ANIMAL SCIENCE REVIEWER BASED ON TOS (MODULE B: ANATOMY & PHYSIOLOGY OF FARM ANIMALS) BY AGRICULTURE REVIEW

50 Multiple-Choice Practice Questions with Detailed Answer Key

Part I: Practice Examination Questions

1. When a meat inspector splits a porcine carcass lengthwise along the exact midline to produce two symmetrical left and right halves, the cut follows which anatomical plane?

- **a.** Transverse plane
- **b.** Median plane
- **c.** Frontal plane
- **d.** Horizontal plane

2. While examining the forelimb of a lame horse, a veterinarian locates a swelling at the fetlock joint relative to the carpal joint. Which directional term accurately describes the position of the fetlock in relation to the carpus?

- **a.** Proximal
- **b.** Cranial
- **c.** Distal
- **d.** Dorsal

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3. When plasma glucose drops below normal levels in a fasted ruminant, pancreatic alpha cells trigger hepatic glucose release until normoglycemia is restored and secretion halts. This coordinated self-regulating loop exemplifies which physiological mechanism?

- **a.** Negative feedback control
- **b.** Positive feedback amplification
- **c.** Feedforward anticipation
- **d.** Allostatic overload

4. Which physiological process in farm mammals operates through a positive feedback loop where the effector response continuously intensifies the initial stimulus until a culminating event ends the cycle?

- **a.** Regulation of blood osmolarity during dehydration
- **b.** Maintenance of core body temperature in cold weather
- **c.** Oxytocin-mediated uterine contractions during parturition
- **d.** Adjustment of arterial blood pressure via baroreceptors

5. Under intense tropical solar radiation, Brahman cattle maintain lower rectal temperatures than temperate European breeds partly because their prominent dewlap and loose skin folds perform which physiological function?

- **a.** Store subcutaneous adipose tissue for metabolic water generation
- **b.** Increase body surface area relative to mass to enhance heat dissipation
- **c.** Trap a thick insulating layer of air against the thoracic wall
- **d.** House dense clusters of apocrine sweat glands absent in European breeds

6. Removal or blockage of the uropygial gland located dorsally at the base of the tail in waterfowl primarily compromises which physiological capability?

- **a.** Thermoregulatory panting during summer heat waves
- **b.** Waterproofing and conditioning of plumage to preserve insulation and buoyancy
- **c.** Secretion of pheromones required for flock hierarchy
- **d.** Synthesis of vitamin D precursors from ultraviolet light

7. In mature laying hens housed in warm tropical poultry barns, the highly vascularized comb and wattles serve an important non-reproductive physiological role by facilitating which process?

- **a.** Direct absorption of atmospheric moisture to prevent dehydration
- **b.** Sensible heat loss through cutaneous vasodilation and convective airflow
- **c.** Production of evaporative sweat droplets across the head
- **d.** Storage of excess dietary calcium during shell formation

8. During vigorous galloping in horses, repeated compression of the frog and digital cushion inside the hoof capsule provides which essential physiological benefit to the lower limb?

- **a.** Pumps venous blood upward against gravity back toward the heart
- **b.** Secretes synovial fluid directly into the coffin joint
- **c.** Generates friction heat to prevent freezing of the phalanges
- **d.** Increases arterial blood viscosity to prevent hoof hemorrhage

9. When fitting a draft animal with a pulling harness, the structural support that bears mechanical tension and serves as the anchor point for the nuchal ligament corresponds to which external anatomical region?

- **a.** Brisket
- **b.** Croup
- **c.** Withers
- **d.** Poll

10. When a flock of grazing sheep is abruptly chased by a stray dog, widespread activation of the sympathetic division of the autonomic nervous system prepares the animals for escape by inducing which combination of responses?

- **a.** Bronchoconstriction, increased ruminal motility, and slowed heart rate
- **b.** Bronchodilation, accelerated heart rate, and inhibition of digestive motility
- **c.** Pupillary constriction, increased salivation, and peripheral vasodilation
- **d.** Decreased blood glucose, enhanced pancreatic secretion, and lowered blood pressure

11. In large livestock with long peripheral nerves extending to the limbs, how does the presence of myelin sheaths interrupted by nodes of Ranvier enhance neuromuscular coordination?

