MEDICAL & PHARMACEUTICAL BIOTECHNOLOGY (BIOT 4246)

Time Allotted : 3 hrs

Full Marks: 70

 $10 \times 1 = 10$

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and <u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

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

Group – A (Multiple Choice Type Questions)

- 1. Choose the correct alternative for the following:
 - (i) The concentration of insulin present in soluble insulin preparations (fast acting insulins) is the following

 (a) 1×10⁻⁹M
 (b) 1×10⁻³M
 (c) 1×10⁻⁷M
 (d) none of the above
 - (ii) Which of the following is not a thrombolytic agent?
 (a) Recombinant human activase
 (b) Urokinase
 (c) Streptokinase
 (d) β-galactosidase
 - (iii) Hypoxia stimulates enhanced EPO production. Which of the following conditions induces hypoxia?
 (a) decreased renal blood flow
 (b) increased haemoglobin oxygen affinity
 - (c) blood loss
 - (d) all of the above

(iv) DNA vaccines are (a) first generation vaccines (b) second generation vaccines (c) third generation vaccines (d) none of the above

- (v) Biosensors which detect change in current is known as
 (a) Piezoelectric Biosensors
 (b) Calorimetric Biosensors
 (c) Optical Biosensors
 (d) Amperometric Biosensors
- (vi) The alpha receptor polypeptide constituent of the high affinity human IL-2 receptor has a molecular mass of has a molecular mass of
 (a) 55kDa
 (b) 75kDa
 (c) 64 kDa
 (d) 82kDa

- (vii) Which drug is responsible for metabolizing the anticoagulant, Warfarin
 (a) APOE4
 (b) GSTO
 (c) CYP2C9
 (d) CYP2D6
- (viii) *Parenterally administered* β-lactam antibiotics exhibit which of the following common/uncommon adverse drug reactions (ADRs)
 (a) superinfection
 (b) urticarial
 (c) pain and inflammation at injection site (d) all of the above
- (ix) "Flipped LDH" is a phenomenon where
 (a) LDH1 level is higher than that of LDH2
 (b) LDH2 level is higher than that of LDH1
 (c) LDH3 level is higher than that of LDH4
 (d) LDH4 level is higher than that of LDH1
- (x) Ceprotin (human protein C concentrate) is a protein based anticoagulant. In its preparation from *pooled human plasma*, special precautionary steps are undertaken to ensure that the finished product Ceprotin is pathogen free. Which of the following represents such a precautionary step?

(a) Ultrafiltration

(b) Incubation with polysorbate 80 (viral inactivation)

(c) IgG based immunoaffinity chromatography

(d) none of the above

Group – B

- 2. (a) (i) Rifampicin is an antibiotic that is a RNA synthesis inhibitor. Like protein synthesis inhibitors it is a bacteriostatic agent. What is it its mechanism of action? For its effectiveness as a drug, name three pharmacological and three pharmacokinetic properties that are *critically i*mportant. (ii) The effectiveness of an intravenous administration of a lifesaving antibiotic is partially dependent on the plasma half life given by $t_{1/2}$ =0.693 X V_d/Cl_{int}. Define the terms in this equation. What are typical values for $t_{1/2}$? What is the significance of a low and high $t_{1/2}$ value?
 - (b) (i) Use a diagram to explain how signal transduction is initiated in the IL-6 receptor. What are its clinical indications? (ii) Give a precise technical definition of a biosimilar drug with two examples (iii) Citing the relevant pharmacokinetic parameters of fast acting insulins, explain in simple structural terms how such fast acting insulins have been generated.

(1+2+3) + (2+2+2) = 12

3. (a) Why is mode of administration a critical issue for biopharmaceutical drug development? Explain by comparing to small molecule drug administration. What are the common modes of administration for a biopharmaceutical drug? What new modes of administration are being researched on with biopharmaceuticals? Explain each answer with relevant examples.

