UNIVERSITI KUALA LUMPUR
INSTITUTE OF MEDICAL SCIENCE TECHNOLOGY

FINAL EXAMINATION

MARCH 2025 SEMESTER

COURSE CODE	:	HDB20303
COURSE TITLE	:	BASIC HEMATOLOGY
PROGRAMME NAME	:	BACHELOR OF BIOMEDICAL SCIENCE (HONOURS)
DATE	:	03 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. 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 16 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

1. Stem cell factor is produced mainly by _____.

    A. endothelial cells

    B. megakaryocytes

    C. thymic epithelium

    D. bone marrow stromal cells

2. The hexose monophosphate pathway (HMP) activity increases the RBC source of _____.

    A. glucose and lactic acid

    B. 2-3- biphosphoglycerate and methemoglobin

    C. ATP and other purine metabolite

    D. NADPH and reduced glutathione

3. The most frequent cause of needle punctures injury is _____.

    A. failure to attach needle firmly to the tube holder

    B. patient movement during venipuncture

    C. improper disposal of phlebotomy equipment

    D. inattention during removal of the needle after venipuncture

4. The factors that affect the quality of a blood smear are the _____.
    I angle of the spreader   III, speed of the spreader
    II.size of the drop of blood   IV. colorfulness of the slide

    A. II, III and IV only

    B. I, II and IV only

    C. I, III and IV only

    D. I, II and III only

5. A 1:20 specimen dilution was prepared for a manual WBC count. The four corner square (mm) were counted giving a total of 250 cells. The total white cell count was _____.

    A. 5000/µL

    B. 12500/µL

    C. 10000/µL

    D. 15000/µL

6. When preparing a peripheral blood smear by using a two slide (wedge) method, the end of the spreader slide is brought to rest at _____ degrees angle in front of the drop of blood.

    A. 10-15

    B. 40-45

    C. 50-55

    D. 30-35

7. A 1:20 dilution was made using a white blood cell (WBC) Thoma pipette with glacial acetic acid as the diluent. The four corner squares on both sides of the hemocytometer were counted for a total of 160 cells. The total of WBC count is _____.

    A. 40.0×10^9/L

    B. 8.0×10^9/L

    C. 16.0×10^9/L

    D. 4.0×10^9/L

8. A 1:200 dilution of the patient's sample was made in a red blood cell (RBC) Thoma pipette with RBC diluting fluid. A total of 336 RBCs were counted in an area of 0.2 mm^2 using a hemocytometer. The patient's total RBC count is _____.

    A. 1.68×10^{12}/L

    B. 3.36×10^{12}/L

    C. 4.47×10^{12}/L

    D. 6.16×10^{12}/L

9. The 400 small squares in the Improved Neubaeur grid ruling are composed of _____.

    A. 5 groups of 80 squares

    B. 20 groups of 20 squares

    C. 25 groups of 16 squares

    D. 40 groups of 10 squares

10. Allergic reactions are frequently associated with an increase of _____.

    A. lymphocytes

    B. eosinophils

    C. monocytes

    D. neutrophils

11. What is the standard number of leukocytes counted when performing a differential leukocyte count (DLC)?

A. 200

B. 250

C. 100

D. 50

12. The hematocrit procedure can be affected by the _____.
I. speed of the centrifuge III. lysis of the blood
II. length of time of centrifugation IV. ratio of fluoride in the capillary tube

A. I, II and III only

B. I, III and IV only

C. II, III and IV only

D. I, II and IV only

13. Which of the following best describes the principle of the cyanmethemoglobin method?

A. Potassium cyanide converts hemoglobin from the ferrous to the ferric state to form methemoglobin, which combines with ferricyanide to produce cyanmethemoglobin.

B. Potassium ferricyanide converts hemoglobin iron from the ferric to the ferrous state to form methemoglobin, which combines with ferricyanide to produce cyanmethemoglobin.

C. Potassium ferricyanide converts hemoglobin iron from the ferrous to the ferric state to form methemoglobin, which combines with potassium cyanide to produce cyanmethemoglobin.

D. Ferricyanide converts hemoglobin from the ferric state to the ferrous state to form methemoglobin, which combines with potassium cyanide to produce cyanmethemoglobin.

