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THE COPPERBELT UNIVERSITY

MCS SCHOOL OF MEDICINE

END OF TERM III TEST – SEPTEMBER, 2019

MBS 210

PHYSIOLOGY

NAME: [redacted]

STUDENT ID NUMBER: ...17115853.....**PROGRAMME:** ..MBChB...**TIME ALLOWED: 2 HOU**

INSTRUCTIONS:

1. Write your number on every page of the answer sheet.
2. Answer **ALL** questions

SECTION – A

Instructions: Unless otherwise specified, choose the single best answer. Answer **ALL** questions.

1. The most abundant protein in blood is:
A. albumin
B. hemoglobin
C. fibrinogen
D. beta-1 globulin
E. All of the above

2. Macrocytes have a mean corpuscular volume greater than:
A. 70 fL
B. 80 fL
C. 90 fL
D. 100 fL
E. 150 fL

3. The amount of hemoglobin contained in normocytes is approximately:
A. 20 pg
B. 25 pg
C. 30 pg
D. 35 pg
E. 50 pg

4. The amount of hemoglobin present in 100 ml of red blood cells is defined as:
A. MCH
B. MCHC
C. hemoglobin index
D. RDW
E. MCV

5. In an individual with a blood hemoglobin concentration of 10 g/dL and a hematocrit of 40, MCHC is approximately:
A. 20 g/dL
B. 25 g/dL
C. 30 g/dL
D. 35 g/dL
E. 50 g/dL

6. A lab technician determines RBC count by manual hemocytometry, blood hemoglobin concentration by Sahli's acid hematin method, and hematocrit using a microcentrifuge. He follows all procedures correctly. Which of the following RBC indices calculated from these measurements would likely be the **most reliable**?

A. Mean corpuscular volume
B. Mean corpuscular hemoglobin
C. Mean corpuscular hemoglobin concentration
D. Mean cell diameter
E. Mean erythrocyte hemoglobin

7. Primary hemostasis refers to cessation of bleeding due to:
A. Formation of a definitive clot
B. Clot retraction
C. Formation of a temporary platelet plug.
D. Vasoconstriction
E. None of the above

8. *Select all correct answers.* Platelet aggregation is stimulated by:
A. thromboxane A_2
B. ADP
C. thrombin
D. serotonin
E. Prostaglandin I_2

9. The adhesion of platelets to subendothelial collagen is impaired in the absence of:
A. von Willebrand factor
B. plasmin
C. heparin
D. antithrombin III
E. All of the above

10. Which of the following clotting factors is **not** vitamin K dependent?
A. Factor II
B. Factor V
C. Factor VII
D. Factor IX
E. Factor X

11. The extrinsic pathway is triggered by the release of:
A. Factor VII
B. Tissue factor
C. Tissue factor pathway inhibitor
D. Contact factor
E. Von Willibrand factor

12. The extrinsic pathway is inhibited by:
A. Tissue factor
B. Thromboplastin

C. Tissue factor pathway inhibitor (TFPI)
D. Contact factor
E. Fibrin stabilizing factor

13. The test that screens the extrinsic pathway is:
A. Prothrombin time (PT)
B. Activated partial thromboplastin time (aPTT)
C. Thrombin time
D. Urea solubility test
E. Clot lysis time

14. The enzyme that ultimately lyses fibrin is:
A. Plasminogen
B. TPA
C. Urokinase
D. Plasmin
E. Tyrpsin

15. Prolongation of prothrombin time does **not** occur when there is a deficiency of only:
A. Factor VIII
B. Factor IX
C. Factor X
D. Vitamin K
E. Protein S

16. *Select all correct answers.* Mutations in which of the following have been implicated in the pathogenesis of hypercoagulable states?
A. Protein C
B. Protein S
C. Factor V
D. Antithrombin III
E. None of the above

17. Factor V Leiden:
A. Is a mutated form of factor IX
B. Is inactivated by protein C
C. Is present in a large subset of patients with venous thromboembolism
D. All of the above
E. None of the above

18. *Select all correct answers.* Which condition(s) is / are characterized by an increase in both bleeding time and clotting time?
A. Afibrinogenemia
B. Hypoprothrombinemia
C. Hemophilia A
D. von Willebrand's disease

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(E) Hypoalbuminemia

19. Red cell antigens A and B are chemically:
A. Phospholipids
(B) Glycosphingolipids
C. Glycopeptides
D. Polypeptides
E. Glycocalyx

