NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF HEALTH, APPLIED SCIENCES AND NATURAL RESOURCES

DEPARTMENT OF HEALTH SCIENCES

QUALIFICATION: BACHELOR OF MEDICAL LABORATORY SCIENCES	
QUALIFICATION CODE: 08BMLS	**LEVEL: 6**
COURSE CODE: HAM621S	**COURSE NAME:** HAEMATOLOGY 2B
SESSION: NOVEMBER 2022	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 100

FIRST OPPORTUNITY EXAMINATION PAPER	
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MODERATOR:	**DR ELZABE VAN DER COLF**

INSTRUCTIONS
1. Answer ALL the questions. 2. Write clearly and neatly. 3. Number the answers clearly.

PERMISSIBLE MATERIALS

1. Pen
2. Calculator

THIS QUESTION PAPER CONSISTS OF 9 PAGES (including this front page)

SECTION A [50]

QUESTION 1 **[20]**

Select one correct answer to each questions below.

1.1 Which cytogenetic changes are expected to be seen in order to confirm a diagnosis of chronic phase of chronic myeloid leukemia (CML)?

(a) t(8;21)(q21.3;q22)
(b) inv(16)(p13.1q22)
(c) t(9;22)(q34;q11.2)
(d) del(5)(q13q33) (1)

1.2 Various diagnostic procedures may be used to confirm a diagnosis of AML or to determine if the disease has spread beyond the bloodstream. Which of the following is often used to confirm a diagnosis of AML?

(a) Bone marrow examination
(b) Computed tomography (CT) of the chest
(c) Ultrasonography of the abdomen
(d) Magnetic resonance imagery (MRI) of the brain (1)

1.3 The first phase of treatment in patients with AML is usually chemotherapy. Its goal is to destroy as many leukaemia cells as possible and put the patient into remission. Which of the following is a treatment that is sometimes given to patients with AML in remission but at risk of relapse?

(a) Radiation therapy
(b) Speen transplantation
(c) Stem cell transplantation
(d) Surgery (1)

1.4 What are the three driver mutations associated with myeloproliferative neoplasms (MPNs)?

(a) JAK2, FLT3 and IDH1
(b) JAK2, MPL and CALR
(c) MPL, TP53, and JAK2
(d) FLT3, MyC and RAS (1)

1.5 Myeloproliferative neoplasms are a result of a(n) _____ JAK-STAT signalling pathway?

(a) Inhibited
(b) Deformed
(c) Overreactive
(d) Normal functioning (1)

1.6 Normal cells require signal molecules called _____ in order to grow.
(a) Mitogens
(b) mRNA
(c) Growth factors
(d) Growth inhibitors (1)

1.7 _____ regulate the activation of genes in a cell.
(a) Signal transducers
(b) Cancer cells
(c) Transcription factors
(d) Enzymes (1)

1.8 Mitosis (M) is immediately followed by _____ when the cell grows and prepares for the next phase.
(a) Gap 1
(b) Synthesis
(c) Gap 2
(d) None of the above (1)

1.9 Proteins that behave like the accelerator on a car and urge cells to go ahead and divide quite precisely are called _____.
(a) Oncogenes
(b) Tumour supper genes
(c) Proto-oncogenes
(d) Alleles (1)

1.10 Genes that act in a manner analogous to the brakes in a car telling the cell, "no, don't divide" are called _____.
(a) Tumor Suppressor genes
(b) Oncogenes
(c) Proto-oncongenes
(d) Alleles (1)

1.11 What does Essential thrombocythemia, Chronic myeloid leukaemia and Polycythaemia vera have in common?

(a) Transform to AML
(b) Transform to ALL
(c) They are all MDS diseases
(d) Transform to IMF (1)

1.12 Which one of the following is considered a hallmark of Essential Thrombocythemia?

(a) Very low platelets count
(b) Abnormally small platelets
(c) Extremely high and large agranular platelets
(d) Splenomegaly and bleeding or thrombosis (1)

1.13 The following results were obtained on a sample of blood analysed in the haematology laboratory. White cell count: 6.3 x 10^9/l, Neutrophils: 28%, Band cells: 33%, metamyelocytes 8%, lymphocytes: 25%, Monocytes: 6 %. How would you describe this blood picture?

