

PART I
Total Value: 75%

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

1. In which direction does an action potential normally travel along an axon?
 - (A) away from the cell body
 - (B) away from the synapse
 - (C) from myelin to dendrites
 - (D) from myelin to nucleus

2. What initiates the action potential in a nerve?
 - (A) influx of calcium ions into the axon
 - (B) influx of sodium ions into the axon
 - (C) outflow of calcium ions from the axon
 - (D) outflow of sodium ions from the axon

3. Which ear structure maintains balance?
 - (A) cochlea
 - (B) malleus
 - (C) semicircular canals
 - (D) tympanic membrane

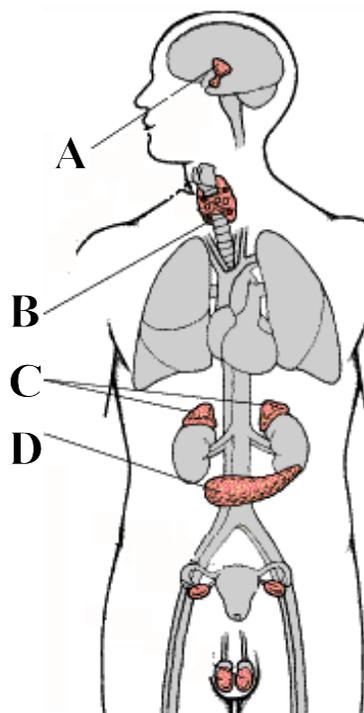
4. What distinguishes target cells from other cells?
 - (A) amount of cellulose in cell membrane
 - (B) amount of phospholipids in cell membrane
 - (C) hormone-specific cell surface receptors
 - (D) hormone-specific cytoplasmic receptors

5. Which gland produces and releases a thyroid-stimulating hormone?
 - (A) anterior pituitary
 - (B) hypothalamus
 - (C) posterior pituitary
 - (D) thyroid

6. What causes gigantism?
 - (A) overproduction of human growth hormone
 - (B) overproduction of insulin
 - (C) underproduction of human growth hormone
 - (D) underproduction of insulin

7. Which term best describes the actions of adrenaline and noradrenaline?
 - (A) antagonistic
 - (B) complementary
 - (C) negative feedback
 - (D) positive feedback

8. Which disorder affects the movement of skeletal muscles due to a dopamine deficiency?
- (A) Alzheimer's
 (B) Huntington's
 (C) Multiple Sclerosis
 (D) Parkinson's
9. Which part of the eye is responsible for absorbing light and preventing internal reflection?
- (A) choroid
 (B) cornea
 (C) iris
 (D) retina
10. Which part of the brain controls movement that is an automatic, involuntary reaction to a stimulus?
- (A) cerebellum
 (B) cerebrum
 (C) hypothalamus
 (D) thalamus
11. What effect does a somatic nervous system stimulant have on the human body?
- (A) decreases the sensitivity of the postsynaptic membrane to acetylcholine
 (B) increases the sensitivity of the postsynaptic membrane to acetylcholine
 (C) makes the membrane permanently impermeable to potassium
 (D) makes the membrane permanently impermeable to sodium
12. Which gland in the diagram below is responsible for controlling metabolism in the heart, liver, kidney, and muscle tissues?