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

    A. Polycythemia vera

    B. Hypoglobulinemia

    C. Inflammation

    D. Hypofibrinogenemia

15. The most important factor determining an ESR is _____.
    I. plasma concentration   III. temperature
    II. RBC size and shape   IV. platelet aggregation

    A. I, II and III only

    B. II, III and IV only

    C. I, III and IV only

    D. I, II and IV only

16. Based on the following laboratory results, calculate the mean cell volume (MCV).

Parameter	Results
Packed cell volume (PCV)	32%
Hemoglobin (Hb)	9 g/dL
Red blood cell count	5.0×10^{12}/L

    A. 64 fL

    B. 180 fL

    C. 640 fL

    D. 18 fL

17. Red blood cells with mean cell volume (MCV) = 100 fL and mean cell haemoglobin concentration (MCHC) = 33 g/dL are classified as _____ and _____.

   A. microcytic, hypochromic

   B. macrocytic, normochromic

   C. normocytic, hypochromic

   D. normocytic, normochromic

18. von Willebrand factor links platelet to collagen via glycoprotein _____ in a vascular injury at areas of fast blood flow such as arteries.

   A. Ib-IX-V

   B. Ia-IIa

   C. VI

   D. IIb-IIIa

19. The platelet alpha-granules contain _____.
   I. fibrinogen   III. adenosine diphosphate (ADP)
   II. von Willebrand factor   IV. factor V

   A. I, II and IV only

   B. II, III and IV only

   C. I, III and IV only

   D. I, II and III only

20. _____ is hydrolyzed to _____ by tissue plasminogen activator (TPA) to initiate fibrinolysis.

   A. Fibrin-bound plasminogen, plasmin

   B. Free plasminogen, plasmin

   C. Thrombin-activatable fibrinolysis inhibitor, free plasminogen

   D. α2-antiplasmin, fibrin-bound plasminogen

21. Platelets accelerate the coagulation process by providing abundant membrane
_____.

A. collagen

B. glycoprotein IIb-IIIa

C. fibrinogen

D. phospholipid

22. The extrinsic coagulation pathway is triggered by tissue damage that exposes
_____ expressed on fibroblasts and smooth muscle cells of the
subendothelial connective tissue.

A. Christmas factor

B. von Willebrand factor (vWF)

C. tissue factor (TF)

D. Stuart-Prower factor

23. Stabilization of cross-linked fibrin polymer from loose insoluble fibrin polymer requires
the action of factor _____.

A. XIIIa

B. XIIa

C. VIIa

D. VIIIa

24. _____ function as principal regulators in the coagulation system to maintain the balance between thrombosis and abnormal bleeding.
    I. Activated protein C (APC)
    II. Antithrombin
    III. High-molecular-weight kininogen (HMWK)
    IV. Tissue factor pathway inhibitor (TFPI)

    A.   II, III and IV only

    B.   I, III and IV only

    C.   I, II and IV only

    D.   I, II and III only

25. Blood specimen intended for hemostasis evaluation is collected in _____ tube.

    A.   sodium fluoride

    B.   lithium heparin

    C.   ethylenediamine tetraacetic acid (EDTA)

    D.   sodium citrate

26. Fresh blood specimen collected for hemostasis evaluation is kept at _____ until testing is performed.

    A. $1^{\circ}C - 6^{\circ}C$

    B. $4^{\circ}C - 8^{\circ}C$

    C. $18^{\circ}C - 24^{\circ}C$

    D. $27^{\circ}C - 37^{\circ}C$

27. Frozen platelet-poor plasma (PPP) must be rapidly thawed at _____.

    A. $37^{\circ}C$

    B. $4^{\circ}C$

    C. $27^{\circ}C$

    D. $8^{\circ}C$

28. Prothrombin time (PT) is most sensitive to deficiency of factor _____.

    A. IX

    B. VIII

    C. VII

    D. XII

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

    A. X, phospholipid

    B. VII, collagen

    C. XII, kaoilin

    D. II, silica

30. _____ measures the time taken for fibrinogen to convert into fibrin.