(a) Leukaemoid reaction
(b) Left shift
(c) Leucoerythroblastic blood picture
(d) Leucocytosis (1)

1.14 Which one of the following statements is correct with regards to epigenetics?

(a) Genes which regulate the rate at which cells divide and die.
(b) Genes which regulate the process of transcription
(c) The heritable changes in gene expression due to the chemical composition of the DNA.
(d) The inactivation of certain genes due to mutations which lead to increased proliferation and decreased apoptosis. (1)

1.15 A patient has a platelet count of 700 x 10^9/l. The platelets are abnormal in size, shape and granularity. The white cell count is 12 x 10^9/l and the haemoglobin is 11g/dl. There is no Philadelphia chromosome. Which of the following is the most likely diagnosis:

(a) Leukaemoid reaction
(b) Polycythaemia Vera
(c) Essential Thrombocythemia
(d) Myelofibrosis (1)

Determine whether the following statements are True or False. Only select the correct letter (a/b) corresponding to your answer.

1.16 The diagnosis of myeloproliferative neoplasms (MPNs) is made exclusively by laboratory assessment.

(a) True
(b) False (1)

1.17 The majority of myelodysplastic syndrome cases can be linked to specific environmental risk factors.

(a) True
(b) False (1)

1.18 Acute Myeloid Leukaemia (AML) French American British (FAB) classification M5a is a monocytic leukaemia with differentiation.

(a) True
(b) False (1)

1.19 A patient with myelofibrosis is not likely to develop acute leukaemia due to the high platelet count.

(a) True
(b) False (1)

1.20 Physiologically, $CD4^+$ count is twice the amount of $CD8^+$ count.

(a) True
(b) False (1)

QUESTION 2 [30]

A 69-year-old female was seen in the clinic for dizziness, lethargy and weakness and on examination she was found to have a large spleen. A bone marrow biopsy showed megakaryocytes that cluster around the marrow sinusoids. The results of her blood count was as follows:

WBC:	16.1×10^9/l
RBC:	5.8×10^{12}/l
Hb:	23g/dl
Plts:	478×10^9/l

2.1 Which disorder is compatible with the case study above? Give reasons for your answer and state the gene mutation present. (4)

2.2 Predict if the serum B12 and erythropoietin levels will be decreased, normal or increased in this condition. (1)

2.3 In which of the four myeloproliferative disorders is the gene found in the above disorder not present? (1)

2.4 Referring to your answer in 2.3, which cytogenetic abnormality does it have, and which genes are involved? (4)

2.5 Discuss the laboratory tests and the expected results in the disorder in 2.3. Include FBC, peripheral blood smear, immunophenotyping and cytochemical staining. (10)

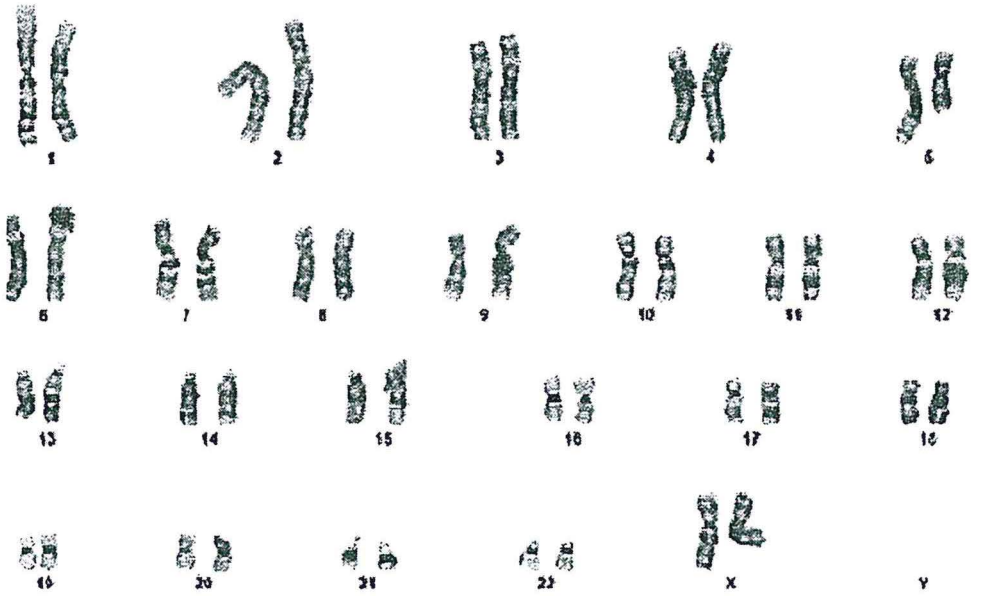
2.5 Identify the AML using FAB classification that is best described by each of the following FAB/WHO descriptions below: (2 marks for each correct answer). (10)