- **a.** Allows action potentials to jump between unmyelinated gaps to maximize conduction velocity
- **b.** Prevents sodium ions from entering the axon during depolarization
- **c.** Converts electrical impulses directly into hormonal signals along the axon
- **d.** Eliminates the need for neurotransmitter release at the neuromuscular junction

12. When a growing pig accidentally brushes its snout against an active electric fence, its head jerks backward before conscious pain is perceived because the immediate motor command is coordinated within which structure?

- **a.** Cerebral cortex
- **b.** Spinal cord
- **c.** Cerebellum
- **d.** Hypothalamus

13. A newborn calf suffering from congenital cerebellar hypoplasia following prenatal viral infection will most characteristically display which functional deficit?

- **a.** Complete loss of visual acuity and pupillary light reflex
- **b.** Inability to regulate body temperature and thirst
- **c.** Severe tremors, wide-based stance, and loss of muscular coordination
- **d.** Absence of voluntary respiration and cardiac pacemaker activity

14. Which region of the diencephalon functions as the master neuroendocrine integrator that converts external environmental inputs such as ambient temperature and day length into pituitary-regulating signals?

- **a.** Medulla oblongata
- **b.** Pons
- **c.** Hypothalamus
- **d.** Corpus callosum

15. While a dairy cow rests quietly and ruminates after morning feeding, heightened parasympathetic outflow through the vagus nerve drives which physiological effect?

- **a.** Stimulation of forestomach contractions, salivary flow, and reduced heart rate
- **b.** Rapid hepatic glycogenolysis and splenic contraction
- **c.** Dilation of bronchial airways and skeletal muscle arterioles
- **d.** Suppression of gastric acid secretion and intestinal peristalsis

16. Shortly after calving, a high-yielding Holstein cow experiences a sudden drop in blood calcium concentration. To restore normocalcemia, increased secretion of parathyroid hormone triggers which physiological response?

- **a.** Inhibition of bone resorption and increased urinary calcium excretion
- **b.** Stimulation of osteoclast activity in bone and enhanced renal calcium reabsorption
- **c.** Rapid deposition of calcium salts into the skeletal matrix
- **d.** Suppression of vitamin D activation in the renal tubules

17. Following the digestion and absorption of a high-corn ration in finishing swine, rising blood glucose concentration stimulates pancreatic beta cells to release insulin, which drives which metabolic shift?

- **a.** Mobilization of adipose triglycerides and hepatic gluconeogenesis
- **b.** Cellular uptake of glucose by muscle and adipose tissues and glycogen synthesis
- **c.** Breakdown of skeletal muscle protein into circulating amino acids
- **d.** Conversion of liver glycogen into free glucose for bloodstream release

18. During nursing in swine, vigorous massaging of the mammary glands by piglets initiates a neural reflex that causes oxytocin to enter the bloodstream from which endocrine structure?

- **a.** Anterior pituitary gland
- **b.** Adrenal medulla
- **c.** Posterior pituitary gland
- **d.** Pineal gland

19. When outdoor-housed beef cattle endure several weeks of cold winter temperatures, sustained elevation of circulating thyroxine and triiodothyronine supports survival primarily by inducing which adjustment?

- **a.** Increasing cellular oxygen consumption and basal metabolic heat production
- **b.** Decreasing appetite to conserve gastrointestinal energy
- **c.** Stimulating cutaneous sweating to insulate the hair coat
- **d.** Lowering cardiac output to reduce peripheral circulation

20. Prolonged crowding and long-distance transport of feeder steers elevate blood cortisol secreted by the adrenal cortex, resulting in which characteristic pair of physiological effects?

- **a.** Enhanced antibody production and rapid muscle protein accretion
- **b.** Elevated blood glucose via gluconeogenesis and suppression of immune defenses
- **c.** Decreased lipolysis and marked hypoglycemia
- **d.** Increased sodium excretion and lowered arterial blood pressure

21. In seasonally polyestrous sheep adapted to temperate latitudes, decreasing day lengths in autumn initiate the breeding season because prolonged darkness increases nocturnal secretion of melatonin from which organ?

