SUBJECT: VETERINARY PHYSIOLOGY

CHAPTER 3: EXCRETION (IIPER1699624056)

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TERMINOLOGIES:

- **Excretion:** It is the process by which the body gets rid of unwanted substances and extra materials.
- **Autoregulation:** The kidneys can maintain a relatively constant GFR despite changes in blood pressure, this ability of the kidney is known as autoregulation.
- **Renal Blood Flow (RBF):** It is the blood volume delivered per unit time.
- **Glomerulus:** It is a network of small blood vessels (or, capillaries) known as a tuft, which is located at the beginning of a nephron in the kidney where the filtration of blood occurs.
- **Bowman's Capsule:** It is a cup-shaped sac that is part of the nephron in the mammalian kidney which surrounds the glomerulus and collects the filtrate.
- **Glomerular Filtration Rate (GFR):** It is defined as the volume of fluid that is filtered through the glomerulus into Bowman's capsule per unit of time.
- **Dehydration:** It occurs when there is excess loss of water and electrolytes from the body and the body doesn't have enough water and other fluids to carry out its normal functions.
- Severe dehydration occurs when the loss of water is more than 10% of the total body weight.
- **Blood:** A specialized connective tissue in which there is liquid intercellular substance known as plasma in which the formed elements call the blood cells are suspended.
- **Blood Plasma**: It is the fluid part of the blood. It is clear or straw-colored and it makes up about 55% of the total blood volume present in the body.
- **Lymph:** It is a body fluid (similar to blood plasma in composition) which contains

a high number of lymphocytes that circulate throughout the body in the lymphatic system.

- **Diuresis:** It is the increased production and excretion of urine by the kidneys which helps in regulating the body's fluid balance by eliminating the excess water, electrolytes and waste products through the urine.
- **Antidiuretic Hormone (ADH):** It is the hormone released by the pituitary gland which helps to regulate water reabsorption in the kidneys.
- **Aldosterone**: it is the hormone released by the adrenal glands which helps to regulate sodium and potassium balance in the kidneys.
- **Hypovolemia:** It involves a reduction in blood volume and is frequently linked with dehydration.
- **Hypervolemia:** It is an elevation in blood volume and is often associated with excessive fluid intake or overhydration.
- **Hypokalemia:** Reduced levels of potassium in the bloodstream.
- **Hyperkalemia:** Increased levels of potassium in the bloodstream.

REFRESHER POINTS:

- Kidneys are the chief excretory organs
- Nephron is the functional unit of the kidney
- The number of nephrons varies considerably among different species

Species	No. of nephrons in two kidneys (approx..)
Cow	8.0×10^6
Pig	2.5×10^6
Dog	8.3×10^6
Cat	3.8×10^6
Human	2.0×10^6

- Glomerular filtration rate is 125ml/min or 180 L/day

- Glomerular membrane is completely impermeable to plasma proteins
- GFR can be measured by creatinine clearance or inulin clearance
- Blood flow to the two kidneys is normally 22% of the total cardiac output

Sl.no	Part	Amount of GFR reabsorbed	Remarks/function
1	Proximal tubule (action of PTH)	65%	Decrease Ca excretion
2	Descending loop of Henle	15%	More permeable to water Less permeable to urea & sodium
	The ascending loop of Henle		Less permeable to water More permeable to urea
3	Distal tubule (action of aldosterone)	10%	Active Na+ transport Secretion of K+
5	Collecting tubule (action of ADH)	9.3%	Permeable to water

- Plasma load; total amount of substance in the plasma that passes through the kidneyseach minute (plasma load of glucose -600mg/min).
- Tubular load; fraction of plasma load that is filtered as glomerular filtrate (tubular loadof glucose – 125 mg/min).
- Urine is thick in horse
- Tubular fluid contains 2 buffer systems namely; Ammonia buffer and phosphate buffer
- Glucosuria is a characteristic finding in enterotoxemia
- The metabolic end product of protein in mammals is urea whereas in birds & reptiles,it is uric acid
- The differences in birds from mammals include; the presence of two major nephron types, renal portal system, and formation of uric acid.
- Avian kidney has 2 types of nephrons; Mammalian type (25% glomerular filtrate) &reptilian type (75% glomerular filtrate)

- Transport of tubular fluid from Bowman's capsule to the renal pelvis occurs due to hydrostatic pressure gradient
- Transport of urine from the renal pelvis to the urinary bladder occurs due to peristalsisin the ureters.
- Two countercurrent mechanisms of the kidney are countercurrent multiplier (loops ofHenle) and countercurrent exchanger (vasa recta).
- Two types of mammalian nephron:

1) Cortical nephron/superficial nephrons: Short loop of Henle located in cortex & its main function is reabsorption & secretion of substances
2) Juxtamedullary nephron: A long loop of Henle extended deep in the renal medulla &its main function is concentrating the urine

- Protein molecules are not filtered generally through glomerulus because of their largemolecular size & polyanionic nature
- Juxtaglomerular (JG) apparatus is the specialized structure formed at the junction ofDCT & Glomerular afferent arteriole
- The three cells of JG are macula densa, juxtaglomerular cells (JG cells), and extraglomerular mesangial cells (Lacis cells).
- Micturition is by parasympathetic activity
- Diuretics: agents/drugs that increase urine output, useful for treating oedema & hypertension.
- Loop diuretics (furosemide): Inhibiting Na^+-K^+-2Cl- cotransport in luminal membraneof thick ascending limb of loop of Henle
- Osmotic diuretics (mannitol): inhibit water & solute reabsorption by increasing effective osmotic pressure of tubular fluid of PCT
- Aqueous solutions containing different amounts of materials, or solutes, make up body fluids in animal physiology. Body fluids in animals vary with their body weight, age, sex and their nutritional values.
- Body fluids are classified into three specific fluid compartments, namely the intracellular fluid (ICF), extracellular fluid (ECF), and interstitial fluid (IF) compartments. Each compartment is separated from each other by some form of a physical barrier.
- Intracellular fluid is approximately 40% of the total body weight of animals and the extracellular fluid comprises 20% of the total body weight.