    A. Bleeding time

    B. Prothrombin time

    C. Thrombin time

    D. Activated partial thromboplastin time

31. Vitamin K catalyzes reactions in certain coagulation factors to allow binding of _____ to the factors and followed with subsequent binding of factors to _____.

    A. Ca^{2+}, collagen

    B. phospholipid, Ca^{2+}

    C. tissue factor, Ca^{2+}

    D. Ca^{2+}, phospholipid

32. Modern coagulation analyzers have greatly enhanced the ability to perform coagulation testing as a result of which of the following?

   A. Automatic adjustment of results for interfering substances.

   B. Maintenance of a level of accuracy and precision similar to that of manual methods.

   C. Increase in reagent volume capabilities to improve sensitivities.

   D. Improved flagging capabilities to identify problems in sample quality or instrument function.

33. Which of the following is considered to be an advantage of the mechanical end-point detection methodology, a principle used in automated coagulation analyzer?

   A. It can measure proteins that do not have fibrin formation as the end point.

   B. It can incorporate multiple wavelengths into a single testing sequence.

   C. It has the ability to provide a graph of clot formation.

   D. It is not affected by lipemia in the test sample.

34. An automated blood cell-counting analyzer with 3-parts differential function measures the _____.

   I. granulocytes   III. basophils
   II. lymphocytes   IV. monocytes

   A. I, II and IV only

   B. II, III and IV only

   C. I, II and III only

   D. I, III and IV only

35. Which of the following explains the primary use of Levey-Jennings charts?

    A. Maintenance of laboratory equipment with the International Sensitivity Index (ISI).

    B. Identification of outliers, trends and shifts in data that may indicate a malfunction or other problem.

    C. Determination of the best fit line through a large set of data points.

    D. Generation of a standard curve from a sample concentration.

36. Which of the following best summarizes the circled data shown in the Levey-Jennings chart below?
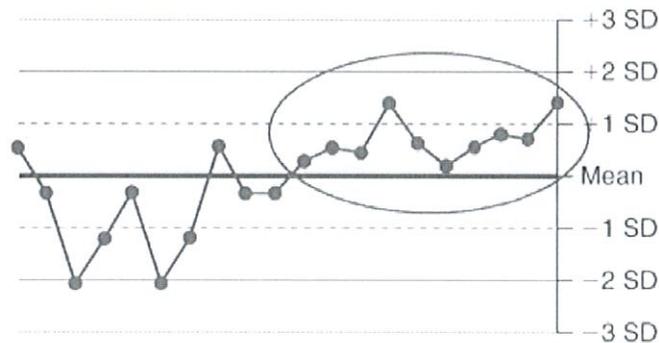
Refer Below - Figure1 : Levey-Jennings chart .

Figure 1: Levey-Jennings chart

    A. The data comply with at least 3 of the Westgard rules, so the recent run may be accepted.

    B. The data have several outliers, so the recent run must be rejected.

    C. The data violate the Westgard rules of 10_x so the recent run must be rejected.

    D. The data fall within 2 SD of the mean, so the recent run can be accepted.

37. Which of the following is a crucial feature of a substance used as a control?

  A. It should be provided and maintained by manufacturer of the assay or equipment.

  B. It should be stored at 32°C to prevent degradation.

  C. It should be constructed from real human tissues or fluids.

  D. It should mimic the chemical and physical properties of a typical patient specimen.

38. The following is a Levey-Jenning chart measuring a single control. Which of the Westgard rule is violated in this chart?
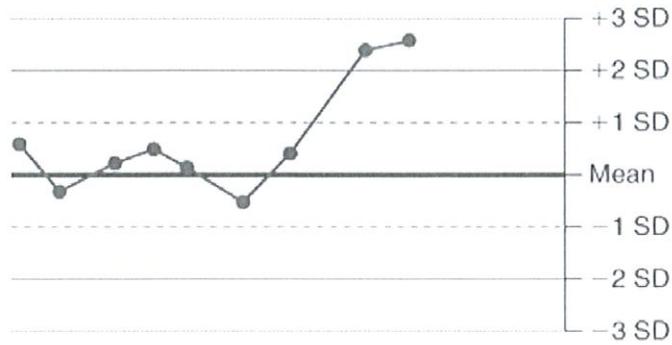   *Refer Below - Figure2 : Levey-Jenning control chart .*