- **a.** Thyroid gland
- **b.** Thymus gland
- **c.** Pineal gland
- **d.** Anterior pituitary gland

22. If fertilization fails to occur in a cycling cow, structural and functional regression of the corpus luteum around day 17 of the estrous cycle is initiated by prostaglandin F2 alpha released from which tissue?

- **a.** Uterine endometrium
- **b.** Ovarian granulosa cells
- **c.** Hypothalamic nuclei
- **d.** Cervical mucosa

23. During necropsy of a healthy steer, the myocardium of the left ventricular wall appears nearly three times thicker than that of the right ventricular wall. This morphological difference reflects which functional requirement?

- **a.** The left ventricle must hold a substantially larger volume of blood per beat
- **b.** The left ventricle generates far greater pressure to pump blood through the entire systemic circuit
- **c.** The left ventricle receives high-pressure venous blood directly from the vena cava
- **d.** The left ventricle must overcome the high vascular resistance of the pulmonary capillaries

24. In the mammalian heart, the spontaneous rhythmic electrical impulse that initiates atrial contraction and establishes the intrinsic cardiac pace originates in which specialized tissue?

- **a.** Purkinje fibers
- **b.** Atrioventricular bundle
- **c.** Sinoatrial node
- **d.** Mitral valve annulus

25. Following venous return into the right side of the heart in a pig, deoxygenated blood is propelled out of the right ventricle toward the lungs through which major vessel?

- **a.** Pulmonary vein
- **b.** Pulmonary artery
- **c.** Thoracic aorta
- **d.** Caudal vena cava

26. When comparing blood smears under a microscope from a broiler chicken and a dairy cow, how do mature avian erythrocytes structurally differ from those of cattle?

- **a.** Avian erythrocytes are elliptical and retain a distinct nucleus
- **b.** Avian erythrocytes lack hemoglobin and transport oxygen dissolved in plasma
- **c.** Avian erythrocytes are smaller, spherical, and completely anucleated
- **d.** Avian erythrocytes contain multiple lobed nuclei similar to neutrophils

27. When cattle are relocated from sea-level pastures to high-elevation mountain grazing areas with reduced atmospheric oxygen partial pressure, renal erythropoietin release induces which compensatory hematological response?

- **a.** Accelerated differentiation and release of erythrocytes from red bone marrow
- **b.** Rapid breakdown of old platelets to expand plasma volume
- **c.** Conversion of lymphocytes into oxygen-carrying monocytes
- **d.** Shrinkage of splenic sinusoids to reduce circulating blood volume

28. Water-soluble nutrients such as glucose and amino acids absorbed across the small intestinal mucosa of swine are delivered directly to the liver for metabolic processing and detoxification via which blood vessel?

- **a.** Hepatic artery
- **b.** Caudal vena cava
- **c.** Hepatic portal vein
- **d.** Thoracic lymphatic duct

29. Because poultry lack a muscular diaphragm separating the thoracic and abdominal cavities, how do broiler chickens generate the pressure gradient needed to draw air into their respiratory tract during inspiration?

- **a.** Contraction of smooth muscle rings embedded inside the air sacs
- **b.** Outward movement of the ribs and downward swing of the sternum expanding the thoracoabdominal cavity
- **c.** Peristaltic pumping of the trachea and syrinx
- **d.** Direct compression of the rigid lungs by the pectoral flight muscles

30. In the avian respiratory system, unidirectional airflow passes through rigid lungs where actual diffusion of oxygen and carbon dioxide between inspired air and blood capillaries takes place exclusively in which structures?

- **a.** Abdominal and thoracic air sacs
- **b.** Parabronchi and air capillaries
- **c.** Blind-ending alveolar sacs
- **d.** Syrinx and primary bronchi

31. Premature newborn foals occasionally suffer severe respiratory distress shortly after birth if their lungs produce insufficient pulmonary surfactant. What is the critical physiological role of this substance?

- **a.** Stimulates the phrenic nerve to initiate diaphragmatic contraction
- **b.** Reduces surface tension within alveoli to prevent alveolar collapse during expiration
- **c.** Binds carbon dioxide in alveolar air to speed exhalation
- **d.** Lubricates the pleural membranes to eliminate chest wall friction

32. During strenuous racing in Thoroughbred horses, the accumulation of carbon dioxide and lactic acid in active skeletal muscle capillaries enhances oxygen supply to working fibers through which biochemical shift?