- The intracellular fluid is also known as Cytosol. It is the site of multiple cell processesincluding metabolic processes (such as glycolysis, gluconeogenesis, and PPP).
- Barriers which separate the different types of body fluids:

Plasma membrane	Separates ICF from surrounding interstitial fluid
Blood vessel wall	Separate interstitial fluid from plasma

- Components of fluid:

Intracellular body fluid	▪ High amount of potassium, phosphate, and magnesium ▪ Low amounts of bicarbonate, chloride, sodium, and protein
Extracellular body fluid	▪ High amounts of sodium, chloride, and bicarbonates ▪ Low amounts of potassium, phosphate, and magnesium

- Sodium ion (Na^+): Major electrolyte found in the extracellular fluid which is theosmotically active cation in the extracellular fluid
- Chloride ion (Cl^-): The predominant anion in the extracellular fluid
- Bicarbonates: Important in maintaining the acid-base balance
- The Sodium-potassium pumps present in the cell membranes are responsible for maintaining the high potassium and low sodium levels in the intracellular fluids
- Fluid movement between different compartments is caused by

Hydrostatic pressure	▪ Causes movement of fluid between compartments ▪ The force exerted by the blood on the walls of blood vessels due to the pumping action of the heart.
Osmotic pressure	▪ causes movement of the fluid between the compartments along the osmotic gradient ▪ The force generated by the fluid due to the variance in concentration of all solutes on either side of a semi-permeable membrane.

- Water balance exists when the water intake is equal to the water output.
- The Thirst mechanism is the primary regulator of water intake which is derived from the osmotic pressure of extracellular fluids and a thirst center present in the

hypothalamus.

- The primary regulators of water output are the distal convoluted tubules and the collecting ducts within the nephrons.
- Acid-base balance of the body fluid is essential for homeostasis in the body. The water/sodium balance in the body is tightly regulated by the nervous system.
- Abnormalities of Body Fluid Volume Regulation: Hyponatremia and Hypernatremia

Abnormality	**Cause**	**Plasma Na+ Concentration**	**Extracellular Fluid Volume**	**Intracellular Fluid Volume**
Hyponatremia—dehydration	Adrenal insufficiency; overuse of diuretics	↓	↓	↑
Hyponatremia—overhydration	Excess ADH (SIADH); bronchogenic tumours	↓	↑	↑
Hypernatremia—dehydration	Diabetes insipidus; excessive sweating	↑	↓	↓
Hypernatremia—overhydration	Cushing's disease; primary aldosteronism	↑	↑	↓

- Lymph is a body fluid (similar to blood plasma in composition) which contains a high number of lymphocytes that circulate throughout the body in the lymphatic system.
- Lymph contains a large amount of white blood cells which fight infections.
- Cerebrospinal fluid (CSF) is a lymph fluid that acts as the brain's lymphatic system
- CSF is present in the brain ventricles and the cranial and spinal subarachnoid spaces
- CSF maintains the intracranial pressure of the brain and acts as a lubricant and amechanical barrier against shock.
- Clinicopathological indicators of fluid and electrolyte imbalances
    - Dehydration
    - Overhydration
- Dehydration: Excessive loss of water from the body.
- Severe dehydration occurs when the loss of water is more than 10% of the total bodyweight.
- Dehydration leads to a decrease in volumes and increase in the osmolarity in both

theICF and ECF

- Cellular overhydration also called water intoxication is caused by renal insufficiency or consumption of large amounts of water.
- Fluid therapy is a plan that aims at supplying water and electrolytes in amounts that fulfill regular daily fluid requirements and replenish fluids lost through urinary, gastrointestinal, and evaporative functions.
- Fluid therapy can be divided into four phases: the resuscitation phase, the optimizationphase, the stabilization phase, and the evacuation phase.
- Indications of fluid therapy:
    - Dehydration: When there is excess loss of water from the body, fluid therapy can be administered to restore the water balance.
    - Surgery: fluid therapy is administered to the animals, before, during and after any surgical procedures to compensate for the loss of any fluid and also to maintain the normal functions of the organs and blood pressure.
- 2 types of fluid:
    - Crystalloids: Lactated Ringer's solution, 0.45% NaCl (hypotonic solution), 3% NaCl (hypertonic solution), 5% Dextrose in water, etc.
    - Colloids: Albumin, Dextran, Hydroxyethyl starch (or Hetastarch), Haemaccel and Gelofusine
- Routes of administration for IV fluids
    - Intravenous (IV) route: the fluid is directly injected into the vein of theanimal. It is the most common and the most rapid method for fluid delivery.
    - Subcutaneous (SC) route: fluids are injected under the skin (Subcutaneous layer). This route is suitable for restoring mild dehydration or for maintenance fluids.
    - Intraperitoneal (IP) route: It is directly administered into the abdominalcavity.
    - Oral route: It can be directly administered/ingested orally. This route isespecially for restoring very mild dehydration.

A. Fill in the blanks

1. _____has the lowest plasma clearance
2. _____increases GFR
3. The body's most powerful sodium-retaining hormone is _____
4. Glomerular epithelium has a _____charge
5. The marker substance for estimation of GFR is _____
6. The Micturition centre is located at _____
7. ___ is the process of emptying the urinary bladder
8. Counter current is formed by _____
9. During low blood pressure, the kidney secretes _____
10. The macrophage of the kidney is a _____
11. Marked loss of sodium and accumulation of potassium from the body in the absence of _____
12. A major excretory product in birds is _____
13. Specific gravity of urine is highest in _____
14. Epithelial cells present in the visceral layer of the bowmen's capsule are _____
15. Kidneys are situated outside the _____
16. Juxtamedullary nephrons make up about ___ of the total number
17. When water moves across the tight junction, some of the solutes are carried with it. This process is referred to as _____
18. Urine is thick in_____
19. Diuretics that inhibit NaCl reabsorption in the early distal tubule are _____
20. The inability of the kidney to concentrate or dilute the urine is called _____
21. Loss of large quantities of plasma proteins into the urine is characterized by _
22. Body fluids are liquid solutions with varying concentrations of substances, called _____
23. _____encompasses the interstitial fluid, blood plasma, and fluids present in other reservoirs within the body

24. _____are fluids located in the small spaces between cells that are not confined within blood vessels.
25. _____are the fluids present in the cytosol of cells
26. _____is also referred to as plasma volume
27. _____is present outside the capillaries and it immediately surrounds the cells
28. _____is found in body cavities
29. The _____ assists the solute in influencing the movement of water between cells and their surrounding medium.
30. Fluid moves between compartments as a result of ____, which is the force a fluid exerts against a wall.
31. In Osmosis, the water moves from the side where the_____to the side of the membrane where _____
32. During the transfer of certain solutes between compartments, the _____transport necessitates energy consumption whereas the _____transport process does not require energy consumption.
33. _____ assists in regulating the water movement within the nephrons of the kidneys to ensure the effective filtration of blood and the formation of urine.
34. Hydrostatic pressure is also known as _____
35. The majority of the CSF is produced by the _____situated within the ventricles of the brain.
36. _____is a condition of the blood which results due to the excess loss of hydrogen ions.
37. _____is a condition of excess acidity of the blood which results from an overabundance of hydrogen ions.
38. _____may lead to rapid reduction in plasma sodium concentration, for example, can cause brain cell oedema and neurological symptoms.
39. The_____is the primary regulator of water intake in animals.
40. _____ causes osmotic diuresis in animals.
41. The primary target of fluid therapy is to maintain and restore the _____ in animals.

