The Royal College of Pathologists
Pathology: the science behind the cure

Stage A Chemical Pathology Examination

Objective structured practical examination (OSPE)

SAMPLE QUESTIONS

The following questions are examples. They are intended to allow candidates to become familiar with the style and content of the Stage A Examination.

Answers, together with marks for each question, are also provided below. Please remember that the marking scheme is a general guide for the examiners.

Please also note that when marking the examination, examiners will consider additional information provided by the candidates and may assess the overall standard of the responses.

SAMPLE QUESTIONS

No	Topic	Additional materials provided at station	Assessor required?
1 (Bank 2)	Haemolysis	Request form See Sample Question 1 (Image)	No
2 (Bank 9)	Serum protein electrophoresis	Photograph of serum protein electrophoresis See Sample Question 2 (Image)	No
3 (Bank 21a)	Calculation	Calculator	No
4 (Bank 34)	Spectrophometery	Calculator with log functions	No
5 (Bank 17)	External quality assurance	EQA return See Sample Question 5 (Image)	No

INVESTORS IN PEOPLE

QUESTION 1 - HAEMOLYSIS

Materials required

- Request form

Material provided online on the College website at: Sample Question 1 (Image)

Assessor required

- No

Question

You are presented with the following results when working as duty biochemist. The patient is a 51-year-old woman who has been seen in the Outpatients Department and the clinical information given on the request form is "Pre-admissions Clinic".

Serum:		**Reference range**
Sodium	139 mmol/L	137-144
Potassium	7.4 mmol/L	3.5-4.9
Creatinine	74 μmol/L	60-110
Albumin	40 g/L	37-49
Corrected calcium	2.4 mmol/L	2.2-2.6
Phosphate	1.8 mmol/L	0.8-1.4
Alkaline phosphatase (ALP)	94 U/L	45-105
Aspartate transaminase (AST)	71 U/L	1-31
Total bilirubin	14 μmol/L	1-22

1. (a) What **ONE** factor is the most likely cause of her raised potassium? **(4 marks)**

   (b) Give **TWO** other causes that can be excluded from the information given. **(4 marks)**

2. Describe **ONE** action you could take to confirm this. **(4 marks)**

3. What comments would you add to this report?
   (**NO MORE THAN 4 ANSWERS WILL BE SCORED**). **(8 marks)**

INVESTORS IN PEOPLE

Marking scheme

No.	Question	Answer	Marks
	You are presented with the following results when working as duty biochemist. The patient is a 51-year-old woman who has been seen in the Outpatients Department and the clinical information given on the request form is "Pre-admissions Clinic".		
1a	What **ONE** factor is the most likely cause of her raised potassium?	Haemolysis.	4
1b	Give **TWO** other causes that can be excluded from the information given.	EDTA contamination excluded by information given. Delay in transit excluded by information given.	2 2 (Max 8)
2	Describe **ONE** action you could take to confirm this.	Check haemolytic index on analyser or visual inspection.	4
3	What comments would you add to this report? (No more than 4 will be scored).	Sample haemolysed and therefore unsuitable for: Analysis of potassium; Phosphate; AST. (These results would be deleted prior to authorisation.)	2 2 2 2 (Max 8)

QUESTION 2 - SERUM PROTEIN ELECTROPHORESIS

Materials required

- Photograph of serum protein electrophoresis
  Material provided online on the College website at: Sample Question 2 (Image)

Assessor required

- No

Question

The photograph shows **TWO** serum protein electrophoretic strips.

1. What is the scientific principle of this method? **(4 marks)**

2. What substance is present at arrow X? **(4 marks)**

3. What is shown by arrow Y? **(4 marks)**

4. What electrophoretic test would you arrange to further investigate substance Y? **(4 marks)**

5. In which disorder is this finding classically seen? **(4 marks)**

Marking scheme

No.	Question	Answer	Marks
	The photograph shows **TWO** serum protein electrophoretic strips.		
1	What is the scientific principle of this method?	Different proteins have different molecular weights (size) and charges, and therefore move at different speeds and directions in an electric field.	4
2	What substance is present at arrow X?	Albumin.	4
3	What is shown by arrow Y?	A paraprotein band.	4
4	What electrophoretic test would you arrange to further investigate substance Y?	Immunofixation.	4
5	In which disorder is this finding classically seen?	Myeloma.	4

QUESTION 3 – CALCULATION

Materials required

- Calculator

Assessor required

- No

Question

A blood sample was analysed several times using a point of care testing device to measure the glucose concentration. The following results were obtained: 3.1, 4.2, 4.3, 4.7, 5.0, 5.3, 5.7, 5.8, 6.9 mmol/L.

