UNIVERSITI KUALA LUMPUR
INSTITUTE OF MEDICAL SCIENCE TECHNOLOGY

FINAL EXAMINATION

MARCH 2025 SEMESTER

COURSE CODE	:	HDD20203
COURSE TITLE	:	HEMATOLOGY 1
PROGRAMME NAME	:	DIPLOMA OF MEDICAL LABORATORY TECHNOLOGY
DATE	:	02 JULY 2025
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. Section A consist 25 MCQ or EMQ questions. Answer ALL questions.
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 15 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 25 marks)

Answer ALL questions.

Please use the objective answer sheet provided.

1. The major type of hemoglobin present in a normal adult is _____, which is composed of _____ chains.

   A. hemoglobin A_2; $\alpha_2\delta_2$

   B. hemoglobin F; $\alpha_2\gamma_2$

   C. hemoglobin A; $\alpha_2\beta_2$

   D. hemoglobin Portland; $\zeta_2\gamma_2$

2. Given that a hematocrit (Hct) = 45%, hemoglobin (Hb) = 12 g/dL and red blood cell count = $5x10^{12}$/L, calculate the mean cell volume (MCV).

   A. 240 fL

   B. 24 fL

   C. 900 fL

   D. 90 fL

3. Polycythemia vera is caused by a/an _____.

   A. *JAK2* gene mutation

   B. erythropoietin-secreting tumor

   C. excessive loss of plasma volume

   D. adaptive response to low oxygen level

4. The figure below shows a hemoglobin electrophoresis pattern of a toddler sample. Which of the following is the most likely condition?
Refer Below - Figure1 : Hemoglobin electrophoresis .

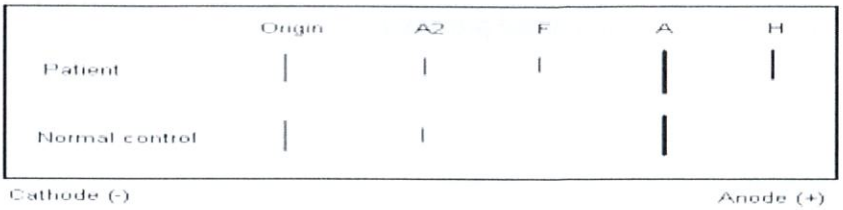

Figure 1: Hemoglobin electrophoresis

A. Alpha thalassemia silent carrier

B. Alpha thalassemia intermedia

C. Alpha thalassemia minor

D. Alpha thalassemia major

5. The erythrocyte sedimentation rate (ESR) is affected by the _____.
I. white blood cell number
II. plasma protein concentration
III. red blood cell number
IV. red blood cell size

A. II, III and IV only

B. I, III and IV only

C. I, II and IV only

D. I, II and III only

6. The hematocrit procedure can be affected by the _____.
I. speed of centrifugation
II. duration of centrifugation
III. lysis of the blood
IV. temperature

A. III and IV only

B. I and II only

C. I, II and IV only

D. I, II and III only

7. Which of the following conditions is associated with a relative increase in hematocrit level?

A. Pregnancy

B. Polycythemia vera

C. Diarrhea

D. Chronic obstructive pulmonary disorder (COPD)

8. Which of the following statements is true regarding erythrocyte sedimentation rate (ESR)?

A. Decreased ESR is seen in megaloblastic anemia.

B. Reduced erythrocytes count is associated with a reduced ESR.

C. Increase in the temperature leads to a false decreased ESR.

D. Decreased ESR is seen in sickle cell disease.

9. _____ testing is a simple, quick, and cost-effective method traditionally used to screen hemoglobin levels in blood donors, especially in low-resource settings.

A. Potassium cyanide

B. Sodium citrate

C. Copper sulfate

D. Potassium ferricyanide

10. Which of the following hemoglobin derivatives is not determined by cyanmethemoglobin method?

    A. Carboxyhemoglobin

    B. Sulfhemoglobin

    C. Oxyhemoglobin

    D. Methemoglobin

11. Which of the following parameters is increased in the secondary polycythemia?

    A. Arterial oxygen saturation

    B. Platelet count

    C. Erythropoietin

    D. Leukocyte count

12. Which of the following anemias is characterized by microcytic hypochromic erythrocytes?

    A. Megaloblastic anemia

    B. Iron deficiency anemia

    C. Aplastic anemia

    D. Anemia of chronic disease

13. Which of the following conditions is associated with an elevated erythrocyte sedimentation rate (ESR)?

    A. Hypoglobulinemia

    B. Polycythemia vera

    C. Hypofibrinogenemia

    D. Inflammation

14. A low hematocrit level is associated with _____.

    A. anemia

    B. hypoxia

    C. dehydration

    D. burns

15. Megaloblastic anemia is mainly due to the deficiency of _____ with manifestation of _____ erythrocytes.

    A. thiamin; microcytic

    B. iron; microcytic

    C. cobalamin; normocytic

    D. folate; macrocytic

16. Erythrocytes in anemia associated with chronic kidney disease are _____.

    A. microcytic and hypochromic

    B. microcytic and normochromic

    C. macrocytic and normochromic

    D. normocytic and normochromic

17. Which of the following conditions will cause a false increased erythrocyte sedimentation rate (ESR)?

    A. The testing is done two hours after blood collection.

    B. Improper ratio of anticoagulant to whole blood.

    C. The specimen temperature is between 4°C to 8°C.

    D. The tube is allowed to stand for more than one hour.

18. The figure below shows erythrocytes in a peripheral blood film with marked larger zone of central pallor. Estimate the mean cell hemoglobin concentration (MCHC).
Refer Below - Figure2 : Peripheral blood film .