42. The maintenance fluids are the fluids given to compensate for ongoing losses and to meet the needs of the animals
43. _____ are the type of fluid solutions that contain electrolytes and can pass through the cell membranes.
44. _____ are the type of fluid solutions that contain large molecules and stay within bloodvessels.
45. _____ is the area between the arachnoid mater and the pia mater through which cerebrospinal fluid circulates.
46. _____ are small, bean-shaped structures that filter lymph and contain immune cells.
47. _____ is the network of vessels, nodes, and organs that helps in transporting the lymph throughout the body.
48. The major electrolytes present in the extracellular fluid include sodium, chloride, and _____.
49. Adrenal glands that release aldosterone hormone, promote the reabsorption of _____ and excretion of_____in the kidneys.
50. During long periods of dehydration, the release of the _____ hormone stimulates the thirst response, encouraging water intake.

(A) Multiple-choice questions

1. Major anion in ECF is
    a) Sulphate
    b) Chloride
    c) Phosphate
    d) Bicarbonate

2. Normal glomerular filtration rate (GFR) is
    a) 100 ml/min
    b) 125 ml/min
    c) 150 ml/min
    d) 200 ml/min

3. Marker substance for estimation of renal plasma flow (RPF)
    a) Creatinine
    b) Para amino hippuric acid (PAH)
    c) Mannitol
    d) Inulin

4. Normal filtration fraction (FF) at the glomerulus of the kidney is
    a) 5% of RPF
    b) 10% of RPF
    c) 20% of RPF
    d) 30% of RPF

5. The highest rate at which a substance is reabsorbed from the renal tubule is known as
a) Glomerular filtration rate
b) Transport maximum

c) Net filtration pressure

d) Renal threshold

6. During micturition
   a) Detrusor muscle contraction and relaxation of the internal urethral sphincter.
   b) Detrusor muscle relaxation and contraction of the internal urethral sphincter.
   c) Detrusor muscle contraction and contraction of the internal urethral sphincter.
   d) Detrusor muscle relaxation and relaxation of the internal urethral sphincter.

7. Spironolactone acts as a diuretic by
   a) Stimulating action of vasopressin
   b) Inhibiting/action of vasopressin
   c) Inhibiting action of aldosterone
   d) Stimulating action of aldosterone

8. Obligatory water re-absorption occurs in
   a) PCT
   b) DCT
   c) Loop of Henle
   d) collecting duct

9. Specialized cells of DCT seen in close contact with afferent and efferent arterioles are
   a) Macula densa
   b) Lacis cell
   c) Glomerular cells
   d) Podocytes

10. Which of the following decreases the glomerular filtration rate
   a) Nor epinephrine
   b) Angiotensin II

c) Endothelin cells

d) All of the above

11. The capillary that drains into an arteriole

a) Lymphatic capillary

b) Glomerular capillary

c) Pulmonary capillary

d) Systemic capillary

12. Marker substance for estimation of plasma volume

a) Inulin

b) Sucrose

c) Evans blue dye (T-1824)

d) All of the above

13. Epithelial cells present in the visceral layer of Bowman's capsule

a) Glomeruli

b) Pedicels

c) Podocyte

d) Juxta glomerular cell

14. During hypoxia, kidney secretes

a) Erythropoietin

b) Thrombopoietin

c) Renin

d) Calcitriol

15. The water content of the plasma is

a) 60-71%

b) 70-81%

c) 81-82%

d) 91-92%

16. Marker substance for estimation of total body water content

a) Antipyrine

b) Deuterated

c) Tritiated water

d) All of the above

17. Net filtration pressure at the glomerulus of the kidney is

a) 10 mm Hg

b) 12 mm Hg

c) 12.5 mm Hg

d) 15 mm Hg

18. Afferent arteriole of the glomerulus is supplied by

a) Interlobular artery

b) Pulmonary artery

c) Hepatic artery

d) None of the above

19. The number of nephrons in two kidneys of cattle is

a) 4,000,000

b) 8,000,000

c) 6,000,000

d) 5,000,000

20. The number of nephrons in the pig is

a) 1.25,000,000

b) 2.5,000,000

c) 3,000,000

d) 4,000,000

21. The dog has only
    a) 1 papilla
    b) 2 papillae
    c) 3 papillae
    d) None

22. The right kidney is slightly
    a) Higher than the left
    b) Lower than the left
    c) Same level
    d) None

23. The product of the permeability of the membrane and the filtration area of the glomerularcapillary wall is called
    a) Glomerular filtration
    b) Filtration Coefficient (Kf)
    c) Glomerular filtration rate
    d) None of the above

24. Important functions of kidneys are
    a) Regulation of acid-base balance
    b) Regulation of arterial pressure
    c) Produce erythropoietin
    d) All of the above

25. Differences in birds and mammals include the presence of
    a) Two major nephron types
    b) Renal portal system
    c) Formation of uric acid
    d) All of the above

26. Bowmen's capsular fluid has the same composition of plasma except
    a) Colloids
    b) Crystalloids
    c) Emulsoids
    d) Cel-sols

27. Powerful diuretics that decrease active reabsorption in the thick ascending loop of Henle
    a) Furosemide
    b) Bumetanide
    c) Ethacrynic acid
    d) All of the above

28. Which of the following is not associated with diabetes mellitus
    a) Increased urine formation
    b) Increased thirst
    c) Renal threshold for glucose is exceeded
    d) Lack of ADH

29. If excess glucose fails to be reabsorbed (renal threshold exceeded), the effective OsmoticPressure in the tubular lumen
    a) Increased
    b) Not changed
    c) Decreased
    d) Becomes ineffective