- **a.** Increasing hemoglobin affinity for oxygen to retain more gas in the blood
- **b.** Decreasing hemoglobin affinity for oxygen so oxygen dissociates more readily into tissues
- **c.** Converting dissolved oxygen directly into bicarbonate ions
- **d.** Blocking myoglobin from binding oxygen inside muscle cells

33. During prolonged summer heat waves, laying hens frequently produce thin-shelled and soft-shelled eggs primarily because rapid, sustained panting disrupts blood chemistry in which manner?

a. Excessive carbon dioxide exhalation causes respiratory alkalosis that lowers blood bicarbonate needed for shell calcification

b. Retention of carbon dioxide causes metabolic acidosis that dissolves ovarian follicles

c. Elevated blood oxygen levels inhibit intestinal absorption of dietary phosphorus

d. Increased evaporation directly dehydrates the shell gland epithelium

34. When goats grazing in dry pastures experience water restriction and rising plasma osmolarity, antidiuretic hormone minimizes urinary water loss by acting specifically on which renal structures?

a. Dilating the afferent arterioles to increase glomerular filtration

b. Increasing water permeability of the distal convoluted tubules and collecting ducts

c. Blocking active sodium transport across the proximal convoluted tubule

d. Inhibiting urea synthesis in the renal cortex

35. Under normal healthy conditions in cattle, the glomerular filtrate entering Bowman's capsule contains water, electrolytes, and glucose, yet lacks plasma proteins such as albumin primarily due to which structural barrier?

a. Active secretion of proteins back into the efferent arteriole

b. Size selectivity and negative electrical charge of the glomerular filtration membrane

c. Complete enzymatic digestion of proteins inside the renal artery

d. Immediate reabsorption of intact proteins by the loop of Henle

36. Desert-adapted sheep can excrete highly concentrated urine during drought because the anatomical arrangement of the loop of Henle creates which physiological condition within the renal medulla?

a. A steep osmotic concentration gradient established by countercurrent multiplication

b. A uniform hypotonic interstitial fluid surrounding the collecting ducts

c. High hydrostatic pressure that forces water out of the renal pelvis

d. Complete cessation of glomerular filtration in juxtamedullary nephrons

37. Compared to swine and cattle, poultry require far less water to eliminate nitrogenous waste from protein catabolism because their kidneys excrete nitrogen predominantly in which form?

a. Highly soluble urea dissolved in dilute urine

b. Free ammonia diffused directly across the cloacal wall

c. Sparingly soluble uric acid precipitated as a semi-solid white paste

d. Creatinine crystals stored inside a muscular urinary bladder

38. Following severe blood loss or dehydration in a steer, activation of the renin-angiotensin-aldosterone system stimulates the adrenal cortex to release aldosterone, which restores blood volume by promoting which tubular action?

a. Sodium reabsorption and potassium excretion in the distal tubules and collecting ducts
b. Direct excretion of sodium and chloride into the renal pelvis
c. Glucose secretion into the proximal convoluted tubules
d. Vasodilation of systemic arterioles to lower peripheral resistance

39. In bulls and rams, the intricate venous network known as the pampiniform plexus wraps closely around the coiled testicular artery to perform which vital thermoregulatory role for spermatogenesis?

a. Warms arterial blood to core abdominal temperature before it reaches the seminiferous tubules
b. Operates as a countercurrent heat exchanger that cools incoming arterial blood below body temperature
c. Shunts blood away from the testes during the breeding season
d. Synthesizes testosterone directly from venous cholesterol

40. Spermatozoa freshly released from the seminiferous tubules of a boar are immotile and incapable of fertilizing an oocyte until they transit through which ductal structure to acquire progressive motility and fertilizing capacity?

a. Vas deferens
b. Epididymis
c. Seminal vesicle
d. Bulbourethral gland

41. Following artificial insemination in a cow at the proper stage of estrus, the union of a capacitated spermatozoon with the ovulated oocyte normally takes place in which specific segment of the reproductive tract?

a. Uterine body
b. Cervical rings
c. Ampullary-isthmic junction of the oviduct
d. Infundibular fimbriae

42. As an ovulated yolk descends through the functional left oviduct of a laying hen, which elongated glandular segment secretes the dense and thin layers of albumen around the yolk?

a. Infundibulum
b. Magnum
c. Isthmus
d. Vagina

43. During the 24- to 26-hour egg formation cycle in chickens, the developing egg spends approximately 18 to 20 hours undergoing water plumping and calcium carbonate deposition inside which oviductal region?

