UNIVERSITI KUALA LUMPUR
INSTITUTE OF MEDICAL SCIENCE TECHNOLOGY

FINAL EXAMINATION

OCTOBER 2025 SEMESTER

COURSE CODE	:	HDB30803
COURSE TITLE	:	ADVANCED HEMATOLOGY
PROGRAMME NAME	:	BACHELOR OF BIOMEDICAL SCIENCE (HONOURS)
DATE	:	24 JANUARY 2026
TIME	:	9:00AM - 12:00PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of TWO sections.
4. Answer ALL questions for Section A.
5. Section B consist of four questions. Answer THREE (3) questions only.
6. Please write your answer on the answer booklet provided.
7. Please answer all questions in English only.
8. Please answer MCQ/EMQ questions using OMR sheet. ☐ *Tick if applicable*
9. Refer to the attached Formula/ Appendies. ☐ *Tick if applicable*

THERE ARE 17 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

1. Which of the following is the morphological classification of hemolytic anemia?

   A. normochromic, normocytic

   B. normochromic, microcytic

   C. hypochromic, microcytic

   D. normochromic, macrocytic

2. Which of the following tests is not useful in determining increased erythrocyte destruction?

   A. Unconjugated bilirubin

   B. Total leukocyte count

   C. Reticulocyte count

   D. Serum haptoglobin

3. Hemolytic anemia may result in _____.

   A. petechia

   B. loss of vibratory sense

   C. acidosis

   D. jaundice

4. A 30-year-old woman has history of mild fatigue for many years. The lab diagnosis shows the hemoglobin value of 11.1g/dL, hematocrit value of 28.8%, MCV value of 83fL, platelets count of 229,000/μL, WBC count of 7340/μL. The peripheral blood film demonstrates the presence of small RBCs that lack of central pallor. The osmotic fragility of RBCs is increased, and the Coombs test is negative. Which of the following defects are involved in the pathogenesis of this disorder?

   A. Erythrocyte cytoskeleton

   B. Clonal stem cell defect

   C. Hemoglobin synthesis

   D. Iron utilization from iron stores

5. Which of the following is a feature of a chronic extravascular hemolytic anemia?

   A. Raised serum conjugated bilirubin

   B. Low reticulocyte count

   C. Gallstone

   D. Hypocellular bone marrow

6. Alice is hospitalized due to acute intravascular hemolytic anemia. Which of the following results confirmed her diagnosis?

   A. Decrease of plasma bilirubin.

   B. Decrease of plasma haptoglobin.

   C. Increase of marrow ferritin.

   D. Increase of plasma transferrin.

7. An 18-year-old Swedish girl presents with jaundice and anemia. Laboratory studies are significant for a decreased mean cell volume (MCV), an increased mean corpuscular hemoglobin concentration (MCHC), and an increase in osmotic fragility of the red blood cells. Red blood cells on peripheral blood smear (PBS) are most likely to be _____.

   A. anisocytes

   B. spherocytes

   C. schistocytes

   D. macrocytes

8. Which of the following is false about hereditary spherocytosis?

   A. Splenomegaly is very common.

   B. Increased ratio of RBC surface area to volume.

   C. Mean corpuscular volume is usually normal.

   D. Mean corpuscular hemoglobin concentration is increased.

9. Which of the following pathway is related to glucose-6-phosphate dehydrogenase (G6PD)?

   A. Hexose monophosphate shunt

   B. Purine salvage pathway

   C. Embden-Meyerhof pathway

   D. Methemoglobin reductase pathway

10. Which of the following is the most observable feature of the red blood cells in G6PD deficiency?

   A. Howell-jolly bodies

   B. Heinz bodies

   C. Crescent bodies

   D. Cabot rings

11. A 25-year-old African American man is given anti-malarial prophylaxis for a trip to West Africa. Over the next week, he develops increasing fatigue. On physical examination, there are no abnormal findings. Laboratory investigation demonstrates that the hematocrit level is 30%. The peripheral blood smear shows RBCs with numerous Heinz bodies. There is a family history of this disorder, with males, but not females, affected. Which of the following is the most likely diagnosis?