30. Which of the following nephron components is lacking in reptilian nephrons
    a) Bowman's capsule
    b) Loop of Henle
    c) PCT

d) DCT

31. Renal portal blood enters the vascular supply perfusing the renal tubules at the level of

a) Glomerulus

b) Vasa recta

c) Perivascular capillary

d) Vena cava

32. Uric acid precipitates in the renal tubules to

a) Avoid ammonia toxicity

b) Avoid obligatory water excretion

c) Make it more slippery

d) Have a better mixing with feces

33. Which one of the following hormones promotes tubular reabsorption of Na" and tubularsecretion of K'

a) ADH

b) Aldosterone

c) Secretin

d) Vasopressin

34. Water reabsorption from urine deposited in the cloaca may occur in the

a. Cloaca

b. Colon and caecum

c. Colon

d. Rectum

35. Which one of the following nephron parts accounts for the largest amount of water, glucose,amino acids and vitamin reabsorption

a) Glomerulus

b) DCT

c) PCT

d) CT

36. Which one of the following measurements would be the lowest in any one-time

a) Renal blood flow

b) Renal plasma flow

c) Renal perfusion fraction of cardiac output

d) Filtration rate of glomerulus

37. What prevents the backflow of urine from the bladder into the ureters

a) Angle of ureter entrance at the ureterovesical junction

b) A discrete muscular sphincter

c) Constant peristaltic waves towards the bladder

d) There is nothing to prevent it.

38. Which one of the following nephron parts is associated with the establishment of a highsalt concentration in the medulla of the kidney?

a) Bowman's capsule

b) Loop of Henle

c) PCT

d) DCT

39. The cells in the late distal and cortical collecting tubules that secrete potassium are called

a) Principal cells

b) Lacis cell

c) Glomerular cells

d) None of the above

40. Which hormone to a large extent determines whether the kidney excretes a dilute or aconcentrated urine

a) Secretin

b) ADH

c) Aldosterone

d) Vasopressin

41. The kidneys after ingestion of excess water

a) Remove excess water as well as solutes

b) Remove excess water but the total amount of solute excreted remains relativelyconstant

c) Does not remove excess water as well as solutes

d) None of the above

42. Conservation of water by the kidney by excreting concentrated urine

a)Australian hopping mouse can concentrate urine to as high as 10,000 mOsm/L

b) Animals adapted to aquatic environments have minimal urine concentrating ability;they can concentrate the urine to only about 500 mOsm/L

c)Both are correct

d) None of them is correct

43. Percentage of JM nephron in various species

a) Beaver is 0%,

b) Pig is 3%,

c) Cat & Dog is 100%)

d) All of the above

44. Percentage of plasma concentration for the smallest plasma proteins (albumin) having amolecular weight of about 69,000 appear in the filtrate

a) 0.5 – 0.1

b) 0.1 – 0.15

c) 0.2 – 0.3

d) 0.3 – 0.4

45. Protein molecules are normally restricted from filtration through the glomerular

membranebecause of

a) Their size and polyanionic nature

b) Their molecular shape

c) Their size and polycationic nature

d) Their combinations with cations

46. Which of the following have the highest values for hematocrit and plasma protein concentration

a) Blood in the afferent arterioles

b) Blood in the efferent arterioles

c) Tubular filtrate

d) None of the above

47. Relative medullary thickness (mm) for kidneys in dogs is

a) 3

b) 4.3

c) 4.8

d) 5.8

48. The thin descending limb, thin ascending limb, and thick ascending limb of the loop ofHenle:

a) Have the same lumen diameter

b) Have the same relative medullary thickness

c) Have a lumen diameter corresponding to the limb being thin or thick

d) All of the above

49. High plasma concentration of creatinine is an indication of

a) Liver disease

b) Kidney disease

c) Lung disease

d) None of the above

50. Aquatic animals generally excrete

a) Uric acid

b) Urea

c) Ammonia

d) Both (a) and (c)

51. which marks the beginning of distal tubules in mammalian nephron

a) Juxta-glomerular cells

b) Macula densa

c) Lacis cells

d) None of the above

52. Osmolarity of plasma is about

a. 100 mOsm/kg of water

b. 200 mOsm/kg of water

c. 300 mOsm/kg of water

d. 400 mOsm/kg of water

53. The pH of urine in herbivores is usually

a) Alkaline

b) Acidic

c) Neutral

d) Both (a) and (b)

54. Consistency of urine is thick and syrupy in the horse due to the presence of

a) Pyruvate

b) Carbonate

c) Sulphate

d) Nitrate

55. Angiotensinogen is a proenzyme converted to an active form by
    a) Angiotensin I
    b) Angiotensin-converting enzyme (ACE)
    c) Renin
    d) Rennin

56. Angiotensin I is converted to Angiotensin II by
    a) Bradykinin
    b) Angiotensin-converting enzyme (ACE)
    c) Renin
    d) Rennin

57. The only part in the renal tubule where sodium is secreted
    a) Ascending thin loop of Henle
    b) Ascending thick loop of Henle
    c) Descending loop of Henle
    d) Distal tubule

58. Cortical nephrons lack
    a) Glomerulus
    b) Ascending thin limb
    c) Descending thin limb
    d) Proximal tubule

59. which of the following is the function of the kidney
    a) Erythropoiesis
    b) Regulation of acid-base balance
    c) Produce rennin
    d) All of the above

60. Which of the following substances are not filtered during glomerular filtration

a) Proteins with a molecular weight of more than 70,000 Dalton

b) Salts

c) Amino acid

d) Both (a) and (c)

61. Water, which is the most important constituent of the body fluid makes up about _____of the total weight of the animal.

a) 40

b) 50 %

c) 60%

d) 70%

62. Intracellular fluid is approximatelyof the total body weight

a) 40%

b) 50%

c) 60%

d) 30%

63. Extracellular fluid is approximatelyof the total body weight

a) 40%

b) 50%

c) 60%

d) 20%

64. Solute uses the _____ to help water travel between cells and the surrounding medium.

a) Brownian movement

b) Hydrostatic pressure

c) Osmotic pressure

d) None of the above

65. Interstitial fluid (IF) is _____

a) the fluid that bathes all of the body's cells except for blood cells

b) the fluid component of blood

c) fluid that is contained inside cells by their plasma membranes.

