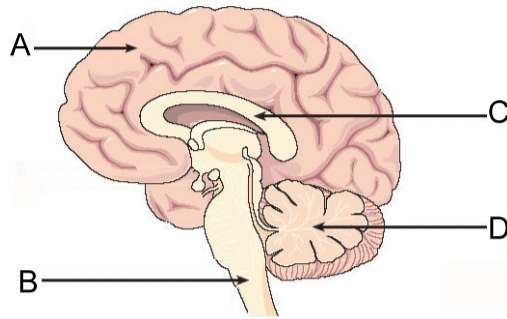


PART I
Total Value: 75%

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

1. Damage to which structure below would result in the heart stopping?



- ✓ (A) A
(B) B
(C) C
(D) D

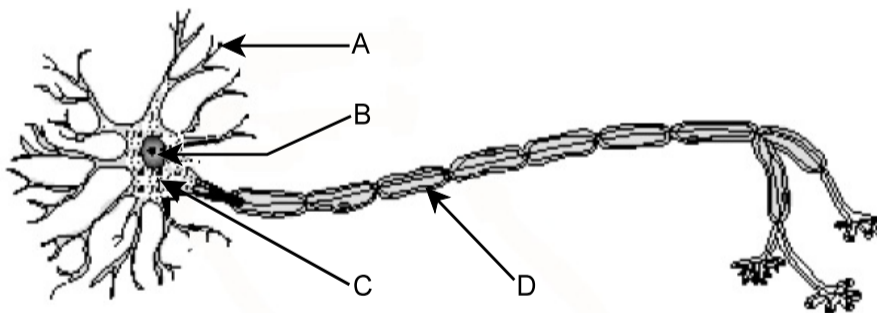
2. Which nervous system division is directly responsible for relaying information to and from the skeletal muscles?

- (A) autonomic
✓ (B) parasympathetic
(C) somatic
(D) sympathetic

3. In which order does an impulse pass through a reflex arc?

- (A) receptor → motor neuron → interneuron → sensory neuron → effector
(B) receptor → motor neuron → sensory neuron → interneuron → effector
✓ (C) receptor → sensory neuron → motor neuron → interneuron → effector
(D) receptor → sensory neuron → interneuron → motor neuron → effector

4. Which structure below is responsible for receiving information from another neuron?



- ✓ (A) A
(B) B
(C) C
(D) D

5. Which shows the ion distribution inside the neuron membrane during an action potential?

	[K ⁺]	[Na ⁺]
(A)	high	high
(B)	high	low
✓ (C)	low	high
(D)	low	low

6. Which best describes the role of cholinesterase?

- ✓ (A) breaking down a neurotransmitter
- (B) inhibiting a post-synaptic neuron
- (C) stimulating a post-synaptic neuron
- (D) synthesizing a neurotransmitter

7. Which nervous system disorder is caused by low dopamine production?

- (A) Alzheimer's
- (B) Meningitis
- (C) Multiple Sclerosis
- ✓ (D) Parkinson's

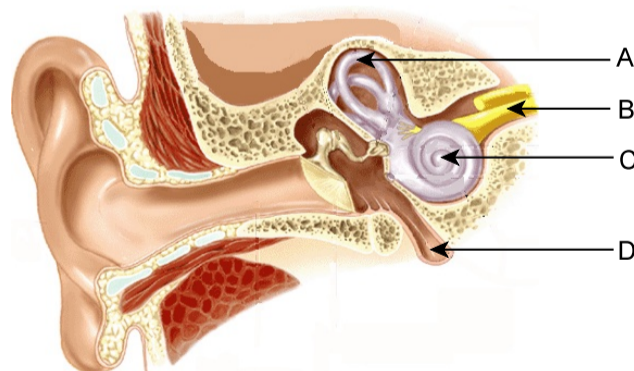
8. Which technology would produce a 3-D image of the brain?

