

**Assessment
Exemplars**

Biology

30

This document was written primarily for:

Students	✓
Teachers	✓ of Biology 30
Administrators	✓
Parents	
General Audience	
Others	

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Biology 30 Assessment Exemplars

These Biology 30 assessment exemplars were developed by Learner Assessment in cooperation with the Curriculum Branch of Alberta Education to assist teachers with the interpretation of curricular outcomes in the revised Program of Studies (implemented in September 2008). The assessment exemplars, which include multiple-choice and numerical-response questions, illustrate how a particular concept can be assessed. Teachers are encouraged to use other assessment tools as well as machine-scored questions to assess the learning of their students.

This exemplar document parallels the Biology 30 Program of Studies. Each outcome is identified by a letter that indicates the unit of study (A, B, C, or D); by a number that indicates the general learner outcome within the unit; and by a number that indicates the specific outcome (SO). Each specific outcome is further classified as knowledge (k); science, technology, and society (sts); or skills (s). For example, A2.6k indicates that the concept is from Unit A, general outcome 2, specific outcome 6, and that the outcome is knowledge-based. Each exemplar has been classified according to its assessment standard at either the acceptable standard (AS) or at the standard of excellence (SE).

The two written-response questions on Part A of the Biology 30 Diploma Examination are designed to assess concepts from all four units of the Program of Studies. Examples of written-response questions are available online at education.alberta.ca by following the path: Administrators > (Provincial Testing) Diploma Examinations > Information Bulletins > Biology 30.

This exemplars document is neither exhaustive nor prescriptive. Its purpose is simply to provide a variety of useful examples of how specific outcomes in the Biology 30 Program of Studies can be assessed.

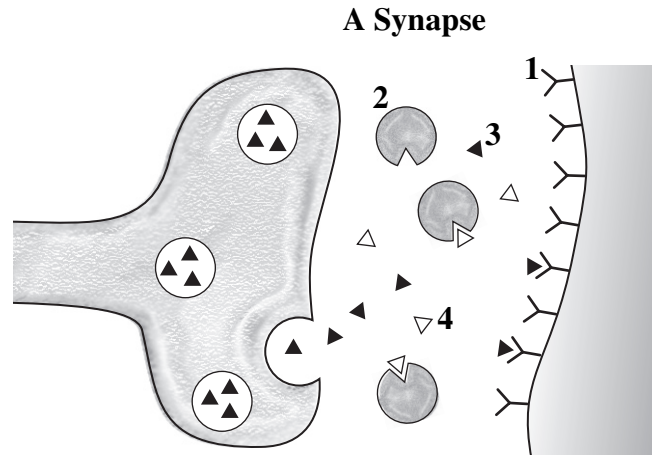
The exemplars from each of the four units can be found on the following pages:

Unit A	Pages 2 – 21
Unit B	Pages 22 – 39
Unit C	Pages 40 – 61
Unit D	Pages 62 – 83

SO: A1.1k, 1.2s
Standard: AS

Use the following information to answer the next two questions.

Alzheimer disease is caused by a decrease in the production of the neurotransmitter acetylcholine in the brain. Cholinesterase inhibitors, such as the drug donepezil, can slow the development of symptoms in the early-to-middle stages of Alzheimer disease, but they cannot stop the progression of the disease. The donepezil molecule has a shape that allows it to attach to the active site on cholinesterase, thereby preventing the cholinesterase from binding to acetylcholine.



1. In the diagram above, acetylcholine and donepezil are numbered
- A. 1 and 2 respectively
 - B. 2 and 1 respectively
 - C. 3 and 4 respectively
 - D. 4 and 3 respectively

Answer: C

SO: A1.1k, 1.3sts
Standard: SE

2. How does donepezil affect synaptic transmission?
- A. Donepezil breaks down acetylcholine so that less acetylcholine is available in the synapse.
 - B. Donepezil replaces cholinesterase so that more acetylcholine is available in the synapse.
 - C. Donepezil blocks the release of acetylcholine so that less acetylcholine is available in the synapse.
 - D. Donepezil prevents the breakdown of acetylcholine so that more acetylcholine is available in the synapse.

Answer: D

SO: A1.1k, 1.6k, 1.3s
Standard: SE

Use the following information to answer the next question.

In a research study on the detection of odours, individuals were asked to smell gradually decreasing concentrations of specific familiar chemicals. Women of reproductive age were more able to detect weak odours than were men, children, and postmenopausal women. The researchers concluded that female sex hormones might increase sensitivity to familiar odours.

3. The **most likely** inference that can be made from this study is that, in comparison with men, children, and postmenopausal women, women of reproductive age have
- A. more receptors for odour detection
 - B. a lower threshold level for familiar odours
 - C. the ability to interpret odours more quickly
 - D. the ability to adapt to familiar odours more quickly

Answer: B

SO: A1.2k, 1.2sts
Standard: AS

Use the following information to answer the next five questions.

Multiple sclerosis (MS), a disease of the nervous system, typically has symptoms of uncontrolled muscle responses, weakness, paralysis, and vision difficulties. Researchers believe that MS occurs as a result of the body's immune system destroying the myelin sheath that surrounds the axon of a nerve cell. The result is a scarring of brain tissue or of spinal cord tissue.

4. Damage to the myelin sheath of an optic neuron affects the speed of neural transmission to the visual centre, which is found in which lobe of the cerebrum?
- A. Frontal lobe
 - B. Parietal lobe
 - C. Occipital lobe
 - D. Temporal lobe

Answer: C

SO: A1.3k
Standard: AS

5. Another symptom of MS is an exaggerated pupillary light reflex. Some of the events that occur during this reflex are listed below.

- 1 Motor neuron depolarizes
- 2 Sensory neuron depolarizes
- 3 Interneuron depolarizes
- 4 Light receptors stimulated

The order in which the events listed above occur during a pupillary light reflex is _____, _____, _____, and _____.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Answer: 4231

SO: A1.2k
Standard: AS

6. Which of the following rows indicates events that would result from stimulation of sympathetic motor neurons in the heart, skin, and liver?

Row	Heart	Skin	Liver
A.	Increased heart rate	Decreased blood flow	Conversion of glycogen to glucose
B.	Increased heart rate	Increased blood flow	Conversion of glucose to glycogen
C.	Decreased heart rate	Decreased blood flow	Conversion of glycogen to glucose
D.	Decreased heart rate	Increased blood flow	Conversion of glucose to glycogen

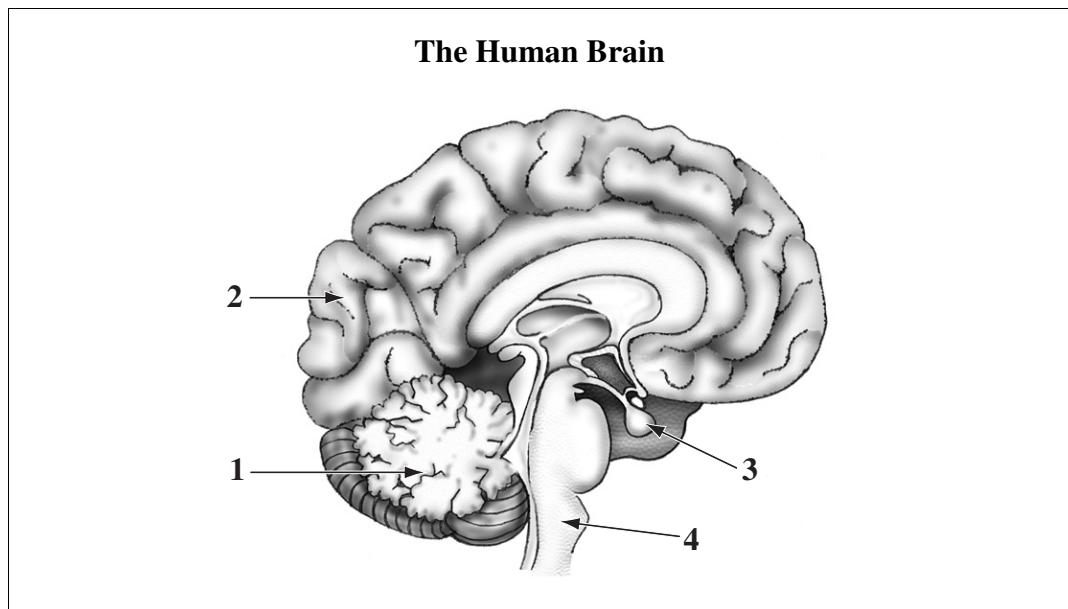
Answer: A

SO: A1.1k, 1.3s
Standard: SE

9. On the graph, the period from 0.5 ms to 1.0 ms represents the neuron's
- A. refractory period, which is when repolarization occurs
 - B. refractory period, which is when minimum depolarization occurs
 - C. threshold period, which is when repolarization occurs
 - D. threshold period, which is when minimum depolarization occurs
- Answer: A

SO: A1.2k, 1.2s
Standard: AS

Use the following information to answer the next question.



10. The area of the brain that controls the sympathetic and parasympathetic nervous systems is labelled
- A. 1
 - B. 2
 - C. 3
 - D. 4
- Answer: D

SO: A1.2k
Standard: AS

Use the following information to answer the next two questions.

Between seven and 12 months of age, infants begin to display a marked fear of strangers. Infants also begin to socially reference their responses during the same period. Some research indicates that extremely fearful children often have very anxious parents.

- 11.** The division of the nervous system that is directly responsible for physiological responses to fear is the
- A.** sensory nervous system
 - B.** somatic nervous system
 - C.** sympathetic nervous system
 - D.** parasympathetic nervous system

Answer: C

SO: A1.2k
Standard: AS

Use the following additional information to answer the next question.

Biofeedback consists of conscious efforts to control body responses that are normally involuntary. This technique can be used to control abnormal fear.

- 12.** Conscious efforts to control body responses through biofeedback originate in the
- A.** medulla
 - B.** cerebrum
 - C.** cerebellum
 - D.** hypothalamus

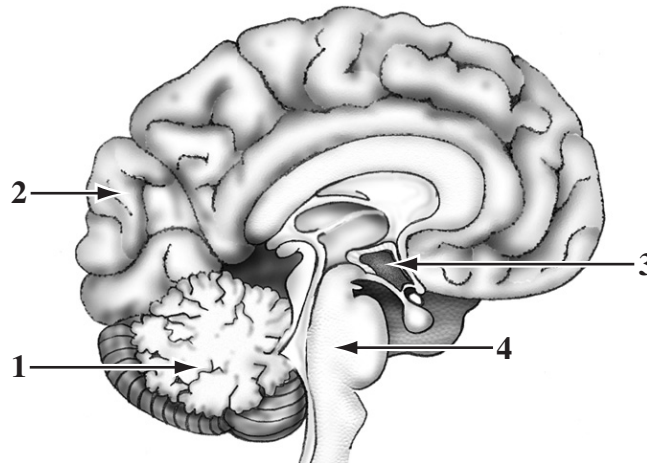
Answer: B

SO: A1.2k, 1.2s
Standard: AS

Use the following information to answer the next two questions.

Individuals with Refsum disease cannot metabolize phytanic acid, which results in a buildup of phytanic acid in body tissues and impairs the development of the myelin sheath on neurons. Symptoms of Refsum disease include hearing and vision loss, decreased muscle coordination, and a reduced sense of smell.

Human Brain



13. In the diagram above, two areas of the brain whose function can be affected in a person with Refsum disease are numbered

- A. 1 and 2
- B. 1 and 4
- C. 2 and 3
- D. 3 and 4

Answer: A

SO: A1.4k
Standard: AS

14. Symptoms of vision loss in individuals with Refsum disease include cataracts and impaired night vision. Which of the following rows identifies the structure of the eye that is affected by cataracts and the cells that, when damaged, result in night vision loss?

Row	Cataracts	Night Vision Loss
A.	Retina	Rod cells
B.	Lens	Rod cells
C.	Lens	Cone cells
D.	Retina	Cone cells

Answer: B

SO: A1.3k
Standard: AS

Use the following information to answer the next question.

After accidentally hitting your thumb with a hammer, you immediately withdraw your hand. You do not feel pain for a short period of time.

- 15.** This sequence of events may be explained by the fact that the
- A.** threshold of the receptor has been so greatly exceeded that the neuron does not pass the message to the brain
 - B.** neural impulse is so large that the brain is unable to interpret the signal because it is beyond the range of tolerance
 - C.** neural processing occurred in the spinal cord first, which caused you to quickly remove your thumb from further damage
 - D.** sensory receptors in the thumb were damaged by the blow and are unable to initiate a stimulus to the sensory nerve

Answer: C

SO: A1.3k
Standard: AS

Use the following information to answer the next question.

Individuals know that touching a hot stove can be painful. When an individual accidentally touches a hot stove, a reflex arc is initiated, which causes the person to withdraw his or her hand before he or she senses the pain.

- 16.** Which of the following lists identifies the neural pathway in a reflex arc?
- A.** Receptor, sensory neuron, effector, motor neuron
 - B.** Motor neuron, interneuron, sensory neuron, effector
 - C.** Sensory neuron, receptor, interneuron, motor neuron
 - D.** Receptor, sensory neuron, interneuron, motor neuron

Answer: D

SO: A1.4k
Standard: AS

Use the following information to answer the next question.

Structures of Sensory Perception

- 1 Optic nerve
- 2 Proprioceptor
- 3 Photoreceptor
- 4 Occipital lobe
- 5 Temporal lobe
- 6 Auditory nerve

17. After light enters the eye, the structures of sensory perception listed above that are stimulated are _____, _____, and _____.

(Record all **three digits** of your answer in **lowest-to-highest numerical order** in the numerical-response section on the answer sheet.)

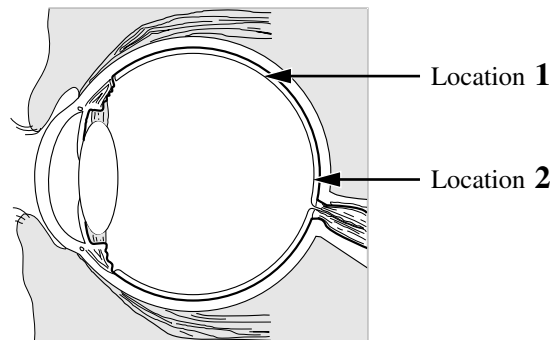
Answer: 134

SO: A1.4k, 1.2s, 1.3sts
Standard: AS

Use the following information to answer the next question.

Erectile dysfunction, which is defined as the inability to maintain an erection, can sometimes be treated with the drug sildenafil citrate. A side effect of sildenafil citrate is that it can result in temporary difficulties in distinguishing between the colours blue and green.

The Human Eye



18. The cells in the eye that are affected by sildenafil citrate and the primary location of these cells, as labelled above, are, respectively,

- A. rod cells and location 1
- B. rod cells and location 2
- C. cone cells and location 1
- D. cone cells and location 2

Answer: D

SO: A1.5k, 1.3sts
Standard: AS

Use the following information to answer the next question.

Researchers have linked the release of airbags in cars to impaired hearing. When an airbag is released, there is a rapid increase in air pressure, which can damage the inner ear.

Structures of the Human Ear

- 1 Ossicles
- 2 Cochlea
- 3 Auditory canal
- 4 Tympanic membrane

19. The sequence in which the highly compressed pressure waves created by the release of an airbag travel through the structures of the human ear is _____, _____, _____, and _____.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Answer: 3412

SO: A1.5k, 1.3s, 1.3sts
Standard: AS

Use the following information to answer the next three questions.

The Norwegian military has developed a Personal Active Radio/Audio Terminal (PARAT) earpiece that blocks unwanted noise while allowing other sound to come through clearly. The PARAT is contained in a sealed unit that physically blocks most sound while the tiny computer inside the unit analyzes which sounds it will filter through into the ear.

