

# Q and answers



Phase Test (attempt March 2008). Q1. Fill in the missing words mark) Protein targeting to the endoplasmic reticulum is generally co translational, whereas targeting to mitochondria is generally post translational.

Q2. Proteins targeted initially to the endoplasmic reticulum may finally be sorted to:(1 mark)

- A) the endoplasmic reticulum membrane
  - B) the endoplasmic reticulum lumen
  - C) lysosomes
  - D) the plasma membrane
  - E) all of the above
- ANSWER = E

Q3. Fill in the missing words: (3 marks)

When a protein that is to be targeted to the endoplasmic reticulum is synthesised, as the signal sequence emerges from the ribosome it will be bound by a signal recognition particle that will stop translation and, more importantly, locate the complex to the endoplasmic reticulum by binding to a receptor on the surface.

Q4. What is the most common modification of proteins in the endoplasmic reticulum, and what, in particular is used to target proteins to lysosomes? (1 mark)

ER modification: co translational glycosylation

Lysosome targeting: Mannose-6-phosphate

Q5. What are two common features of an endoplasmic reticular (or bacterial) signal sequence? (1 mark)

Feature 1: A sequence of hydrophobic amino acids near the amino terminal

Feature 2: Presence of basic amino acids after the hydrophobic amino acids

Q6. How many target sites are there within mitochondria and what are they called?(2 marks)

Mitochondria has three target sites. They are

1. NADH-CoQ Reductase
2. Co Q- cytochrome c Reductase
3. Cytochrome c oxidase

Q7. Name two main groups of molecular chaperones and say why they so called:

(1 mark)

Group i) Heat shock proteins HSP 47

Group ii) Endoplasmic reticulum protein 29 ERp29

They are so called because heat shock proteins are released when the cells are exposed to stress and ERp29 is known so because the gene ERp29 encodes for it.

Q8. Which molecular chaperone may have a role in the development of biological species?

(1 mark)

Chaperone: BiP(immunoglobulin heavy chain binding protein)

What is its normal role in cells?

This chaperon has a role in the binding of the heavy immunoglobulin chains which are abnormally folded.

Q9. What is the name of the major spongiform encephalopathy found in humans?(2 marks)

Human SE: Creutzfeldt - Jakob disease

Name THREE classes of this disease (different ways in which people become victims):

- i) It occurs by iatrogenic transmission particularly in transplant of cornea or via growth hormone.
- ii) It can occur genetically if a mutation occurs in germ cells.
- iii) It can be caused sporadically that is without any cause or via a mutation in somatic cells.

Q10. What is the name for the infective form of prion protein? (3 marks)

Name: Prion protein scrapie

How is this protein thought to bring about the disease in a susceptible host?

Answer: Normally this prion protein exists in the form of alpha pleated sheet but in the infectious form it changes to beta pleated sheet. This beta pleated sheet has the ability to convert other normal forms to infective forms and aggregate into filaments.

Why are prnp0/0 (knockout) mice not susceptible to infection with the infective form of the prion?

Answer: This is because these mice lack the gene which forms prion protein.

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Q11. Calculate and fill the missing numbers in the protein purification table for three chromatographic procedures below:(4 marks)

Procedure

Total

protein

(mg)

Total Enzyme

Activity

(nKat)

Specific

activity

Yield (%)

Purification

factor

Ion exchange

355

10780

100

1

Gel filtration

78

8475

Affinity

5

3462

Please show your calculations.

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Q12.

This question (parts a, b c and d) refers to the metabolic pathways and key enzymes illustrated in Figure A.

a. What are the missing metabolite in Box A and Box B? (1 mark)

Box A.....Oxaloacetate.....

Box B.....Triacylglycerol.....

b. Annotate Figure 1 with the following pathways. (2 marks)

Glycolysis

β-oxidation of fatty acids

Ensure that the direction as well as the specific metabolites where the pathway starts and stops is clear.

c. Annotate Figure 1 with the following enzymes (2 marks)

Pyruvate kinase

TAG Lipase

Ensure that it is obvious which reaction the enzyme is linked to.

d. Where does GLUCOSE enter the metabolic pathways outlined in Figure A?  
(1 mark)

ANSWER =  B

Figure A:

Q13.

a. Complete Figure 2 " Metabolic decisions at the Glucose-6-Phosphate crossroads of mammalian intermediary metabolism"

The answer required may be a molecule or a pair of pathways. (3 marks)

With reference to Figure 2:

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b. This is one of the major switch points in mammalian intermediary metabolism. Which of the following is not a choice that is made at this crossroads? (1 mark)

- A) Energy storage
  - B) Aerobic or anaerobic state of the cell
  - C) ATP generation
  - D) Biosyntheses
  - E) NADPH generation
  - F) NADH generation
- ANSWER = B\_\_\_\_\_

Q14.