- **a.** Magnum
- **b.** Isthmus
- **c.** Uterus
- **d.** Infundibulum

44. In female farm mammals approaching the end of estrus, final maturation and rupture of the dominant Graafian follicle to release the ovum are directly triggered by a preovulatory surge of which hormone?

- **a.** Progesterone
- **b.** Luteinizing hormone
- **c.** Prolactin
- **d.** Inhibin

45. A bilateral cryptorchid boar whose testes remain retained inside the abdominal cavity is typically infertile yet continues to display aggressive masculine behavior and libido. Why does this physiological paradox occur?

- **a.** Elevated abdominal temperature destroys spermatogenic germ cells while leaving testosterone-secreting Leydig cells functional
- **b.** Abdominal retention blocks the epididymis while stimulating excess seminal plasma production
- **c.** Core body temperature converts Sertoli cells into androgen-producing tumors
- **d.** Retained testes produce normal spermatozoa that cannot survive passage through the urethra

46. When barn temperature falls below the lower critical temperature of newly weaned piglets, what immediate physiological adjustment must the animals make to prevent hypothermia?

- **a.** Increase peripheral blood flow to the ears and snout
- **b.** Elevate metabolic heat production via shivering and higher feed energy oxidation
- **c.** Initiate rapid panting to generate muscular warmth
- **d.** Decrease thyroid hormone secretion to conserve body fat

47. Because domestic swine possess very few functional sweat glands compared to horses, which physiological and behavioral strategy is most critical for preventing fatal hyperthermia under hot, humid conditions?

- **a.** Wallowing in mud or water for surface evaporative cooling alongside rapid panting
- **b.** Increasing subcutaneous backfat thickness to block solar radiation
- **c.** Elevating heart rate to maximize non-evaporative radiation from the skin
- **d.** Shedding bristles rapidly to expose dark skin pigments

48. When ambient air temperature rises equal to or above the skin surface temperature of a dairy cow, why do conduction, convection, and radiation fail to cool the animal?

- **a.** Cutaneous blood vessels automatically constrict above 35 degrees Celsius
- **b.** The thermal gradient reverses, leaving evaporative heat loss via sweating and panting as the only effective cooling route
- **c.** Hair coat density increases during summer to trap convective air currents
- **d.** Sweat secretion physically blocks infrared radiation from leaving the dermis

49. During episodes of severe summer heat stress, high-producing dairy cows sharply reduce voluntary dry matter intake primarily as a protective physiological response to lower which internal heat source?

- **a.** Solar radiation absorbed through the rumen wall
- **b.** Heat increment generated by ruminal microbial fermentation and nutrient metabolism
- **c.** Frictional heat produced by jaw movement during grazing
- **d.** Exothermic reactions occurring during mammary milk ejection

50. Upon sudden exposure to cold winter winds, sympathetic reflexes trigger pronounced vasoconstriction of cutaneous arterioles in the ears and limbs of a young calf primarily to achieve which thermoregulatory objective?

- **a.** Increase evaporative moisture loss from the skin surface
- **b.** Minimize conductive and convective heat loss from extremities to preserve core body temperature
- **c.** Accelerate delivery of warm blood to the hooves to prevent frostbite
- **d.** Stimulate sweat gland contraction to thicken the epidermis

Part II: Detailed Answer Key & Rationales

Review each correct choice below alongside its underlying anatomical and physiological rationale to reinforce mastery of Module B concepts.

> **1. Correct Answer: b. Median plane**
> The median (midsagittal) plane divides the animal body lengthwise along the exact midline into symmetrical left and right halves. Transverse planes create cranial and caudal segments, while frontal (dorsal) planes divide dorsal from ventral portions.

> **2. Correct Answer: c. Distal**
> On appendages, structures located farther away from the point of attachment to the trunk are termed distal, whereas those closer to the trunk are proximal. Because the fetlock joint lies below the carpus toward the hoof, it is distal to the carpus.