20. The structure of the ear that converts the vibrations transmitted by the PARAT into electrochemical impulses and the structure that carries these impulses to the brain are, respectively, the

- A. cochlea and the optic nerve
- B. cochlea and the auditory nerve
- C. semicircular canals and the optic nerve
- D. semicircular canals and the auditory nerve

Answer: B

SO: A1.2k, 1.3s
Standard: AS

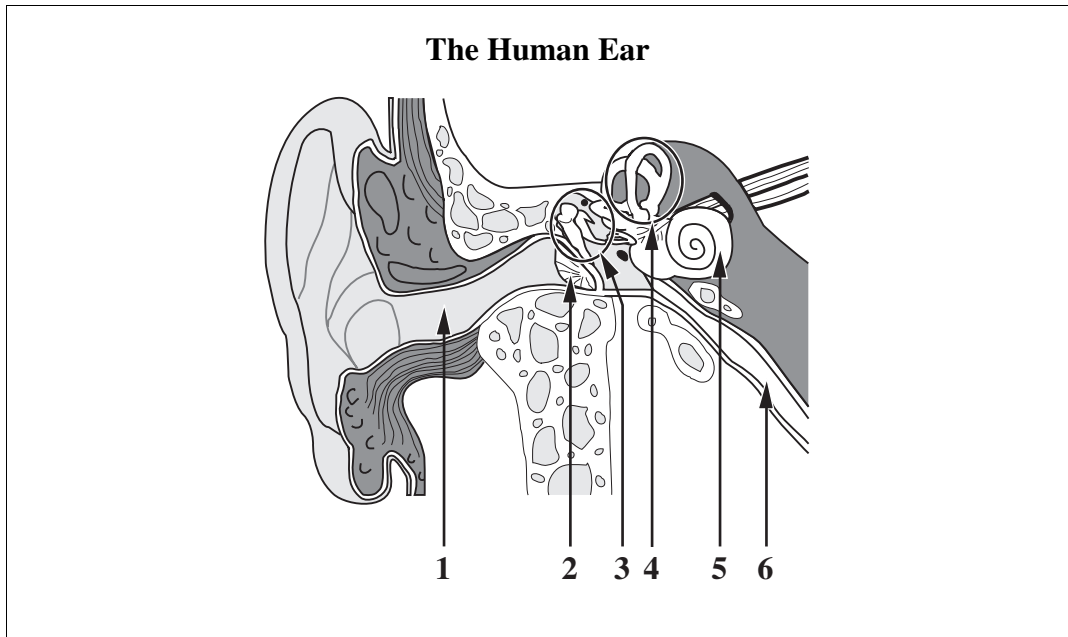
21. The sound transmitted to the ear by the PARAT earpiece is **first** analyzed by the brain in the

- A. frontal lobe
- B. parietal lobe
- C. temporal lobe
- D. occipital lobe

Answer: C

SO: A1.5k, 1.2s
Standard: AS

Use the following additional information to answer the next question.



22. In the diagram above, the four structures of the ear through which sound vibrations pass as they travel from the PARAT to the sensory nerve are _____, _____, _____, and _____.

(Record all **four digits** of your answer in **lowest-to-highest numerical order** in the numerical-response section on the answer sheet.)

Answer: 1235

SO: A1.5k
Standard: AS

23. In the human ear, sounds are translated into nerve impulses in the
- A. ossicles
 - B. oval window
 - C. organ of Corti
 - D. semicircular canals
- Answer: C

SO: A1.4k, 1.5k, 1.6k, 1.3sts
Standard: SE

Use the following information to answer the next question.

Using various mixtures of nutrients and other growth factors, scientists can encourage stem cells to differentiate into any type of cell. Neuroreceptor disorders could potentially be treated with cells produced from stem cells. Listed below are some cell types and some neuroreceptor disorders.

Some Cell Types

- 1 Rod cells
- 2 Cone cells
- 3 Olfactory cells
- 4 Taste receptor cells
- 5 Basilar membrane cells
- 6 Semi-circular canal hair cells

Neuroreceptor Disorders and Descriptions

- Anosmia**—the inability to detect odours as a result of injury to the nasal cavity
- Colourblindness**—a genetic disorder that results in the inability to detect certain colours of light
- Neural Deafness**—the inability to detect sound as a result of damage to sensory structures in the inner ear
- Permanent vertigo**—a severe balance disorder that usually results from physical trauma to the ear

24. Match four of the cell types numbered above with the disorder that the cell could treat, as given below.

Cell Type:	_____	_____	_____	_____
Neuroreceptor Disorder:	Anosmia	Colourblindness	Neural deafness	Permanent vertigo

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)
Answer: 3256

SO: A2.2k
Standard: AS

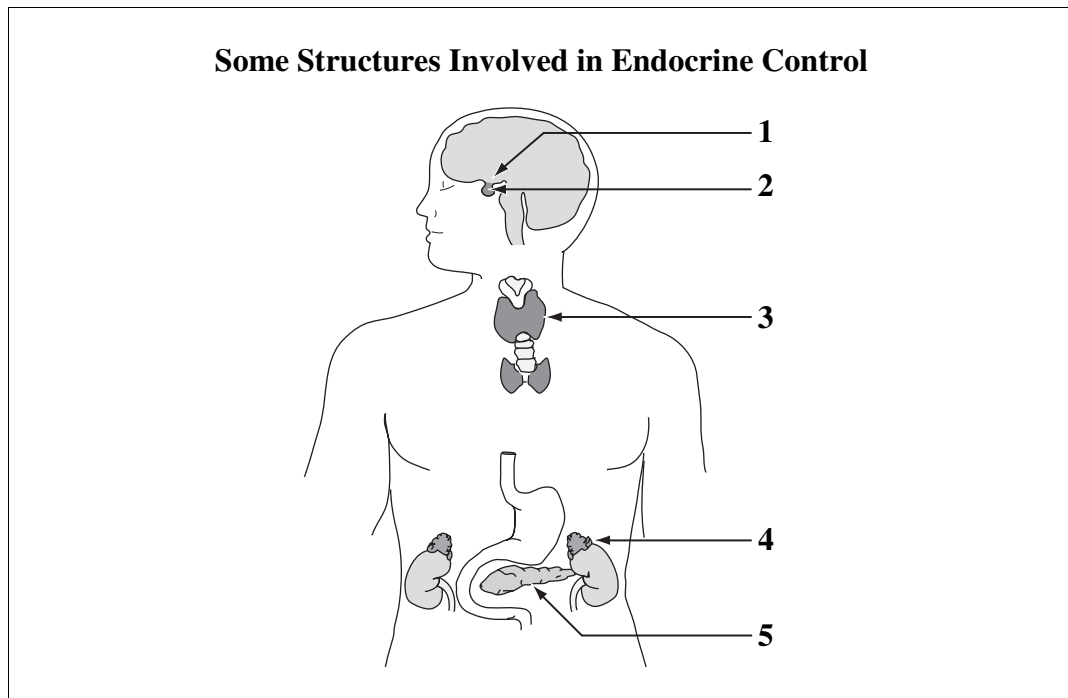
25. Which of the following rows identifies the source of cortisol, the hormone that stimulates the release of cortisol, and an effect of cortisol?

Row	Source	Hormone	Effect
A.	Adrenal gland	ACTH	Increased conversion of amino acids to glucose
B.	Pituitary gland	ACTH	Increased protein synthesis
C.	Adrenal gland	ADH	Increased conversion of glycogen to glucose
D.	Pituitary gland	ADH	Increased water reabsorption

Answer: A

SO: A2.1k
Standard: AS

Use the following diagram to answer the next question.



26. The three structures in the diagram above involved in the normal feedback control of cortisol secretion are numbered _____, _____, and _____.

(Record all **three digits** of your answer in **lowest-to-highest numerical order** in the numerical-response section on the answer sheet.)

Answer: 124

SO: A2.2k, 2.2sts
Standard: SE

Use the following information to answer the next two questions.

Thyroid cancer can develop slowly over many months or even years. Because the symptoms are frequently overlooked, diagnosis is often delayed. However, thyroid cancer is usually treated successfully with a combination of surgery, radioactive iodine, and thyroid medication.

27. Surgical removal of the thyroid gland results in
- A. a decrease in thyroxine levels and TSH levels
 - B. an increase in thyroxine levels and TSH levels
 - C. an increase in thyroxine levels and a decrease in TSH levels
 - D. a decrease in thyroxine levels and an increase in TSH levels
- Answer: D*

SO: A2.2k, 2.3k
Standard: AS

28. Following the removal of the thyroid gland, thyroid medication is prescribed in order to
- A. increase sodium reabsorption and water retention
 - B. decrease sodium reabsorption and water retention
 - C. increase the rate of metabolism and the rate of heat production
 - D. decrease the rate of metabolism and the rate of heat production
- Answer: C*

SO: A2.2k, 2.3k
Standard: AS

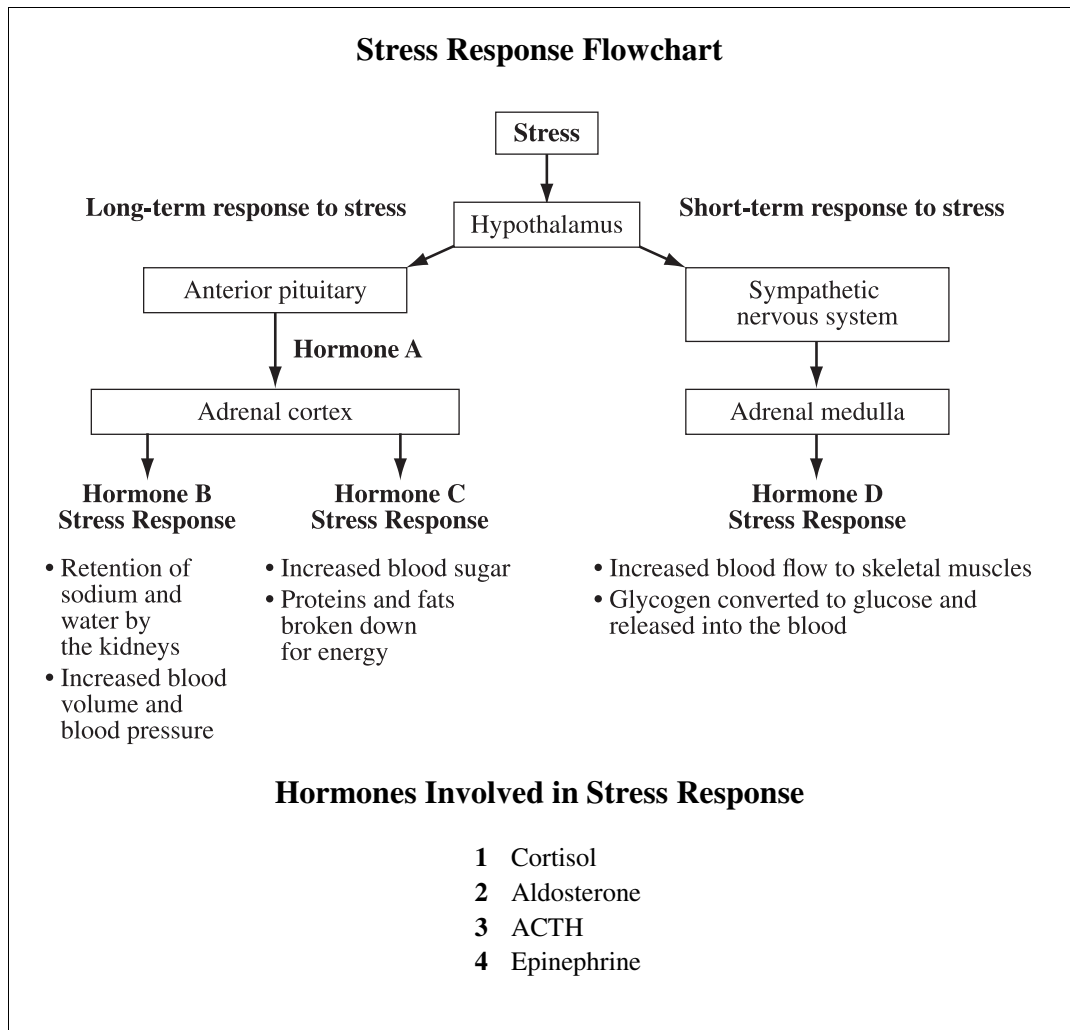
Use the following information to answer the next question.

Chemicals found in alcohol and tea have a diuretic effect. Diuretics cause the body to produce greater-than-normal volumes of urine.

29. Diuretic chemicals counteract the effect of the hormone
- A. ADH
 - B. insulin
 - C. cortisol
 - D. prolactin
- Answer: A*

SO: A2.3k, 2.5k
 Standard: SE

Use the following information to answer the next two questions.



30. Match each of the hormones involved in the stress response with the hormones represented in the flowchart above.

Hormone Number: _____
Flowchart Letter:
 Hormone A Hormone B Hormone C Hormone D

(Record your **four-digit answer** in the numerical-response section on the answer sheet.)

Answer: 3214

SO: A2.5k
Standard: SE

- 31.** The short-term response to stress occurs faster than the long-term response to stress because the
- A.** blood from the adrenal medulla travels faster than does the blood from the adrenal cortex
 - B.** adrenal medulla responds to nervous stimulation, which is faster than hormonal stimulation
 - C.** adrenal medulla is controlled by the hypothalamus whereas the adrenal cortex is controlled by the pituitary
 - D.** hormone from the adrenal medulla acts on cells more quickly than the hormones from the adrenal cortex

Answer: B

SO: A2.2k, 2.3k
Standard: AS

- 32.** Which of the following hormones plays a role in returning the salt concentration in the blood to homeostatic levels following heavy exercise?
- A.** Cortisol
 - B.** Thyroxine
 - C.** Aldosterone
 - D.** Epinephrine

Answer: C

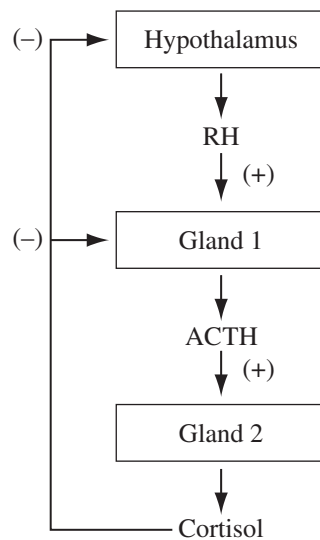
SO: A2.4k 2.3s
Standard: SE

Use the following information to answer the next two questions.

Researchers suggest that the brain has a daily “internal clock” that is controlled by the endocrine and nervous systems. The hormone ACTH helps to regulate the nervous system and gives the body the ability to respond to changes in sleep patterns. The release of ACTH is suppressed during sleep but increases before a person awakes.

The feedback loop below illustrates part of the regulatory hormonal control of the internal clock.

Regulatory Hormone Feedback Loop



33. The secretion of ACTH is suppressed during sleep as a result of

- A. increased activity of the pituitary gland
- B. decreased secretion of RH by the hypothalamus
- C. decreased secretion of cortisol by the adrenal cortex
- D. increased nervous system input to the medulla oblongata

Answer: B

SO: A2.5k, 2.3s
Standard: SE

Use the following additional information to answer the next question.

In a study in which the brain's internal clock was investigated, two groups of volunteers were awakened at 6:00 A.M. One group had been told that they would be awakened at 6:00 A.M., and the other group had been told that they would be awakened at 9:00 A.M. The group expecting to be awakened at 6:00 A.M. had increased levels of ACTH at 5:00 A.M., but the level of ACTH remained low in the group expecting to sleep later.

—based on Born, Jan, Kirsten Hansen, Lisa Marshall, Matthias Mölle, and Horst L. Fehm. 1999. Timing the end of nocturnal sleep. *Nature* 397 (January): 29.

- 34.** The results of this study indicate that the sleep-wake cycle is
- A.** variable, because the adrenal cortex responded to an anticipated event
 - B.** variable, because the hypothalamus responded to an anticipated event
 - C.** not variable, because the adrenal cortex cannot respond to an anticipated event
 - D.** not variable, because the hypothalamus cannot respond to an anticipated event
- Answer: B*

SO: A2.4k
Standard: AS

- 35.** Low levels of calcium ions in the blood cause
- A.** decreased secretion of PTH and increased deposition of calcium in the bones
 - B.** decreased secretion of calcitonin and increased deposition of calcium in the bones
 - C.** increased secretion of PTH and movement of calcium from the bones to the blood
 - D.** increased secretion of calcitonin and movement of calcium from the bones to the blood

Answer: C

SO: A2.2k
Standard: AS

- 36.** The release of thyroxine from the thyroid is directly regulated by
- A.** TSH
 - B.** TRH
 - C.** iodine
 - D.** thyroxine
- Answer: A*

SO: A2.6k
Standard: AS

- 37.** A characteristic symptom of hyperthyroidism is
- A.** lethargy
 - B.** weight loss
 - C.** intolerance to cold
 - D.** slowed mental processes
- Answer: B*

SO: A2.2k, 2.3k
Standard: AS

- 38.** Parathormone and calitonin are hormones that work antagonistically. Two other hormones that work antagonistically are
- A.** TSH and thyroxine
 - B.** insulin and glucagon
 - C.** ADH and aldosterone
 - D.** prolactin and oxytocin
- Answer: B*

SO: A2.6k
Standard: AS

- 39.** Diabetes insipidus is a disorder in which the body fails to produce sufficient ADH. One symptom of this disorder that is directly related to ADH secretion is
- A.** the production of large amounts of dilute urine
 - B.** a decrease in the glucose concentration in the blood
 - C.** an increase in the glucose concentration in the urine
 - D.** the production of small amounts of concentrated urine
- Answer: A*

SO: A2.3s
Standard: AS

Use the following information to answer the next two questions.