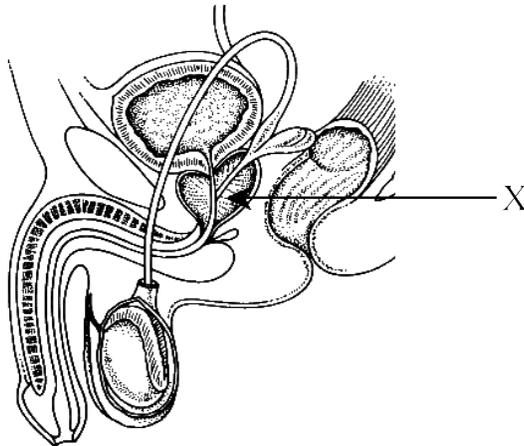
- (A) A
 (B) B
 (C) C
 (D) D

13. What is the best way to treat a child with repeated middle ear infections due to fluid build-up behind the ear drum?
- (A) Administer antibiotics for several years.
 (B) Implant eustachian tubes.
 (C) Prepare the child for the loss of hearing.
 (D) Provide a hearing aid.
14. What would be the best treatment for an individual with an intolerance to cold, decreased heart rate, and weight gain, despite a decreased appetite?
- (A) combination of insulin, exercise, and diet to control insulin levels
 (B) diet to reduce the amount of dietary iodine, increasing thyroxine production
 (C) increase the amount of vitamin D to increase levels of blood calcium
 (D) injections of thyroid hormone to increase metabolic activity
15. A newly discovered drug is found to increase the volume of urine production. When ADH is administered, the volume of urine returns to normal. Which best describes the action of the new drug?
- (A) blocks the release of ADH from the kidney
 (B) blocks the release of ADH from the pituitary
 (C) triggers the release of ADH from the kidney
 (D) triggers the release of ADH from the pituitary
16. What refers to the division of a cell's cytoplasm during cellular replication?
- (A) cytokinesis
 (B) karyokinesis
 (C) meiosis
 (D) mitosis
17. Which best describes the daughter cells produced from meiosis?
- | | quantity | chromosome number |
|-----|----------|-------------------|
| (A) | four | diploid |
| (B) | four | haploid |
| (C) | two | diploid |
| (D) | two | haploid |
18. Which involves the haploid development of a cell into an adult?
- (A) budding
 (B) binary fission
 (C) fragmentation
 (D) parthenogenesis
19. Which hormone is responsible for stimulating the corpus luteum to produce progesterone?
- (A) estrogen
 (B) FSH
 (C) LH
 (D) testosterone

20. Which contraceptive procedure requires surgery?

- (A) abstinence
- (B) condom
- (C) diaphragm
- (D) vasectomy

21. What is structure X in the diagram below?



- (A) prostate
- (B) seminal vesicle
- (C) urethra
- (D) vas deferens

22. What does an intrauterine device prevent?

- (A) fertilization
- (B) implantation
- (C) menstruation
- (D) ovulation

23. What primary membrane is the innermost membrane surrounding the fetus during development?

- (A) allantois
- (B) amnion
- (C) chorion
- (D) yolk

24. Which is responsible for milk production after childbirth?

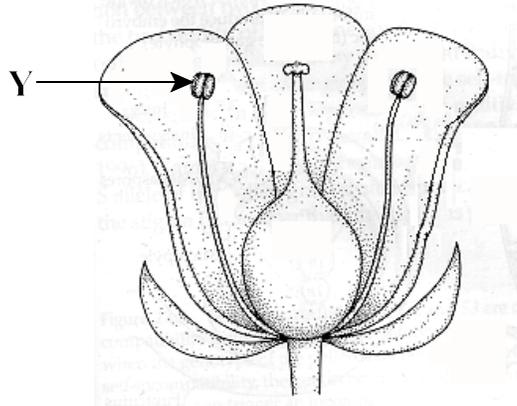
- (A) progesterone
- (B) prolactin
- (C) oxytocin
- (D) tetragen

25. What refers to cell division without cell growth?

- (A) cleavage
- (B) fertilization
- (C) implantation
- (D) morula

26. Two daughter cells are produced from mitosis. One of these cells has one more than the normal amount of chromosomes while the other cell has one less than the normal amount. In which stage did an error most likely occur?
- (A) anaphase
 - (B) interphase
 - (C) prophase
 - (D) telophase