20. *Select all correct answers.* Red blood cell antigens A and B are also present in:
A. Saliva
(B) Semen
(C) Amniotic fluid
D. Pancreas
(E) Liver

21. The red blood cells of a person with the Bombay blood group do **not** have:
A. GLUT
(B) H substance
C. Spectrin
D. Ankyrin
(E) None of the above

22. Most of the iron in the body is present in:
(A) Hemoglobin
B. Myoglobin
C. Ferritin
D. Transferring
E. Liver

23. In an Rh-negative mother not previously sensitized by the Rh antigen, Rh incompatibility does not usually have a serious consequence during the first pregnancy **because:**
A. Antibodies are not able to cross placenta
(B) The titer of IgG is low during the primary immune response
C. IgG is ineffective against fetal red cells
D. Massive hemolysis in the fetus is compensated by increased erythropoiesis
E. None of the above

24. In the context of blood transfusions, ABO compatibility is important because:
A. There are 3 antigens in this system
B. The A and B antigens are present in all cells
(C) When an individual's RBC lacks the A or B antigen, the corresponding

antibody is invariably present in serum.

D. O is a strong antigen

25. A 55-year-old male accident victim in the ED urgently requires a transfusion. His blood group could not be determined as his red cell group and plasma group did not match. Emergency transfusion should be done with:

A. RBC corresponding to his red cell group and colloids and crystalloids
B. Whole blood corresponding to his plasma group.
C. O positive RBC, colloids and crystalloids
D. AB negative blood
E. All of the above

26. In the adult, most of the circulating erythropoietin originates from:

A. Interstitial cells (fibroblasts) surrounding peritubular capillaries in the renal cortex
B. Perivenous hepatocytes
C. Kupffer cells of liver
D. Osteoblastic cells of the bone marrow
E. Macrophages

27. Osmotic fragility of red blood cells is **decreased** in:

A. Sickle cell anemia
B. Hereditary spherocytosis
C. Microcytic hypochromic anemia
D. Macrocytic anemia
E. All of the above

28. Hereditary spherocytosis occurs due to mutations in genes coding for:

A. Spectrin and ankyrin
B. Na-K ATPase
C. Glucose-6-phosphate dehydrogenase
D. Pyruvate kinase
E. Glutathione

29. CO_2 is formed as an end product of:

A. heme metabolism
B. arginine metabolism
C. oxidation of acetoacetate
D. Bilirubin reduction
E. All of the above

30. Heme is converted to bilirubin mainly in the:

A. kidneys

B. liver
C. spleen
D. bone marrow
E. Muscle

31. The protein that binds extracorpuscular hemoglobin is:
A. hemin
B. haptoglobin
C. hemopexin
D. haptopexin
E. All of the above

32. When a serum sample is electrophoresed, which of the following bands is normally **absent?**
A. Albumin
B. α_1 globulin
C. α_2 globulin
D. Fibrinogen
E. γ-globulin

33. Which of the following is **not** synthesized in the liver?
A. IgG
B. α_2 macroglobulin
C. Albumin
D. Angiotensinogen
E. All of the above

34. Which of the following plasma proteins are protease inhibitors?
A. α_1 antitrypsin
B. Transferrin
C. C-reactive protein
D. Antithrombin III
E. All of the above

35. Which of the following is a 'negative' acute phase reactant?
A. Albumin
B. C-reactive protein
C. α_2 macroglobulin
D. Transferrin
E. All of the above

36. ESR is increased in:
A. anemia
B. hypofibrinogenemia
C. spherocytosis
D. polycythemia

E. Hypertension

37. The average half-life of neutrophils in the circulation is:
A. 6 hours
B. 5 days
C. 2 weeks
D. 1 month
E. 120 days

38. The protein content of lymph draining from the_____is highest.
A. Choroid plexus
B. Skeletal muscle
C. Liver
D. Gastrointestinal tract
E. Lungs

39. Which of the following is **incorrect** about fetal hemoglobin (HbF)?
A. In comparison to HbA, HbF has greater affinity for 2,3–BPG
B. The oxygen dissociation curve of HbF is shifted to the left relative to HbA.
C. At low PO_2, HbF gives up more oxygen to tissues than HbA.
D. All are correct
E. None of the above