Drinking coffee may protect a person against Parkinson disease, a neurological disorder resulting from reduced production of the neurotransmitter dopamine by affected cells in the brain. In an experiment, mice were given caffeine in an amount equivalent to approximately one cup of coffee for a human. The mice were then given MPTP, a chemical that destroys dopamine-producing neurons, thus causing symptoms similar to those of Parkinson disease. These mice showed a much smaller reduction in dopamine levels than mice that were not given caffeine before being given MPTP.

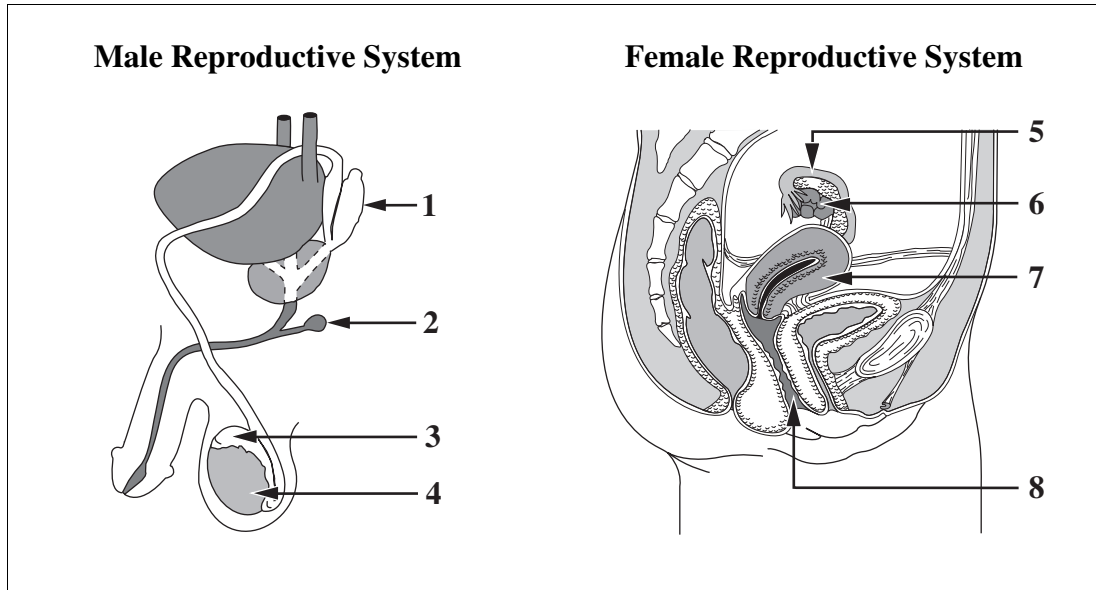
- 40.** The manipulated variable in the experiment described above was the
- A.** ingestion of MPTP
 - B.** ingestion of caffeine
 - C.** secretion of dopamine
 - D.** destruction of dopamine-producing neurons
- Answer: B*

SO: A2.3s
Standard: AS

- 41.** In a well-designed experiment, variables that would be kept the same in both the experimental and control groups of mice are the
- A.** diet and health of the mice
 - B.** amounts of caffeine and MPTP ingested
 - C.** age of the mice and amount of caffeine ingested
 - D.** size of the mice and amount of dopamine produced
- Answer: A*

SO: B1.1k, B1.2k, B1.2s
 Standard: AS

Use the following information to answer the next question.



42. Match four of the structures of the male and female reproductive systems numbered above with the appropriate descriptions, as given below.

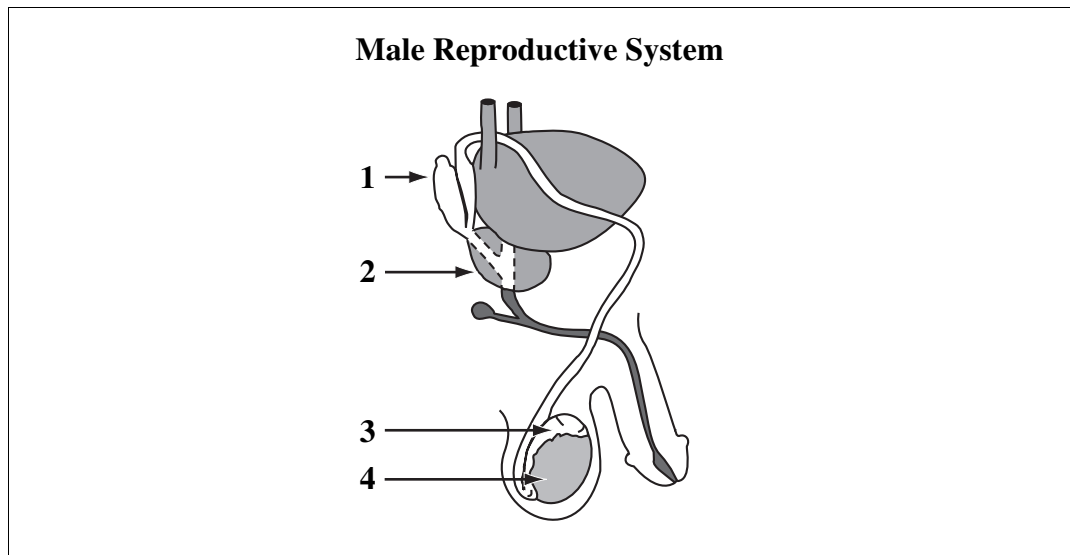
Structure:	_____	_____	_____	_____
Description:	Site of spermatogenesis	Site of oogenesis	Site of production of fructose fluid, which makes up a portion of the semen	Usual site of the first mitotic division after fertilization

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Answer: 4615

SO: B1.2k, 1.2s
Standard: AS

Use the following diagram to answer the next question.



43. Which numbers on the diagram above indicate the site of sperm production and the site of prostate fluid production?
- A. 3 and 1 respectively
 - B. 3 and 2 respectively
 - C. 4 and 1 respectively
 - D. 4 and 2 respectively

Answer: D

SO: B1.2k
Standard: AS

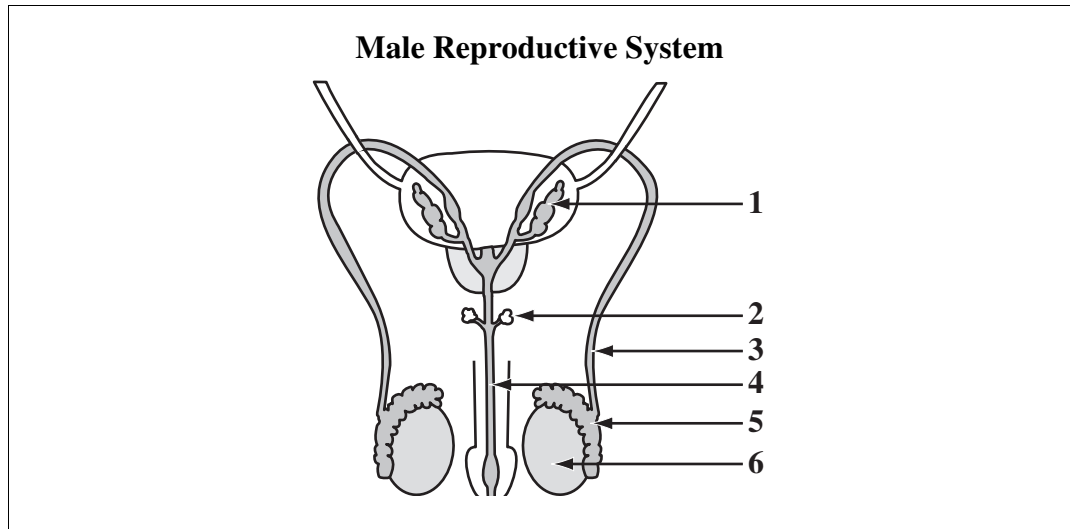
44. Which of the following rows identifies a substance that is present in semen and the structure that produces the substance?

Row	Substance present in semen	Structure that produces substance
A.	Sperm	Vas deferens
B.	Mucus	Prostate gland
C.	Fructose	Seminal vesicle
D.	Testosterone	Interstitial cells

Answer: C

SO: B1.3k, 1.2s
Standard: AS

Use the following information to answer the next question.



45. In a normal male, the sequence of the structures numbered above through which sperm cells travel from the time when spermatogenesis occurs to the time when ejaculation occurs is _____, _____, _____, and _____.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)
Answer: 6534

SO: B1.5k, 1.1sts
Standard: SE

Use the following information to answer the next question.

A study showing that the hormone progesterone thins the vaginal wall of monkeys has raised concerns that the use of certain contraceptives may increase a woman's risk of infection by HIV, the AIDS virus. HIV can be transmitted through sexual activity.

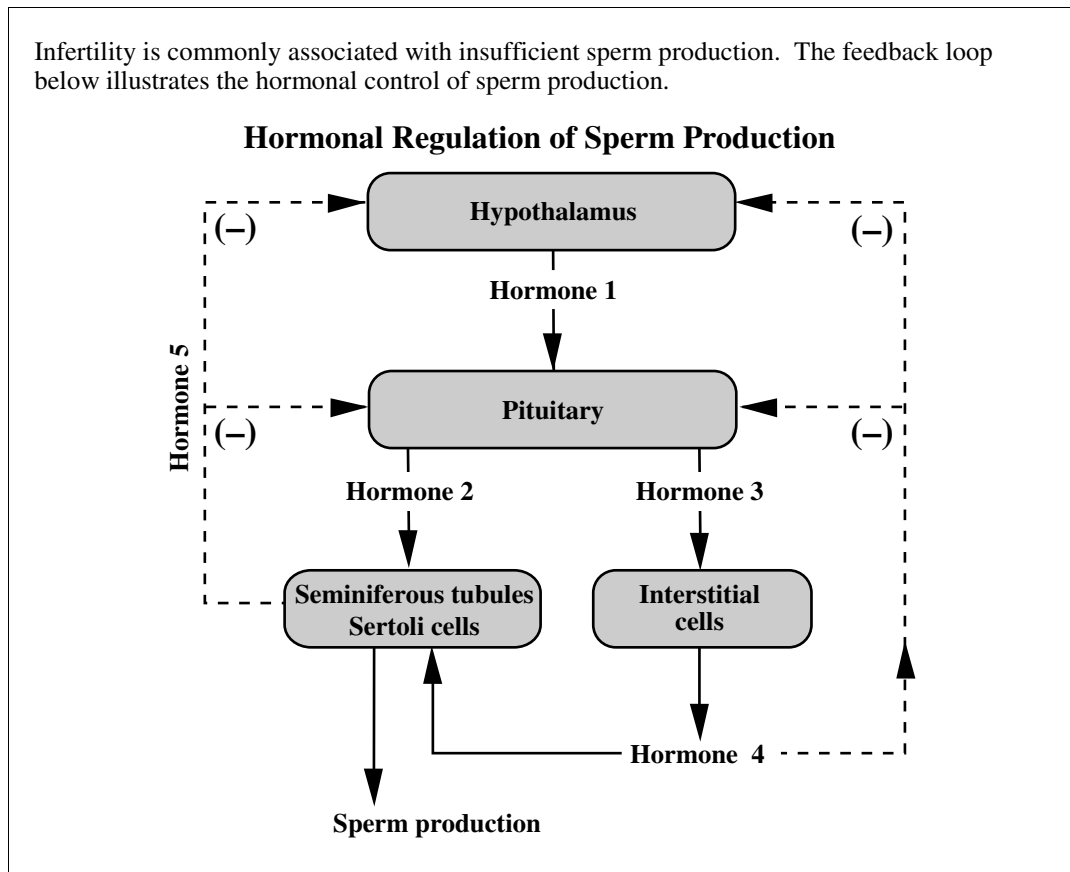
—based on *Science News*, 1996. Contraceptive concerns about HIV.
Science News 150 (October 19): 249.

46. If progesterone produced thinner-than-normal vaginal walls in women, a main concern would be that the thinner vaginal walls would
- A. not produce the enzymes necessary to combat HIV
 - B. not produce the hormones necessary to combat HIV
 - C. provide a thinner barrier and therefore less protection from HIV infection during childbirth
 - D. provide a thinner barrier and therefore less protection from HIV infection during sexual intercourse

Answer: D

SO: B2.1k, 2.3k, 2.3s
Standard: AS

Use the following additional information to answer the next two questions.



47. In the diagram above, the hormones FSH, LH, and testosterone are labelled, respectively,

- A. 2, 3, 4
- B. 2, 3, 5
- C. 3, 2, 4
- D. 3, 2, 5

Answer: A

SO: B2.1k, 2.3k, 2.3s
Standard: AS

48. If infertility were due to decreased production of hormone 1 by the hypothalamus, then fewer sperm would be produced because there would be

- A. low levels of hormone 2
- B. high levels of hormone 3
- C. high levels of hormone 4
- D. low levels of hormone 5

Answer: A

SO: B2.2k, 2.2sts
Standard: AS

Use the following information to answer the next question.

Research on the effect of cocaine on blood flow in the brain revealed that males and females react differently to the drug. Men who use cocaine have a 20% decrease in blood flow in the brain. Women who use cocaine have no change in blood flow in the brain at the beginning of their menstrual cycle.

—Kaufman, Marc J., Jonathan M. Levin, Luis C. Maas, Thellean J. Kukes, Rosemond A. Villafuerte, Kerstin Dostal, Scott E. Lukas, Jack H. Mendelson, Bruce M. Cohen, and Perry F. Renshaw. 2001. Cocaine-induced cerebral vasoconstriction differs as a function of sex and menstrual cycle phase. *Biological Psychiatry* 49: 774–781.

49. Which of the following hormones **most likely** play a role in reducing the effects of cocaine on blood flow in a woman’s brain at the beginning of the woman’s menstrual cycle?
- A. FSH and progesterone
 - B. LH and progesterone
 - C. FSH and estrogen
 - D. LH and estrogen

Answer: C

SO: B2.2k, 2.2sts
Standard: SE

Use the following information to answer the next two questions.

Researchers found that the timing of breast cancer surgery in a woman’s menstrual cycle affects the outcome of the surgery. Surgery to remove a cancerous tumour is most successful during a woman’s luteal phase, partly because the hormone that has the highest concentration in the luteal phase seems to cause the tissue surrounding the tumour to compress the tumour.

50. According to the findings, on which day or days of a woman’s menstrual cycle would it be **best** to perform surgery to remove a cancerous breast tumour?
- A. Days 1 to 5
 - B. Days 6 to 13
 - C. Day 14
 - D. Days 15 to 28

Answer: D

SO: B2.2k
Standard: AS

51. The hormone that has a high concentration **only** during the luteal phase and, therefore, that probably contributes to the success of breast cancer tumour removal at this stage is

- A. LH
- B. FSH
- C. estrogen
- D. progesterone

Answer: D

SO: B2.2k, 2.3s
Standard: SE

Use the following additional information to answer the next question.

Researchers have found evidence that during the part of the menstrual cycle in which a woman's estrogen level is highest, her spatial skills are weakest whereas her motor skills and articulation skills are enhanced. Another study measured testosterone levels in saliva. The study found that relatively low testosterone levels in males enhanced their mathematical reasoning, but there was no correlation between testosterone levels and a woman's mathematical reasoning ability.

Statements Related to Women's' Hormonal Levels and Skill Levels

- 1 During pregnancy, a woman's motor skills are enhanced.
- 2 During pregnancy, a woman's spatial skills are enhanced.
- 3 During pregnancy, a woman's articulation skills are reduced.
- 4 A woman's spatial skills are enhanced around day 1 of her menstrual cycle.
- 5 A woman's motor skills are enhanced around day 14 of her menstrual cycle.
- 6 Increased testosterone and increased estrogen increase a woman's spatial skills.
- 7 Increased testosterone and decreased estrogen increase a woman's spatial skills.
- 8 A woman's mathematical skills are enhanced around day 14 of her menstrual cycle.

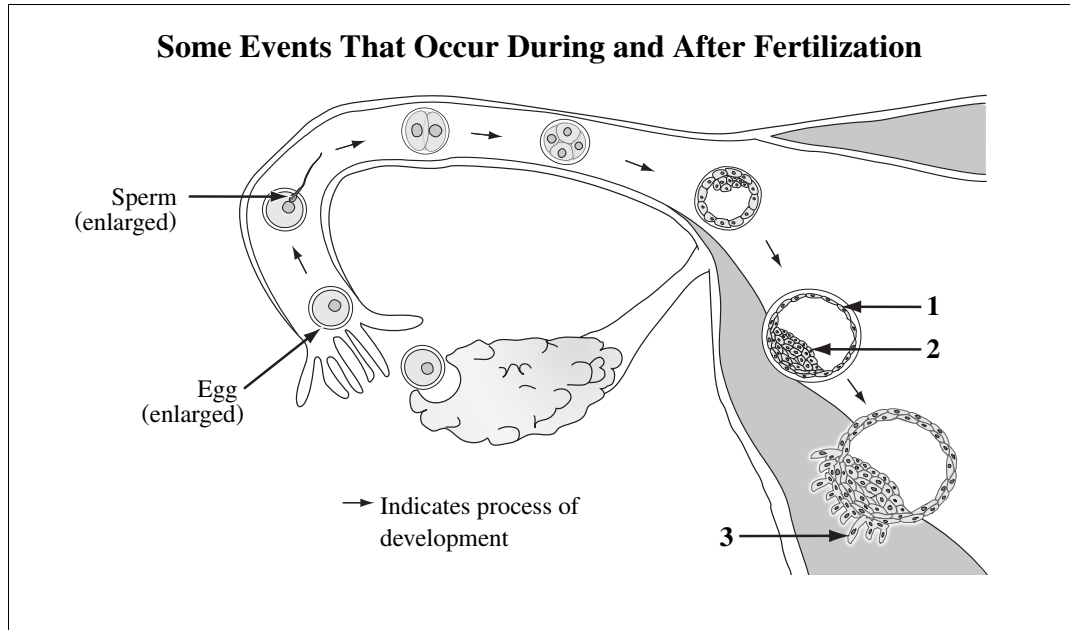
52. The research described above supports the **four** statements numbered _____, _____, _____, and _____.