- ✓ (A) CAT Scan
- (B) EEG
- (C) PET Scan
- (D) X-ray

9. Which structure of the eye enables a person to see in low light situations?

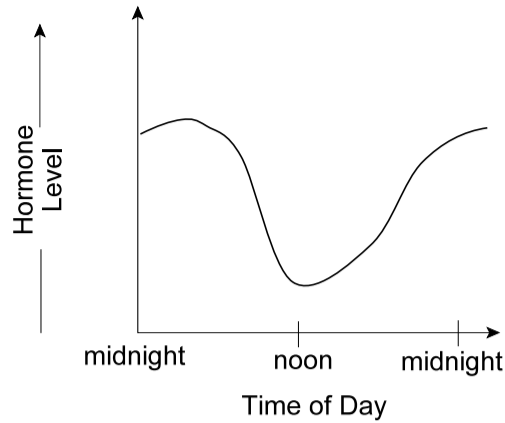
- (A) cones
- (B) cornea
- ✓ (C) rods
- (D) sclera

10. Which structure below allows air pressure to equalize?



- (A) A
- (B) B
- (C) C
- ✓ (D) D

11. Which hormone best fits the graph below?



- (A) adrenaline
- (B) estrogen
- ✓ (C) melatonin
- (D) thyroxine

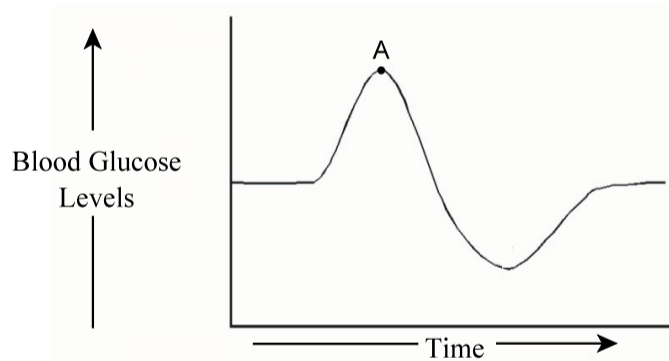
12. Which disorder is caused by a deficiency of thyroxine?

- (A) dwarfism
- (B) gigantism
- (C) hyperthyroidism
- ✓ (D) hypothyroidism

13. Which would result if the target gland were not stimulated during a negative feedback loop?

- (A) The hypothalamus would be inhibited.
- (B) The hypothalamus would be stimulated.
- ✓ (C) The target gland would not secrete its hormone.
- (D) The target gland would secrete its hormone.

14. The graph below shows the blood glucose levels of a healthy person over a short period of time. Which hormone is most likely secreted by the pancreas at point A?



- (A) glucagon
- ✓ (B) insulin
- (C) melatonin
- (D) somatotropin

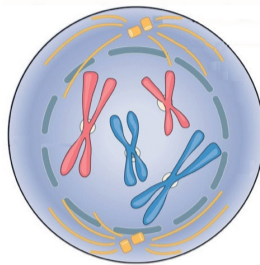
15. Which hormone acts on a positive feedback control mechanism?

- (A) calcitonin
- ✓ (B) oxytocin
- (C) parathyroid
- (D) thyroxine

16. In which phase of the cell cycle does DNA replicate?

- (A) anaphase
- ✓ (B) interphase
- (C) metaphase
- (D) telophase

17. Which phase is indicated in the diagram below?



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

18. An error in which stage of meiosis would produce a human egg cell with 24 chromosomes?

- ✓ (A) anaphase (I)
- (B) prophase (I)
- (C) metaphase (II)
- (D) telophase (II)

19. Which best describes a sperm cell?

- (A) contains large amounts of cytoplasm
- (B) diploid
- (C) larger size than egg cells
- ✓ (D) motile

20. Which involves culturing human cells for treating medical disorders?

- (A) amniocentesis
- (B) fetoscopy
- (C) *in vitro* maturation
- ✓ (D) therapeutic cloning

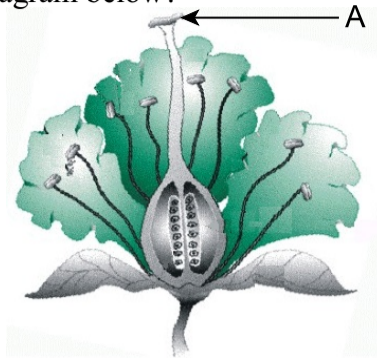
21. Which type of asexual reproduction is used by bacteria?