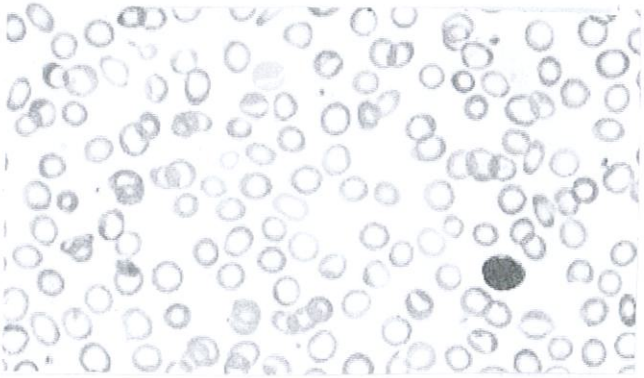

Figure 2: Peripheral blood film

A. MCHC < 30 g/dL

B. MCHC = 36 g/dL

C. MCHC = 34 g/dL

D. MCHC > 38 g/dL

19. The following statement describes the principle used in _____ method for the measurement of hemoglobin.
"*Hydrochloric acid converts the hemoglobin to a brown-coloured compound (X), which is then compared to the brown glass standard*"

A. Wintrobe's

B. Drabkin's

C. Westergren's

D. Sahli's

20. The following figure illustrates findings in a peripheral blood film. The arrows highlight erythrocytes exhibiting a feature known as _____.
Refer Below - Figure3 : Peripheral blood film .

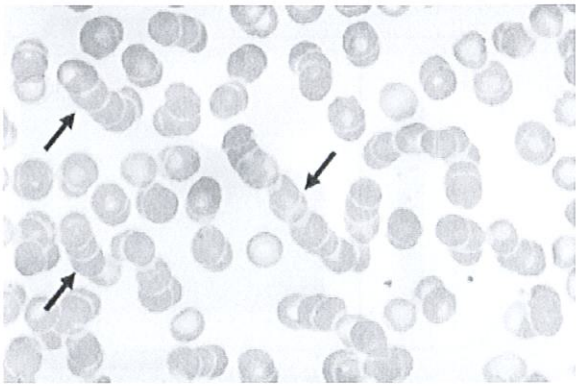

Figure 3: Peripheral blood film

A. sickle cell formation

B. poikilocytosis

C. anisocytosis

D. rouleaux formation

21. Determine the hematocrit level measured by using the hematocrit reader, as shown in the following figure.
Refer Below - Figure4 : Hematocrit level .

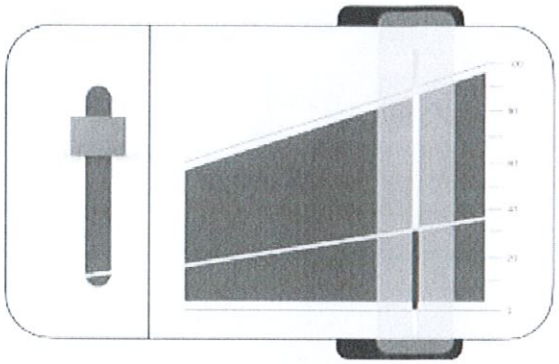

Figure 4: Hematocrit level

A. 65%

B. 38%

C. 95%

D. 40%

22. Identify the brown-coloured compound (X) specified in the following statement.
"Hydrochloric acid converts the hemoglobin to a brown-coloured compound (X), which is then compared to the brown glass standard"

A. X = methemoglobin

B. X = carboxyhemoglobin

C. X = cyanmethemoglobin

D. X = acid hematin

23. Given that a hematocrit (Hct) = 42%, hemoglobin (Hb) = 13 g/dL and red blood cell count = $5x10^{12}$/L, calculate the mean cell hemoglobin (MCH).

A. 2.6 pg

B. 8.4 pg

C. 31 pg

D. 26 pg

24. Red blood cells with mean cell volume (MCV) = 70 fL and mean cell hemoglobin concentration (MCHC) = 30 g/dL are classified as _____.

