ROYAL CIVIL SERVICE COMMISSION
BHUTAN CIVIL SERVICE EXAMINATION (BCSE) 2024
EXAMINATION CATEGORY: TECHNICAL

PAPER III: SUBJECT SPECIALISATION PAPER FOR MEDICAL LABORATORY TECHNOLOGY

Date	: October 5, 2024
Total Marks	: 100
Writing Time	: 150 minutes (2.5 hours)
Reading Time	: 15 Minutes (prior to writing time)

GENERAL INSTRUCTIONS:

1. Write your Registration Number clearly and correctly on the Answer Booklet.
2. The first 15 minutes is to check the number of pages of Question Paper, printing errors, clarify doubts and to read the instructions. You are NOT permitted to write during this time.
3. This paper consists of **TWO SECTIONS**, namely SECTION A & SECTION B:
   - **SECTION A** has two parts: Part I - 30 Multiple Choice Questions
     Part II - 4 Short Answer Questions

     All questions under SECTION A are **COMPULSORY**.
   - **SECTION B** consists of two Case Studies. Choose only **ONE** case study and answer the questions of your choice.
4. All answers should be written on the Answer Booklet provided to you. Candidates are not allowed to write anything on the question paper. If required, ask for additional Answer Booklet.
5. All answers should be written with correct numbering of Section, Part and Question Number in the Answer Booklet provided to you. Note that any answer written without indicating the Section, Part and Question Number will NOT be evaluated and no marks will be awarded.
6. Begin each Section and Part in a fresh page of the Answer Booklet.
7. You are not permitted to tear off any sheet(s) of the Answer Booklet as well as the Question Paper.
8. Use of any other paper including paper for rough work is not permitted.
9. You must to hand over the Answer Booklet to the Invigilator before leaving the examination hall.
10. This paper has **10 printed pages**, including this instruction page.

GOOD LUCK

SECTION A

PART I: Multiple Choice Questions [30 marks]

Choose the correct answer and write down the letter of your chosen answer in the Answer Booklet against the question number e.g. 31 (d). Each question carries ONE mark. Any double writing, smudgy answers or writing more than one choice shall not be evaluated.

1. Correct statement regarding microscope is:
   a) Electrons are used as a source of illumination in Electron microscope
   b) Antonie Van Leeuwenhoek developed microscope first time
   c) Knoll & Ruska developed electron microscope
   d) All the above

2. All of the following are acid-fast organisms EXCEPT:
   a) Mycobacterium tuberculosis
   b) Nocardia
   c) Isospora belli
   d) Staphylococcus

3. Identify correct statement regarding bacteria:
   a) Respiration, cell division and sporulation are the functions of mesosome in bacteria.
   b) Capsule in bacteria enables adherence to surface and protection against phagocytosis
   c) Heterotrophs are the bacteria that are unable to synthesize their own food materials.
   d) All the above

4. Which of the following is most resistant to sterilization?
   a) Tubercle bacilli
   b) Viruses
   c) Spores
   d) Prions

5. Most accurate method of diagnosis of Helicobacter pylori is:
   a) Culture
   b) Biopsy urease test
   c) Histopathology
   d) Urea breath test

6. Anti-D given to a Rh negative pregnant woman with Rh- positive fetus, before delivery is an example of:
   a) Artificial active immunity
   b) Artificial passive immunity
   c) Natural passive immunity
   d) Adaptive immunity

7. Normal sperm count human being is
   a) 80 - 160 millions / ml
   b) 40 - 80 millions /
   c) 100 - 120 millions / ml
   d) 140 - 200 millions / ml

8. The basic component of Leishman's stain is:
   a) Eosin
   b) Malachite green
   c) Methylene blue
   d) None of the above

9. Which of the following is a Romanowsky stain
   a) Leishman's stain
   b) Giemsas stain
   c) Jenners stain
   d) All the above

10. Which of the following types of microscopy is valuable in the identification of crystals that are able to rotate light?
    a) Compound bright field
    b) Dark field
    c) Polarizing
    d) Phase-contrast

11. What should be the ratio between the volume of the tissue and the fixative:
    a) 1:5
    b) 1:10
    c) 1:20
    d) 1:100