> **3. Correct Answer: a. Negative feedback control**
> Negative feedback maintains homeostasis by initiating an effector response that counteracts the initial deviation from a physiological set point. Once blood glucose normalizes, glucagon secretion stops, preventing hyperglycemia.

> **4. Correct Answer: c. Oxytocin-mediated uterine contractions during parturition**
> During parturition, fetal pressure on the cervix stimulates neurohypophyseal oxytocin release, which intensifies myometrial contractions and drives further cervical stretching until expulsion of the fetus terminates the cycle.

5. Correct Answer: b. Increase body surface area relative to mass to enhance heat dissipation
Zebu cattle (Bos indicus) possess an enlarged dewlap, prepuce, and ears that expand skin surface area relative to body mass, promoting greater sensible (convective and radiative) and evaporative heat loss in hot climates.

6. Correct Answer: b. Waterproofing and conditioning of plumage to preserve insulation and buoyancy
The uropygial (preen) gland secretes an oily lipid mixture spread across feathers during preening, maintaining feather barbule interlocking, water repellency, thermal insulation, and buoyancy in waterfowl.

7. Correct Answer: b. Sensible heat loss through cutaneous vasodilation and convective airflow
Because birds lack sweat glands, unfeathered appendages such as the comb and wattles receive increased blood flow during heat stress, acting as thermal windows for non-evaporative heat dissipation.

8. Correct Answer: a. Pumps venous blood upward against gravity back toward the heart
Weight-bearing compresses the elastic digital cushion and frog against the venous plexuses of the foot, squeezing blood upward through valved veins to assist venous return from the distal limb.

9. Correct Answer: c. Withers
The withers, formed by the tall dorsal spinous processes of the cranial thoracic vertebrae, serve as the primary attachment for the nuchal ligament supporting the head and neck and provide a sturdy shoulder collar seat.

10. Correct Answer: b. Bronchodilation, accelerated heart rate, and inhibition of digestive motility
Sympathetic fight-or-flight activation dilates airways and increases cardiac output to maximize oxygen delivery to skeletal muscles while diverting blood away from non-urgent gastrointestinal functions.

11. Correct Answer: a. Allows action potentials to jump between unmyelinated gaps to maximize conduction velocity
Voltage-gated sodium channels cluster at the unmyelinated nodes of Ranvier, enabling saltatory conduction in which nerve impulses leap rapidly from node to node along myelinated axons.

12. Correct Answer: b. Spinal cord
Withdrawal (flexor) reflexes are mediated through polysynaptic reflex arcs integrated directly within the gray matter of the spinal cord, producing rapid protective movement prior to cortical pain awareness.

13. Correct Answer: c. Severe tremors, wide-based stance, and loss of muscular coordination
The cerebellum fine-tunes motor output, balance, and proprioception. Underdevelopment (often caused by in utero Bovine Viral Diarrhea virus infection) produces classic cerebellar ataxia and intention tremors.

14. Correct Answer: c. Hypothalamus
The hypothalamus links the nervous and endocrine systems by integrating sensory and environmental cues and secreting releasing or inhibiting hormones that govern the anterior pituitary gland.

15. Correct Answer: a. Stimulation of forestomach contractions, salivary flow, and reduced heart rate
Parasympathetic rest-and-digest signaling via cranial nerve X (vagus) promotes reticuloruminal motility, digestive secretions, and a lower resting heart rate during rumination.

16. Correct Answer: b. Stimulation of osteoclast activity in bone and enhanced renal calcium reabsorption
Parathyroid hormone (PTH) defends against hypocalcemia (milk fever) by mobilizing calcium from bone, reducing urinary calcium loss, and activating renal calcitriol to boost intestinal calcium absorption.

17. Correct Answer: b. Cellular uptake of glucose by muscle and adipose tissues and glycogen synthesis
Insulin is an anabolic hormone secreted during the absorptive state that promotes GLUT4-mediated glucose uptake into myocytes and adipocytes while stimulating glycogenesis and lipogenesis.

18. Correct Answer: c. Posterior pituitary gland
Oxytocin is synthesized in hypothalamic nuclei and stored in axon terminals within the posterior pituitary (neurohypophysis), from which tactile teat stimulation triggers its release for milk letdown.