(Record your **four-digit answer from lowest to highest numeric order** in the numerical-response section on the answer sheet.)

Answer: 1457

SO: B3.1k, 3.3s
 Standard: AS

Use the following diagram to answer the next question.



53. Which of the following rows identifies structure 3 and the structure it becomes part of?

Row	Structure 3	Structure It Becomes Part of
A.	Chorion	Placenta
B.	Amnion	Chorion
C.	Placenta	Amnion
D.	Placenta	Chorion

Answer: A

SO: B3.1k, 3.1sts, 3.2sts
Standard: AS

Use the following information to answer the next question.

Scientists in Japan have created an artificial womb. In it, they placed goat fetuses, which developed for up to three weeks. The device is composed of a clear plastic box that is filled with fluid at 37°C and connected to various machines that maintain vital functions. Inside the clear plastic box, the fetus is connected to a dialysis machine that removes wastes and provides nutrients to the fetus.

In the future, scientists hope to use this device to study the process of human development.

- 54.** The structure in the human female that the clear plastic box functions as and a structure that normally surrounds the fetus are, respectively,
- A.** a uterus and the allantois
 - B.** a placenta and the allantois
 - C.** a uterus and the amniotic sac
 - D.** a placenta and the amniotic sac

Answer: C

SO: B3.1k, 3.2sts
Standard: AS

Use the following information to answer the next question.

The drug RU-486 can be used in combination with a particular prostaglandin to end a pregnancy. RU-486 blocks the effects of progesterone, and the prostaglandin stimulates uterine contractions.

- 55.** The effect of RU-486 on a woman would be the deterioration of the
- A.** uterus
 - B.** endometrium
 - C.** corpus luteum
 - D.** developing follicles

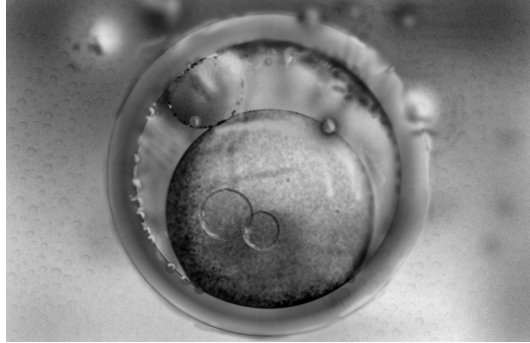
Answer: B

SO: B3.1k, 3.3s
Standard: AS

Use the following information to answer the next question.

Fertilization

Fertilization occurs when a sperm fuses with an egg to form a zygote. In this photomicrograph of a zygote, the sperm and egg nuclei are just fusing. One polar body is also visible.



56. The event shown above normally occurs in the

- A. ovary
 - B. uterus
 - C. vagina
 - D. Fallopian tube
- Answer: D*

SO: B3.1k, 3.1sts, 3.2sts
Standard: SE

Use the following information to answer the next question.

Abnormal genetic material can be identified in a mature ovum by analyzing a polar body that develops during formation of the ovum. The polar body normally contains the same number of chromosomes as the mature ovum.

57. The analysis of a polar body would be **most useful** prior to the procedure of

- A. amniocentesis
 - B. ultrasound imaging
 - C. *in vitro* fertilization
 - D. chorionic villi sampling
- Answer: C*

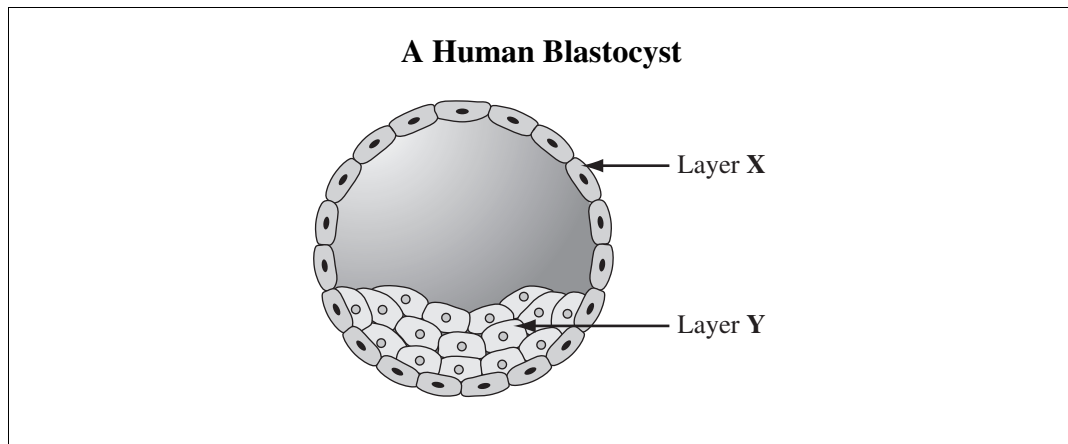
SO: B3.2k
Standard: AS

58. During the first three days of development, the human embryo obtains nutrients and energy from the
- A. seminal fluid
 - B. amniotic fluid
 - C. cytoplasm of the mother's egg
 - D. mitochondria of the father's sperm

Answer: C

SO: B3.2k
Standard: SE

Use the following information to answer the next question.



59. In the diagram above, the structure that develops from layer X and the structure that develops from layer Y are, respectively, the
- A. embryo and the amnion
 - B. chorion and the amnion
 - C. chorion and the embryo
 - D. embryo and the chorion

Answer: C

SO: B3.3k
Standard: AS

Use the following information to answer the next question.

Some Organs and Tissues That Develop in an Embryo

- 1 Muscle and blood
- 2 Lining of digestive tract
- 3 Brain and outer layer of skin

60. Match the organs and tissues listed above with the germ layer from which they develop, as indicated below.

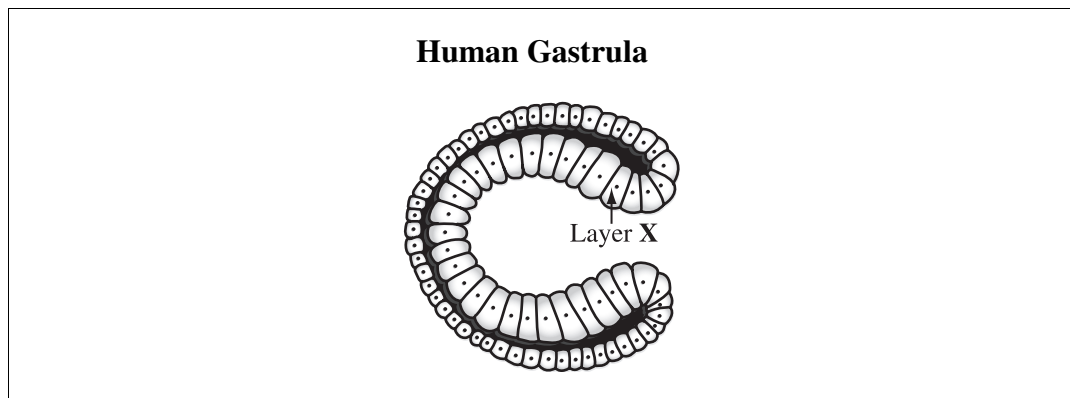
Organs and Tissues: _____
Germ Layer: **Endoderm** **Mesoderm** **Ectoderm**

(Record all **three digits** of your answer in the numerical-response section on the answer sheet.)

Answer: 213

SO: B3.3k, 3.3s
Standard: SE

Use the following diagram to answer the next question.



61. Which of the following rows identifies layer X as shown in the diagram above and structures that develop from this layer?

Row	Layer X	Structures That Develop From Layer X
A.	Ectoderm	Skeletal, cardiac, and smooth muscles
B.	Mesoderm	Lining of the respiratory tract
C.	Endoderm	Lining of the digestive tract
D.	Mesoderm	Ear and eye

Answer: C

SO: B3.2k, 3.4k, 3.2s, 3.2sts
Standard: AS

Use the following information to answer the next question.

Spina bifida is a serious birth defect in which the vertebrae do not form normally around the spinal cord. A woman can greatly reduce the risk of her baby having spina bifida by taking folic acid supplements.

- 62.** Folic acid is critical to the normal formation of the vertebrae and spinal cord during the
- A.** cleavage of the blastocyst
 - B.** formation of the blastocyst
 - C.** first trimester of development
 - D.** third trimester of development

Answer: C

SO: B3.2k
Standard: AS

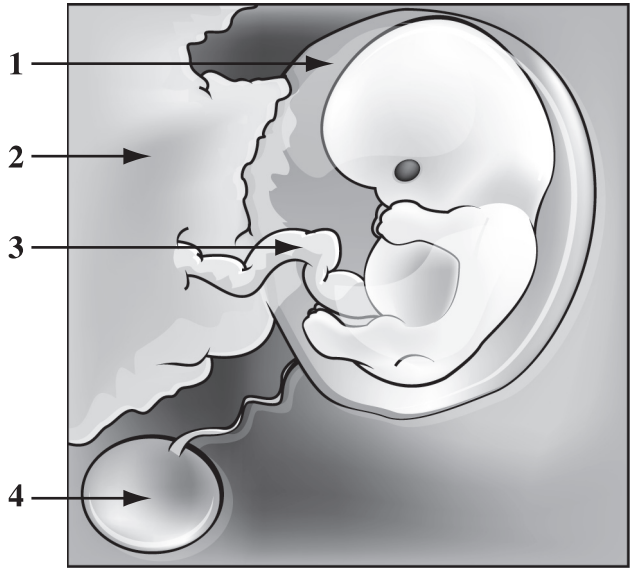
- 63.** Which of the following events occur during the first trimester in human development?
- A.** Nervous system forms, heart pumps blood, tube-like gut forms
 - B.** Nervous system forms, sex differentiation occurs, fingernails develop
 - C.** Heart pumps blood, tube-like gut forms, lungs become fully functional
 - D.** Lungs become fully functional, heart pumps blood, sex differentiation occurs

Answer: A

SO: B3.1k, 3.3s
Standard: SE

Use the following information to answer the next question.

Human Embryo Six Weeks After Fertilization



Descriptions of Embryonic Structures' Functions

- A** Provides protection
- B** Transports embryonic blood
- C** Is used for nourishment in vertebrates other than mammals
- D** Is the site of exchange between embryonic and maternal blood

64. Match each embryonic structure, as numbered above, with the letter that represents its function, as listed above.

Structure:
Function: **A** **B** **C** **D**

(Record your **four-digit answer** in the numerical-response section on the answer sheet.)

Answer: 1342

SO: B3.2k
Standard: AS

Use the following information to answer the next question.

Premature infants born at 24-weeks gestation face a wide spectrum of physiological problems.

65. These problems arise because prior to the third trimester of pregnancy, fetuses
- A. have organs that are underdeveloped
 - B. have not yet begun cell specialization
 - C. depend upon amniotic fluid for oxygen
 - D. depend upon amniotic fluid for nutrients

Answer: A

SO: B3.4k, 2.1k, 3.3s
Standard: SE

Use the following information to answer the next question.

Research has shown that the interests and abilities of a female twin may be influenced by sharing the uterus with a male twin. In sets of non-identical twins with one female and one male, the females appear to have brain activity patterns that are more similar to males than to other females.

66. Which of the following hormones is **most likely** responsible for influencing the development of brain activity patterns in a female who has a male twin?
- A. FSH
 - B. Estrogen
 - C. Testosterone
 - D. Progesterone

Answer: C

SO: B3.4k, 3.3s, 3.2sts
Standard: SE

Use the following information to answer the next question.

In the late 1950s and early 1960s, the drug thalidomide was prescribed to pregnant women to combat morning sickness. Thalidomide was found to cause birth defects, such as stunted growth of the arms and legs.

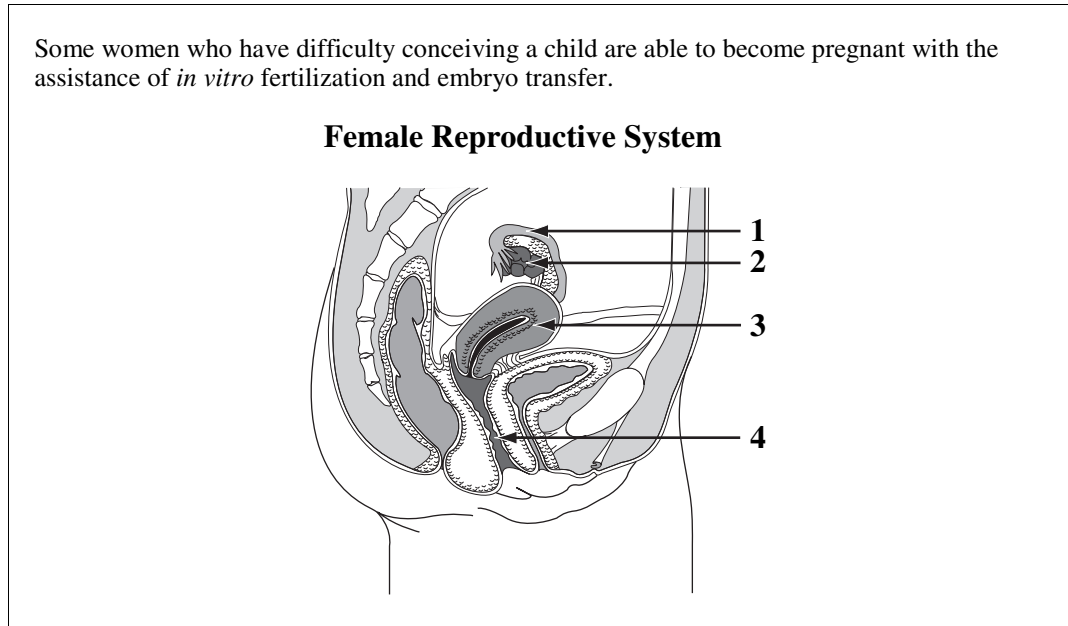
67. Which of the following rows identifies the classification of thalidomide as a factor affecting fetal development and the trimester during which exposure to thalidomide would have the **greatest** effect on a fetus?

Row	Classification	Trimester
A.	Genetic	First
B.	Environmental	First
C.	Genetic	Second
D.	Environmental	Second

Answer: B

SO: B3.5k
Standard: AS

Use the following information to answer the next three questions.



