2021

BIOCHEMISTRY — GENERAL

Paper : SEC-A-1

(Tools and Techniques in Biochemistry)

Full Marks : 80

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer ***any ten*** questions : 2×10

(a) What is Good's buffer?

(b) Calculate the amount of $K_2Cr_2O_7$ (M.W. : 294.18) required in grams for the preparation of 250 mL $\left(\frac{N}{10}\right)$ aqueous solution of it.

(c) Mention the limitations of Beer-Lambert's law.

(d) What is quantum yield? Can it be more than unity?

(e) Define a primary standard substance with a proper example.

(f) What is a glass electrode?

(g) Calculate the wavenumber of an electromagnetic radiation of wavelength 280 nm.

(h) Why phosphorescence lifetimes are greater than fluorescence lifetimes?

(i) Calculate the pH of 10^{-9} M HCl.

(j) What is an NFPA diamond?

(k) Name one acidic and one alkaline biological buffer.

2. Answer ***any four*** questions :

(a) Between normality and molality, which one is a better scale for measuring the concentration of a solution and why? Define buffer capacity. Comment on its dependence on buffer concentration. 2+1+2

(b) What are intrinsic and extrinsic fluors? Draw a Jablonski diagram depicting only the non-radiative transitions. 2+3

(c) Derive the Henderson-Hasselbalch equation for an acidic buffer HA and its metal salt MA. Calculate the pH of a buffer containing 0.01 M acetic acid and 0.01 M sodium acetate (pK_a of acetic acid = 4.75). 3+2

(d) What are Green Fluorescent Proteins (GFP)? How can FRET be used to measure the distance between a donor and an acceptor chromophore? 2+3

(e) What is the basic principle and instrumentation of uv-visible spectroscopy? 5

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3. Answer ***any four*** questions :

(a) (i) What is the principle of Lowry assay of protein estimation?

(ii) How is it different from BCA assay?

(iii) What is ELISA? Mention two types of it. 4+2+(2+2)

(b) (i) Mention the personal and chemical safety precautions that must be observed in a biochemical laboratory.

(ii) Why are ethers stored in air-tight dark containers?

(iii) Can a secondary standard solution be used without proper standardization? 4+3+3

(c) (i) Differentiate between dynamic and static quenching mechanisms.

(ii) Which one of them depends on the viscosity coefficient of the medium?

(iii) Write the Stern-Volmer equation mentioning how the Stern-Volmer quenching constant can be measured graphically.

(iv) Why is fluorescence more sensitive than absorption spectroscopy? (2+2)+2+2+2

(d) (i) What is the full form of BCA assay?

(ii) How does a BCA assay detect protein concentration?

(iii) What factors affect BCA assay?

(iv) What are the importances of virtual laboratory? 2+3+2+3

(e) (i) Derive a relation between absorbance and transmittance of a sample.

(ii) Which of the above is additive and why?

(iii) Determine the molar extinction coefficient of a 1.5×10^{-4} M protein solution which shows an absorbance of 0.60 at 280 nm in a 0.5 cm path-length cuvette.

(iv) Why is the detector placed perpendicularly to the source of radiation in a fluorescence spectrophotometer? 3+2+3+2