19. Correct Answer: a. Increasing cellular oxygen consumption and basal metabolic heat production
Thyroid hormones (T3 and T4) upregulate sodium-potassium ATPase activity and mitochondrial respiration across tissues, raising basal metabolic rate and calorigenesis during chronic cold acclimation.

20. Correct Answer: b. Elevated blood glucose via gluconeogenesis and suppression of immune defenses
Cortisol mobilizes amino acids and fatty acids to fuel hepatic gluconeogenesis during chronic stress while simultaneously inhibiting lymphocyte proliferation and inflammatory cytokine production.

21. Correct Answer: c. Pineal gland
Retinal photoreceptors relay darkness signals to the pineal gland, which secretes melatonin during the dark phase. Longer autumn nights prolong melatonin secretion, stimulating GnRH pulses in short-day breeders like sheep.

22. Correct Answer: a. Uterine endometrium
In the absence of maternal recognition of pregnancy (interferon-tau in ruminants), the uterine endometrium secretes pulses of prostaglandin F2 alpha that reach the ovary countercurrently to induce luteolysis.

23. Correct Answer: b. The left ventricle generates far greater pressure to pump blood through the entire systemic circuit
Both ventricles eject equal stroke volumes, but systemic vascular resistance is roughly five to six times higher than pulmonary resistance, requiring a much thicker left ventricular myocardium.

24. Correct Answer: c. Sinoatrial node
Located in the right atrial wall near the cranial vena cava opening, the sinoatrial (SA) node exhibits the fastest spontaneous pacemaker depolarization and sets the normal sinus rhythm.

25. Correct Answer: b. Pulmonary artery
The right ventricle pumps oxygen-poor systemic venous blood through the pulmonary semilunar valve into the pulmonary trunk and pulmonary arteries for gas exchange in the lungs.

26. Correct Answer: a. Avian erythrocytes are elliptical and retain a distinct nucleus
Unlike mammalian red blood cells, which extrude their nuclei during maturation and take a biconcave disc shape, avian erythrocytes remain oval and nucleated throughout their lifespan.

27. Correct Answer: a. Accelerated differentiation and release of erythrocytes from red bone marrow
Renal interstitial cells detect tissue hypoxia at high altitudes and secrete erythropoietin (EPO), stimulating erythropoiesis in red bone marrow to increase blood oxygen-carrying capacity.

28. Correct Answer: c. Hepatic portal vein
Venous blood draining the gastrointestinal tract converges into the hepatic portal vein, routing absorbed monosaccharides, amino acids, and xenobiotics directly through hepatic sinusoids before systemic circulation.

29. Correct Answer: b. Outward movement of the ribs and downward swing of the sternum expanding the thoracoabdominal cavity
Inspiratory muscles pull the sternal and vertebral ribs cranially and laterally while lowering the keel, creating subatmospheric pressure that expands the avian air sacs like bellows.

30. Correct Answer: b. Parabronchi and air capillaries
Avian air sacs are poorly vascularized reservoirs that ventilate the lungs; gas exchange occurs strictly across the thin blood-gas barrier of the microscopic air capillaries branching from parabronchi.

31. Correct Answer: b. Reduces surface tension within alveoli to prevent alveolar collapse during expiration
Secreted by type II alveolar epithelial cells late in gestation, phospholipid-rich surfactant lowers intra-alveolar surface tension, stabilizing small alveoli and reducing the work of breathing.

32. Correct Answer: b. Decreasing hemoglobin affinity for oxygen so oxygen dissociates more readily into tissues
Elevated carbon dioxide, hydrogen ions (lower pH), and temperature shift the oxygen-hemoglobin dissociation curve to the right (the Bohr effect), enhancing oxygen unloading in metabolically active muscle.

33. Correct Answer: a. Excessive carbon dioxide exhalation causes respiratory alkalosis that lowers blood bicarbonate needed for shell calcification
Thermal hyperventilation blows off carbon dioxide, raising blood pH and depleting bicarbonate ions required by the shell gland to synthesize calcium carbonate for eggshells.

34. Correct Answer: b. Increasing water permeability of the distal convoluted tubules and collecting ducts
Antidiuretic hormone (vasopressin) promotes insertion of aquaporin-2 water channels into principal cells of the late distal tubule and collecting duct, allowing osmotic water reabsorption into the hypertonic medulla.