68. In the diagram above, the organ into which an embryo produced by *in vitro* fertilization is transferred is numbered

- A. 1
- B. 2
- C. 3
- D. 4

Answer: C

SO: B3.5k
Standard: AS

69. To prepare her uterus for the implantation of an embryo, a woman can be given injections of

- A. FSH and LH
- B. estrogen and LH
- C. progesterone and FSH
- D. estrogen and progesterone

Answer: D

SO: B3.5k
Standard: AS

70. Which of the following hormones would be administered to a woman following the implantation of an embryo conceived through IVF in order to maintain the pregnancy?
- A. LH
 - B. FSH
 - C. Estrogen
 - D. Progesterone
- Answer: D*

SO: B3.5k, 3.1sts, 3.2sts, 3.3s
Standard: SE

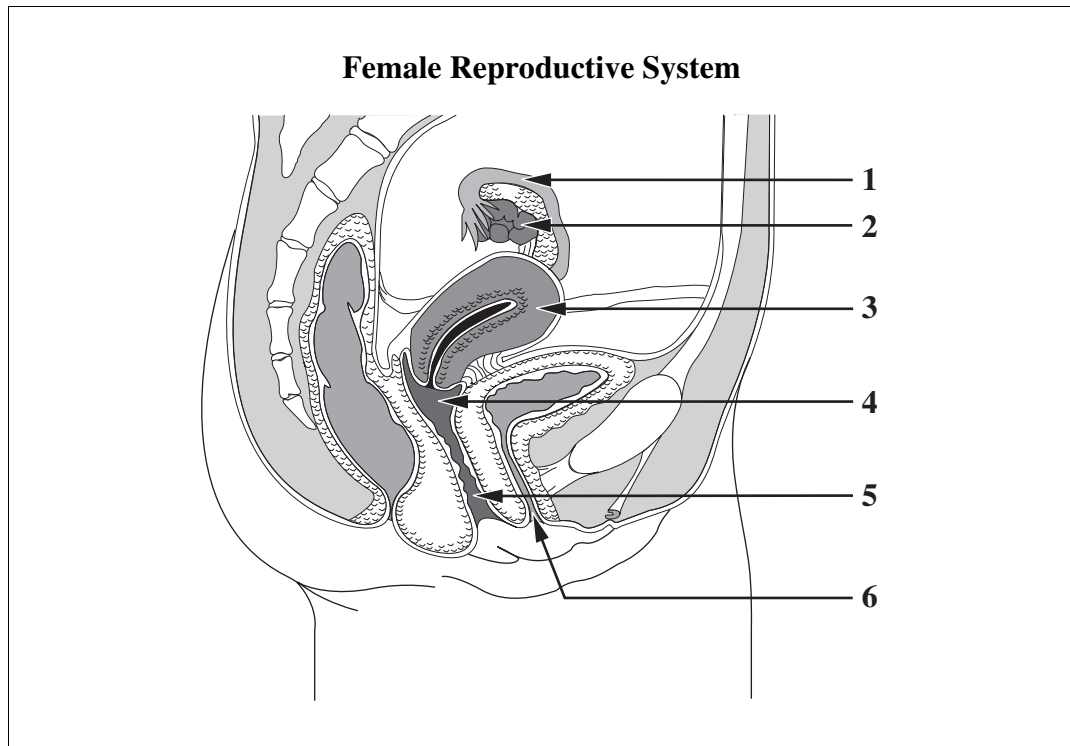
Use the following information to answer the next three questions.

A contraceptive ring for women is being tested in the Netherlands. The flexible plastic ring can be folded and inserted into the vagina. Once inserted, it springs back into shape and fits around the cervix, where it releases hormones at a constant rate for three weeks. These hormones are the same as the ones found in most oral contraceptives.

71. Like most oral contraceptives, the contraceptive ring prevents pregnancy by **directly** inhibiting
- A. ovulation
 - B. fertilization
 - C. implantation
 - D. menstruation
- Answer: A*

SO: B3.5k, 1.1k, 1.2s, 3.1sts, 3.2sts
 Standard: AS

Use the following additional information to answer the next question.



72. In the diagram above, the site of insertion of the contraceptive ring, the site where the ring is placed and secretes hormones, and the normal site of fertilization are numbered, respectively, _____, _____, and _____.

(Record all **three digits** of your answer in the numerical-response section on the answer sheet.)

Answer: 541

SO: B3.5k, 3.1sts, 3.2sts
 Standard: SE

73. Which of the following rows identifies the hormones released by the contraceptive ring and their effect on the secretion of reproductive hormones in a woman?

Row	Hormones released by the contraceptive ring	Effect on the secretion of reproductive hormones in a woman
A.	FSH and LH	Stimulate estrogen and progesterone
B.	FSH and LH	Inhibit estrogen and progesterone
C.	Estrogen and progesterone	Stimulate FSH and LH
D.	Estrogen and progesterone	Inhibit FSH and LH

Answer: D

SO: C1.1k, 1.4k
Standard: AS

74. The process that occurs to form an eight-cell embryo from a zygote is
- A. mitosis of diploid cells
 - B. mitosis of haploid cells
 - C. meiosis of diploid cells
 - D. meiosis of haploid cells
- Answer: A

SO: C1.1k, 2.5k, 1.1sts
Standard: AS

Use the following information to answer the next three questions.

Atlantic salmon (*Salmo salar*) are raised commercially in fish pens on the Pacific coast of Canada. Genetically altered Atlantic salmon have been developed for commercial use. If some of the Atlantic salmon escape their pens, hybridization could occur with native (Pacific) salmon stocks. Eventually, the original salmon stocks could disappear.

One way to address this concern is to sterilize the captive fish. Sex reversal in female salmon can be induced. Sex-reversal of a female fish produces a fish with female sex chromosomes and a male reproductive tract. Sex-reversed females can be used to produce sperm with only X chromosomes. These sperm fertilize eggs from normal females, and the fertilized eggs are then treated with heat or pressure shock to induce triploidy ($3n$). This creates a population of sterile female fish for commercial markets.

75. The sex chromosomes of the sterile female fish are
- A. XO
 - B. XX
 - C. XXY
 - D. XXX
- Answer: D

SO: C2.5k
Standard: AS

76. Male reproductive tract development in fish, as in humans, normally occurs because a
- A. Y chromosome inhibits estrogen secretion by the gonads
 - B. Y chromosome stimulates testosterone secretion by the gonads
 - C. single X chromosome inhibits estrogen secretion by the gonads
 - D. single X chromosome stimulates testosterone secretion by the gonads
- Answer: B

SO: C3.3k, 3.1sts, 3.2sts
Standard: AS

Use the following additional information to answer the next question.

Atlantic salmon have been genetically modified with the growth hormone gene from the Pacific Chinook salmon (*Oncorhynchus tshawytscha*), thereby allowing the fish to reach market size more quickly.

77. In Atlantic salmon that are genetically modified to carry the Pacific Chinook salmon gene for growth hormone, increased growth occurs after
- A. DNA is translated in the pituitary
 - B. DNA is replicated in the pancreas
 - C. mRNA is translated in the pituitary
 - D. mRNA is replicated in the pancreas

Answer: C

SO: C1.1k, 1.6k, B3.5k
Standard: AS

Use the following information to answer the next question.

Intracytoplasmic sperm injection (ICSI) is a reproductive technology in which a sperm is injected directly into an egg. This technology may be used to overcome infertility problems caused by sperm that are unable to penetrate an egg, or by sperm that lack a proper flagellum.

78. If, during the ICSI process, more than one sperm head were injected into the egg's cytoplasm,
- A. fraternal twins would be formed
 - B. identical twins would be formed
 - C. the zygote would develop into a male child since more male chromosomes would be present
 - D. the zygote would likely not develop because more than a diploid set of chromosomes would be present

Answer: D

SO: C1.2k
Standard: AS

Use the following information to answer the next four questions.

Interleukin-4 is a polypeptide that causes the body's immune system to destroy cancer cells. Researchers have genetically engineered neural stem cells of rats to produce interleukin-4. Previous studies have shown that when neural stem cells are injected into the brain, they migrate throughout it. The researchers hypothesized that the genetically engineered stem cells would carry the interleukin-4 to a brain tumour. When the genetically engineered neural stem cells were injected into rats with malignant brain tumours, the rats survived longer than untreated rats and their tumours became smaller.

- 79.** Malignant brain tumours form as a result of
- A.** abnormal mitosis
 - B.** abnormal meiosis
 - C.** a long interphase stage of the cell cycle
 - D.** a long cytokinesis stage of the cell cycle
- Answer: A*

SO: C3.5k
Standard: AS

- 80.** Compared with a rat's normal neural stem cells, genetically engineered stem cells have altered
- A.** nuclear DNA
 - B.** transfer RNA
 - C.** ribosomal RNA
 - D.** mitochondrial DNA
- Answer: A*

SO: C3.3k, 3.2sts
Standard: AS

- 81.** The organelles that are used by the genetically engineered stem cells to produce interleukin-4 are the
- A.** nucleoli
 - B.** centrioles
 - C.** ribosomes
 - D.** mitochondria
- Answer: C*

SO: C3.4k, 3.5k, 3.2sts
Standard: AS

Use the following additional information to answer the next question.

Four Technologies

- 1 Technology used to view a brain tumour
- 2 Biological tool used to cut the *interleukin-4* gene from DNA
- 3 Process of inserting the *interleukin-4* gene into the rat genome
- 4 Biological tool used to insert the *interleukin-4* gene into rat DNA

82. Match each of the technologies numbered above with its name, as given below.

Technology: _____
Name: **MRI** **Restriction enzyme** **Ligase** **Genetic engineering**

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)
Answer: 1243

SO: C1.2k
Standard: AS

Use the following information to answer the next three questions.

In the embryos of most animals, cytokinesis immediately follows mitosis and, therefore, the embryo grows as a ball of cells. However, *Drosophila* (fruit fly) embryos develop in an unusual manner. In *Drosophila*, separating membranes do not appear until after several thousand nuclei have been produced. This development trait has led researchers to use fruit fly embryos to study development.

83. In most animals, cytokinesis occurs at the end of the mitotic phase known as

- A. anaphase
- B. prophase
- C. telophase
- D. metaphase

Answer: C

SO: C3.3k
Standard: SE

Use the following additional information to answer the next two questions.

A protein called bicoid normally produced at one end of a *Drosophila* embryo diffuses in a gradient to promote head–thorax–abdomen development. If bicoid is added to the other end of the embryo, the embryo produces two heads.

84. Normally, bicoid initiates transcription to control development. The bicoid protein controls development by binding to
- A. DNA, which causes DNA to copy itself
 - B. tRNA, which causes tRNA to join amino acids
 - C. mRNA, which causes mRNA to start protein synthesis
 - D. DNA, which causes DNA to produce mRNA for a particular gene
- Answer: D

SO: C3.3s
Standard: SE

Use the following additional information to answer the next question.

In an experiment, bicoid concentrations were increased in an entire *Drosophila* embryo. This increase resulted in a head but no thorax being produced. Reducing total bicoid protein concentrations by mutating the bicoid gene resulted in no head or thorax being produced.

85. The **best** interpretation of these results is that the bicoid protein
- A. only turns on genes responsible for head development
 - B. only turns on genes responsible for thorax development
 - C. concentrations in the embryo must be the same for all cell nuclei in order for the embryo to develop normally
 - D. concentrations in the embryo must have a gradient from one end of the embryo to the other in order for the embryo to develop normally
- Answer: D

SO: C1.3k
Standard: AS

Use the following information to answer the next question.

Some Events That Occur in Various Stages of Oogenesis

- 1 DNA replication takes place.
- 2 Centromeres split; sister chromatids pull apart.
- 3 Homologous chromosomes align at the equator of the cell.
- 4 Homologous chromosomes separate; members of each chromosome pair move to opposite poles.

86. Match each of the events that occur in oogenesis numbered above with the stage at which it occurs, as given below.

Event: _____
Stage: **Interphase** **Metaphase I** **Anaphase I** **Anaphase II**

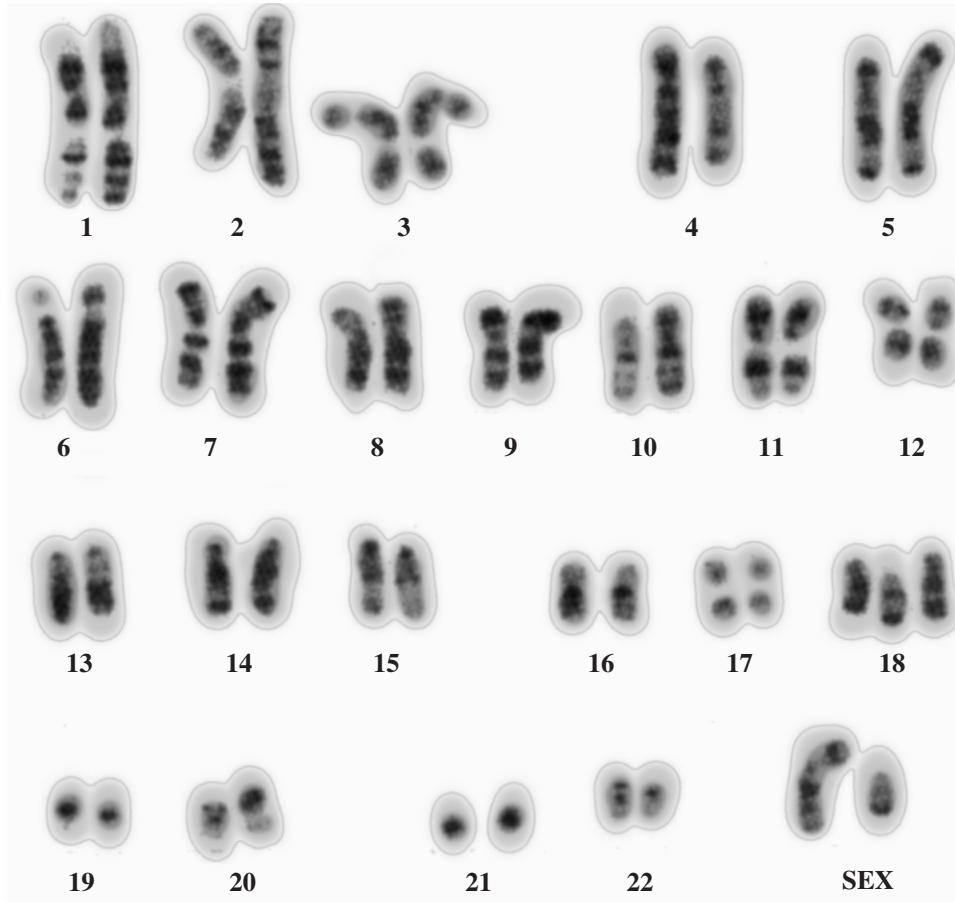
(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Answer: 1342

SO: C1.1k, 2.5k, 1.3s
 Standard: SE

Use the following information to answer the next question.

Most autosomal trisomies are lethal. The average survival age for infants with Patau syndrome (trisomy 13) is six months. Infants with Edward syndrome (trisomy 18) survive, on average, only two to four months. Individuals with Down syndrome (trisomy 21) can survive into adulthood. In order to identify autosomal trisomies, chorionic villus sampling can be used to obtain cells that are then used to create a karyotype like the one shown below.



87. The sex and the condition of the individual whose karyotype is shown above are given in row

Row	Sex	Condition
A.	Female	Patau syndrome
B.	Female	Down syndrome
C.	Male	Edward syndrome
D.	Male	Normal

Answer: C

SO: C1.3k
Standard: AS

Use the following information to answer the next question.

Geneticists have discovered that some species have X and Y chromosomes that are virtually homologous except for a sex-determining region on one of the chromosomes. Other species, including humans, have very small portions of the X and Y chromosomes that carry similar genes. Furthermore, in humans, it is the Y chromosome that contains a dominant sex-determining allele.

88. The small homologous portions of human X and Y chromosomes are important in
- A. mitosis because the chromosomes pair up and avoid segregation
 - B. meiosis because the chromosomes pair up and avoid segregation
 - C. mitosis because the chromosomes pair up and segregate properly
 - D. meiosis because the chromosomes pair up and segregate properly

Answer: D

SO: C1.1k, 1.7k
Standard: AS

Use the following information to answer the next question.

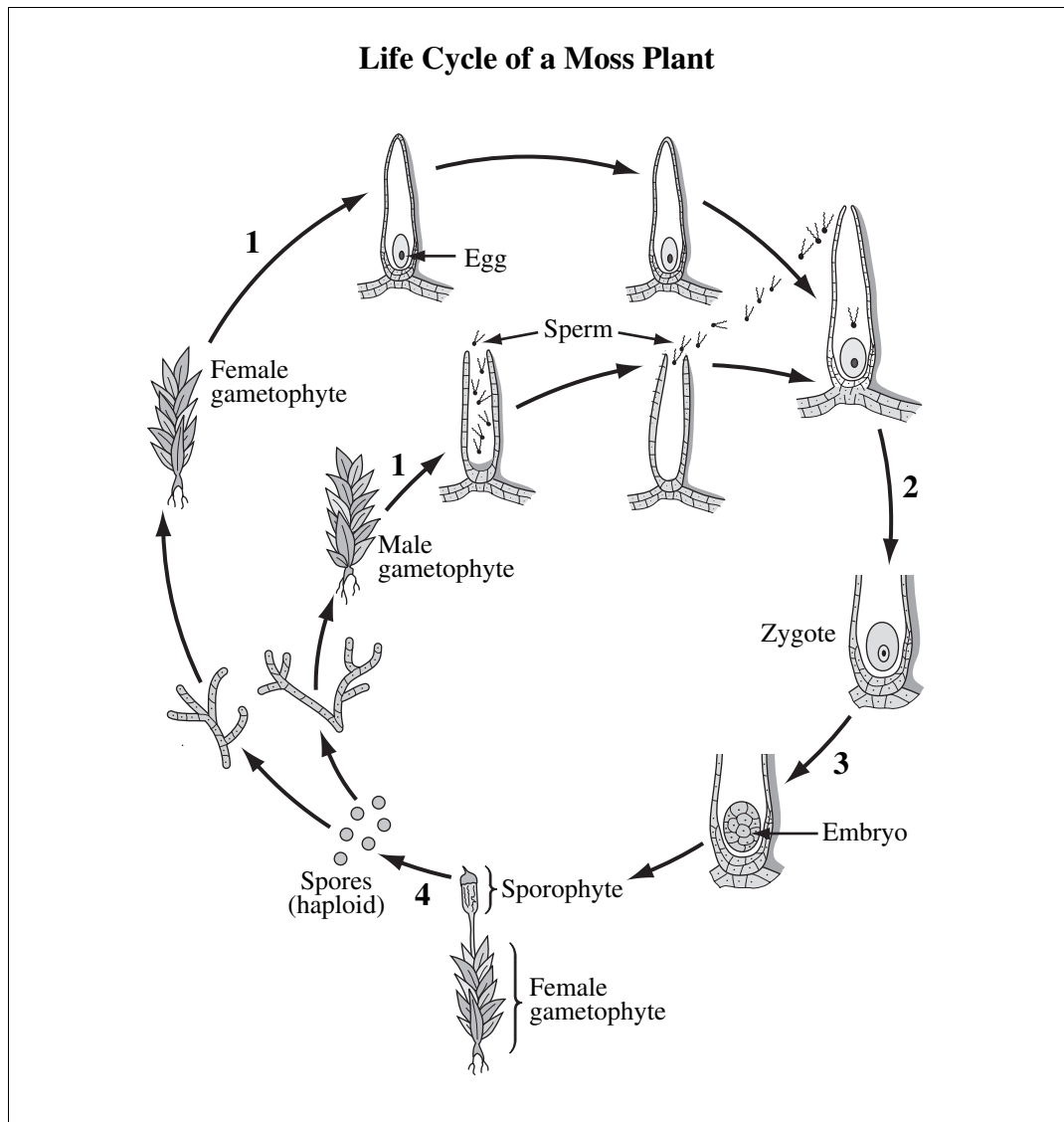
Whiptail lizards are all female, so they must reproduce by parthenogenesis. This is a type of reproduction in which females produce offspring from unfertilized eggs that have undergone chromosome doubling after meiosis. Although all whiptail lizards are females, they undergo courtship patterns similar to other types of lizards that have both sexes.