- ✓ (A) binary fission
- (B) budding
- (C) fragmentation
- (D) parthenogenesis

22. Which best describes why human sperm may lack energy to swim to the egg?

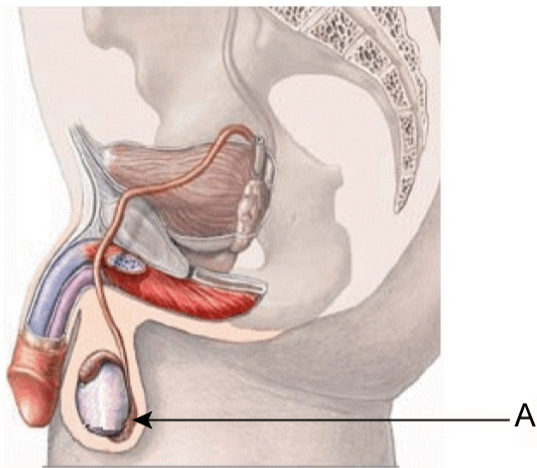
- (A) The acrosome's contents have been emptied.
- ✓ (B) The middle piece of the sperm cell is damaged.
- (C) The prostate gland secretes an acid fluid.
- (D) The scrotum holds the testis too close to the body.

23. What is structure A in the diagram below?



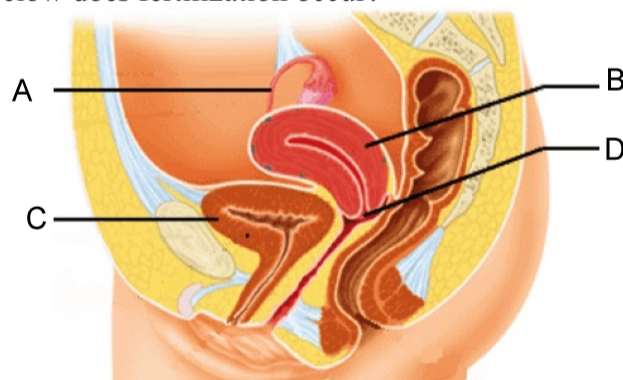
- (A) anther
- (B) pistil
- (C) pollen
- ✓ (D) stigma

24. What is structure A in the diagram below?



- ✓ (A) epididymis
- (B) prostate
- (C) urethra
- (D) van deferens

25. In which structure below does fertilization occur?



- ✓ (A) A
- (B) B
- (C) C
- (D) D

26. Which structure is shed during normal menstrual flow?

- (A) cervix
- ✓ (B) endometrium
- (C) fimbriae
- (D) oviduct

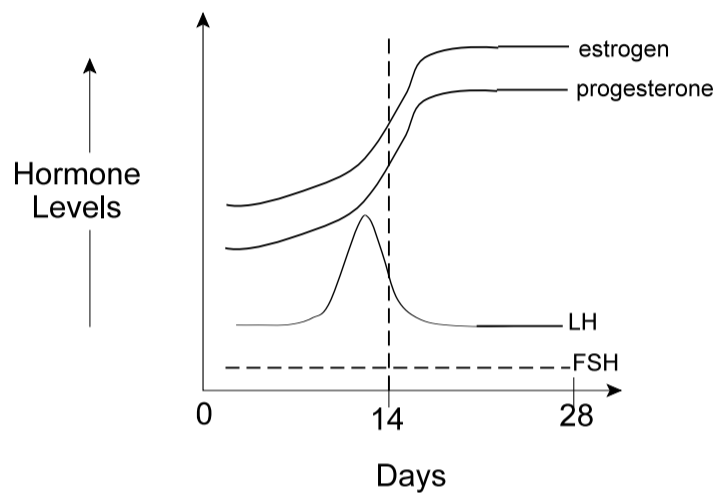
27. Which sexually transmitted infection most commonly affects the liver?

- (A) chlamydia
- (B) gonorrhea
- ✓ (C) hepatitis
- (D) syphilis

28. Which requires superovulation?

- (A) artificial insemination
- ✓ (B) *in vitro* fertilization
- (C) tubal ligation
- (D) vasectomy

29. What is the most probable explanation for the hormone levels at day 17 below?



- (A) Corpus luteum prohibits FSH production.
- (B) Menstruation is occurring.
- (C) The egg is being released.
- ✓ (D) The female is using oral contraceptives.

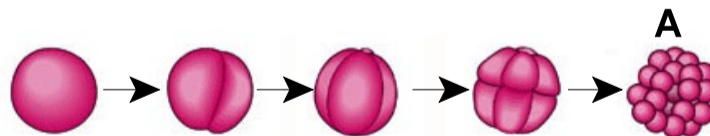
30. Which is best for regulating menstrual cycles?

