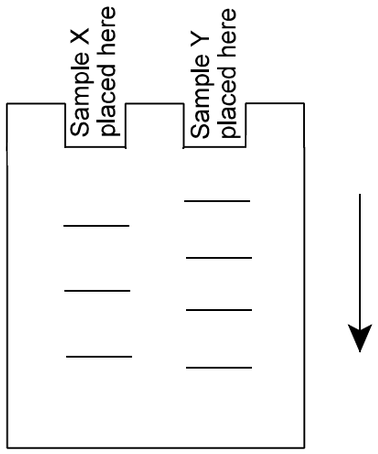
Sample Y:

i) What is used in the process of cutting the DNA samples?

_____

_____

ii) Place the numbers of the fragments from the sample strips in the correct order on the blanks in the diagram of the gel electrophoresis plate below.



Value

2% 79.(a) Selective breeding has been used to obtain desirable traits within a species. Explain how selective breeding could be used to improve the racing ability of horses.

2% (b) Explain how global warming could cause directional selection in polar bears.