89. According to the information on whiptail lizards, the somatic cells of offspring produced from the whiptail lizard's unfertilized eggs would have a chromosome number of
- A. n
 - B. $2n$
 - C. $4n$
 - D. $n + 2$

Answer: B

SO: C1.4k, 1.7k, 1.2s
Standard: SE

Use the following diagram to answer the next two questions.



90. In the life cycle of a moss plant, genetic variation can occur during the processes represented on the diagram above by the numbers

- A. 1 and 2
- B. 2 and 3
- C. 2 and 4
- D. 3 and 4

Answer: C

SO: C1.4k, 1.7k, 1.2s
Standard: SE

- 91.** In moss plants, spores and gametes are similar in that both are
- A. diploid cells
 - B. haploid cells
 - C. produced by mitosis
 - D. produced by meiosis
- Answer: B*

SO: C2.1k
Standard: AS

- 92.** Mendel's principle of segregation states that alternate forms of a gene separate during
- A. fertilization
 - B. seed dispersal
 - C. cross-pollination
 - D. gamete formation
- Answer: D*

SO: C2.1k
Standard: AS

- 93.** An organism is heterozygous for two pairs of genes. The number of different combinations of alleles that can form for these two genes in the organism's gametes is
- A. 1
 - B. 2
 - C. 4
 - D. 8
- Answer: C*

SO: C2.1k
Standard: AS

Use the following information to answer the next two questions.

An inheritable mutation in the DNA that codes for an enzyme that breaks down a neurotransmitter in the brain has been found to be associated with abnormally aggressive behaviour. Females who are heterozygous for the mutation associated with abnormally aggressive behaviour do not have an aggressive phenotype.

94. The reason that heterozygous females do **not** express the mutation is that

- A. nondisjunction occurs
- B. gene dominance occurs
- C. gene segregation occurs
- D. independent assortment occurs

Answer: B

SO: C3.6k, 3.2s
Standard: AS

Use the following additional information to answer the next question.

The mutation associated with abnormally aggressive behaviour results in the normal codon for glutamine becoming a stop codon.

95. Which of the following mutations would change a normal codon for glutamine into a stop codon?

- A. CAA to ATT
- B. GAA to UAA
- C. GAG to UAG
- D. CAG to UAG

Answer: D

SO: C2.2k, 2.5k, 2.3s
Standard: AS

Use the following information to answer the next two questions.

Tay-Sachs disease is a hereditary disease that kills 1 in 360 000 individuals in the general population. Children who are homozygous for Tay-Sachs disease die at an early age. Genetic screening can be done to determine if an individual is a carrier of the Tay-Sachs allele.

96. What type of inheritance is demonstrated in Tay-Sachs disease?

- A.** Autosomal recessive
- B.** Autosomal dominant
- C.** Sex-linked recessive
- D.** Sex-linked dominant

Answer: A

SO: C3.2k, 3.2sts
Standard: SE

Use the following additional information to answer the next question.

Genetic screening can involve producing complementary DNA probes of a gene's alleles and determining if these bind to an individual's DNA sample.

97. Genetic screening results show that an individual is a carrier of Tay-Sachs disease if the individual's DNA binds to

- A.** none of the DNA probes
- B.** two of the normal allele DNA probes
- C.** two of the defective allele DNA probes
- D.** one of the normal allele DNA probes and one of the defective allele DNA probes

Answer: D

SO: C2.2k
Standard: SE

Use the following information to answer the next question.

The coat colour of Labrador retrievers is determined by two alleles. The black allele, B , is dominant to the brown allele, b . A second pair of alleles, E and e , affects the expression of the coat colour: the homozygous recessive condition, ee , prevents the expression of black or brown and produces a pup with a yellow coat.

Genotype	Phenotype
$B_E_$	Black
$bbE_$	Brown
$__ee$	Yellow

98. If two Labrador retrievers with the genotype $BbEe$ were to be crossed, what phenotypic ratio would be expected in their offspring?

Ratio: _____ : _____ : _____
Phenotype: **Black** **Brown** **Yellow**

(Record all **three digits** of your answer in the numerical-response section on the answer sheet.)

Answer: 934



SO: C3.7k, 3.2sts
Standard: AS

Use the following information to answer the next two questions.

A deletion mutation in mitochondrial DNA causes Kearns–Sayre syndrome (KSS). A large sample of different types of somatic cells was removed from a male with KSS, tested, and found to contain the deletion. The only type of mitochondrial DNA that was found in somatic cells from the man’s mother was mitochondrial DNA that did not have the KSS deletion.

99. A reasonable hypothesis to explain these results is that the mutation in the mitochondrial DNA that caused KSS in the man first occurred in the

- A. mother’s oocytes
- B. man’s somatic cells
- C. man’s spermatocytes
- D. mother’s somatic cells

Answer: A

SO: C3.6k, 3.7k
Standard: AS

100. Both males and females can be affected by mitochondrial mutations, but only females can transmit genetic mutations to their offspring. For this inheritance pattern, which of the following rows identifies the contributions to the zygote made by the sperm and by the egg?

Row	Sperm Contribution	Egg Contribution
A.	Nuclear contents only	Both nuclear and cytoplasmic contents
B.	Both nuclear and cytoplasmic contents	Nuclear contents only
C.	Neither nuclear nor cytoplasmic contents	Both nuclear and cytoplasmic contents
D.	Both nuclear and cytoplasmic contents	Neither nuclear nor cytoplasmic contents

Answer: A

SO: C3.7k, 3.2s
Standard: AS

Use the following information to answer the next question.

Over time, mitochondrial DNA accumulates non-lethal mutations at a constant rate. There is a higher degree of variation in mitochondrial DNA in earlier populations than in more recent populations. Scientists have taken samples of mitochondrial DNA from people living on different continents and compared the number of mitochondrial DNA mutations in these samples. They used this data as evidence to determine the order in which Earth's continents were populated.

101. In this study, the manipulated variable was the

- A.** amount of mitochondrial DNA tested
- B.** time of migration from one continent to another
- C.** amount of variation in mitochondrial DNA base sequences
- D.** geographic location of subjects whose sample of mitochondrial DNA was tested

Answer: D

SO: C2.3k
Standard: AS

Use the following information to answer the next question.

Autism is a disorder that results from abnormal brain development. Studies have shown that a mutation in the *WNT2* gene has been associated with autism in some people. Another gene, *RELN*, is also associated with autism. *WNT2* and *RELN* are linked genes.

102. *WNT2* and *RELN* are referred to as linked genes because they

- A. produce similar proteins
- B. are exchanged during meiosis
- C. have similar nucleotide sequences
- D. are located on the same chromosome

Answer: D

SO: C2.3k, 2.3s
Standard: AS

Use the following information to answer the next two questions.

The cross-over frequencies of four genes found on human chromosome 6 are shown below.

	Legend	Gene Pairs	Cross-over Frequencies
1	Diabetes mellitus	1 and 2	21%
2	Ovarian cancer	1 and 3	12%
3	Rh blood group (3)	2 and 3	9%
4	Ragweed sensitivity	2 and 4	19.5%

103. The order in which the four genes listed in the legend above are located on chromosome 6 is _____, _____, _____, and _____.

(Record your **four-digit answer** in the numerical-response section on the answer sheet.)

Answer: 1432 or 2341

SO: C2.3k, 2.3s
Standard: AS

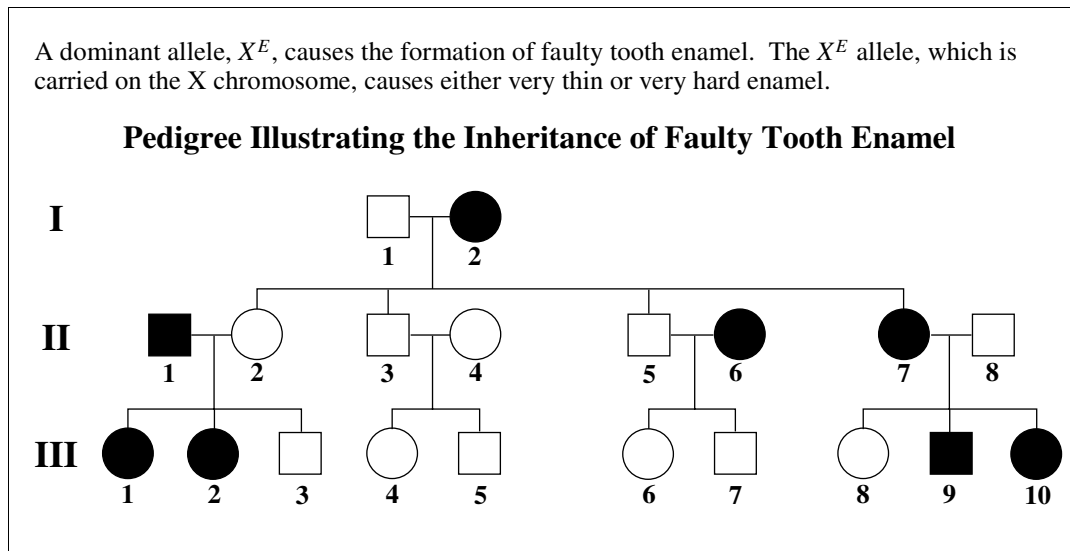
104. What is the approximate cross-over frequency between the diabetes mellitus gene and the ragweed sensitivity gene?

- A. 1.5%
- B. 10.5%
- C. 15.0%
- D. 22.5%

Answer: A

SO: C2.5k, 2.3s
 Standard: SE

Use the following information to answer the next two questions.



105. The genotypes of individuals **II-6** and **III-7** are identified in row

Row	II-6	III-7
A.	$X^E X^E$	$X^E Y$
B.	$X^E X^e$	$X^e Y$
C.	$X^e X^e$	$X^E Y$
D.	$X^E X^E$	$X^e Y$

Answer: B

SO: C2.2k, 2.5k, 2.3s
 Standard: AS

106. A woman who is heterozygous for faulty tooth enamel marries a man with normal tooth enamel. What is the probability that their first child will be a boy with normal tooth enamel?

Answer: _____

(Record your answer as a value from 0 to 1, rounded to two decimal places, in the numerical-response section on the answer sheet.)

Answer: 0.25

SO: C3.1k
Standard: AS

Use the following information to answer the next question.

In 1953, Watson and Crick developed a model of the structure of DNA. They performed no experiments themselves. Instead, they used the discoveries of other scientists and, using a trial-and-error approach, they worked out the structure as one would solve a puzzle, given a number of clues.

The following statements describe some discoveries about DNA made prior to 1953.

- 1 Chromosomes and genes are composed of DNA.
- 2 X-ray diffraction of the DNA molecule shows that it is a spiral (helix).
- 3 All of the diploid cells in a particular organism contain the same amount of DNA.
- 4 The DNA molecule is composed of deoxyribose sugar, phosphate, and four different nitrogen bases.
- 5 DNA is found mainly in the nucleus of eukaryotic cells.
- 6 Analyses of proportions of the nitrogen bases in DNA suggest that thymine pairs with adenine and guanine pairs with cytosine.

- 107.** Three discoveries that would have provided **essential clues** to Watson and Crick as they worked out the structure of DNA are given in statements _____, _____, and _____.

(Record all **three digits** of your answer in **lowest-to-highest numerical order** in the numerical-response section on the answer sheet.)

Answer: 246

SO: C3.2k
Standard: AS

108. If guanine and cytosine make up 56% of the nitrogen bases present in a DNA molecule, what percentage of the DNA's nitrogen bases are made up of adenine?

- A. 22%
- B. 25%
- C. 28%
- D. 44%

Answer: A

SO: C3.1k, 3.2k
Standard: AS

109. Which of the following rows describes a DNA molecule?

Row	Components	Backbone	Molecules that form the links between two strands
A.	Amino acids, sugars, and bases	Sugars and bases	Amino acids
B.	Amino acids, sugars, and bases	Sugars and amino acids	Bases
C.	Phosphates, sugars, and bases	Sugars and bases	Phosphates
D.	Phosphates, sugars, and bases	Sugars and phosphates	Bases

Answer: D

SO: C3.4k, 3.2s, 3.2sts
Standard: AS

110. In order to synthesize large quantities of DNA fragments and then separate them, an enzyme and a technology that can be used are, respectively,

- A. ligase and karyotyping
- B. ligase and gel electrophoresis
- C. DNA polymerase and karyotyping
- D. DNA polymerase and gel electrophoresis

Answer: D

SO: C3.5k, 3.3s, 3.2sts
Standard: SE

Use the following information to answer the next three questions.

Plant roots absorb nutrients. They also release specific proteins as a way of protecting the plant against disease. Scientists can engineer plants to produce certain proteins. Scientists select a specific gene for a protein; for example, the gene that codes for a viral protein. This gene is altered by adding two DNA sequences: a DNA sequence that will signal root cells to secrete the viral protein and a DNA sequence that activates the gene in root cells. The modified gene is then inserted into plant cells that will develop into complete plants. When plants are grown hydroponically in a nutrient solution rather than in soil, scientists can easily collect the released proteins from the solution.

- 111.** The ability of the DNA sequence to activate the gene in root cells in order to produce the viral protein is evidence that in plants,
- A.** some genes are recessive
 - B.** genes can be turned on and off
 - C.** all DNA codes for the production of proteins
 - D.** all cells that have the same DNA produce the same proteins

Answer: B

SO: C3.3k
Standard: AS

Use the following additional information to answer the next question.

Processes in Protein Synthesis in Plant Root Cells

- 1** mRNA exits the nucleus.
- 2** Amino acids are joined to form a polypeptide.
- 3** mRNA forms on a specific section of exposed DNA.
- 4** tRNA carrying a specific amino acid binds to mRNA.

- 112.** The sequence in which the processes in protein synthesis in plant root cells listed above occur is _____, _____, _____, and _____.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Answer: 3142

SO: C3.5k, 3.3s
Standard: AS

113. Viral DNA will be present in every cell of a plant if the viral DNA is inserted into a

- A. plant zygote
- B. plant root cell
- C. plant somatic cell
- D. plant's transport system

Answer: A

SO: C3.6k, 3.1sts
Standard: AS

Use the following information to answer the next two questions.

The American Wirehair cat breed was first seen in a litter of New York farm cats in 1966. Two cats that had normal coats produced a litter of kittens, one of which had whiskers and coat hair that were wire-like. The allele for this wire-like hair is dominant to the allele for normal hair.