d) fluids found between membranes

66. The force applied by a fluid against a surface due to its own weight or pumping action is called the

a) Osmotic pressure

b) Hydrostatic pressure

c) Capillary pressure

d) None of the above

67. Body fluids are classified into which of the following specific fluid compartments?

a) Intracellular fluid

b) Extracellular fluid

c) Interstitial fluid

d) All of the above

68. The __ transport process requires the consumption of ATP to facilitate the movement of the solutes between the compartments against their concentration gradient

a) Active

b) Passive

c) Simple

d) Facilitated

69. The _____ transport process utilizes the ability of a molecule or ion to pass through a membrane and in this transport process the molecules diffuse from an area of higher concentration to an area of lower concentration.

a) Diffusion

b) Active

c) Passive

d) Facilitated diffusion

70. When the hydrostatic pressure in the kidneys increases, then

a) There is an increase in the amount of water leaving the capillaries, and more urinefiltrate is formed.
b) There is a decrease in the amount of water leaving the capillaries, and more urine filtrateis formed
c) There is an increase in the amount of water leaving the capillaries, and less amount ofurine filtrate is formed
d) There is a decrease in the amount of water leaving the capillaries, and less urine filtrateis formed

71. A cation has a(n) _____charge

a) Neutral

b) Positive

c) Alternating

d) Negative

72. An anion has a(n)___ charge.

a) Neutral

b) Positive

c) Alternating

d) Negative

73. The fluid found inside and outside the cells is called as

a) Extracellular fluid

b) Intracellular fluid

c) Body fluid

d) Interstitial fluid

74. An intracellular fluid

a) Interstitial fluid

b) Cytosol

c) Lymph

d) Blood plasma

75. The excess loss of water and electrolytes from the body is called

a) Thirst

b) Dehydration

c) Sweating

d) Panting

76. Functions of the Cerebrospinal fluid (CSF) include

a) Maintaining the intracranial pressure of the brain

b) Act as a lubricant

c) Act as a mechanical barrier against shock

d) All of the above

77. The pH of CSF is

a) 6.5-7

b) 7.3-7.4

c) 6.3-6.4

d) 6.8-7.1

78. Which of the following is an example of transcellular fluid?

a) Intraocular fluid
b) Intravascular fluid
c) Synovial fluid
d) Cerebrospinal fluid

79. Osmoconcentration is the

a) Loss of salt and increased water concentration

b) Loss of water and increased salt concentration
c) Loss of water and salt both
d) None of the above

78. _____is a clear, colorless liquid that fills the ventricles (cavities) of the brain and the spinal cord
a) Synovial fluids
b) Amniotic fluids
c) Peritoneal fluids
d) Cerebrospinal fluids

79. The body fluid or liquid found inside the cells and contained by their plasma membranes is called
a) Interstitial fluid
b) Transcellular fluid
c) Cytosol
d) Extracellular fluid

80. The body fluid composition of tissue varies by
a) Tissue type
b) Age of the animal
c) Gender of the animal
d) All of the above

80. The chief intracellular cation is
a) Na^+
b) K^+
c) Ca^{+2}
d) Cl^-

81. The chief extracellular cation is
a) Na^+
b) K^+
c) Ca^{+2}
d) Cl^-

82. Dehydration
a) Occurs when the loss of water is more than 10% of the total body fluid.

b) Decrease in volumes in both the ICF and ECF
c) Increase in the osmolarity in both the ECF and ICF
d) All of the above

83. What is diuresis?
a) Increased production and excretion of urine
b) Decreased production of urine
c) Normal urine production
d) Inability to produce urine

84. Which of the hormones promotes the reabsorption of water and helps in reducing diuresis?
a) Antidiuretic hormone (ADH)
b) Cortisol
c) Insulin
d) Aldosterone

85. the purpose of fluid therapy is to
a) To induce anesthetic conditions during surgical procedures
b) To promote weight gain in the animals
c) To maintain and restore hydration levels in the body
d) To prevent dental issues of the animals

86. Lactated Ringer's solution is a type of fluid
a) Colloid
b) Hypertonic solution
c) Crystalloid
d) Alkalizing solution

87. Haemaccel is a type of fluid
a) Colloid
b) Hypertonic solution
c) Crystalloid
d) Alkalinizing solution

88. Intravenous (IV) fluid administration is commonly used to treat:
a) Mild dehydration
b) Severe dehydration

c) Routine hydration maintenance
d) Both a and b

89. Subcutaneous (SC) fluid administration is commonly used to treat:
a) Mild dehydration
b) Severe dehydration
c) Routine hydration maintenance
d) Both a and c

90. During shock, the fluid therapy helps by:
a) Decreasing the blood volume through increased excretion
b) Increasing the tissue perfusion
c) Lowering the blood pressure by increasing the blood volume
d) Increasing the blood volume through infusions

91. From where is the cerebrospinal fluid (CSF) produced?
a. Hypothalamus
b. Spinal cord
c. Choroid plexus in the brain
d. Adrenal gland

92. Formation of lymph occurs in which part of the body?
a) Bone marrow
b) Spleen
c) Lymph nodes
d) Spinal cord

95. The main function of the lymph in the body is
a) Carrying oxygen from the lungs
b) Carrying oxygen to tissues
c) Carrying nutrients to cells
d) Immune defense

96. Elevated levels of blood urea nitrogen (BUN) indicate
a) Hypokalemia
b) Hypercalcemia
c) Overhydration

d) Dehydration

97. Hyponatremia is the deficiency of

a) Sodium

b) Calcium

c) Potassium

d) Magnesium

98. The condition in which there is a high content of potassium in the blood is

a) Hyperkalemia

b) Hypokalemia

c) Hyponatremia

d) Hypocalcemia

99. The primary physiological process associated with diuresis is

a) Sodium reabsorption

b) Water retention

c) Urine production

d) Aldosterone secretion

100. In the _____ part of the nephron, the majority of water reabsorption occurs during diuresis

a) Proximal convoluted tubule

b) Distal convoluted tubule

c) Collecting duct

d) Loop of Henle

(A) Match the following:

	Column A		Column B
a	Pig	i	4.15×10^6
b	Cow	ii	1.0×10^6
c	Human	iii	1.9×10^6
d	Cat	iv	4.0×10^6
e	Dog	v	1.25×10^6

a) a-v, b-iv, c-ii, d-iii, e-i

b) a-iv, b-iii, c-ii, d-i, e-v

c) a-v, b-iii, c-ii, d-i, e-iv

d) a-ii, b-iv, c-iii, d-i, e-v

2. Removal of wastes and excess materials from the body through

	Column A		Column B
a	Volatile substance	i	Skin
b	Soluble, non-irritant solid substance	ii	Liver
c	Fats and its derivatives	iii	Kidneys
d	Heavy metals	iv	Lungs

a) a-i, b-iv, c-iii, d-ii

b) a-iv, b-iii, c-i, d-ii

c) a-ii, b-iv, c-iii, d-i

d) a-iii, b-ii, c-i, d-iv

3. Important transport maximus for substances that are actively reabsorbed by the tubules

	Column A		Column B
a	Glucose	i	1.5mM/min
b	Plasma protein	ii	75 mg/min
c	Urate	iii	375 mg/min
d	Amino acids	iv	30 mg/min
e	Lactate	v	15 mg/min

a) a-iii, b-v, c-iv, d-ii, e-i
b) a-ii, b-iv, c-iii, d-i, e-v
c) a-iv, b-ii, c-iii, d-v, e-i
d) a-iii, b-iv, c-v, d-i, e-ii
e) a-ii, b-v, c-i, d-iii, e-iv

4. Classes of diuretic

	Column A		Column B
a	Loop diuretics	i	Triamterene
b	Osmotic diuretics	ii	Furosemide
c	Aldosterone antagonists	iii	Spironolactone
d	Sodium channel blockers	iv	Acetazolamide
e	Carbonic anhydrase inhibitors	v	Mannitol

a) a-ii, b-iv, c-iii, d-v, e-i
b) a-i, b-v, c-ii, d-iv, e-iii
c) a-ii, b-v, c-iii, d-i, e-iv
d) a-iii, b-i, c-ii, d-v, e-iv
e) a-i, b-iv, c-v, d-ii, e-iii

5. Hormonal control of tubular reabsorption:

	Column A		Column B
a	Aldosterone	i	Increases Na^+ and water reabsorption
b	Angiotensin II	ii	Increases water reabsorption
c	ADH	iii	Increases Na^+ reabsorption and increases K^+secretion
d	Sympathetic nervou ssystem	iv	Increases Ca reabsorption
e	Parathyroid hormone	v	Its activation increases Na^+ reabsorption

a. a-iii, b-i, c-ii, d-v, e-iv
b. a-ii, b-iii, c-ii, d-i, e-v
c. a-iv, b-i, c-v, d-ii, e-iii
d. a-i, b-iii, c-iv, d-v, e-ii

6. Causes of chronic renal failure

	Column A		Column B
a	Metabolic disorder	i	Renal calculi
b	Immunologic disorders	ii	Renal hypoplasia
c	Urinary tract obstruction	iii	Glomerulonephritis
d	Congenital disorders	iv	Diabetes mellitus
e	Primary tubular disorders	v	Nephrotoxins

a) a-iv, b-ii, c-i, d-v, e-iii
b) a-v, b-ii, c-iii, d-iv, e-i
c) a-v, b-iii, c-iv, d-ii, e-i
d) a-iv, b-iii, c-i, d-ii, e-v

7. Nephrons and its function

	Column A		Column B
a	Superficial nephrons	i	Its main function is to concentratethe urine
b	Juxtamedullary nephron	ii	Its main function is the reabsorption& secretion of substances
c	Loops of Henle	iii	Countercurrent exchanger
d	vasa recta	iv	Countercurrent multiplier

a) a-ii, b-i, c-iv, d-iii
b) a-i, b-ii, c-iii, d-iv
c) a-iii, b-iv, c-ii, d-i
d) a-iv, b-iii, c-i, d-ii

8. Nature and formation of filtrate

	Column A		Column B
a	Glomerular filtrate	i	Ultrafiltrate of plasma
b	Diuresis	ii	High hydrostatic pressurefavouring filtration
c	Glomeruli	iii	Increased urine formation
d	Peritubular capillaries	iv	Low hydrostatic pressurefavouring reabsorption

a) a-iii, b-ii, c-iv, d-i
b) a-iii, b-ii, c-i, d-iv
c) a-i, b-iii, c-ii, d-iv
d) a-i, b-ii, c-iii, d-iv

9. Percentage of JM nephron (long looped nephron) in various species

	Column A		Column B
a	Pig	i	27
b	Dog	ii	28
c	Kangaroo rat	iii	0
d	Rat	iv	3
e	Beaver	v	100

a) a-iii, b-v, c-i, d-iv, e-ii
b) a-iv, b-v, c-i, d-ii, e-iii
c) a-iv, b-iii, c-ii, d-i, e-v
d) a-v, b-iv, c-iii, d-ii, e-i

10. Classes of diuretic and tubular site of action

	Column A		Column B
a	Thiazide diuretics	i	Proximal tubule
b	Loop diuretics	ii	Distal tubule and connecting tubule
c	Carbonic anhydras einhibitors	iii	Thick ascending limb of loop of Henle
d	Competitive inhibitors of aldosterone	iv	Mainly proximal tubule
e	Osmotic diuretics	v	Cortical collecting tubule

a) a-ii, b-iii, c-iv, d-v, e-i
b) a-i, b-iii, c-v, d-ii, e-iv
c) a-ii, b-iii, c-i, d-v, e-iv
d) a-iii, b-iv, c-i, d-ii, e-v

11. Body fluid compartments

	Column A		Column B
a	Extracellular fluid	i	the fluid filling up the spaces of chambers formed from the linings of the epithelial cells
b	Intracellular fluid	ii	the body fluid located within the cellor all cells of an organism
c	Interstitial Fluid	iii	the body fluid located outside thecell or cells of an organism
d	Transcellular fluid	iv	the fluid filling up the spacesbetween cells

a) a-iii, b-ii, c-iv, d-i
b) a-i, b-ii, c-iii, d-iv
c) a-iv, b-iii, c-ii, d-i
d) a-iii, b-ii, c-i, d-iv

12. Examples of different body fluids

	Column A		Column B
A	Interstitial Body Fluid	i	Blood plasma
B	Transcellular body fluid	ii	Lymphatic fluid, renal interstitialfluid
C	Intravascular body fluid	iii	Intraocular, peritoneal, pleural,cerebrospinal, digestive, and synovial fluid.

a) A-i, B-ii, C-iii
b) A-iii, B-ii, C-i
c) A-ii, B-iii, C- i

13. Abnormalities of Body Fluid Volume Regulation & their cause

	Column A		Column B

A	Hyponatremia—dehydration	i	Excess ADH (SIADH); bronchogenic tumours
B	Hyponatremia—overhydration	ii	Cushing's disease; primary aldosteronism
C	Hypernatremia—dehydration	iii	Diabetes insipidus; excessive sweating
D	Hypernatremia—overhydration	iv	Adrenal insufficiency; overuse of diuretics

a) A-i, B-ii, C-iii, D- iv
b) A-iii, B-ii, C-iv, D-i
c) A-ii, B-iii, C- i, D-iv
d) A-iv, B-i, C-iii, D-ii

14.