27. What is structure Y in the diagram below?



- (A) anther
 - (B) pistil
 - (C) pollen
 - (D) style
28. How do steroids decrease sperm production?
- (A) convert protein from testes into muscle tissue
 - (B) increase stimulation of the pituitary gland
 - (C) interfere with the control of testosterone levels
 - (D) suppress the production of thyroxine
29. A couple suspects an inheritable condition may have been passed to their unborn child. If the fetus is 10 weeks old, what diagnostic procedure would be the best choice?
- (A) amniocentesis
 - (B) chorionic villus sampling
 - (C) ultrasound
 - (D) X-ray crystallography
30. Which best characterizes the offspring produced from a reproductive system that involves the union of haploid gametes?
- (A) enhanced genetic diversity and a diploid chromosome number equal to the parents
 - (B) enhanced genetic diversity and a diploid chromosome number twice the parents
 - (C) reduced genetic diversity and a diploid chromosome number equal to the parents
 - (D) reduced genetic diversity and a diploid chromosome number twice the parents
31. Which hormone is properly paired with its action?
- (A) estrogen - stimulates ovulation
 - (B) follicle stimulating hormone - increases primary sexual characteristics
 - (C) luteinizing hormone - stimulates follicle development
 - (D) progesterone - maintains uterine lining for implantation

32. Which is the correct sequence of stages in a monthly menstrual cycle?
- (A) follicular, ovulation, luteal, menstruation
 - (B) luteal, follicular, ovulation, menstruation
 - (C) menstruation, luteal, ovulation, follicular
 - (D) ovulation, follicular, luteal, menstruation
33. Which best describes the daughter cells produced if S phase were eliminated from the cell cycle?
- (A) They would be genetically identical to each other.
 - (B) They would be genetically identical to the parental cell.
 - (C) They would have half the genetic material found in the parental cell.
 - (D) They would synthesize the missing genetic material on their own.
34. Which cell would be most affected by a chemotherapy agent?
- (A) fat
 - (B) muscle
 - (C) nerve
 - (D) sperm
35. Which best describes the hormone levels of a pregnant person?
- | | Progesterone levels | FSH levels | Estrogen levels |
|-----|----------------------------|-------------------|------------------------|
| (A) | decrease | increase | no change |
| (B) | decrease | no change | increase |
| (C) | increase | increase | no change |
| (D) | increase | no change | increase |
36. Which is the science of heredity?
- (A) evolution
 - (B) genetics
 - (C) inheritance
 - (D) karyotyping
37. Which refers to the trait expressed in a heterozygous individual?
- (A) allele
 - (B) chromosome
 - (C) dominant
 - (D) recessive
38. Who discovered fundamental principles of genetics by breeding garden peas?
- (A) Darwin
 - (B) Margulis
 - (C) Mendel
 - (D) Watson

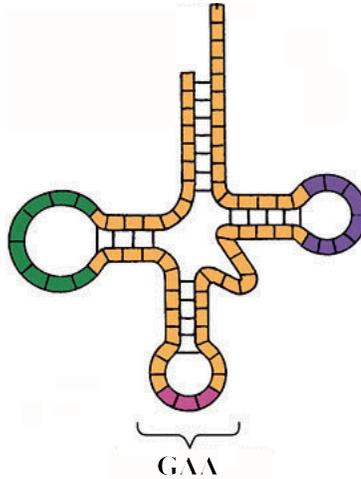
39. If a sex-linked trait affects more males than females, which conclusion can be made about the trait?
- (A) incompletely dominant
 - (B) incompletely recessive
 - (C) X-linked dominant
 - (D) X-linked recessive
40. In which field did Rosalind Franklin conduct her research?
- (A) DNA fingerprinting
 - (B) gel electrophoresis
 - (C) gene cloning
 - (D) X-ray crystallography
41. Which refers to an organism with two different alleles for a single trait?
- (A) cross-fertilized
 - (B) heterozygous
 - (C) homozygous
 - (D) segregated
42. Which refers to the physical appearance of an organism?
- (A) genetic drift
 - (B) genetic heritage
 - (C) genotype
 - (D) phenotype
43. Which chromosome mutation results when a part of one chromosome changes places with another part of the same chromosome?
- (A) deletion
 - (B) duplication
 - (C) inversion
 - (D) translocation
44. Which illustrates genetic relationships among a group of individuals?
- (A) karyotype
 - (B) gene map
 - (C) pedigree
 - (D) punnett square
45. Which best describes the two individuals involved in a test cross?
- (A) Both are homozygous dominant.
 - (B) Both are homozygous recessive.
 - (C) One has an unknown genotype and one is homozygous dominant.
 - (D) One has an unknown genotype and one is homozygous recessive.
46. Which nitrogen base is found only in the nucleus?
- (A) adenine
 - (B) cytosine
 - (C) guanine
 - (D) thymine