40. Problems of massive transfusion most commonly include:
A. Metabolic alkalosis
B. Hyperkalaemia
C. Coagulopathy
D. None of the above
E. All of the above

41. Which immunoglobulin would exist as a monomer in tears, saliva & mucus secretions
A. IgA
B. IgG
C. IgM
D. IgE
E. IgD

42. Erythropoietin is a glycoprotein which:
A. Stimulates red and white cell production
B. Is broken down in the kidney
C. Has a half life of days
D. None of the above
E. All of the above

43. Erythropoietin:
A. Red cell maturation 24 to 72 hours
B. Inactivated by Kupffer cells
C. Metabolised in liver
D. Half-life is 5 mins
E. None of the above

44. Antithrombin III inactivates which coagulation factor?
A. XIa
B. IIIa
C. Ia
D. IXa
E. All of the above

45. Vitamin K neutralizes:
A. Factor 5
B. Heparin
C. Antithrombin 3
D. Plasminogen
E. None of the above

46. Platelet activation will NOT occur without:
A. Ca^{+2}
B. Vessel wall damage
C. Von Willebrand factor
D. Serotonin
E. All of the above

47. Glycoprotein CD_4 is expressed on:
A. Cytotoxic T cells
B. Suppressor T cells
C. Helper T cells
D. Plasma cells
E. Complement Determinant cells

48. HLA antigens are found on:
A. All leucocytes
B. B cells
C. T cells
D. All nucleated cells
E. All cells

49. Which of the following is *not* primarily a function of blood plasma?
A. Transport of hormones
B. Maintenance of red cell size
C. Transport of chylomicrons

D. Transport of antibodies
E. Transport of O_2

50. A hematocrit of 41% means that in the sample of blood analyzed
A. 41% of the hemoglobin is in the plasma
B. 41% of the total blood volume is made up of blood plasma
C. 41% of the total blood volume is made up of red and white blood cells and platelets
D. 41% of the hemoglobin is in red blood cells
(E) 41% of the formed elements in blood are red blood cells

51. In normal human blood
A. the eosinophil is the most common type of white blood cell
B. there are more lymphocytes than neutrophils
(C) the iron is mostly in hemoglobin
D. there are more white cells than red cells
E. there are more platelets than red cells

52. Lymphocytes
A. all originate from the bone marrow after birth
B. are unaffected by hormones
C. convert to monocytes in response to antigens
D. interact with eosinophils to produce platelets
(E) are part of the body's defense against cancer

53. In which of the following diseases is the structure of the hemoglobins that are produced normal but their amount reduced?
A. Chronic blood loss
B. Sickle cell anemia
(C) Hemolytic anemia
D. Thalassemia
E. Transfusion reactions

54. Plasma
A. Contains about 50% water.
B. Contains about 40% plasma proteins.
C. Volume changes considerably from moment to moment.
D. Is a colloidal solution.
(E) All of these

55. The liquid portion of the blood with fibrinogen and some of the clotting proteins removed is;
A. Plasma
B. Platelets.
C. Plasma proteins.
D. Formed elements.
(E) Serum

56. Cells in the red bone marrow that give rise to all the formed elements of the blood are called

A. Fibrinogen.
B. Globulins
C. Megakaryoblasts
D. Proerythroblasts
E. Stem cells

57. Which of these areas does NOT contain red marrow in the adult?

A. Sternum
B. Ribs
C. Pelvis
D. distal femur
E. vertebrae

58. Each hemoglobin molecule has _____ heme group(s) and _____ globin molecule(s).

A. 1, 2
B. 1, 4
C. 2, 4
D. 4, 2
E. 4, 4

59. The form of hemoglobin that has carbon dioxide attached is called:

A. Oxyhemoglobin.
B. Deoxyhemoglobin.
C. Carboxyhemoglobin.
D. Carbaminohemoglobin.
E. All of the above

60. Pernicious anemia is an example of:

A. Hypochromic anemia.
B. Nutritional anemia.
C. Hemorrhagic anemia.
D. Hemolytic anemia.
E. Polycythemia.

SECTION B: ANSWER ALL QUESTIONS

1. Explain the mechanism by which aspirin prevents intravascular clotting (5 marks)

Aspirin is a drug that inhibits the cyclooxygenase enzyme needed for the production of prostaglandins A_2. Prostaglandins A_2 further form, thromboxane A_2 and prostacyclin. Endothelial cells are able to regenerate cyclooxygenase enzyme and restore the production of prostacyclin more rapidly than thromboxane A_2. Prostacyclin increases in amount and is a substance that inhibits platelet aggregation. Elevated amounts therefore prevent intravascular clotting.