1. Define the mean value. Calculate the mean for this set of results. **(4 marks)**

2. Define the median value. What is the median of this set of results? **(4 marks)**

3. Define the mode of a distribution. **(3 marks)**

4. What percentage of a normal population is included by the mean +/- 1 standard deviation? **(3 marks)**

5. What percentage of a normal population is included by the mean +/- 2 standard deviations? **(3 marks)**

6. What percentage of a normal population is included by the mean +/- 3 standard deviations? **(3 marks)**

Marking scheme

Nº	Question	Answer	Marks
	A blood sample was analysed several times using a point of care testing device to measure the glucose concentration. The following results were obtained: 3.1, 4.2, 4.3, 4.7, 5.0, 5.3, 5.7, 5.8, 6.9 mmol/L.		
1.	Define the mean value. Calculate the mean for this set of results.	Σ(x)/n. Or sum of the values divided by number of values. 5 mmol/L	4
2.	Define the median value. What is the median of this set of results?	The value in the middle of an ordered sequence. 5 mmol/L	4
3.	Define the mode of a distribution.	Most commonly occurring value.	3
4.	What percentage of a normal population is included by the mean +/- 1 standard deviation	66%	3
5.	What percentage of a normal population is included by the mean +/- 2 standard deviations?	95 %	3
6.	What percentage of a normal population is included by the mean +/- 3 standard deviations?	99.7%	3

QUESTION 4 – SPECTROPHOMETERY

Materials required

- Logarithmic tables ($\log_{10}$)
- Calculator

Assessor required

- No

Question

The transmittance of a solution of NADH at 340 nm in a cuvette with a 1 cm light path is 50%. The molar extinction coefficient of NADH at 340 nm is 6220 L/mol/cm.

1. Calculate the absorbance of this NADH solution (to two significant decimal points) and write your calculations on the answer paper. **(10 marks)**

2. Assuming the Beer Lambert Law applies, calculate the concentration of NADH in this solution (to one significant decimal place in µmol/L) and write your calculations on the answer paper.

   Beer Lambert Law is: $A = \varepsilon * c * l$

   Where: A = absorbance, ε = molar extinction coefficient, c = concentration in mol/L and l = light path in cm

   Absorbance (A) = $\log_{10} (I_o / I_T)$ and % Transmittance(T) = $(I_T / I_o) * 100$

   Where I_o = intensity of incident light and I_T = intensity of transmitted light

   (10 marks)

Marking scheme

No.	Question	Answer	Marks
	The transmittance of a solution of NADH at 340 nm in a cuvette with a 1 cm light path is 50%. The molar extinction coefficient of NADH at 340 nm is 6220 L/mol/cm.		
1.	Calculate the absorbance of this NADH solution (to two significant decimal points) and write your calculations on the answer paper.	**0.30** % Transmittance(T) = $(I_T/I_o) * 100$ Absorbance (A) = $\log_{10} (I_o/ I_T)$ Where I_o = intensity of incident light and I_T = intensity of transmitted light Rearranging, $I_o/ I_T = 100/T$ And $A = \log_{10} (100/T)$ Therefore: $A = \log_{10} (100) - \log_{10} (50) = 2 – 1.6990 = 0.3$ Absorbance = 0.3	10
2.	Assuming the Beer Lambert Law applies, calculate the concentration of NADH in this solution (to one significant decimal place in µmol/L) and write your calculations on the answer paper.	**48.2 µmol/L** Beer Lambert Law is: $A = \varepsilon * c * l$ Where: A = absorbance, ε = molar extinction coefficient, c = concentration in mol/L and l = light path in cm Therefore $0.3 = 6220 * c * 1$ Rearranging, c = 0.3/6220 = 0.0000482 mol/L = 48.2 µmol/L Concentration = 48.2 µmol/L	10

QUESTION 5 – EXTERNAL QUALITY ASSURANCE

Materials required

- EQA return
  Material provided online on the College website at: Sample Question 5 (Image)

Assessor required

- No

Question

You are provided with the UKNEQAS quality control return for distribution 790 for urea for laboratory 1.

An 'A' score of 139 has been returned for laboratory 1 on this distribution for urea.

1. a. What analytical method for urea does laboratory 1 use? **(2 marks)**
   b. What parameter pertaining to this assay does the 'A' score represent or measure? **(2 marks)**
   c. How would you interpret the change in the 'A' score since distribution 779? **(4 marks)**

The values for the 'A' and 'B' scores are plotted for distributions 779–790.

2. What might explain the values returned by laboratory 1 for distribution 788? **(8 marks)**

The 'B' score is plotted against the 'C' score for laboratories in the scheme.

3. How does the performance of laboratory 1 compare on average to the others in the group? **(4 marks)**

Marking scheme

No	Question	Answer	Marks
	You are provided with the UKNEQAS quality control return for distribution 790 for urea for laboratory 1. An 'A' score of 139 has been returned for laboratory 1 on this distribution for urea.		
1a.	What analytical method for urea does laboratory 1 use?	Conductimetric Beckman reagents (12BK)	2 (1)
1b.	What parameter pertaining to this assay does the 'A' score represent or measure?	Accuracy score	2
1c.	How would you interpret the change in the 'A' score since distribution 779?	Since the period of distribution, accuracy has deteriorated.	4
2.	The values for the 'A' and 'B' scores are plotted for distributions 779 – 790. What might explain the values returned by laboratory 1 for distribution 788?	 Error in transmitting data. Calibration error. Reagent problem (old, made up incorrectly etc).	 2 2 4
3.	The 'B' score is plotted against the 'C' score for laboratories in the scheme. How does the performance of laboratory 1 compare on average to the others in the group?	 Average, but slightly poorer precision (higher 'C' score) than most.	 4