47. What remains constant in Chargaff's rule?
- (A) adenine and guanine
 - (B) adenine and thymine
 - (C) cytosine and thymine
 - (D) cytosine and uracil
48. Which process results in a phenotype determined by the additive effects of two or more genes?
- (A) codominance
 - (B) incomplete dominance
 - (C) polygenic inheritance
 - (D) sex linkage
49. What is the minimum number of point mutations that can cause DNA to code for a different amino acid?
- (A) 1
 - (B) 2
 - (C) 3
 - (D) 4
50. During transcription, what information is copied?
- (A) DNA to mRNA
 - (B) mRNA to DNA
 - (C) mRNA to tRNA
 - (D) tRNA to mRNA
51. In pea plants, tall is dominant over short and purple flowers are dominant over white. 500 offspring were produced from a cross between two pea plants that are both heterozygous for each trait. Approximately, how many of the offspring would be tall with purple flowers?
- (A) 30
 - (B) 90
 - (C) 280
 - (D) 500
52. What would be the maximum number of amino acids contained in a protein made up of 30 nucleotides?
- (A) 10
 - (B) 15
 - (C) 30
 - (D) 60
53. Which group is arranged from largest to smallest?
- largest* \longrightarrow *smallest*
- (A) cell, nucleotide, nucleus, DNA, chromosome
 - (B) cell, nucleus, chromosome, DNA, nucleotide
 - (C) chromosome, nucleotide, cell, DNA, nucleus
 - (D) chromosome, nucleus, cell, DNA, nucleotide

54. When does nondisjunction occur?

- (A) anaphase of meiosis
- (B) DNA replication
- (C) RNA replication
- (D) telophase of meiosis

55. Which codon binds to the molecule below?



- (A) ATT
- (B) AUU
- (C) CTT
- (D) CUU

56. How many different genotypes would occur in the offspring of a cross between a homozygous individual and a heterozygous individual?

- (A) 1
- (B) 2
- (C) 3
- (D) 4

57. In horses, roan coats (red and white hairs) result from codominance. If two roan coat horses are crossed, what would be the expected phenotype ratios?

- (A) all roan
- (B) $\frac{1}{2}$ roan, $\frac{1}{4}$ red, $\frac{1}{4}$ white
- (C) $\frac{1}{2}$ roan, $\frac{1}{2}$ red
- (D) $\frac{1}{2}$ roan, $\frac{1}{2}$ white

58. What is the likelihood that a couple's first child will be a female and second child is a male?

- (A) 12.5%
- (B) 25%
- (C) 50%
- (D) 75%

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

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

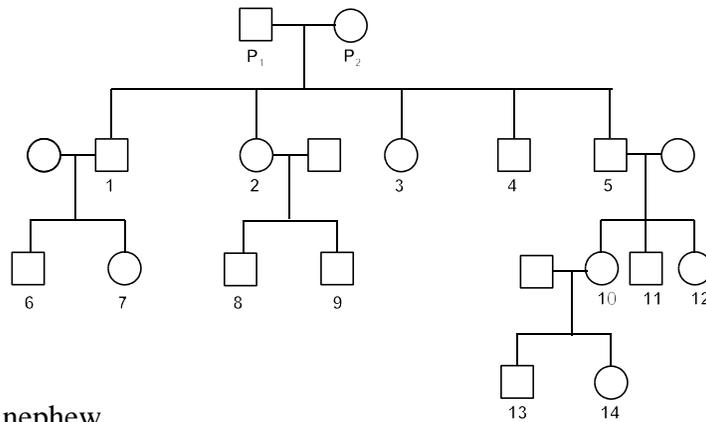
60. If a double-stranded DNA is found to contain 30% guanine, what is the percentage of adenine present?

