21. Which of the electron carriers in the electron transport chain of mitochondria would you find moving electrons through rapid lateral diffusion within the lipid bilayer of the membrane from complex I to complex III?
   a) a flavoprotein
   b) cytochrome c
   c) an iron sulfur protein
   d) *ubiquinone
   e) cytochrome a

22. What is the degree of conformational change caused by a single proton binding in the F0 portion of the F type ATP synthase?
   a) 45 degrees
   b) *30 degrees
   c) 120 degrees
   d) 360 degrees
   e) none of the above

23. What type of redox center within the respiratory chain does not contain any non-amino acid components?
   a) cytochrome c
   b) FMN
   c) *ubiquinone
   d) none of the above
   e) all of the above

24. An uncoupling protein would do the following
   a) transport protons against a concentration gradient
   b) function as a source of heat production
   c) stop ATP synthesis
   d) decrease the rate of electron transport
   e) *both b and c

25. Glycolysis leads to the production of ___________ and two molecules of ATP. In the absence of oxygen, fermentation leads to the production of ___________. Glycolysis plus the citric acid cycle can convert the carbons of glucose to ___________, storing the energy as ATP, ___________ and ___________.

26. The inside part (analogous to the cytosol of a bacterium) of a mitochondrion is called the:
   a) cytosol
   b) stroma
   c) intermembrane space
   d) *matrix
   e) periplasm

27. Porins may be found:
   a) in the outer membrane of gram-negative bacteria
   b) in the outer membrane of chloroplasts
   c) in the outer membrane of mitochondria
   d) in the inner membrane of mitochondria
   e) *in a), b) and c) but not d)

28. The major production of ATP during aerobic metabolism occurs when electrons from ___________ and ___________ are transferred to ___________.
   a) FADH₂, NADH, H₂O
   b) O₂, FADH₂, NADH
   c) FADH₂, O₂, NADH
   d) NADH, O₂, FADH₂
   e) *FADH₂, NADH, O₂
29. The glyoxylate shunt
   a) provides extra electrons to make ATP
   b) *produces additional intermediates in the TCA cycle
   c) prepares precursors for FA synthesis
   d) prepares glucose for fermentation
   e) provides signals to neighboring cells

30. Which of the following statements about mitochondria is false?
   a) They contain an inner and an outer membrane.
   b) The region enclosed by the inner membrane is termed the matrix.
   c) They contain DNA and ribosomes.
   d) They are an important site for energy production in cells.
   e) *They contain stacked internal thylakoid membranes.

31. If you isolate mitochondria and place them in buffer with a low pH they begin to manufacture ATP. Why?
   a) Low pH increases the concentration of base causing mitochondria to pump out H⁺ to the inter membrane space leading to ATP production.
   b) *The high external acid concentration causes an increase in H⁺ in the inter membrane space leading to increased ATP production by ATP synthetase.
   c) Low pH increases the acid concentration in the mitochondrial matrix, a condition that normally causes ATP production.
   d) Low pH increases the OH⁻ concentration in the matrix resulting in ATP production by ATP synthetase.

32. The electron transport chain is located predominantly in the:

   a. Outer membrane of the mitochondria.
   b. Intermembrane space of the mitochondria.
   c. *Inner membrane of the mitochondria
   d. Matrix of the mitochondria
   e. Cytoplasm of the cell

33. What cellular compartment becomes acidic (high concentration of hydrogen ions) during mitochondrial electron transport?
   a. Mitochondrial stroma
   b. Cytoplasm.
   c. Endoplasmic reticulum.
   d. *Space between inner and outer mitochondrial membranes
   e. Thylakoid membranes

34. Synthesis of one ATP by the F-type ATPase is accomplished by:
   a. the complete rotation of the gamma subunit
   b. *a 120 degree of rotation of the gamma subunit
   c. a 180 degree of rotation of the gamma subunit
   d. substrate-level phosphorylation
   e. none of the above

35. Which of the following activities in mitochondria require proton-motive force?
   a. ATP synthesis
   b. Phosphate transport
   c. ATP transport
   d. ADP transport
   e. *all of the above