12. What is the usual concentration of the commercial formaldehyde available:
    a) 7 to 10%
    b) 17 to 27%
    c) 37 to 40%
    d) 40 to 50%

13. What vein/veins is not used to obtain a venous blood sample:
    a) basilica vein
    b) cephalic vein
    c) medial cubital vein
    d) femoral vein

14. A blood specimen collected in a heparinized tube is centrifuged. It will separate into:
    a) Serum and clot
    b) Plasma and clot
    c) Serum and plasma
    d) Plasma, buffy coat, RBC

15. Hemolysis may result from:
    a) Using a 25-gauge needle on an adult
    b) Vigorously shaking the blood specimen
    c) Refrigerating the vacutainer before use
    d) All the above

16. Which statement is false when setting up an ESR:
    a) it must be read in exactly one hour
    b) it should be set up near a centrifuge
    c) the blood level must be at exactly zero
    d) it should be performed on fresh blood

17. Which microscope makes things appear three dimensional?
    a) Simple microscope
    b) Compound microscope
    c) Phase contrast microscope
    d) Dissection microscope

18. During the preparation of a routine H&E slide, what allows the tissue to hold its form?
    a) Fixation
    b) Embedding in paraffin
    c) Staining
    d) Slicing

19. During the window period of patient with AIDS, best diagnostic test is:
    a) ELISA
    b) Western Blot
    c) Rapid test
    d) RT-PCR

20. Method of sterilization used for culture media is:
    a) Autoclave
    b) Hot air oven
    c) Pasteurization
    d) None of the above

21. Temperature range used for autoclaving is:
    a) 100°C for 10 min
    b) 100°C for 30 min
    c) 121°C for 15 min
    d) 121°C for 30 min

22. Reflected light is used in
    a) Light microscope
    b) Phase contrast microscope
    c) Dark field microscope
    d) Electron microscope

23. The 'word' which refers to the 'closeness of a result on repeated analysis' is
    a) Accuracy
    b) Sensitivity
    c) Precision
    d) Specificity

24. Choose the most correct cause of random laboratory errors from the following:
    a) Calibration errors
    b) Change in the reagent lot
    c) Inappropriate pipetting
    d) Expiring of reagents

25. Choose the incorrect characteristic of frozen serum used as quality control material:
    a) It is in liquid form which is ready made to be used.
    b) It can be stored at room temperature
    c) It is stable for longer period at 2-8^{o}C
    d) Doesn't effect by the light

26. All the following Westgard's control rules detect systemic error except:
    a) R4 rules
    b) 8x rules
    c) 7T Rules
    d) 3_{1s} Rule

27. End point method of measurement involves:
    a) Recording of absorbance at the certain interval of time during the chemical reactions.
    b) Recording of absorbance at the fixed time when the reaction is about to be completed.
    c) Recording of absorbance at the fixed time when the reaction is completed.
    d) Recording of absorbance at the beginning of the reaction.

28. All the following are incorrect statement of the Beer's-Lambert Law Except:
    a) Absorbance is indirectly proportional to the concentration of the solution in the cuvette.
    b) Absorbance is indirectly proportional to the intensity of the monochromatic light striking the cuvette with solution.
    c) Absorbance is directly proportional to the thickness of the cuvette.
    d) Absorbance is indirectly proportional to the temperature of the solution.

29. All the following tests are lipid panels EXCEPT:
    a) Triglyceride
    b) Cholesterol
    c) LDL/HDL
    d) LDH

30. Choose any of the following parameters which can be used to calculate coefficient variation in the Laboratory IQC:
    a) Variance and mean
    b) Median and variance
    c) Standard deviation and the mean
    d) Square root of Variance