- ✓ (A) birth control pill
- (B) rhythm method
- (C) spermicidal jelly
- (D) tubal ligation

31. Which is the correct pathway of sperm to the egg?

- (A) vagina → cervix → oviduct → uterus
- ✓ (B) vagina → cervix → uterus → oviduct
- (C) vagina → oviduct → cervix → uterus
- (D) vagina → oviduct → uterus → cervix

32. In which part of the human female reproductive system does stage A occur?



- (A) ovary
- ✓ (B) oviduct
- (C) uterus
- (D) vagina

33. Which primary embryonic membrane becomes the placenta?
- (A) allantois
 - (B) amnion
 - ✓ (C) chorion
 - (D) yolk sac
34. Which hormone causes contractions of the uterus?
- (A) estrogen
 - (B) progesterone
 - (C) prolactin
 - ✓ (D) oxytocin
35. Which procedure is best to determine if a fetus has an abnormal chromosome number?
- ✓ (A) amniocentesis
 - (B) genetic counselling
 - (C) *in vitro* maturation
 - (D) ultrasound
36. Which refers to an organism with two identical alleles for a single trait?
- (A) cross-fertilized
 - (B) heterozygous
 - ✓ (C) homozygous
 - (D) segregated
37. Who proposed the Law of Independent Assortment?
- (A) Darwin
 - (B) Griffith
 - ✓ (C) Mendel
 - (D) Morgan
38. Which genotype(s) express a recessive trait?
- (A) tt and Tt
 - ✓ (B) tt only
 - (C) TT and Tt
 - (D) TT only
39. What is the chance that a couple will have three girls in a row?
- ✓ (A) $\frac{1}{8}$
 - (B) $\frac{1}{4}$
 - (C) $\frac{1}{3}$
 - (D) $\frac{1}{2}$

40. The parents of a blue-eyed man were both brown-eyed. He marries a brown-eyed woman, whose father was brown-eyed and whose mother was blue-eyed. What are the possible genotypes of the offspring?

- (A) Bb only
- (B) bb only
- ✓ (C) Bb and bb
- (D) BB and bb

41. Which parental cross would produce 50% of its offspring with the recessive trait?

- (A) TT × TT
- ✓ (B) tt × Tt
- (C) Tt × Tt
- (D) tt × tt

42. In the Punnet square below, which offspring are homozygous for both traits?

	<i>TR</i>	<i>Tr</i>	<i>tR</i>	<i>tr</i>
<i>tR</i>	1	2	3	4
<i>tr</i>	5	6	7	8

- (A) 1 and 6
- (B) 2 and 5
- ✓ (C) 3 and 8
- (D) 4 and 7

43. In horses, roan coats (red and white hairs) result from codominance. If a roan male is mated with a white female, what would be the expected phenotype ratios?

- (A) all roan
- (B) ½ roan, ¼ red, ¼ white
- (C) ½ roan, ½ red
- ✓ (D) ½ roan, ½ white

44. In snapdragon flowers, red is incompletely dominant to white. What is the phenotypic ratio of the offspring in the F₂ generation in a cross between a red flower and a white flower?

- (A) all pink
- (B) 3 red, 1 white
- ✓ (C) 1 red, 2 pink, 1 white
- (D) 1 red, 1 pink, 2 white

45. Which pattern of inheritance occurs when both alleles are fully expressed in the phenotype of a heterozygous individual at the same time?

- ✓ (A) codominance
- (B) incomplete dominance
- (C) polygenic inheritance
- (D) sex linkage

46. Which represents a test cross?

- (A) bb × bb
- (B) bb × BB
- ✓ (C) B₋ × bb
- (D) B₋ × BB

47. Which are possible blood types for the parents of a child with type AB blood?

	mother	father
(A)	A	A
(B)	A	O
✓ (C)	B	A
(D)	B	O

48. Who proposed that Mendel's factors were carried on chromosomes?

- (A) Griffith
- (B) Levene
- (C) Morgan
- ✓ (D) Sutton

49. Which type of trait is human height?

- (A) complete
- (B) incomplete
- (C) monogenic
- ✓ (D) polygenic

50. What is the probability that a male inherits his Y chromosome from his father?

- (A) 0
- (B) 0.25
- (C) 0.50
- ✓ (D) 1.0

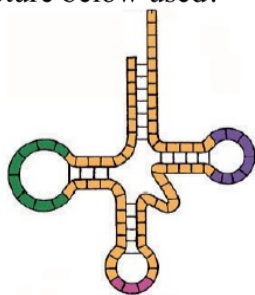
51. Who proposed the double helix model of DNA?

