

Code: \_\_\_\_\_

Score: \_\_\_\_\_

Please provide short answers to the following 30 questions.

1. Which sugar in a typical diet does not contain a reducing anomeric carbon?  
sucrose (Lecture 1; SG p. 14; D p. 1142)
2. Which is the major digestible carbohydrate in a typical human's diet?  
starch, amylopectin, amylose (Lecture 1; SG pp. 14; D pp. 1073-1074, 1142)
3. Fructose and galactose enter the liver and are phosphorylated at carbon number  
1 (Lecture 4; SG pp. 62, 64; D pp. 307-309)
4. The increased concentration of which ion in the lumen of the small intestines will  
increase the absorption of glucose?  
sodium ion (Na<sup>+</sup>) (Lecture 1; D pp. 1067-1068)
5. Which organelle is associated with defective catabolism of glycopeptides,  
mucopolysaccharides, and oligosaccharides?  
lysosome (Lecture 6; D CC 8.7 p. 349)
6. List two metabolic processes of the liver that are increased by the actions of  
glucagon.  
gluconeogenesis and glycogenolysis (Lectures 3+4; SG pp. 28-30, 66; D pp. 311,  
327)
7. In which tissue are GLUT-3 transporters mainly responsible for the transport of  
glucose into the cell?  
brain (Lecture 2; SG p. 16; D p. 271)
8. Electrons from FADH<sub>2</sub> (produced during the tricarboxylic acid cycle) enter the  
respiratory chain through which protein complex?  
complex II (succinate dehydrogenase flavoprotein complex) (Lectures 7+8; SG  
pp. 45, 51-52; D pp. 236-237, Fig 6.40 256-258)
9. Which major metabolic product produced under normal circumstances by  
erythrocytes and by muscle cells during intense exercise is recycled through the  
liver in the Cori cycle?  
lactate (Lecture 3; SG pp. 67-68; D pp. 299-301, 528-529)

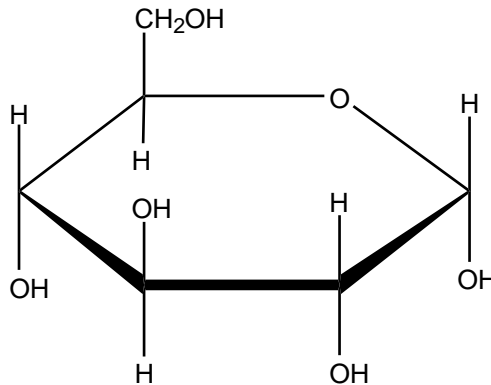
10. The key regulatory enzyme of the pentose phosphate pathway is positively regulated by which coenzyme? Name the enzyme.

$\text{NADP}^+$ , glucose-6-phosphate dehydrogenase (Lectures 5+6; D p. 337)

11. An individual accidentally ingests a compound that inhibits glucose-6-phosphatase. After an overnight fast, this individual, compared with a healthy person, would have a higher level of which macromolecule in the liver?

glycogen (Lecture 4; D p. 316)

12. Provide the complete name of the structure shown below.



$\alpha$ -D-glucopyranose (Lecture 1; D p. 1140)

13. Which glycolytic enzymes are involved in substrate-level phosphorylation?

glyceraldehyde-3-phosphate dehydrogenase, phosphoglycerate kinase and pyruvate kinase (Lecture 2; SG pp. 20-21; D pp. 276-278)

14. Familial fructokinase deficiency causes no symptoms because

hexokinase can phosphorylate fructose (Lectures 2,3,9; SG p. 64; D CC 8.2 p. 342)

15. Given that the standard free energy change ( $\Delta G^\circ$ ) for the hydrolysis of ATP is  $-7.3 \text{ kcal mol}^{-1}$  and that for the hydrolysis of glucose-6-phosphate is  $-3.3 \text{ kcal mol}^{-1}$ , what is the  $\Delta G^\circ$  for the phosphorylation of glucose?