2. State the causes and consequences of hypoproteinemia (10 marks)

i) Reduced protein intake (in diet)
ii) Malabsorption of proteins in intestines.
iii) Trauma or severe injury leading to excessive blood loss.
iv) Lead to liver damage.
v) Eodema due to loss of albumin plasma protein.
vi) Glomerulonephritis.
vii) Oliguria.
viii) Failure of blood to clot due to low clotting factors.
ix) Kwashiorkor in children.
x) Stunted growth in children.

3. What are the components of the Prothrombin activation complex? (4 marks)

i) Platelet factor 3 (PL)
ii) Factor X_a
iii) Factor V_a
iv) Factor II_a

4. How is the intrinsic system inhibited? (2 marks)

By inhibiting factor XII.
Exposure to a non-wettable substance.
Exposure to an uncharged surface.

5. Name two factors that activate factor VIII and Name two functions of vWF (4 marks)

i) Thrombin

ii) Factor IXa

i) Von Willebrand forms a complex with factor VIII inactivating it.

ii) Von Willebrand factor initiates platelet aggregation at the site of injury.

6. How does thrombin enhance the clotting process? (3 marks)

Thrombin, which is derived from prothrombin, (in its activated form) converts faster soluble fibrinogen to insoluble fibrin releasing two polypeptides from fibrinogen. These fibrin strands polymerized forming long threads and form a clot retinulum. Thrombin is needed for this process to occur and it occurs in the presence of Ca^{2+} and platelet factor 3.

7. What is the importance of Vitamin K in blood clotting and mention the clotting factors that depend of Vitamin K for their activation? (7 marks)

Vitamin K is an antihemolytic vitamin that is needed for the activation of certain clotting factors necessary in the clotting process.

i) Factor II
ii) Factor VII
iii) Factor IX
iv) Factor X
v) Protein C
vi) Protein S.

8. Mention the clotting factors that form the prothrombin group and those that are not synthesized in the liver (8 marks)

Prothrombin group.

i) Factor II
ii) Factor VII
iii) Factor IX
iv) Factor X

Not synthesized by liver.

i) Factor III
ii) Factor IV
iii) Factor XIII
iv) Von Willebrand factor

9. List the various types of hemoglobin and their polypeptide configurations (4marks)

HbA = $2\alpha 2\beta$.

HbA_{1c} = $2\alpha 2\beta$ (the beta polypeptide contains glucose molecules attached to it).

HbF = $2\alpha 2\gamma$.

HbS = $2\alpha 2\beta$ (on the beta polypeptides, glutamic acid residue replaced by valine residue).

10. Mention the functions of Protein C and S (3 marks)

Protein S is a co factor of Protein C, which is need from the deactivation of factor II and V as it binds to thrombomodulin - thrombin complex on the endothelial wall.

11. List the receptors present of the platelet cell membrane (5 marks)

04

i) ADP.
ii) Von willebrand Factor
iii) Thromboxane A_2
iv) Serotonin
v) Thrombin

12. State the natural anticlotting mechanisms of the body (7 marks)

i) Endothelial cells are constantly producing cyclooxygenase enzyme needed for the production of prostaglandins then furthermore production of prostacyclin, which inhibits platelet aggregation

ii) Basophils and Mast cells are constantly producing heparin, which is a natural anticoagulant, preventing formation of blood clots ~~intravascularly~~ in the intravascular.

03

iii) Fibrinolytic system, produces plasmin which is ingesting any clotting formed and leaving the blood vessel free of ~~clots~~ clots.

13. Without the benefits of mitochondria and ribosomes for synthesizing protein, how is the erythrocyte able to survive for more than 4 months in the face of repeated oxidant stress from high O_2 concentration and repeated mechanical stress? (5 marks)

i) The Red blood cell has a cytoskeleton containing spectrin and ankyrin needed for maintenance of the biconcave shape and cellular volume.

ii) Contains Glucose-6-Phosphate dehydrogenase, a reductase enzyme, forming NADPH (for. maintain osmotic fragility) and protection from oxidative stress.

07

iii) Maintenance of the affinity of Oxygen by the hemoglobin contained in the cell.