- (A) Franklin and Wilkins
- (B) Hershey and Chase
- (C) Sutton and Boveri
- ✓ (D) Watson and Crick

52. In which step of DNA replication are complementary nucleotides added to the template DNA strand?

- ✓ (A) elongation
- (B) initiation
- (C) proofreading
- (D) termination

53. In which process is the structure below used?



- (A) elongation
- (B) initiation
- (C) transcription
- ✓ (D) translation

54. What is the end product of translation?

- (A) DNA
- (B) mRNA
- ✓ (C) polypeptide
- (D) ribosome

Refer to the diagram below to answer the next two questions.

Amino Acids Coded by mRNA Codons

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

55. If the peptide sequence valine-proline-stop were produced through transcription, what DNA sequence was present originally?

- ✓ (A) CAA GGT ACT
- (B) CAC GGG ACC
- (C) GUG CCC UGG
- (D) GUU CCA UGG

56. According to the table, which type of mutation occurred below?

AUA GAA AGU \longrightarrow AUU GAA AGC
original RNA strand *mutated RNA strand*

- (A) frameshift
- (B) mis-sense
- (C) nonsense
- ✓ (D) silent

57. Which mRNA base binds to adenine?

- (A) cytosine
- (B) guanine
- (C) thymine
- ✓ (D) uracil

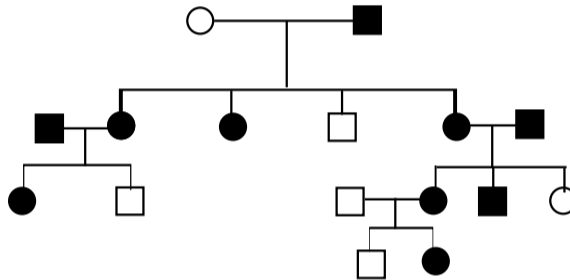
58. Which is the genotype of an individual with Jacob's syndrome?

- (A) XXX
- (B) XXY
- ✓ (C) XYY
- (D) XO

59. Which is a sex-linked disorder?

- (A) Huntington's Disease
- ✓ (B) Muscular Dystrophy
- (C) PKU
- (D) Tay Sachs

60. Which genetic disorder is represented below?



- (A) Down Syndrome
- (B) hemophilia
- ✓ (C) Huntington's
- (D) sickle cell anemia

61. A single hair follicle was found at a murder scene. Which would first be used to determine the origin of the hair?

- (A) DNA sequencing
- (B) gel electrophoresis
- (C) karyotyping
- ✓ (D) polymerase chain reaction

62. Which is a major finding of the Human Genome Project?

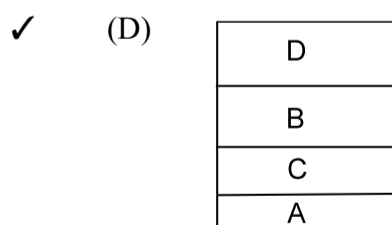
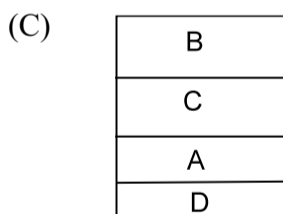
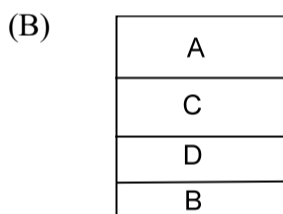
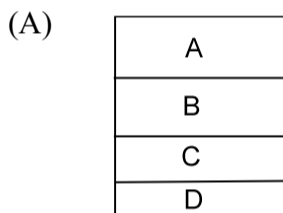
- ✓ (A) All human DNA is 99.9% identical.
- (B) Each gene produces a single protein.
- (C) The human genome is 90% identical to chimpanzees.
- (D) There are 100,000 different genes in human population.

63. What is the advantage of genetically modified golden rice?

- (A) herbicide resistance
- ✓ (B) higher nutrient value
- (C) larger crop production
- (D) rapid growth rate

64. Which scientist would support the following statement?
“Some bacteria are resistant to antibacterial soaps, resulting in some surviving the initial application.”
- ✓ (A) Cuvier
 (B) Darwin
 (C) Lamarck
 (D) Lyell
65. Which branch of comparative science analyzes proteins to determine evolutionary relationships?
- ✓ (A) anatomy
 (B) biochemistry
 (C) embryology
 (D) genetics
66. Which is the correct order of sedimentary rock layers with the fossil information below?