114. The wirehaired kitten produced in the New York farm litter was the result of

- A. selective breeding
- B. a spontaneous mutation
- C. the mating of two cats that were heterozygous for the trait
- D. the mating of a cat that was homozygous recessive for the trait with a cat that was heterozygous for the trait

Answer: B

SO: C2.1k, 2.2k, 2.3s
Standard: AS

115. In order to select breeding stock for the wirehair trait, breeders try to determine which of the offspring are homozygous for the wirehair trait. To do this, they should perform a test cross of a potential breeding cat with a cat

- A. with the wirehair phenotype
- B. with a heterozygous genotype
- C. without the wirehair phenotype
- D. with a homozygous dominant genotype

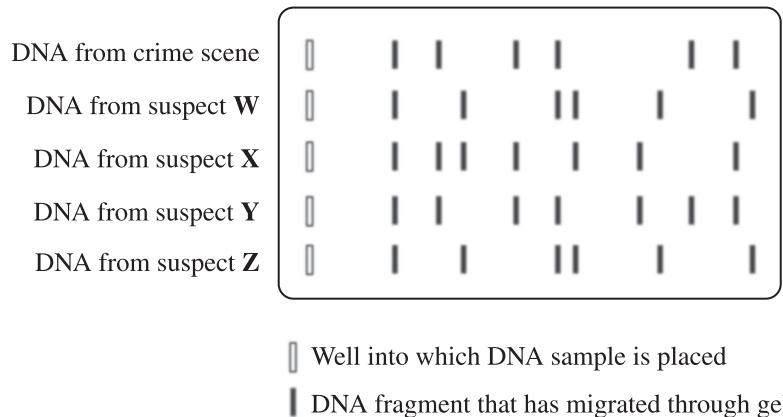
Answer: C

SO: C3.7k
Standard: SE

Use the following information to answer the next question.

In a simulated forensic investigation, five DNA samples were prepared for gel electrophoresis. Four of the samples were obtained from volunteer suspects (W, X, Y, and Z), and the fifth sample was taken from the crime scene. The DNA samples were treated with enzymes and placed into wells in a gel with electrodes at each end. When electricity was applied to the gel, the DNA fragments migrated toward the opposite end of the gel.

Electrophoresis Gel from a Simulated Forensic Investigation



116. Based on the evidence shown in the illustration of the electrophoresis gel, which of the following statements is **most probable**?

- A. Suspect W and suspect Y are closely related.
- B. Suspect W and suspect Z are identical twins.
- C. Suspect X left biological evidence at the crime scene.
- D. Suspect Y left biological evidence at the crime scene.

Answer: B

SO: C3.7k, 3.3s, 3.1sts
Standard: AS

Use the following information to answer the next question.

In the late 1980s, some molecular biologists found evidence in human genes suggesting that all people share a common female ancestor who lived in Africa about 200 000 years ago. These biologists studied DNA transmitted only through mitochondria, and they used a “molecular clock” that assumes mutations occur at a known, constant rate. Another researcher used DNA possessed and transmitted only by males to trace humans to a common male ancestor who lived 188 000 years ago.

- 117.** Which part of the human cell would the researcher have studied in order to trace the ancestry of DNA unique to males?
- A.** The X chromosome
 - B.** The Y chromosome
 - C.** RNA in the ribosomes
 - D.** DNA in the mitochondrion

Answer: B

SO: D1.1k, 1.1s, 1.1sts
Standard: AS

Use the following information to answer the next question.

Insecticides have been used to control mosquito populations in order to prevent the spread of malaria, but mosquitoes in malaria-infested areas are developing resistance to these insecticides. In addition, the antimalarial drug chloroquine, once very effective in protecting individuals against *Plasmodium*, has become ineffective, which has resulted in a resurgence of malaria.

- 118.** Some investigators have suggested that some strains of *Plasmodium* have become chloroquine-resistant because these strains have an increased ability to pump chloroquine from their bodies. Other investigators suggest that the resistance stems from changes in some strains of *Plasmodium* that prevent chloroquine from entering the parasites in the first place. These two suggestions can **best** be described as
- A. theories
 - B. hypotheses
 - C. conclusions
 - D. observations

Answer: B

SO: D1.3k, 1.3s
Standard: AS

Use the following information to answer the next question.

Cystic fibrosis (CF) is one of the most common autosomal recessive disorders. Geneticists estimate that 1 in 2 500 Caucasian newborns are affected with CF.

- 119.** The predicted frequency of the recessive allele for CF in the Caucasian population is
- A. 0.02
 - B. 0.04
 - C. 0.25
 - D. 0.33

Answer: A

SO: D1.2k, 1.1sts
Standard: SE

Use the following information to answer the next question.

Atlantic salmon (*Salmo salar*) are raised commercially in fish pens on the Pacific coast of Canada. Genetically altered Atlantic salmon have been developed for commercial use. If these fish are raised in fish pens and some escape, hybridization could occur with native (Pacific) salmon stocks. Eventually, the original salmon stocks could disappear.

Some Facts About Growth-Enhanced Genetically Modified Fish

- 1 Juvenile genetically modified fish have bright coloration.
- 2 Genetically modified fish are slower swimmers than native fish.
- 3 Sterilization techniques for genetically modified fish are not 100% reliable.
- 4 Genetically modified fish eat more than native fish and deplete food sources.
- 5 Genetically modified fish reach sexual maturity at a younger age than native fish.
- 6 Genetically modified fish have a mating advantage over native fish as a result of their larger size.
- 7 Genetically modified fish grow larger in laboratory conditions than in the natural environment.
- 8 Genetically modified fish are 30% more likely to die before reaching sexual maturity than native fish.

- 120.** Four of the facts listed above that are **most likely** to raise concerns that the native fish population might decrease if some genetically modified fish escape from their pens are _____, _____, _____, and _____.

(Record all **four digits** of your answer **from lowest-to-highest numerical order** in the numerical-response section on the answer sheet.)

Answer: 3456

SO: D2.3k
Standard: AS

Use the following information to answer the next question.

Large fishing vessels called trawlers use nets that are dragged along the seabed and often have catastrophic effects on the sea floor habitat. Prohibiting commercial fishing by trawlers could save not only the targeted fish species, but also many other marine species.

121. The recovery of the sea floor habitat after trawlers have been prohibited in a particular region is called

- A. climax succession
- B. pioneer succession
- C. primary succession
- D. secondary succession

Answer: D

SO: D1.2k
Standard: AS

Use the following information to answer the next two questions.

If no restrictions are placed on their population growth, even species that reproduce very slowly have the potential to cover Earth in a short period of time. This fact was understood by Thomas Malthus who wrote his “Essay on the Principle of Population” nearly 200 years ago. Charles Darwin also acknowledged this fact in his book *On the Origin of Species*:

As more individuals are produced than can possibly survive, there must in every case be a struggle for existence, either one individual with another of the same species, or with the individuals of distinct species, or with the physical conditions of life. It is the doctrine of Malthus applied with manifold force to the whole animal and vegetable kingdoms; for in this case there can be no artificial increase of food, and no prudential restraint from marriage. Although some species may be now increasing, more or less rapidly, in numbers, all cannot do so, for the world would not hold them.

Darwin, Charles. 1859. *The Origin of Species*. Avenel, 1979 edition: 117. Public domain.

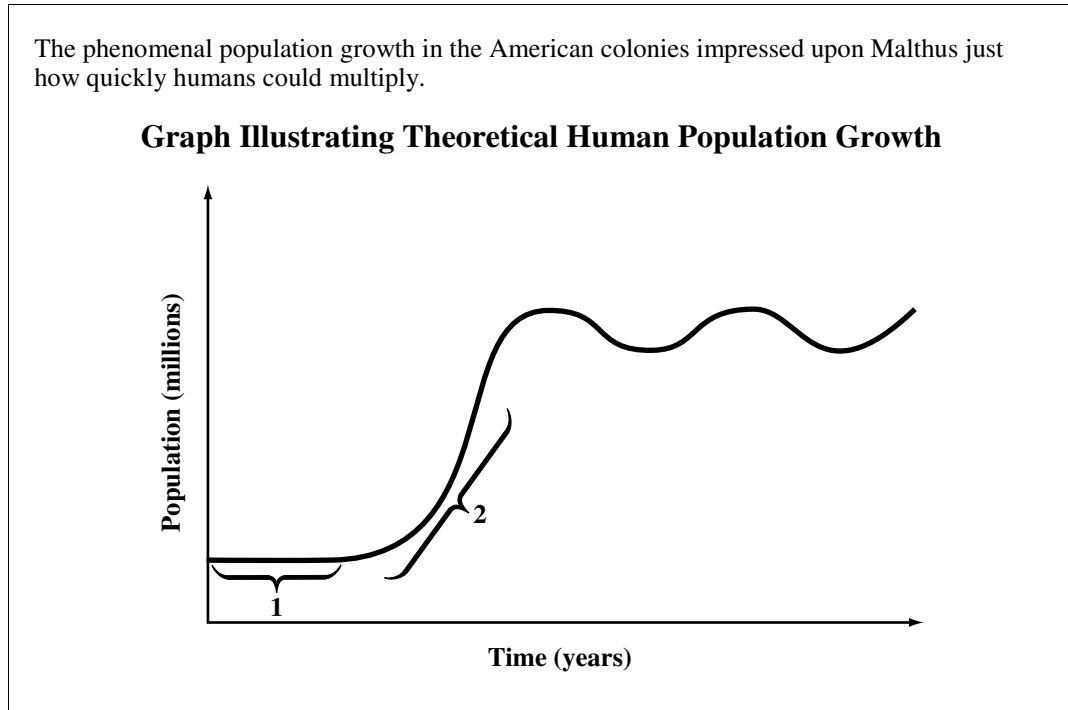
122. Darwin’s description of the struggle for existence among organisms is defined as

- A. predation
- B. mutualism
- C. competition
- D. commensalism

Answer: C

SO: D3.3k, 3.3s
Standard: AS

Use the following additional information to answer the next question.



123. Which of the following rows identifies the region of the graph above that illustrates exponential growth of a population and the type of graph illustrated?

Row	Exponential growth	Type of graph
A.	1	S-shaped
B.	1	J-shaped
C.	2	S-shaped
D.	2	J-shaped

Answer: C

SO: D1.3k, 1.3s
Standard: AS

Use the following information to answer the next two questions.

A high percentage of purebred dogs have genetic defects. Some examples of these defects follow.

- 1 Hip dysplasia, a defect in the hip joints that can cripple a dog, occurs in 60% of golden retrievers.
- 2 Hereditary deafness, due to a recessive autosomal disorder, occurs in 30% of Dalmatians.
- 3 Retinal disease, which may cause blindness, occurs in 70% of collies.
- 4 Hemophilia, an X-linked recessive disorder, is common in Labrador retrievers. Dwarfism is also common in this breed of dog.

124. What is the frequency of the abnormal allele that causes hearing defects in Dalmatians?

Answer: _____

(Record your **answer as a value from 0 to 1, rounded to two decimal places** in the numerical-response section on the answer sheet.)

Answer: 0.55

SO: D1.2k, 1.2s, 1.1sts
Standard: AS

125. The breeding of purebred dogs for certain characteristics related to appearance is blamed for the disturbing number of genetic defects in these animals. These defects are **most likely** the result of

- A. natural selection
- B. non-random mating
- C. geographic isolation
- D. high rates of mutation

Answer: B

SO: D1.4k, 1.1s, 1.1sts
Standard: SE

Use the following information to answer the next two questions.

Because insects are probably our main ecological competitors, scientists search for ways to get rid of them. Scientists have discovered that the hormone ecdysone, produced by all insects, stimulates moulting and development into adult insects. Another hormone, juvenile hormone (JH), inhibits the effect of ecdysone and maintains the insect juvenile state (pupa). Typically, insects winter as pupae and emerge as adults in spring.

126. An effective insecticide would be one that

- A. inhibits JH in the spring
- B. stimulates ecdysone in the spring
- C. maintains a high level of JH in the fall
- D. inhibits the release of ecdysone in the spring

Answer: D

SO: D1.4k, 1.3s
Standard: AS

127. Which of the following statements gives a valid prediction about the effect of the increased light in the spring on the hormones that control the emergence of an adult insect from its pupa case?

- A. The light stimulates the release of JH.
- B. The light inhibits the release of ecdysone.
- C. The light stimulates the release of ecdysone.
- D. The light inhibits the release of both ecdysone and JH.

Answer: C

SO: D2.1k
Standard: AS

Use the following information to answer the next question.

Mites (*Acaropsis woodii*) can live in the trachea of a bee. These mites obtain nutrients from bee tissue. Beekeepers worry when mite populations reach numbers that have the potential to destroy the bee colony.

128. The relationship between bees and mites is called

- A. parasitism
- B. commensalism
- C. interspecific competition
- D. intraspecific competition

Answer: A

SO: D2.1k
Standard: AS

Use the following information to answer the next four questions.

Bighorn sheep are usually found on remote, rocky cliffs in the mountains. In the winter, they graze in lower mountain pastures, and then they move to higher alpine ranges in the spring. They are able to escape predators such as mountain lions and wolves because of their well-developed abilities to climb and jump in their rocky habitat.

Bighorn ewes give birth to a single lamb after a six-month gestation. Within a day, the lamb can run and climb and follow its mother along mountain ledges.

129. In this habitat, the relationship between mountain lions and wolves is one of

- A. commensalism
- B. interdependency
- C. intraspecific competition
- D. interspecific competition

Answer: D

SO: D3.4k
Standard: AS

130. Which of the following rows identifies the reproductive strategy of the bighorn sheep and the evidence for this strategy?

Row	Reproductive Strategy	Evidence
A.	<i>K</i> selection	Long period of gestation, only one offspring produced
B.	<i>K</i> selection	Short period of gestation, offspring develops quickly
C.	<i>r</i> selection	Long period of gestation, only one offspring produced
D.	<i>r</i> selection	Short period of gestation, offspring develops quickly

Answer: A

SO: D3.2k, 3.3s
Standard: AS

Use the following additional information to answer the next two questions.

Between 1960 and 2002, the bighorn sheep population of New Mexico went from approximately 450 sheep to 130 sheep.

McCutchen, Henry E. n.d. Desert bighorn sheep. *Our Living Resources: A Report to the Nation on the Distribution, Abundance, and Health of U.S. Plants, Animals, and Ecosystems*. U.S. Department of the Interior National Biological Service. <http://biology.usgs.gov/s+t/noframe/r039.htm>.

131. What was the growth rate of the bighorn sheep population between 1960 and 2002?

Answer: – _____ sheep/yr

(Record your answer as a **value rounded to two decimal places** in the numerical-response section on the answer sheet.)

Answer: 7.62

SO: D1.1k
Standard: AS

Use the following additional information to answer the next question.

State officials in New Mexico blame the decline in the bighorn sheep population on predation by mountain lions and have responded by increasing the quota for hunting the mountain lions.



132. Which of the following conditions required for Hardy–Weinberg equilibrium in the gene pool of the mountain lion population will **initially** be affected by increased hunting?

- A. Random mating
- B. No new mutations
- C. Large population size
- D. Isolation from other populations

Answer: C

SO: D2.1k
Standard: AS

Use the following information to answer the next two questions.

The organ pipe cactus has flowers that open at night. Bats and insects pollinate these flowers. The fruit of the cactus is eaten by birds and small mammals, which scatter and distribute the fruit seeds. The coyote, in turn, feeds on the birds and small mammals.

133. Which of the following rows identifies the relationships between the organ pipe cactus and insects, and between the organ pipe cactus and small mammals?

Row	Cactus and Insects	Cactus and Small Mammals
A.	Predation	Predation
B.	Predation	Mutualism
C.	Mutualism	Mutualism
D.	Mutualism	Predation

Answer: C

SO: D1.4k, 1.3s
Standard: SE

134. The flowers of the organ pipe cactus open during the night and close during the day to avoid dehydration during the heat of the day. This adaptation of the cacti to the desert climate **most likely** occurred as a result of
- A. increased mutation rates in flowers stimulated by high temperatures
 - B. increased reproductive success of cacti with flowers that opened at night
 - C. the intense heat of the desert, which destroyed all flowers that opened during the day and caused the cacti to open its flowers at night
 - D. the reaction of the cacti to the extreme heat, which caused it to close its flowers during the day and to gradually develop the behaviour of opening its flowers at night

Answer: B

SO: D3.2k, 3.3s, 3.1sts
Standard: AS

Use the following information to answer the next three questions.

The burrowing owl is an endangered species in Canada's western provinces. Research data collected in Saskatchewan's Burrowing Owl Recovery Project indicate that the population has declined by 20% per year between 1991 and 1996. In 1996, a population estimate showed that the number of burrowing owls had declined to 800 breeding pairs.

- 135.** If the decline of the burrowing owl population continued at the same rate, how many breeding pairs would there have been in 1998?

Answer: _____ **breeding pairs**

(Record your **answer as a whole number** in the numerical-response section on the answer sheet.)

Answer: 512

SO: D2.2k
Standard: AS

Use the following additional information to answer the next question.

To obtain data on the burrowing owl population, researchers reached into the burrows to collect and count baby owls. When they did this, the researchers heard a hiss like a rattlesnake coming from the baby owls in the burrow. The owls were attempting to scare off the intruders.

- 136.** The hissing behaviour of the baby owls is an example of

- A.** mimicry
- B.** mutualism
- C.** camouflage
- D.** commensalism

Answer: A

SO: D2.1k, 2.3s
Standard: AS

Use the following additional information to answer the next question.