	Column A		Column B
A	Thirst Mechanism	i	Reduction in the amount of water lost in the urine.
B	The distal convoluted tubules and collecting ductsof the nephrons	ii	Primary regulator of water intake
C	Dehydration	iii	Water loss exceeds waterintake
D	Antidiuretics	iv	Primary regulator of water output

a) A-i, B-ii, C-iii, D- iv
b) A-iii, B-ii, C-iv, D-i
c) A-ii, B-iv, C- iii, D-i
d) A-iv, B-i, C-iii, D-ii

15.

	Column A		Column B
A	Crystalloids	i	Ensures that the proper levels of essential minerals like sodium and potassium in the body are maintained.

B	Colloids	ii	It contains large molecules and stays within blood vessels.
C	Maintenance fluid	iii	It contains electrolytes and can pass through cell membranes.
D	Electrolytic balance	iv	Given to compensate for ongoinglosses of fluid and to meet daily water need

a) A-i, B-ii, C-iii, D- iv
b) A-iii, B-ii, C-iv, D-i
c) A-ii, B-iv, C- iii, D-i
d) A-iv, B-i, C-iii, D-ii

(D). Statement type questions:

1. Statement 1: The plasma glucose levels in a healthy individual rarely reach a point where it leads to the excretion of glucose in the urine.

   Statement 2: In poorly managed diabetes mellitus, elevated plasma glucose levels can surpass the transport maximum, leading to the excretion of glucose in urine.

   a) Only statement 1 is correct
   b) Only statement 2 is correct
   c) Both statements 1 and 2 are correct
   d) Neither statement 1 nor 2 is correct

2. Statement 1: Approximately 65% of the filtered load of sodium and water, along with a slightly lower percentage of chloride, are reabsorbed by the proximal tubule before the filtrate reaches the loop of Henle.

   Statement 2: These percentages can be increased or decreased under normal conditions.

   a) Only statement 1 is correct
   b) Only statement 2 is correct
   c) Both statements 1 and 2 are correct
   d) Neither statement 1 nor 2 is correct

3. Statement 1: The latter portions of the distal tubule and the subsequent cortical collecting tubule share comparable functional features, consisting of both principal cells and intercalated cells.

   Statement 2: Both principal cells and intercalated cells participate in the reabsorption of sodium and water from the lumen, while concurrently secreting potassium ions into the tubular lumen.

a) Only statement 1 is correct
b) Only statement 2 is correct
c) Both statements 1 and 2 are correct
d) Neither statement 1 nor 2 is correct

4. Statement 1: The salt glands in birds release surplus salt when they consume food with high salt content or ingest seawater.

   Statement 2: Salt glands operate exclusively in the presence of a salt load; otherwise, they remain inactive.

   a) Only statement 1 is correct
   b) Only statement 2 is correct
   c) Both statements 1 and 2 are correct
   d) Neither statement 1 nor 2 is correct

5. Statement 1: The concentrating ability of the kidney is impaired due to the rapid flow of tubular fluid through the collecting ducts that prevents adequate water reabsorption. Statement 2: It is also impaired due to the rapid flow through both the loop of Henle and the collecting ducts that prevents the countercurrent mechanism from operating effectively to concentrate the medullary interstitial fluid solutes.

   a) Only statement 1 is correct
   b) Only statement 2 is correct
   c) Both statements 1 and 2 are correct
   d) Neither statement 1 nor 2 is correct

6. Statement 1: As water undergoes osmosis across the tight junction, it carries along some solutes, a phenomenon referred to as solvent drag.

   Statement 2: The reabsorption of water, organic solutes, and ions is linked to sodium reabsorption; alterations in sodium reabsorption notably impact the reabsorption of water and numerous other solutes.

   a) Only statement 1 is correct
   b) Both the statements are correct but statement 2 is not the correct reason for Statement 1
   c) Both the statements are correct and statement 2 is the correct reason for Statement 1
   d) Both the statements are incorrect

7. Statement 1: The right kidney is slightly lower than the left

   Statement 2: A large area is occupied by the liver in which the kidney is located

   a) Only statement 1 is correct

b) Both the statements are correct but statement 2 is not the correct reason forStatement 1
c) Both the statements are correct and statement 2 is the correct reason for Statement 1
d) Both the statements are incorrect

8. Statement 1: The process of glucose reabsorption is denoted as secondary active transport. Statement 2: Glucose is reabsorbed against a chemical gradient, albeit as a secondary process to primary active transport.
    a) Only statement 1 is correct
    b) Both the statements are correct but statement 2 is not the correct reason forStatement 1
    c) Both the statements are correct and statement 2 is the correct reason for Statement 1
    d) Both the statements are incorrect
9. Statement 1: The function of ADH is pivotal in regulating the extent of urine dilution or concentration.
   Statement 2: Without ADH, the distal tubules and collecting ducts exhibit high water permeability, leading the kidneys to eliminate substantial quantities of diluted urine.
    a) Only statement 1 is correct
    b) Both the statements are correct but statement 2 is not the correct reason forStatement 1
    c) Both the statements are correct and statement 2 is the correct reason for Statement 1
    d) Both the statements are incorrect
10. Statement 1: There is a limit for most substances that are actively reabsorbed or secretedat which the solute can be transported (Transport maximum).
    Statement 2: This limit is due to the saturation of the specific transport systems involved when the amount of solute delivered to the tubule (tubular load) exceeds the capacity of the carrier proteins and specific enzymes involved in the transport process.
    a) Only statement 1 is correct
    b) Both the statements are correct but statement 2 is not the correct reason for Statement 1
    c) Both the statements are correct and statement 2 is the correct reason for Statement 1

d) Both the statements are incorrect

11. Statement 1: Utilizing active transport, the sodium-potassium pump moves sodium ions out of cells and potassium ions into cells.