- Fossil B is younger than fossil C.
- Fossil C is younger than fossil A.
- Fossil A is older than fossil D.



67. In a population of guinea pigs, black fur is dominant to white fur. If 10% of the population has the recessive allele, what percent of the population is homozygous dominant, assuming Hardy-Weinberg population?

- ✓ (A) 46%
 (B) 81%
 (C) 90%
 (D) 99%

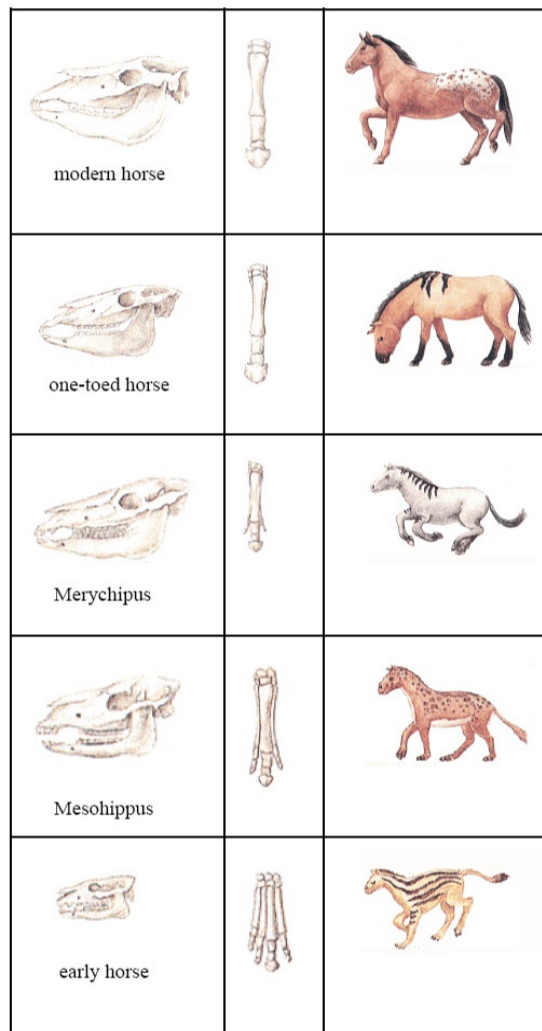
68. If the half-life of carbon is 5730 years, what percent of carbon would be contained in a rock sample that is 22 920 years old?

- ✓ (A) 6.25%
- (B) 12.5%
- (C) 25.0%
- (D) 50.0%

69. Which does the human population on the island of Newfoundland best represent?

- (A) bottleneck effect
- ✓ (B) founder effect
- (C) directional selection
- (D) sexual selection

70. What type of selection is represented in the diagram below?



- (A) artificial
- ✓ (B) directional
- (C) disruptive
- (D) stabilizing

71. What type of pre-zygotic barrier exists when one species of flower pollinates in June and another closely related species pollinates in July?

- (A) habitat isolation
- (B) mechanical isolation
- (C) gametic isolation
- ✓ (D) temporal isolation

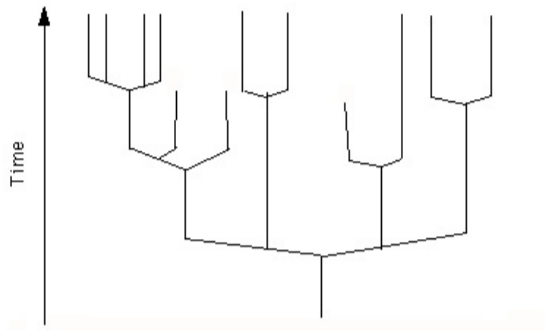
72. In which evolutionary process do two closely reliant species evolve together?

- ✓ (A) coevolution
- (B) convergent
- (C) divergent
- (D) gradualism

73. Which theory supports a religious viewpoint to explain the origin of life?

- (A) Gaia
- ✓ (B) Intelligent Design
- (C) Panspermia
- (D) Serial Endosymbiosis

74. What mode of evolution is indicated by the diagram below?



- (A) coevolution
- (B) convergent evolution
- (C) gradualism
- ✓ (D) punctuated equilibrium

75. Which scientists first suggested that lightning and UV radiation led to the spontaneous development of organic compounds?