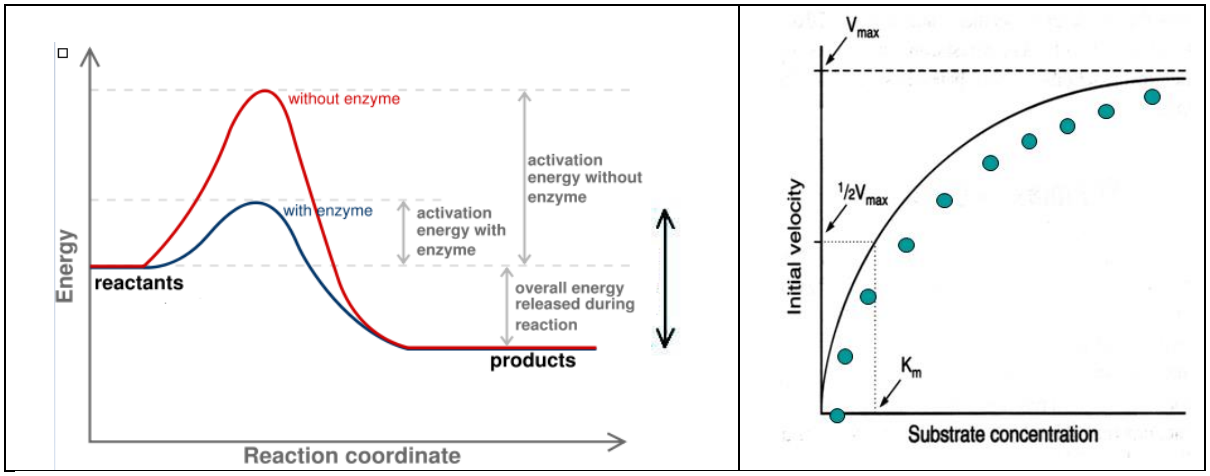
PART II – Short Answer Questions [20 marks]

This part has 4 Short Answer Questions. Answer ALL the questions. Each question carries 5 marks.

1. Following are the category of biochemistry tests performed routinely at Jigme Dorji Wangchuk National Referral Hospital (JDWNRH). Write at least three laboratory tests in each category.
    a) Diabetic profile tests
    b) Liver function tests
    c) Renal function tests
    d) Serum Electrolytes
    e) Lipid profile tests
    f) Cardiac profile tests
    g) Protein panel
    h) Hormones Tests
    i) Tumor markers

2. Explain the principle, procedures and clinical significance of indirect coombs test performed in the blood bank.

3. Explain what you understand from the following two graphs regarding catalytic action of enzymes. Explain Vmax and $_{Km}$ and write some important characteristics of a catalyst.



4. Explain the difference between DNA and RNA in terms of location, structure and functions.

SECTION B: Case Study [50 marks]

Choose either CASE I or CASE II from this section. Each case study carries 50 marks.

CASE I

A 30 year old woman came to the emergency department with shabby look and abnormal behavior complaining of acute abdominal pain, nausea and fever. Upon close clinical examination, her skin and eyes appeared yellowish and pale. Swelling of the legs and ankles were observed. The attendant revealed that she is regular alcohol drinker. She was then examined for vital signs and advised some laboratory tests. Patient was advised to keep under observation for 24 hours.

The results of the vital signs and laboratory results are shown in the following table 1 and 2.

Table 1: **Findings of the Vital Signs**

1	Blood Pressure	Systolic:130 mm Hg	≤120 mm Hg
		Diastolic: 90 mm Hg	≤80 mm Hg
2	Body temperature	40^{o}C	37^{o}C (36.1^{o}C – 37.2^{o}C)
3	Heart beat	120	60-100 beats/Min
4	Respiration rate	25	12-20 breath/Min

Table 2: **Results of the blood/serum analysis**

Sl No	Test parameters	Results	Reference Range
1	Lipase	53 U/L	0 - 60 U/L
2	Amylase	130 U/L	30 - 150 U/L
3	AST	300 U/L	<40 U/L
4	ALT	150 U/L	<40 U/L
5	ALP	530 U/L	30 - 130 U/L
6	Bilirubin	9.5 mg/dl	<1 mg/dl
7	Direct Bilirubin	2.0 mg/dl	0.1 < mg/dl
8	LDH	250U/L	100 - 225 U/L
9	K+	5.0 mmol/L	3.3 - 4.8 mmol/L
10	Na+	130 mmol/L	133 - 146 mmol/L
11	Cl-	92 mmol/L	96 - 109 mmol/L
12	Ca++	2.3 mmol/L	2.1 - 2.6 mmol/L
13	Total Protein	4.6 gm/dl	6-7.8 g/dl
14	Albumin	2.4 g/dl	3.5-5.5 g/dl
15	Fasting Blood glucose	122 mg/dl	80-140 mg/dl
16	Urea	8 mg/dl	7-18mg/dl
17	Creatinine	0.9 mg/dl	0.6-1.2 mg/dl
18	Alpha-fetoproteins (AFP)	60 ng/mL	0 to 40 ng/mL
19	Rapid test for HbsAg/HCV and HIV		Negative