    Statement 2: Transport of the glucose molecules into the cells is accomplished with the help of active transportation using glucose transporters

    a) Only statement 1 is correct
    b) Only statement 2 is correct
    c) Both the statements are correct
    d) Both the statements are incorrect

12. Statement 1: Severe dehydration can lead to kidney failure

    Statement 2: During dehydration the hydrostatic pressure in the kidney drops low, which results in a decrease in the removal of nitrogenous wastes from the bloodstreamhampering the normal functioning of the kidneys

    a) Only statement 1 is correct
    b) The reason for the statement is correct
    c) Both statements and reason are correct
    d) Neither statement nor reason is correct

13. Statement 1: Sweating causes the loss of water from the sweat glands causing the depletion of water and an increase in the solute concentration in the skin tissue.

    Statement 2: During sweating, the depletion of water from the skin tissue and the replacement of the depleted water from the bloodstream to the sweat glands is because ofan osmotic gradient.

    a) Only statement 1 is correct
    b) Only statement 2 is correct
    c) Both the statements are correct
    d) Both the statements are incorrect

14. Statement 1: Sodium depletion in the blood can cause low blood pressure and low urinevolume leading to acute kidney failure

    Statement 2: potassium deficiency in the blood can lead to acute or chronic diarrhoea, apathy, confusion and weakness

    a. Only statement 1 is correct
    b. Only statement 2 is correct
    c. Both the statements are correct
    d. Both the statements are incorrect

15. Statement 1: Loss of water from the extracellular fluid led to increased plasma sodium concentration resulting in increased osmolarity. This results in hypernatremia or dehydration.

    Statement 2: Dehydration can occur from an inability to secrete antidiuretic hormone, whichis needed for the kidneys to conserve water.

    a) Only statement 1 is correct
    b) Only statement 2 is correct
    c) Both the statements are correct
    d) Both the statements are incorrect

16. Statement 1: Males have a higher volume of body fluid as compared to females as femaleshave more amount of fat tissues

    Statement 2: Lean tissues have higher fluid content than fat tissues.

    a) Both the statements are correct and statement 2 is the correct reason for Statement 1
    b) Both the statements are correct but statement 2 is not the correct reason forStatement 1
    c) Both the statements are incorrect
    d) Only statement 2 is correct

17. Statement 1: Crystalloids are fluid solutions that contain larger molecules, preventingthem from passing through cell membranes.

    Statement 2: Lactated Ringer's solution, 0.45% NaCl, and 5% Dextrose in water are crystalloid fluids

    a) Only statement 1 is correct
    b) Only statement 2 is correct
    c) Both the statements are correct
    d) Both the statements are incorrect

18. Statement 1: The central regulation of water and electrolyte balance is carried out by the kidneys.

    Statement 2: The kidneys perform blood filtration, reabsorb vital substances, and eliminate waste products by producing urine.

    a) Both the statements are correct and statement 2 is the correct reason for Statement 1
    b) Both the statements are correct but statement 2 is not the correct reason forStatement 1

c) Both the statements are incorrect

d) Only statement 2 is correct

19. Statement 1: The hormone aldosterone plays a key role in maintaining the electrolyte balance in the body

Statement 2: Aldosterone is released by the adrenal glands and promotes the reabsorption of sodium and excretion of potassium from the kidneys.

a) Only statement 1 is correct

b) Only statement 2 is correct

c) Both the statements are correct

d) Both the statements are incorrect

20. Statement 1: An increase in the hormone levels of aldosterone can contribute tohypokalaemia.

Statement 2: Hypokalaemia is associated with an increased risk of blood clotting.

a) Only statement 1 is correct

b) Only statement 2 is correct

c) Both the statements are correct

d) Both the statements are incorrect

References:

1. Dukes Physiology of Domestic Animals
2. Guyton and Hall Textbook for Medical Physiology
3. Fluid, Electrolyte, and Acid-Base Disorders in Small Animal Practice

ANSWER KEYS:

Fill in the Blanks:

1. Glucose
2. Prostaglandin
3. Angiotensin II
4. Negative
5. Inulin
6. Pons
7. Micturition
8. Vasa recta
9. Renin

10. Mesangial cell
11. Aldosterone
12. Uric acid
13. Horse
14. Podocyte
15. Peritoneal
cavity16. 15%
17. Solvent drag
18. Horse
19. Thiazide derivatives
20. Isosthenuria
21. Nephrotic syndrome
22. Solutes
23. Extracellular fluid (ECF)
24. Interstitial fluid (IF)
25. Intracellular fluid (ICF)
26. Intravascular fluid
27. Interstitial fluid
28. Transcellular fluid
29. Osmotic pressure
30. Hydrostatic pressure
31. water concentration is high (and the concentration of solute is low); the water concentration is low (and the concentration of solute is high)
32. Active; Passive
33. Hydrostatic pressure
34. Capillary blood pressure
35. Choroid plexus
36. Alkalosis
37. Acidosis
38. Hyponatremia or cell swelling
39. Thirst mechanism
40. Diabetes mellitus
41. Hydration level
42. Daily

43. Crystalloids
44. Colloids
45. Subarachnoid space
46. Lymph nodes
47. Lymphatic system
48. Bicarbonate
49. Sodium; Potassium
50. Antidiuretic hormone (ADH)

Multiple choice questions

1. b
2. b
3. b
4. c
5. b
6. a
7. c
8. a
9. a
10. d
11. b
12. c
13. c
14. a
15. d
16. d
17. a
18. a
19. b
20. a
21. a
22. b
23. b
24. d

25. d
26. a
27. d
28. d
29. a
30. b
31. c
32. b
33. b
34. b
35. c
36. d
37. a
38. b
39. a
40. b
41. b
42. c
43. d
44. c
45. a
46. b
47. b
48. a
49. b
50. c
51. b
52. c
53. a
54. b
55. c
56. b
57. c
58. b

59. d
60. a
61. c
62. a
63. d
64. c
65. a
66. b
67. d
68. a
69. c
70. a
71. b
72. d
73. c
74. b
75. b
76. d
77. b
78. d
79. b
80. d
81. d
82. b
83. a
84. d
85. a
86. a
87. c
88. c
89. a
90. d
91. d
92. b

93. c
94. c
95. d
96. d
97. a
98. a
99. c
100. d

Match the Column:

1. a
2. b
3. d
4. c
5. a
6. d
7. a
8. c
9. b
10. c
11. a
12. c
13. d
14. c
15. b

Statement type questions:

1. c
2. c
3. a
4. c
5. c
6. c
7. c

8. c
9. a
10. c
11. a
12. c
13. c
14. c
15. c
16. a
17. b
18. a
19. c
20. a