    A. Hemolytic anemias

    B. Beta thalassemia

    C. Hereditary spherocytosis

    D. G6PD deficiency

12. In glucose-6-phosphate dehydrogenase (G6PD) deficiency, anemia is ultimately resulted from _____.

    A. build up of 2,3-biphosphoglycerate and poor iron binding

    B. oxidative damage of hemoglobin and splenic removal of erythrocytes

    C. decreased formation of normal hemoglobins

    D. membrane protein defects and loss of erythrocyte flexibility

13. The gene defects in paroxysmal nocturnal hemoglobinuria (PNH) is known as _____.

    A. hepatocyte nuclear factor 4α (HNF4α)

    B. Breast cancer gene 1 (BRCA1)

    C. cystic fibrosis transmembrane regulator (CFTR)

    D. phosphatidylinositol glycan A (PIGA)

14. Paroxysmal nocturnal hemoglobinuria (PNH) episodes are usually associated with _____.

A. cold temperatures

B. hot temperatures

C. certain foods or drugs

D. sleep

15. Increased osmotic fragility is found in _____.

A. sickle cell anemia

B. hereditary spherocytosis

C. microcytic anemia

D. pernicious anemia

16. A 31-year-old man presented with a 1-week history of generalized lethargy, malaise, and myalgia. Physical examination revealed jaundice and mild hepatosplenomegaly. The blood film showed a marked spherocytosis and the direct antiglobulin test (DAT) was positive. Which of the following is the most likely diagnosis?

A. Immune complex drug induced hemolytic anemia.

B. Hemolytic disease of the fetus and newborn.

C. Warm autoimmune hemolytic anemia.

D. Hereditary spherocytosis.

17. A 52-year-old woman suffers from an acute onset of normocytic, normochromic anemia, hemoglobinuria, hemosiderinuria, and jaundice accompanied by a decreased serum haptoglobin. What is the most likely cause of this patient's findings?

A. Hemolysis

B. Erythrocytosis

C. Iron deficiency

D. Hemorrhage

18. Which of the following is a cause of congenital hemolytic anemia?

    A. Malaria

    B. Pyruvate kinase deficiency

    C. Red cell fragmentation syndrome

    D. ABO incompatibility

19. Leukopenia is a condition where there is a/an _____.

    A. increase in circulating white blood cells

    B. increase in circulating granulocytes

    C. decrease in circulating white blood cells

    D. decrease in circulating lymphocytes

20. Which of the following is not true about neutropenia?

    A. It occurs in aplastic anemia.

    B. It is caused by aspirin.

    C. It may be caused by acute myeloid leukemia.

    D. It is associated with systemic lupus erythematosus.

21. Which of the following is not a cause of neutrophil leukocytosis?

    A. Asthma

    B. Myocardial infarct

    C. Corticosteroid therapy

    D. Trauma

22. Which of the following is the most common presentation of B-chronic lymphocytic leukemia (B-CLL) at the time of initial diagnosis?

A. Patient is asymptomatic but has increased white cell count.

B. Anemia caused by autoimmune hemolysis.

C. Enlarged lymph nodes.

D. Severe and prolonged infection.

23. Which of the followings is least valuable in the diagnosis of acute myeloid leukemia?

A. Analysis of immunophenotyping of a bone marrow sample.

B. Analysis of clonal rearrangement of the immunoglobulin heavy chain gene.

C. Analysis of cytogenetic of the peripheral blood.

D. Analysis the microscopic morphology of the bone marrow aspirates.

24. A 6-year-old boy demonstrates fatigue, fever and marked pallor. Laboratory studies demonstrated anemia, thrombocytopenia, and leukocytosis. The peripheral blood smear shows 90% blasts that stain positive on immunohistochemistry with terminal deoxynucleotidyl transferase (TdT). Which of the following is the most likely diagnosis?