- (A) 20%
- (B) 30%
- (C) 60%
- (D) 80%

61. With which cellular activity is the replication of DNA most closely associated?

- (A) mitosis
- (B) protein synthesis
- (C) transcription
- (D) translation

62. What is the relationship between individual 6 and individual 10 in the diagram below?



- (A) aunt - nephew
- (B) cousin - cousin
- (C) grandfather - granddaughter
- (D) uncle - niece

63. Which process separates DNA fragments for analysis?

- (A) amplification
- (B) gel electrophoresis
- (C) karyotyping
- (D) sequencing

64. Which most likely changes during evolution?

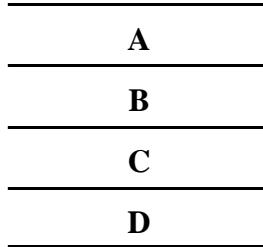
- (A) genetic makeup of an individual
- (B) genetic makeup of a population
- (C) phenotypic makeup of a community
- (D) phenotypic makeup of an individual

65. Darwin's theory of evolution was unable to provide a mechanism for the inheritance of traits. What was later determined to be the mechanism?

- (A) All populations have potential for change.
- (B) Characteristics are inherited as genes.
- (C) Individuals in a population are not alike.
- (D) Natural resources are limiting factors.

66. Which scientist contributed to the early theory of evolution by examining extinct species in the fossil record?
- (A) Cuvier
 - (B) Lamark
 - (C) Malthus
 - (D) Wallace
67. Which reproductive strategy is used in the breeding of pure-bred Labrador Retrievers?
- (A) artificial selection
 - (B) geographic isolation
 - (C) natural selection
 - (D) reproductive isolation
68. Which branch of comparative science describes the relationship between homologous structures?
- (A) anatomy
 - (B) biochemistry
 - (C) cytology
 - (D) embryology
69. Many species of insects have developed a resistance to the insecticide DDT. What process does this illustrate?
- (A) behavioral isolation
 - (B) biogeography
 - (C) directional selection
 - (D) relative dating
70. Who would support the statement below?
- “Improving adult intelligence through education will result in that adult’s children being born with greater intelligence.”*
- (A) Darwin
 - (B) Lamark
 - (C) Miller
 - (D) Oparin
71. For a population in Hardy-Weinberg equilibrium, the frequency of the recessive allele is 0.3. What percentage of the population is heterozygous?
- (A) 3%
 - (B) 21%
 - (C) 42%
 - (D) 52%
72. Which type of selection is occurring when a reptile population lays both very large eggs or very small eggs?
- (A) directional
 - (B) disruptive
 - (C) sexual
 - (D) stabilizing

73. Where in the rock layer below, would you expect to find the most recent and more complex organisms?



- (A) A
(B) B
(C) C
(D) D
74. Which most likely results from geographic and reproductive isolation?
- (A) competition
(B) extinction
(C) overproduction
(D) speciation
75. Two new species, one from Africa and one from South America, resemble each other closely. What would be the best factor to determine if they are related or if they are products of convergent evolution?
- (A) behaviour analysis
(B) DNA comparison
(C) geographic conditions
(D) fossil record

Value

3% 77.(b) What are three ways in which curable sexually transmitted infections are potentially damaging to society?

2% 78.(a) (i) What can result if a part of one chromosome exchanges with another part of a non homologous chromosome in a somatic cell?

2% (ii) What can result if the same mutation above occurs in the blastocyst shortly after fertilization?

Value

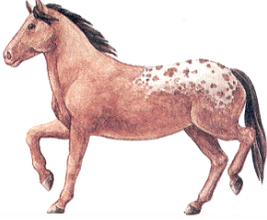
3% 78.(b) In a certain plant, red flowers (R) are dominant to white (r) and long stems (L) are dominant to short (*l*). What is the expected phenotypic ratios of the offspring resulting from a cross between a plant heterozygous for both traits with a plant that has heterozygous red flowers and short stems? Show all workings.

2% (c) A scientist discovered a cure for a lethal disease by placing non-human DNA into a human embryo. Give two reasons as to why you would support or why you would not support this type of genetic engineering?

2% 79.(a) What fraction of carbon-14 remains in a fossil that is approximately 17 190 years old.? The half life of carbon-14 is 5730 years. Show all workings.

Value

2% 79.(b) What mode of evolution is represented in the diagram below? Explain.

 modern horse		
 one-toed horse		
 Merychippus		
 Meshippus		
 early horse		

mode of evolution: _____