What is a futile cycle? Explain how a cell/organism avoids the operation of futile cycles.

(2 marks)

Answer: A futile cycle is one in which the catabolic and anabolic pathways operate at the same time and hence there is a waste of energy. A cell avoids the operation of futile cycles with the assistance of distinctive enzymes which regulate specific pathways and hence prevent the operation of both pathways at the same time. These distinctive enzymes function in different ways.

Q15.

Fill the gaps in the following paragraph (2 marks)

The ketone bodies, acetoacetate\_,  $\alpha$ -\_hydroxybutyrate\_\_ and acetone, are overproduced during

fasting, when fatty acids from stored \_\_lipids\_\_ become the principle oxidizable fuel.

Accumulation of \_acetyl\_\_CoA and its precursor acetylacetyl-CoA favours

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ketone body

formation. Because oxaloacetate is used for gluconeogenesis, it is withdrawn from the

citric acid cycle, bringing this to a near halt. The acetyl-CoA that is produced by

beta oxidation of fatty acids can no longer be oxidized via the citric acid cycle so it accumulates.

Q16.

Which reactions do the following enzymes catalyse? Give the full, balanced reaction.

(2 marks)

Protein kinase:  $\text{Protein} + \text{ATP} \xrightarrow{\text{protein kinase}} \text{ADP} + \text{Protein-PO}_4$

Adenyl cyclase:  $\text{ATP} \xrightarrow{\text{Adenyl cyclase}} \text{cAMP}$

Q17.

Define the following terms with respect to hormone action in mammalian cells. (2 marks)

Hormone

A hormone is a substance which is produced by the specific cells and is carried to the target site where it acts on particular cells and produce particular responses.

Receptor

A receptor is a molecule which has the capability of binding to specific substances like hormones and they integrate their responses.

Q18.

Explain clearly the effect of insulin on a hepatocyte. (2 marks)

Answer: Insulin does not play a role in the uptake of glucose in the liver but it

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has other effects. It increases the synthesis of fatty acids, glycogen and protein synthesis. On the other hand it decreases glycogenolysis and the formation of ketone bodies by the liver.

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Q19.

What type of food yields the highest amount of energy per gram?(1 mark)

A. Carbohydrate

B. Fat

C. Protein

D. Alcohol  
ANSWER = B

Q20.

List the four principal factors that will influence an individual's energy expenditure (2 marks)

i) Physical activity

ii) Normal hormonal balance

iii) Diet of a person

iv) Stress

Q21

Active forms of most enzymes that digest food may normally be found in all of the following except(1 mark)

A. In soluble form in the lumen of the stomach

B. In the saliva

C. Attached to the luminal surface of the plasma membrane of intestinal epithelial cells

D. In zymogen granules of pancreatic exocrine cells

ANSWER = C

Q22.

Cholesystokinin is a potent secretagogue of (1 mark)

- A. Amylase by the salivary glands
  - B. HCl by the stomach
  - C. Gastrin by the stomach
  - D. Hydrolytic enzymes by the pancreas
- ANSWER = D

Q23.

Briefly describe how lipids are digested.

(2 marks)

Answer: The digestion of lipids starts in the mouth where it is acted upon by lingual lipase. In the stomach the action of gastric lipase begins. These two lipases are not great contributors in the digestion of lipids and they act mainly on short to medium chain fatty acids which include the milk fats. Small intestine is the main site where lipid digestion takes place. This occurs with the help of pancreatic lipase, phospholipase A2 and cholesterol esterase. The bile salts also play a role in digestion by emulsification which is the breakdown of large fat droplets into small ones so that the enzymes have a larger surface area to carry out their function.

Q24.

Explain the function of GLUT in the small intestine (1 mark)

Answer: The GLUT in the small intestine is responsible for the absorption of glucose.

Q25.

Briefly describe how the active transport of glucose occurs in the small intestine.

(2 marks)

Answer: Transport of glucose in the small intestine is associated with sodium ions. The sodium ions and glucose share the same transporter and the transport of glucose occurs by cotransport with sodium and is referred to as secondary active transport. The concentration of the sodium in the intestinal cells is low. This causes the movement of sodium in the cells and hence the movement of glucose as it is transported with the sodium ions. The glucose is then moved across the interstitium into the capillaries whereas the sodium ions move into intercellular spaces. The provision of energy for this process is indirect by the active transport of sodium out of the cell. This is the reason why this transport of glucose is referred to as secondary active transport.

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