A. Chronic myeloid leukemia

B. Acute myeloid leukemia

C. Acute lymphocytic leukemia

D. Chronic lymphocytic leukemia

25. Primary polycythemia exists where there is a/an _____.

A. chronic obstructive pulmonary disease in an individual

B. increase in circulating erythrocytes, leukocytes, and platelets

C. decrease of circulating plasma

D. physiologic response to hypoxia

26. The pathophysiology of polycythemia vera is essentially caused by _____.

A. fewer erythrocytes than normal

B. an acquired mutation in Janus Kinase 2

C. increased rate of blood flow

D. decreased blood volume

27. Primary polycythemia is also called _____.

A. blood volume depression

B. stress polycythemia

C. polycythemia vera

D. relative polycythemia

28. Which of the following diseases are classified as Philadelphia negative chronic myeloproliferative disorder (CMPD)?

A. Polycythemia vera and essential thrombocythemia.

B. Myelofibrosis and acute myeloid leukemia.

C. Chronic myeloid leukemia and chronic myelomonocytic leukemia.

D. Chronic lymphocytic leukemia and lymphoma.

29. The leukemia that often shows polycythemia in the early stages of the disease is _____.

A. acute lymphocytic leukemia

B. acute myeloid leukemia

C. chronic myeloid leukemia

D. chronic lymphocytic leukemia

30. Secondary polycythemia may be caused by _____.

A. chronic obstructive pulmonary disease

B. abnormality of bone marrow stem cells

C. dehydration

D. excessive use of diuretics

31. The normal hemostasis response to vascular damage depends on three major factors. Which of the following is not included in that group?

A. Circulating platelets.

B. Stasis of the blood flow.

C. Blood coagulation factors.

D. The blood vessel wall.

32. A coagulation consultation is requested for an asymptomatic patient who previously had a six day surgery and a prolonged hospital course requiring intravenous antibiotics. Her prothrombin time (PT) and activated partial thromboplastin time (APTT) are both prolonged. Mixing studies with normal plasma show that both PT and APTT are completely corrected. Which of the following coagulation factors is most likely to be deficient?

A. Factor VIII

B. Factor X

C. Factor VII

D. Factor IX

33. A 20-year-old woman undergoes extraction of her impacted wisdom teeth. The normal hemostatic process should result in the formation of a blood clot and control of bleeding at the site of extraction. The final step in this normal hemostatic process is the conversion of soluble fibrin to insoluble fibrin, which is mediated by _____.

A. factor II

B. factor XIII

C. factor IX

D. factor VIII

34. Activated partial thromboplastin time (APTT) initiates the coagulation cascade by activating factor _____ with a contact activator such as _____.

A. X, phospholipid

B. XII, kaolin

C. II, silica

D. VII, collagen

35. A serum biochemistry profile of 32-year-old man revealed a marked decrease of fibrinogen. Which of the following clinical features may associate with his condition?
I. Jaundice
II. Epistaxis
III. Angular cheilitis
IV. Spontaneous bruises

A. I and II only

B. II and IV only

C. I and III only

D. III and IV only

36. A 4-year-old boy came to clinic to have bloods taken for a check-up following a recent stay in hospital with a chest infection. However, following venepuncture, his mother has noticed that he bled for quite some time. On examination they also notice multiple petechiae on his legs, without any history of significant trauma. The blood tests show PT 12 seconds (normal 11-14s), APTT 55 seconds (normal 29-39s) & fibrinogen 2.2 g/l (normal 1.9-4.3 g/l). Von Willebrand factor is normal. The factor VIII assay is reduced, whilst factor IX is normal. What is the most likely diagnosis of this child?

    A. Hemophilia B

    B. Idiopathic thrombocytopenic purpura

    C. von Willebrand disease

    D. Hemophilia A

37. Which of these individuals might be considered as the optimal stem cell donor for an adult patient with acute myeloid leukemia in first remission?

    A. An identical twin.

    B. Human leukocyte antigen-matched sibling donor.

    C. Human leukocyte antigen-matched unrelated donor.

    D. A cord blood stem cell donation.

38. Which of the following diseases may be cured by both allogeneic and autologous hematopoietic cell transplantation?

    A. Thalassemia

    B. Fanconi anemia

    C. Sickle cell anemia

    D. Acute leukemia

39. A 19-year-old Swedish female presents with jaundice and anemia. Laboratory findings show a reduced mean cell volume (MCV), elevated mean corpuscular hemoglobin concentration (MCHC), and increased osmotic fragility of red blood cells. The most likely red blood cell morphology to be seen on the peripheral blood smear are _____.

A. macrocytes

B. schistocytes

C. anisocytes

D. spherocytes

40. Which of the following is the most common cause of death following allogeneic stem cell transplantation?

A. Graft-versus-host disease

B. Infections

C. Idiopathic pneumonitis

D. Relapse of the underlying condition

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

Discuss the hematopoietic stem cell transplantation (SCT) including the sources of hematopoietic stem cells, type of SCT, the reason of doing the transplantation and complications associated with the SCT.