2.5.1	Slide: increased eosinophils, hypersegmented with large abnormal granules, blasts with/out Auer rods, monocytes increased, SB/ MPO >3% +, $CD33^+$, $CD13^+$, $CD11b^+$, FISH/PCR: Inv(16;16)
2.5.2	Slide: Blasts are pleomorphic, Bizarre platelets, bare nuclei, micro-megakaryoblasts, Dry tap: Fibrosis, MPO^+, SB –, $CD41^+$, $CD42^+$, $CD61^+$
2.5.3	Slide: increased myeloblasts, Auer rods +/-, monocytes <1%, ≥3% + with SB or MPO, Immunophenotyping: $CD117^+$, MPD
2.5.4	Slide: Monocytes + Promonocytes (25 -75%), MPO –, $CD11b^+$, Increased muramidase
2.5.5	Slide: increased in both myeloid and erythroid precursors, BM: erythroblasts >50% of all nucleated cells, Iron laden mitochondria and ferritin molecules with electron microscopy, $CD13^+$, $CD33^+$, + transferrin receptor

SECTION B [50]

QUESTION 3 **[20]**

A 57-year-old male presented with anaemic symptoms and easy bruises. The following karyotypic results were obtained.



3.1 Mention the myelodysplastic disorder that the karyotype result is associated with. (2)

3.2 Describe the laboratory features of this disease. (8)

3.3 Myelodysplastic syndrome (MDS) is a heterogeneous group of disorders which have certain features in common. Describe and discuss the pathogenesis of MDS. (5)

3.4 Match the sentence in column A with the appropriate sentence from column B. (5)

Column A		**Column B**	
3.4.1	Child with whooping cough	A	Leucocytosis with a left shift
3.4.2	Marked bacterial infection	B	Thromboctosis with small, normal platelets
3.4.3	Infectious Mononucleosis	C	Lymphocytosis with smear cells
3.4.4	Bone Marrow infiltration	D	Leuco-erythroblastic reaction with tear-drops poikilocytes
3.4.5	Marked blood loss	E	Lymphocytosis with activated lymphocytes++

QUESTION 4 [30]

A 58-year-old man had been complaining of progressive tiredness for many months. Recently he had noticed that he was bruising easily and was experiencing night sweats. A physical examination by the doctor revealed that he had hypertension, a slight fever and an enlarged spleen. A full blood count, differential count and a LAP score test were requested.

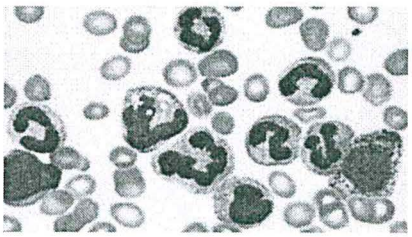
Full blood count

White Cell Count	22.7	$X10^9/l$
Red Cell Count	3.6	$X10^{12}/l$
Haemoglobin	10.8	g/dl
Platelets	600	$X10^9/l$

Differential count

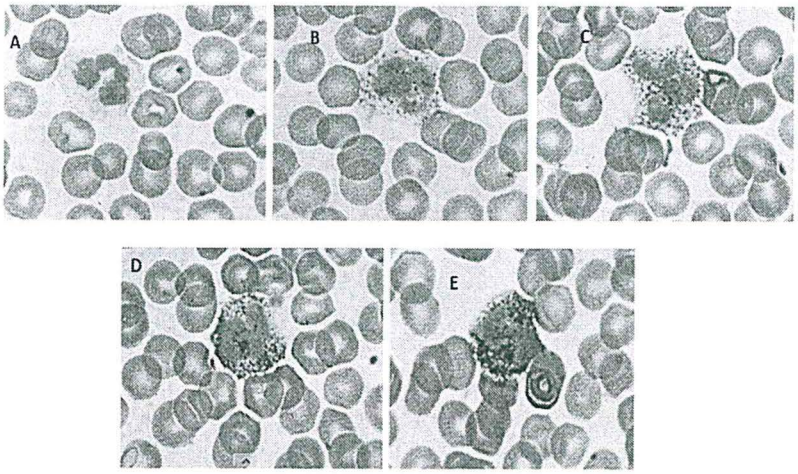
Neutrophils	38%
Band cells	13%
Metamyelocytes	9%
Myelocytes	10%
Promyelocytes	2%
Eosinophils	1%
Basophils	1%
Lymphocytes	21%
Monocytes	3%
Blasts	2%
nRBCs	10%

Peripheral blood smear



4.1 Correct the white cell count (show all calculations). (4)

4.2 The total cell numbers were as follows; A=90 ; B=5; C=3;D=2 and E=0. Calculate the LAP score (show all calculations). (7)



4.3 Based on your LAP score above, what is most likely to be the diagnosis for this patient? (2)

4.4 Name other condition in which the LAP score is useful and the expected score value. (2)

4.5 State the Coulter principle and describe its use in haematology automation. (10)

4.6 The heterophile antibody test (monospot) is used in the diagnosis of mononucleosis. Describe the test and state its principle. (5)

End of Examination

Total Marks: [100]