A. normocytic and hypochromic

B. normocytic and normochromic

C. macrocytic and normochromic

D. microcytic and hypochromic

25. Which of the following statements is true regarding aplastic anemia?

A. Platelet hyperfunction is common in aplastic anemia.

B. The bone marrow film shows replacement of haemopoietic tissue by fat.

C. Megakaryocytes are the main cells present in the bone marrow.

D. The peripheral blood film reveals hypochromic microcytic anemia.

SECTION B (Total: 75 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

A 40-year-old female presented to a private laboratory for her routine annual health screening. She reported no known medical conditions requiring ongoing treatment. Blood samples were collected into multiple tubes, including an EDTA tube for full blood count (FBC), a sodium fluoride tube for glucose analysis, and a plain tube for both liver function tests and lipid profile assessment. In addition, a peripheral blood film examination was performed. The results of the full blood count are presented in the table below.
Based on the information given, answer the following questions:
Refer Below - Table1 : Full blood count results .

Table 1: Full blood count results

Test	Result	Unit	Reference interval
Full blood count			
Total WBC	6.5	$x10^9/L$	4.5 – 11.0
RBC	4.5	$x10^{12}/L$	4.0 – 5.0
Hemoglobin	13.0	g/dL	12.0 – 16.0
Hematocrit	40	%	38 – 46
MCV	x	fL	80 – 100
MCH	y	pg	28 – 34
MCHC	z	g/dL	32 – 36
Platelet count	300	$x10^9/L$	150 – 450

(a) State the correct order of draw for the blood sample collection.

(3 marks)

(b) Explain the importance of adhering to the correct order of draw when collecting blood into multiple tubes.

(3 marks)

(c) Calculate the values of **x, y** and **z**. Show all calculations and the formulas used.

(6 marks)

(d) Based on your calculation in (c), state the morphology of the red blood cells.

(2 marks)

(e) Describe the procedure for preparing the peripheral blood film using the wedge method.

(8 marks)

(f) State one commonly used stain for peripheral blood film and the staining outcome.

(3 marks)

Question 2

A 10-month-old previously well boy was referred to Hospital Ampang due to lethargy and pallor. Physical examination revealed a frontal bossing, maxillary expansion and a saddle nose. Laboratory investigations, as shown in the table below, confirmed a diagnosis of beta thalassemia major.

Based on the information given, answer the following questions:

Refer Below - Table2 : Laboratory investigation results .

Table 2: Laboratory investigation results

Test	Result	Reference Interval
Red blood cell (RBC)	3.8 x 10^{12}/L	4.0 – 5.2 x 10^{12}/L
Hematocrit (Hct)	20%	35 – 45%
Hemoglobin (Hb)	6.0 g/dL	12.0 – 16.0 g/dL
MCV	52 fL	80 – 100 fL
MCHC	30 g/dL	32 – 36 g/dL
Serum erythropoietin	Normal	
Peripheral blood film (PBF)	Anisocytosis, poikilocytosis, reticulocytosis, Howell-Jolly bodies, codocytes	
Hb electrophoresis	Presence of HbF but absence of HbA	
Liver biopsy	Deposition of compound ***Y***	

(a) State the etiology of beta thalassemia major.

(2 marks)

(b) State the other types of beta thalassemia and their etiology.

(6 marks)

(c) Based on the MCV and MCHC value, describe the expected morphology of the red blood cells observed in the peripheral blood film.

(5 marks)

(d) Name the most likely compound **(Y)** deposited in the liver and state how it can be identified.

(3 marks)

(e) Describe the morphology of codocytes and Howell–Jolly bodies observed in the peripheral blood film. Include a diagram of each in your answer.

(6 marks)

(f) Identify the confirmatory test for the boy's condition. Justify your answer.

(3 marks)

Question 3

Sickle cell anemia is a genetically inherited blood disorder characterized by the presence of abnormally shaped red blood cells, leading to chronic hemolytic anemia and a range of systemic complications. While the condition is more common in regions with a historical prevalence of malaria, such as sub-Saharan Africa, the Middle East, and parts of South Asia; it is occasionally diagnosed in Malaysia. Although relatively rare in the country, sporadic cases have been identified through national screening programs and diagnostic efforts.

Based on the information given, answer the following questions:

(a) Discuss the etiology of sickle cell anemia.

(5 marks)

(b) Explain the pathogenesis of sickle cell anemia leading to the observed clinical features.

(10 marks)

(c) Discuss the main laboratory tests used in the investigation of sickle cell anemia and their typical findings.

(10 marks)

Question 4

A Medical Laboratory Technology student on clinical attachment is instructed by the laboratory supervisor to perform a manual red blood cell (RBC) count for a patient's specimen, as the automated hematology analyzer is temporarily out of service. The student uses a hemocytometer (improved Neubauer chamber) and follows the standard manual method.

Based on the information given, answer the following questions:

(a) Explain the importance of red blood cell (RBC) count in the clinical setting.

(4 marks)

(b) List the materials and reagents required to perform a manual RBC count.

(5 marks)

(c) Describe the steps involved in diluting a blood specimen using the standard dilution ratio prior to cell counting. Specify the final dilution ratio achieved.

(5 marks)

(d) Describe the procedure for charging the hemocytometer with the specimen before performing cell counting.

(3 marks)

(e) Calculate the RBC count per microlitre (µL) of blood, given that the average number of cells counted in both sides of the hemocytometer is 540. Show the formula and your calculation.

(8 marks)

END OF EXAMINATION PAPER