The burrowing owl habitat is open prairie grass. The owls live in ground squirrel holes that have been enlarged by badgers. The young owls are cared for by both parents who feed them a diet consisting of mice, moles, and insects. Other prairie predators such as the rattlesnake and kestrel (sparrow hawk) also rely upon these same food sources.

137. Which of the following rows identifies the relationship between the kestrel and the burrowing owl and the relationship between the burrowing owl and badger?

Row	Kestrel/Burrowing Owl	Burrowing Owl/Badger
A.	Predation	Mutualism
B.	Predation	Commensalism
C.	Interspecific competition	Mutualism
D.	Interspecific competition	Commensalism

Answer: D

SO: D2.3k, 2.1sts
Standard: AS

Use the following information to answer the next three questions.

In heavily populated regions of Canada, the landscape is now dominated by what scientists call “invasive” non-native species. One invasive species, the Norway maple, has a dense rooting system, reaches sexual maturity quickly, and spreads many seeds over a wide area. Another invasive species, pampas grass, relies on allies such as humans to cut out vegetative competition before it proceeds to dominate the landscape.

138. By maintaining a stronghold on the environment and preventing further environmental changes, the Norway maple could be described as

- A. a climax species
- B. a pioneer species
- C. a seral stage species
- D. an intermediate species

Answer: A

SO: D3.2k, 3.3s
Standard: AS

139. Which of the following rows identifies the two strategies that give the Norway maple a high biotic potential?

Row	Strategy 1	Strategy 2
A.	Dominates the landscape	Reaches sexual maturity early
B.	Reaches sexual maturity early	Produces many seeds
C.	Spreads seeds over a large area	Dominates the landscape
D.	Spreads seeds over a large area	Has dense rooting system

Answer: B

SO: D2.1k
Standard: AS

140. The relationship exhibited between pampas grass and other native plants is

- A.** parasitism
- B.** commensalism
- C.** interspecific competition
- D.** intraspecific competition

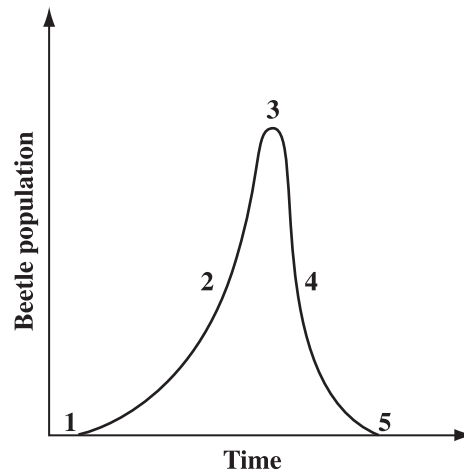
Answer: C

SO: D3.1k, 3.3s
Standard: SE

Use the following information to answer the next question.

The lodgepole pine forests of British Columbia are currently being threatened by infestations of insects called mountain pine beetles. An infested lodgepole pine becomes progressively damaged by the feeding activities of the rapidly growing beetle population in the tree. A secondary infection by fungi eventually kills the tree. Early detection of beetle-infested trees and their removal by selective logging would affect the population of both lodgepole pines and mountain pine beetles.

A Population of Mountain Pine Beetles on a Lodgepole Pine



Three Equations Representing Population Change

- A (Immigration + Natality) = (Emigration + Mortality)
- B (Immigration + Natality) < (Emigration + Mortality)
- C (Immigration + Natality) > (Emigration + Mortality)

141. Match three of the regions numbered on the graph above with the letters of the equations representing population change.

Region on Graph:
Equation: **A** **B** **C**

(Record all **three digits** of your answer in the numerical-response section on the answer sheet.)

Answer: 342

SO: D3.1k, 3.3s
Standard: AS

Use the following information to answer the next two questions.

The red-winged blackbird's adaptability has allowed it to become one of the most abundant birds in North America.

A Study of a Red-Winged Blackbird Nesting Site

The initial population of red-winged blackbirds was 208.

	End of Year 1	End of Year 2
Births	22	43
Deaths	4	7
Birds entering area	0	2
Birds leaving area	2	5

- 142.** A conclusion about this nesting site study is that the red-winged blackbird population increased because
- A.** natality plus immigration exceeded mortality plus emigration
 - B.** mortality plus emigration exceeded natality plus immigration
 - C.** natality plus emigration exceeded mortality plus immigration
 - D.** mortality plus immigration exceeded natality plus emigration

Answer: A

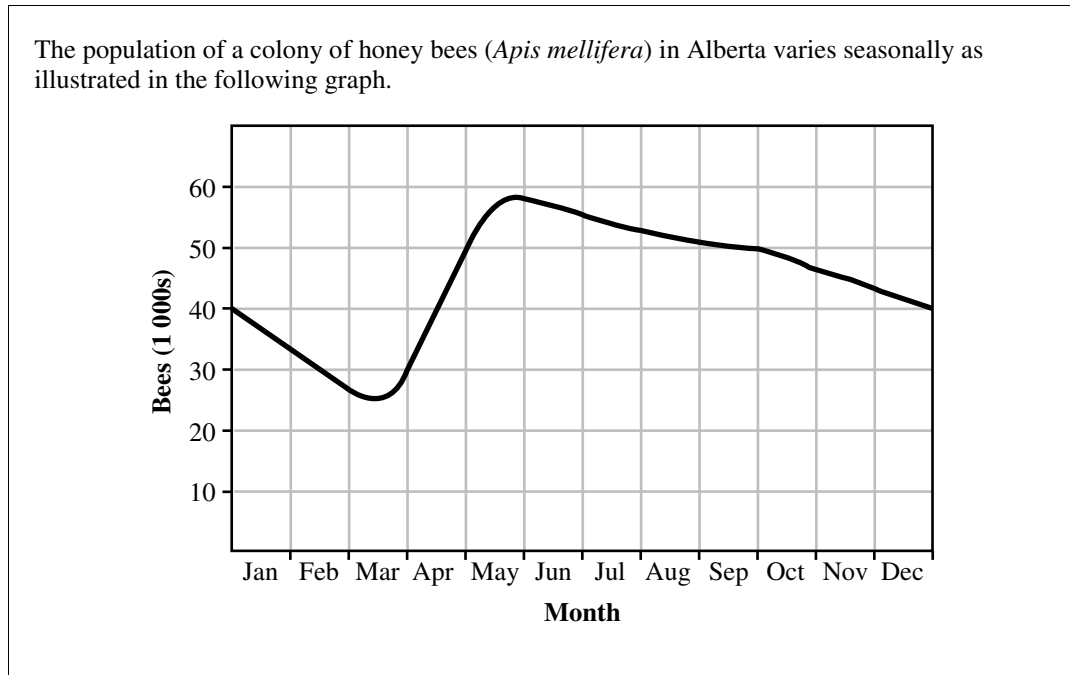
SO: D2.1k
Standard: AS

- 143.** Gause's principle states that when two different populations occupy the same ecological niche, one of the populations will be eliminated. Both the mallard duck and the red-winged blackbird occupy wetland areas. The duck and the red-winged blackbird can live in the same habitat because there is
- A.** little intraspecific competition for food and breeding areas
 - B.** little interspecific competition for food and breeding areas
 - C.** significant intraspecific competition for food and breeding areas
 - D.** significant interspecific competition for food and breeding areas

Answer: B

SO: D3.3s
Standard: SE

Use the following information to answer the next question.



144. The portion of the graph for April **most likely** indicates the effect of
- A. an increase in parasitism
 - B. a decrease in competition
 - C. a decrease in limiting factors
 - D. an increase in environmental resistance

Answer: C

SO: D3.2k, 3.3s
Standard: AS

Use the following information to answer the next two questions.

A team of scientists recommends moving grizzly bears into the North Cascades area of British Columbia in order to save the resident population, which has been classified as threatened. The grizzly population in the North Cascades was estimated to be only 23 bears in 2001. The goal of the recovery plan is to increase the number of grizzlies in the 9 810 km² area to 150 bears by 2050.

—based on “Recovery Plan for Grizzly Bears in the North Cascades of British Columbia,” 2001



North Cascades Grizzly Bear Recovery Team. 2001. *Recovery Plan for Grizzly Bears in the North Cascades of British Columbia*. Ministry of Environment, Government of British Columbia.
http://wlapwww.gov.bc.ca/wld/documents/recovery/ncgbrt_final.pdf (accessed November 20, 2006).

- 145.** In the North Cascades of British Columbia in 2001, what was the density of the grizzly bear population per 1 000 square kilometres?

Answer: _____ grizzly bears/1 000 km²

(Record your answer **as a value rounded to two decimal places** in the numerical-response section on the answer sheet.)

Answer: 2.34

SO: D3.2k, 3.3s
Standard: AS

- 146.** What is the projected per capita growth rate of the grizzly bear population in the North Cascades of British Columbia from 2001 to 2050?

Answer: _____

(Record your answer **as a value rounded to two decimal places** in the numerical-response section on the answer sheet.)

Answer: 5.52

SO: D3.2k, 3.3s
Standard: AS

Use the following information to answer the next question.

In 1999, an endangered population of 35 adult kakapo parrots inhabited Codfish Island, a small island off the coast of New Zealand. This species of flightless birds became endangered following the arrival of humans and the introduction of new predatory species such as rats.

- 147.** In 1999, 8 eggs hatched but only 6 kakapo chicks survived the season. No adult parrots died. What was the per capita growth rate for that year?

Answer: _____

(Record your **answer rounded to two decimal places** in the numerical-response section on the answer sheet.)

Answer: 0.17

SO: D3.2k
Standard: AS

Use the following information to answer the next question.

The Sonoran Desert in the southwestern United States has unique climatic conditions. It has a warmer average temperature, less frequent frosts, and more rainfall than other deserts. This unique climate results in more diversity in the organisms that occupy this particular desert.

- 148.** The factors that contribute most to the relatively great diversity of organisms in the Sonoran Desert as compared with that in other deserts are
- A.** biotic factors that increase the biotic potential
 - B.** abiotic factors that reduce reproductive isolation
 - C.** abiotic factors that reduce environmental resistance
 - D.** biotic factors that increase the carrying capacity of the area

Answer: C

SO: D3.2k, 3.3k, 3.3s, 3.1sts
Standard: AS

Use the following information to answer the next question.

The human population is not expected to level off until after it passes the 10 billion mark, which will occur sometime in the middle of the 21st century. This prediction is partially based on the fact that the population growth rate has slowed down as a result of the increased use of birth control and death from diseases such as AIDS.

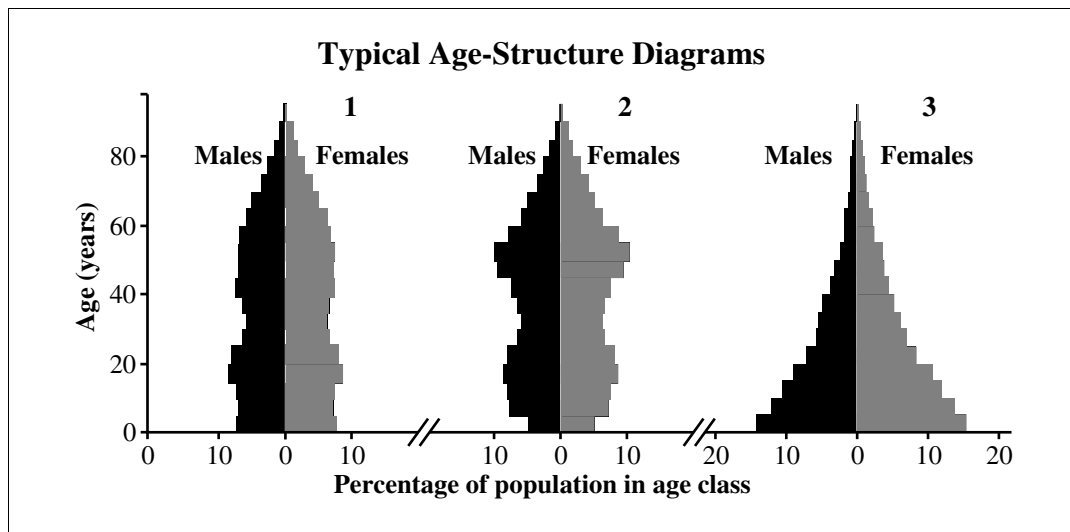
149. The term that describes the expected levelling off of the human population is

- A. J-shaped curve
- B. biotic potential
- C. carrying capacity
- D. population density

Answer: C

SO: D3.3k, 3.3s
Standard: SE

Use the following information to answer the next question.



150. At the end of the 20th century, Mexico's population could have been described as expanding, Sweden's as stabilized, and Canada's as declining. Match each of the diagrams numbered above with the country named below that the diagram could represent.

Diagram: _____
Country: Mexico Sweden Canada

(Record all **three digits** of your answer in the numerical-response section on the answer sheet.)
Answer: 312

SO: D3.3k, 3.1sts
Standard: AS

Use the following information to answer the next four questions.

In Canada, to manage the harvest of fish, government departments issue quotas based on population estimates. Problems in salmon and cod fisheries have drawn attention to problems in the calculation of the estimates. Quotas based on these estimates have led to overharvesting and have driven the cod fishery into collapse.

- 151.** The carrying capacity for northern cod in Canada's Atlantic region may be described as the
- A.** harvest quota that permits sustainable yield
 - B.** harvest quota that matches the natural mortality of the cod
 - C.** decline on a growth curve that shows the population size dropping
 - D.** plateau on a growth curve that shows the population size has reached a limit
- Answer: D*

SO: D3.1k, 3.3s, 3.1sts
Standard: AS

- 152.** The Atlantic cod moratorium is a government-enforced period of no fishing. Which of the following measures would be most useful when predicting the size of the cod population in the future?
- A.** Cod lifespan and natality rate
 - B.** Cod biotic potential and future fishing quotas
 - C.** Migration patterns and predator population size
 - D.** Present population size and present population growth rate
- Answer: D*

SO: D3.4k, 3.1sts
Standard: AS

Use the following additional information to answer the next two questions.

Fisheries' quotas could have been set too high because government regulators expected cod stocks to grow rapidly after harvest.

- 153.** An assumption made by regulators that led them to this expectation could have been that cod
- A.** have low fecundity and high mortality
 - B.** are relatively *r*-selected with a high biotic potential
 - C.** have high competition and density-independent natality
 - D.** are relatively *K*-selected in regions of high environmental resistance
- Answer: B*

SO: D1.2k, 1.2sts
Standard: SE

Use the following additional information to answer the next question.

Terms and Descriptions Related to Populations		
Term	Effect of Small Population	Result of Rebuilt Population
1 Carrying capacity	4 Increased mutation rate	7 Hardy–Weinberg equilibrium
2 Biotic potential	5 Chance loss of genes	8 Secondary succession to a different climax community
3 Genetic drift	6 Increased intraspecific competition	9 Reduced genetic variability

- 154.** Drastic reduction of a population raises the concern that a recovered population may show significant differences from the original population. Identify the term, effect, and result, as numbered above, that describe this concern.

Answer: _____
Term **Effect** **Result**

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)
Answer: 359

SO: D3.4k, 3.3s
Standard: AS

Use the following information to answer the next three questions.

Komodo Island National Park is one of the last refuges of the Komodo dragon lizard. It is estimated that there are 3 500 Komodo dragons living in the 520 km² park.

Characteristics of Komodo Dragons

- 1 Classified as reptiles
- 2 Can live up to 30 years
- 3 Females mate once a year
- 4 Sexually mature at about six years of age
- 5 Females lay between 20 and 30 eggs per year
- 6 The young live in trees until they are one year old
- 7 Over three metres in length and weigh up to 70 kg
- 8 Adult Komodo dragons will eat young Komodo dragons

- 155.** Four characteristics of Komodo dragons that allow scientists to classify them as relatively *K*-selected strategists are _____, _____, _____, and _____.

(Record all **four digits** of your answer **in lowest-to-highest numerical order** in the numerical-response section on the answer sheet.)

Answer: 2347

SO: D3.2k, 3.3s
Standard: AS

- 156.** What is the population density of Komodo dragons in Komodo Island National Park?

Answer: _____ dragons/km²

(Round and record your **answer to two decimal places** in the numerical-response section on the answer sheet.)

Answer: 6.73

SO: D2.1k, 2.3s
Standard: AS

Use the following additional information to answer the next question.

Komodo dragons have up to 50 strains of bacteria living on the meat stuck between their teeth. If a deer that has been bitten by a Komodo dragon manages to escape, it will die within a week as a result of bacterial infection. Komodo dragons can then feast on the dead deer. The Komodo dragons themselves are resistant to bacterial infection.

157. Which of the following rows identifies the relationship between the Komodo dragon and bacteria and the relationship between the deer and bacteria?

Row	Komodo Dragon and Bacteria	Deer and Bacteria
A.	Mutualism	Predation
B.	Parasitism	Predation
C.	Mutualism	Parasitism
D.	Parasitism	Parasitism

Answer: C