(b) Give three examples of β -lactam antibiotics. Draw the structure of Cephalosporin C highlighting the β -lactam ring. Outline the mechanisms (with reaction diagrams) behind the two modes of β -lactam resistance. What are common and infrequent ADRs of β -lactam antibiotics?

(1.5 + 1.5 + 1.5 + 1.5) + (1 + 1 + 3 + 1) = 12

Group – C

- 4. (a) What generation vaccines are DNA vaccines? What are the key components of DNA vaccine? Cite the ways DNA vaccines are made and introduced into animal tissue. What is the main advantage of a DNA vaccine? Name 3 diseases for which different types of DNA vaccines were developed?
 - (b) What are the different types of stem cells? Explain briefly how two of these stem cell types can be used to prevent or treat a disease or condition.

(1+2+2+1+2) + (2+2) = 12

- 5. (a) Itemize the approaches to control/inhibit gene expression at protein synthesis level. Provide specific examples of two such common approaches.
 - (b) Use the example of markers for cancer to highlight how cluster of differentiation (CD) markers can be used for the diagnosis of lymphomas and leukemia. Your answer should clearly define and state the biological role of these proteins.

(5+2)+5=12

Group – D

- 6. (a) In gel filtration, the addition of polyethylene glycol to the running buffer has been observed to make the protein elute at a later stage as if they were of smaller size. Explain this observation. Suggest other co-solvents that would have a similar effect.
 - (b) The covalent structure of a protein is analyzed well using mass spectrometry techniques. This allows for accurate mass determination and detection of posttranslational modifications in proteins and is used in conjunction with separation methods like HPLC. Why are ESI and MALDI considered better as mass spectrometric ionization methods for proteins? Use analyte characteristics and upper limit of mass detection to answer this question.
 - (c) One of the applications of proteomics is its use for disease detection and diagnosis. What are the protein process parameters that are used for biomarker identification? What is the physiological definition of a biomarker? What are the biological and biomedical reasons that that make proteins ideal biomarkers? Explain with one example.
 - (d) Depict a chromatogram of two analytes (e.g. two different proteins) that shows complete resolution and how retention times are calculated. What is the expression for retention factor?

(2 + 1) + 3 + 3 + 3 = 12

- 7. (a) In quality control of protein based pharmaceuticals, what are the HPLC based chromatographic strategies that can be adopted for separation? What are the distinguishing characteristics of any one such separation method?
 - (b) Two proteins of molecular weights 2.5×10^5 and 1×10^4 were eluted out a gel filtration column at 220 ml and 300 ml respectively. Using the linear part of a standard elution volume vs MW of proteins plot (V_e= a-b log M), determine the molecular weight of a protein that elutes out at 270 ml from the column under the same conditions.
 - (c) Draw a flowchart for development, optimization and validation of immunoassays. Explain the steps.

(2+2)+4+4=12

Group – E

- 8. (a) What are the essential biochemical characteristics of the enzyme alkaline phosphatase? In what tissues is the activity of alkaline phosphatase detectable at appreciable level? How has alkaline phosphatase been applied in the detection of bone disease? What are the specific assay characteristics for this enzyme?
 - (b) What are the specific characteristics of single walled carbon nanotubes (SWCNT)? What properties make them efficient for drug delivery purposes? Against what disease has nano particles been successfully used as a carrier for a drug molecule? Illustrate using a specific example.

(2 + 1 + 2 + 1) + (3 + 1 + 2) = 12

- 9. (a) Briefly describe the working principle of Salivary alcohol biosensor.
 - (b) If Alkaline phosphatase level in blood is increased, it is not clear whether this is due to liver or bone disease. Name and describe the test used to differentiate the cause?
 - (c) What do you mean by "Flipped LDH"?

6 + (1 + 3) + 2 = 12

Department & Section	Submission Link
ВТ	https://classroom.google.com/c/MzE3MzAzMDUyMjE1/a/MzU5ODAyNDA2ODMw/details