- (A) Gould and Eldridge
- (B) Miller and Urey
- ✓ (C) Oparin and Haldane
- (D) Watson and Crick

PART II
Total Value: 25%

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

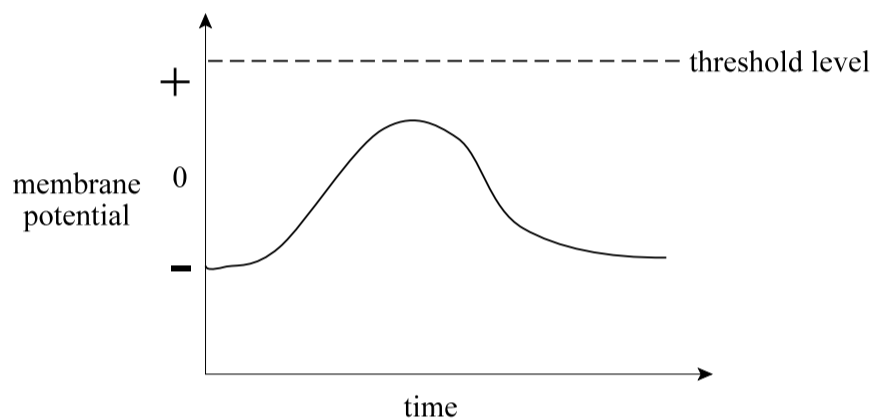
Value

3% 76.(a) A stimulus is received by a neuron. The membrane surrounding the neuron continues to be depolarized. Why might this occur and what is the result?

Drugs/medication that would interfere with the Na^+/K^+ pump. **1.5 marks**

Result being no repolarization. **1.5 marks**

2% (b) **The graph below shows the potential difference between the inside and the outside of a motor neuron. Did an action potential pass down the neuron? Why or why not?**



No. **1 mark**

The stimulus has not reached the threshold level. **1 mark**

2% 77.(a) **How do the roles of the generative and tube nuclei differ in pollination and fertilization?**

Generative Nucleus: produces sperm for fertilization. **1 mark**

Tube Nucleus: produces pollen tube through the pistil so sperm can reach and fertilize the egg. **1 mark**

2% (b) **A pair of female identical twins marry a set of male identical twins. Give two biological reasons why children from both couples are not identical to each other.**

Possible answers include:

1. Independent assortment
2. Mutation
3. Crossing over may have occurred

1 mark each with explanation

0.5 marks each with no explanation

Value

3% (c) Eggs were fertilized through *in vitro* fertilization. After the eggs were frozen and stored for a few years, the donor couple no longer required them for fertility purposes and decided to donate them to science.

(i) Why are these embryonic cells valuable to scientists?

Stem cells may be obtained.

1 mark

(ii) Describe two ways these cells are used by scientists.

(ii) Possible answers include:

1. Therapeutic cloning
2. Treat diseases
3. Medical research/discoveries

1 mark each

3% 78.(a) In humans, normal color vision (R) is dominant to color blindness (r). This is a sex-linked trait (X-linked). Brown eye color (B) is dominant to blue (b) eye color. If a color blind, heterozygous brown-eyed female mated with a normal, blue-eyed male, what percentage of the offspring would be color blind, blue-eyed males?

Parents: Female (BbX^rX^r)
Male (bbX^rY)

	bX^R	bY
BX^r	BbX^RX^r	BbX^rY
bX^r	bbX^RX^r	bbX^rY

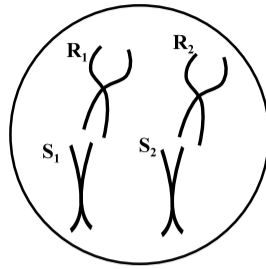
Answer: 25%

0.5 mark for each parent

1 mark for cross

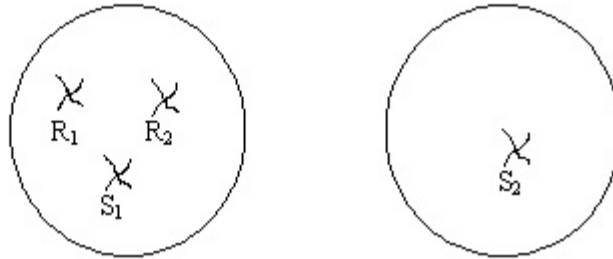
1 mark for correct answer

- 3% (b) Non-disjunction occurs during meiosis I in the cell below in one homologous pair (R_1 and R_2). Sketch the four cells produced showing the chromosome arrangement of each.