Figure 2: Levey-Jenning control chart

  A. Rule 1_{2s}

  B. Rule 1_{3s}

  C. Rule R_{4s}

  D. Rule 2_{2s}

39. Which of the following is true about the data point noted by the arrow in the Levey-Jennings chart provided?
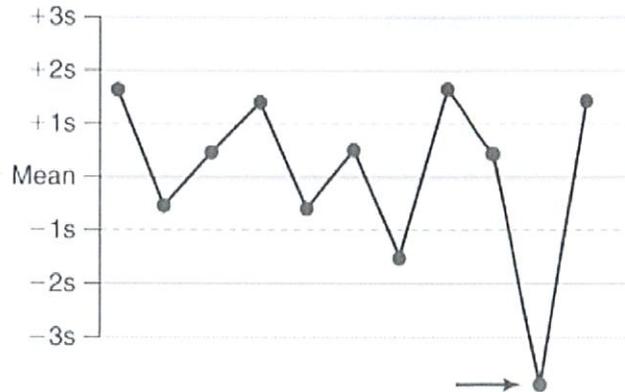
Refer Below - Figure3 : Levey-Jennings chart .

Figure 3: Levey-Jennings chart

A. It suggests the data are trending downward.

B. It is an outlier.

C. It suggests a shift has occurred.

D. It suggests a standard dispersion.

40. The 4_{1s} in the Westgard rule best describe that the control has _____.

A. a point exceeds +/- three standard deviations

B. 4 consecutive points exceed +1 standard deviation, or 4 consecutive points exceed -1 standard deviation

C. two consecutive points are beyond +2 standard deviations from the mean or beyond -2 standard deviations from the mean

D. one point is beyond +2 standard deviations, and the following point is beyond -2 standard deviations or vice versa

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

Discuss the sequence of events involves in the primary hemostasis.

(20 marks)

Question 2

Quality assurance (QA) in the hematology laboratory ensures reliability, accuracy, and precision of laboratory test results. It involves systematic processes and procedures designed to monitor, evaluate, and improve all aspects of laboratory operations. Discuss the key components of QA in hematology laboratory.

(20 marks)

Question 3

The erythrocyte sedimentation rate (ESR) is a blood test that measures how quickly red blood cells settle at the bottom of a test tube over a specific time. It can indicate inflammation in the body but does not diagnose a specific condition.

(a)   Describe three stages of cells sedimentation process in the ESR test.

(9 marks)

(b)   With the aid of illustration, explain the procedure of ESR determination that you have performed in the hematology laboratory.

(11 marks)

Question 4

The following figure illustrates the schematic diagram set-up of principle X used in an automated blood cell counting analyzer.
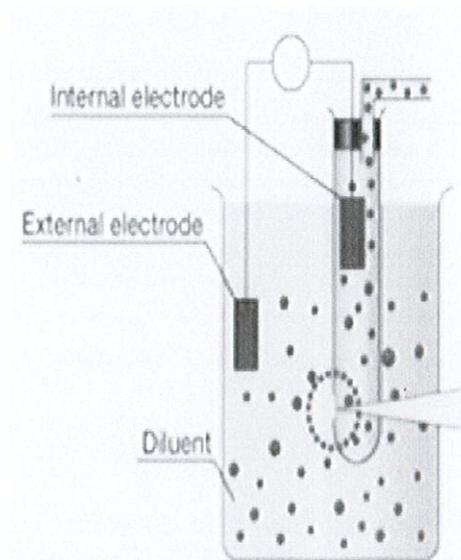
Refer Below - Figure4 : Automated CBC analyzer .

Figure 4: Automated CBC analyzer

(a)   Name the principle X used and explain how blood cells are counted by this method.

(9 marks)

(b)   State the difference between 3-part and 5-part differential cell counter of this automated blood analyzer.

(6 marks)

(c)   Illustrate the distribution curve of red blood cells, platelets and white blood cells in a normal individual.

(5 marks)

END OF EXAMINATION PAPER