Answer the following questions

1. What is the primary disease diagnosed by the doctor from the clinical symptoms supported by

laboratory results? **(5 marks)**

2. List down all the clinical symptoms and abnormal tests which supported the doctor to diagnose the primary disease for this patient? **(10 marks)**
3. List down all the tests advised by doctors which have been tested normal and explain why you think the doctor has prescribed those normal tests. **(10 marks)**
4. Which type of bilirubin is increased in this patient? Explain the general causes for increase of bilirubin. **(5 marks)**
5. Explain the steps of bilirubin metabolism with flow diagram in terms of its formation, storage, transportation and excretion. **(20 marks)**

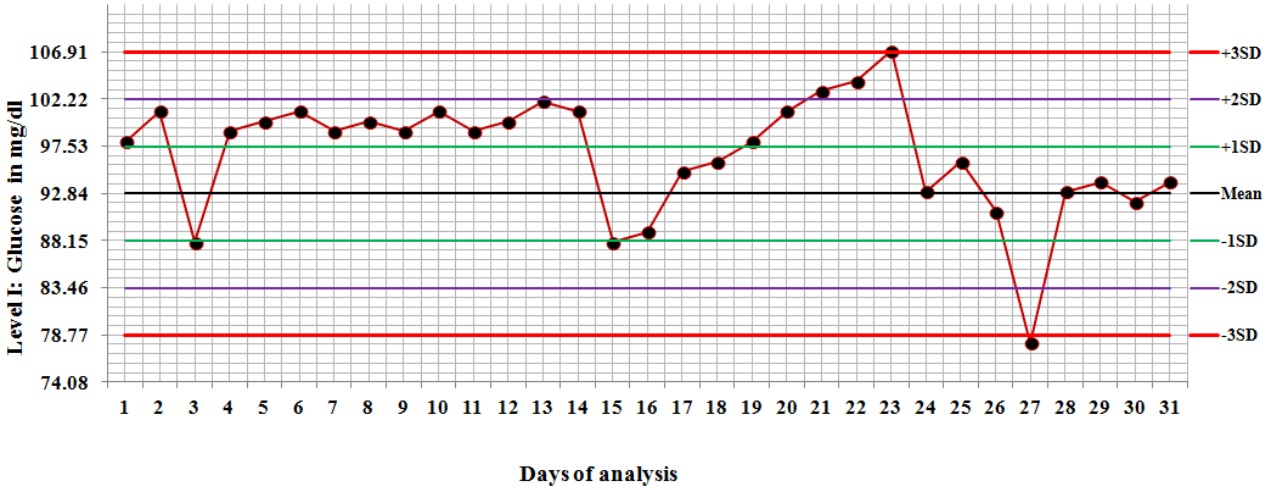
CASE II

Internal Quality control for glucose has been established using the results of the control level I for 12 consecutive days as shown in the table. The control results of 12 days are trimmed at ±2SD or by using CLIA CV. Daily IQC results are plotted on LJ chart and Westgard's Multi-QC rules are used for detection of the errors.

1. Complete the table and calculate the following parameters using the data given in the table. Correct steps of calculation and unit should be shown for each parameter: **(25 marks)**
   a) Standard Deviation (SD)
   b) Coefficient of variation (CV)
   c) Mean±2SD
   d) Mean±3SD

Days	Xi (g/dl)	$Xi-\bar{X}$	$(Xi-\bar{X})^2$
1	98		
2	101		
3	88		
4	89		
5	95		
6	87		
7	96		
8	91		
9	96		
10	93		
11	94		
12	86		

2. Following L-J chart has been generated using the quality control level I.
   a) Name the control rule violations seen in the Graph **(10 marks)**
   b) For each rule violation, state the possible causes and suggest some corrective actions to be taken for each violation. **(15 marks)**


106.91
102.22
97.53
92.84
88.15
83.46
78.77
74.08
Level I: Glucose in mg/dl
+3SD
+2SD
+1SD
Mean
-1SD
-2SD
-3SD
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Days of analysis

TASHI DELEK