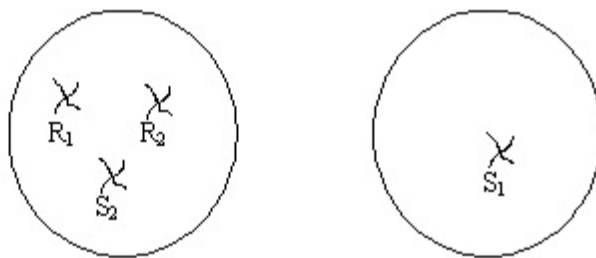


After meiosis I:
Either:

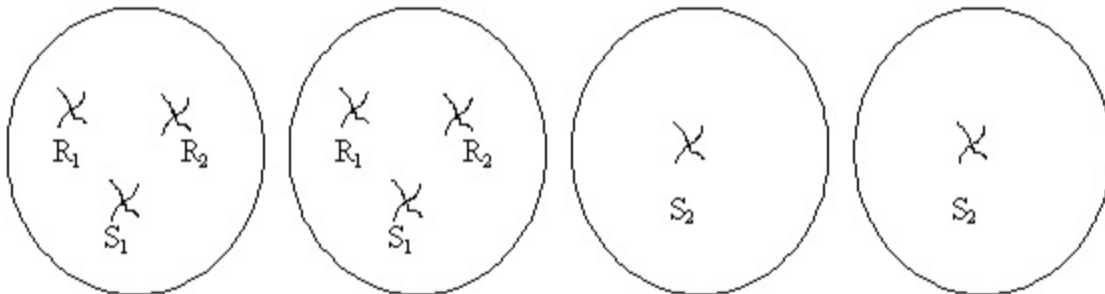
1 mark



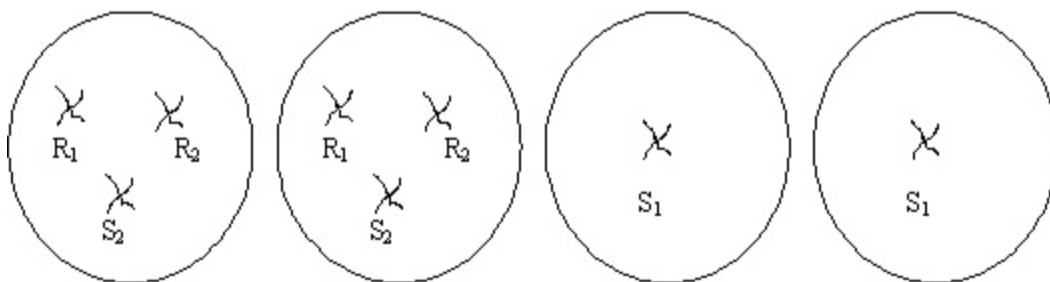
Or:



After Meiosis II: **2 marks**
Either:



or



*If non-disjunction has occurred the resultant gametes would show 3 chromosomes and 1 chromosome.

Value

- 2% **78.(c) A female, ten weeks pregnant, has an uncle with Tay-Sachs disease. The father of the fetus has a brother with Tay-Sachs disease also. Which procedure would be best for determining if the fetus has this disorder? Explain.**

A blood test must be taken to test for the presence/absence of the enzyme for fat breakdown in lysosome. Absence of the enzyme indicates Tay-Sachs.

1 mark – identify blood test

1 mark – explanation of how it is used

- 2% **(d) Unidentified human remains were discovered after a natural disaster. Explain which genetic engineering technique could be used to identify the remains.**

Gel electrophoresis would be used to give the DNA fingerprint. Then it would be compared to family/data banks for ID.

- 3% **79. A teacher observed that the frequency of students able to roll their tongues has decreased over thirty years. Is this population in Hardy-Weinberg Equilibrium? Give three reasons to support your answer.**

No.

1. The population frequency is changing, therefore it isn't in Hardy-Weinberg equilibrium.
2. The population is not isolated.
3. The population size may be small.
4. Mutations could have occurred.
5. Non-random mating.

1 mark for each explanation