(20 marks)

Question 2

Mrs. Nurin is a 68-year-old Malay woman who has retired for the past 10 years. She was encouraged to go to her family doctor by her husband. On physical examination, the doctor observed a plethoric appearance on her face. She also complained a severe headache lately and discomfort in her chest and stomach areas. Moreover, her body also itches easily after a hot shower but there was no sign of skin rashes. The doctor carried out several blood and other necessary tests. The laboratory results were shown in the following table;
Refer Below - Table1 : Patient's results on blood profiles and genetic testing. .

Table 1: Patient's results on blood profiles and genetic testing.

Test:	**Result:**
Hemoglobin concentration	17.5 g/dL
Hematocrit	60%
RBC count	6.8×10^{12} / L
WBC	13.2×10^{9} / L
Platelets	525×10^{9} / L
Serum erythropoietin	Normal
Serum uric acid	>7 mg/dL
Chest X-ray	Enlarged spleen
Genetic test	Expression of JAK2 (V617F) mutation

(a) Based on the above findings, identify the abnormality demonstrated in this patient.

(2 marks)

(b) Explain the possible pathogenesis related to the changes in (a).

(12 marks)

(c) If the doctor performed a bone marrow biopsy, outline the possible findings on her bone marrow diagnosis.

(2 marks)

(d) State two possible complications associated with her abnormality.

(4 marks)

Question 3

A 2-year-old boy was brought to the emergency department by his mother for oozing blood from his mouth following a fall nearly 6 hours ago. His mother also reported that he tended to bleed for prolonged periods from his immunization sites, but there was no history of bruising or hematomas. The patient was on antibiotics for a recent ear infection. There was no known family history of a bleeding disorder. Table below demonstrates the laboratory results of his blood counts as well as coagulation profiles.

Refer Below - Table2 : Patient's results on blood counts and coagulation profiles. .

Table 2: Patient's results on blood counts and coagulation profiles.

Parameter	Patient Value	Normal Range
Hemoglobin	12.3 g/dL	(10.5-13.5)
Hematocrit	35.4%	(33.0-39.0)
WBC	7.9×10^9 / L	(6.0-17.5)
Platelets	368×10^9 / L	(156-369)
PT	11.3 s	(10.0-12.8)
APTT	37.2 s	(24.4-33.2)
Factor VIII	0.16 U/mL	(0.60-1.50)
Factor IX	0.82 U/ mL	(0.60-1.50)
vWF antigen	0.16 s	(0.78-1.53)
vWF Ristocetin factor	<0.10 U/mL	(0.50-1.50)

(a) Identify the most likely disease in the patient.

(2 marks)

(b) State three subtypes of the disease stated in (a).

(3 marks)

(c) Based on the laboratory findings, explain the possible causes of (a).

(12 marks)

(d) State three treatment options for this disease.

(3 marks)

Question 4

A 57-year-old female has the following haematological and coagulation profile post-admission to the intensive care unit (ICU) after a laparotomy for intra-abdominal sepsis with significant blood loss. Her laboratory results is shown in the following table:
Refer Below - Table3 : The patient's laboratory results on blood coagulation profiles. .

Table 3: The patient's laboratory results on blood coagulation profiles.

Parameter	Patient Value	Normal Adult Range
Haemoglobin	65 g/L*	115 – 165
White cell count	2.77 x 10^9/L*	3.5 – 11.0
Platelets	14 x 10^9/L	150 – 400
Prothrombin Time (PT)	28.9 seconds*	12.0 – 15.0
International Normalised Ratio (INR)	2.7*	0.8 – 1.1
Activated Partial Thromboplastin Time (APTT)	122.5 seconds*	25.0 – 37.0
Fibrinogen	1.1 g/L*	2.2 – 4.3

(a) Identify the disease demonstrated in this patient.

(2 marks)

(b) Describe four other causes that may contribute to her condition stated in (a).

(8 marks)

(c) State why both prothrombin time (PT) and activated partial thromboplastin time (APTT) are increased in this disease.

(4 marks)

(d) State three treatment options for this disease.

(6 marks)

END OF EXAMINATION PAPER