35. Correct Answer: b. Size selectivity and negative electrical charge of the glomerular filtration membrane
Fenestrated capillary endothelium, negatively charged basement membrane glycoproteins, and podocyte filtration slits restrict large, anionic plasma proteins like albumin from entering Bowman's space.

36. Correct Answer: a. A steep osmotic concentration gradient established by countercurrent multiplication
Differential permeability and active ion pumping between the descending and ascending limbs of long juxtamedullary loops of Henle build a hyperosmotic medullary interstitium essential for concentrating urine.

37. Correct Answer: c. Sparingly soluble uric acid precipitated as a semi-solid white paste
Birds are uricotelic; synthesizing poorly water-soluble uric acid allows nitrogen excretion with minimal obligatory water loss, conserving body water and reducing flight weight.

38. Correct Answer: a. Sodium reabsorption and potassium excretion in the distal tubules and collecting ducts
Aldosterone upregulates basolateral sodium-potassium pumps and apical sodium channels in principal cells, conserving sodium and osmotically obliged water to restore extracellular fluid volume.

39. Correct Answer: b. Operates as a countercurrent heat exchanger that cools incoming arterial blood below body temperature
Cooler venous blood ascending from the scrotal skin absorbs heat from warm testicular arterial blood flowing in the opposite direction, keeping intratesticular temperature 4 to 6 degrees Celsius below core temperature.

40. Correct Answer: b. Epididymis
During passage through the caput, corpus, and cauda epididymis, spermatozoa undergo membrane remodeling, acquire progressive forward motility, and are stored until ejaculation.

41. Correct Answer: c. Ampullary-isthmic junction of the oviduct
Sperm transport upward from the isthmus meets the newly ovulated oocyte descending through the ampulla at the ampullary-isthmic junction, the physiological site of fertilization in livestock.

42. Correct Answer: b. Magnum
The magnum is the longest segment of the avian oviduct and synthesizes and secretes nearly all of the egg white (albumen) proteins over roughly three hours.

43. Correct Answer: c. Uterus
Inside the uterus (shell gland), the developing egg first absorbs water and electrolytes to plump the albumen and then receives its calcified calcium carbonate shell over 18 to 20 hours.

44. Correct Answer: b. Luteinizing hormone
High estradiol concentrations from the preovulatory follicle trigger positive feedback on the hypothalamus and anterior pituitary, generating a surge of luteinizing hormone (LH) that induces follicular rupture and ovulation.

45. Correct Answer: a. Elevated abdominal temperature destroys spermatogenic germ cells while leaving testosterone-secreting Leydig cells functional
Meiotic germ cells in the seminiferous tubules are highly thermosensitive and degenerate at core body temperature, whereas interstitial Leydig cells continue synthesizing testosterone normally.

46. Correct Answer: b. Elevate metabolic heat production via shivering and higher feed energy oxidation
Below the lower critical temperature, cold-induced thermogenesis increases through involuntary skeletal muscle shivering and elevated feed energy catabolism to maintain homeothermy.

47. Correct Answer: a. Wallowing in mud or water for surface evaporative cooling alongside rapid panting
Because porcine sweat glands are non-functional for thermoregulation, swine rely on behavioral wallowing to wet the skin for prolonged evaporative cooling combined with increased respiratory rate.

48. Correct Answer: b. The thermal gradient reverses, leaving evaporative heat loss via sweating and panting as the only effective cooling route
Sensible heat transfer (conduction, convection, and radiation) requires a temperature gradient from warm skin to cooler surroundings; when ambient temperature exceeds skin temperature, only latent heat of vaporization cools the cow.

49. Correct Answer: b. Heat increment generated by ruminal microbial fermentation and nutrient metabolism
Digestion, microbial fermentation in the rumen, and post-absorptive nutrient metabolism produce substantial metabolic heat (heat increment); lowering feed intake reduces this internal thermal load.

50. Correct Answer: b. Minimize conductive and convective heat loss from extremities to preserve core body temperature
Alpha-adrenergic sympathetic vasoconstriction shunts warm arterial blood away from poorly insulated peripheral extremities, reducing skin temperature and conserving core heat.