$-4.0 \text{ kcal mol}^{-1}$  (Lectures 7+8; SG p. 37; D p. 225)

16. Which one activity is simultaneously stimulated by epinephrine in heart muscle and inhibited by epinephrine in liver?

glycolysis (Lecture 3; SG p. 29; D pp. 295-298)

17. Which are the two monosaccharides and the amino acid that comprise the core structure of *N*-linked glycoproteins?

mannose, *N*-acetylglucosamine, asparagine (Lecture 6; D p. 350)

18. Following a diet fad meal of skim milk and yogurt, an adult female patient experiences abdominal distention, nausea, cramping, and pain followed by a watery diarrhea. This set of symptoms has been observed each time that the meal is consumed. A likely diagnosis is

lactase deficiency (Lectures 1+9; D CC 26.4 pp. 1075, 1095)

19. Which types of glycosidic linkages are found in glycogen?

$\alpha$ -1,4 and  $\alpha$ -1,6 glycosidic linkages (Lecture 4; SG p. 26; D pp. 314, 316)

20. In which mitochondrial subcompartment will the electron transport chain be found?

inner mitochondrial membrane (Lecture 8; SG p. 54; D p. 241)

21. A muscle-building nutritional supplement that contains succinate was advertised with the statement, "Succinate will provide your muscles with energy even when oxygen is depleted." In the absence of oxygen, the oxidation of 1 mole of succinate in muscle would yield how many moles of ATP?

0 (Lecture 7+8; SG p. 39; D p. 238)

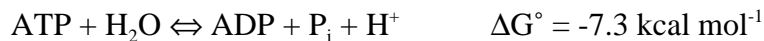
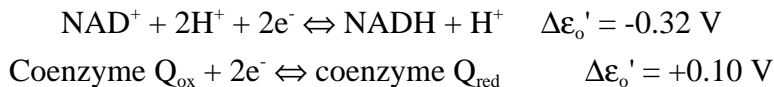
22. List two compounds that are highly toxic to humans because any one of them can generate the most highly reduced state of most of the respiratory chain carriers and list the protein complex they inhibit.

carbon monoxide, cyanide, azide, complex IV (cytochrome oxidase) (Lecture 8; SG p. 51-52; D p. 259)

23. Which are the two monosaccharides that comprise the repeating units of hyaluronate and in which organelle are the polysaccharide chains assembled?

*N*-acetylglucosamine, glucuronic acid, endoplasmic reticulum (Lecture 6; D Fig 8.11 p. 356)

24. After 2 days of fasting, which major process produces blood glucose?  
gluconeogenesis (Lectures 4+9; D p. 539)
25. In an individual at rest who has fasted for 12 hours, indicate three enzymes that will be phosphorylated in the liver.  
glycogen synthetase, PFK-2, phosphorylase, phosphorylase kinase, and pyruvate kinase (Lecture 3+4; SG p. 32; D pp. 295-299, 322-330, 539)
26. Which metabolite is common to both the oxidative and the nonoxidative branch of the pentose phosphate pathway?  
ribulose-5-phosphate (Lecture 5; SG pp. 59-60; D pp. 337-340)
27. Which three enzymes from the carbohydrate metabolic pathways require thiamine pyrophosphate as a coenzyme?  
 $\alpha$ -ketoglutarate dehydrogenase, pyruvate dehydrogenase, transketolase (Lectures 5+7; SG p. 38; D pp. 228, 234, 338)
28. Name one shuttle and two coenzymes that facilitate translocation of reducing equivalents from the cytosol to the mitochondrial matrix.  
 $\alpha$ -glycerol phosphate or malate-aspartate shuttle, NADH, FADH<sub>2</sub>, coenzyme Q (ubiquinone) (Lectures 8+9; SG p. 57; D p. 244)
29. Which three enzymes from carbohydrate metabolism contain Fe as a cofactor?  
aconitase, succinate dehydrogenase, NADH dehydrogenase, cytochrome oxidase (Lectures 2,7,8,9; SG pp. 44-45; D pp. 251-256)
30. Predict the integral number of ATP molecules that could be produced based upon the following information.



$$\Delta G^\circ = -nF \Delta\epsilon_o' \text{ where } F = 23 \text{ kcal V}^{-1} \text{ mol}^{-1}$$

$$\Delta G^\circ = -2(23 \text{ kcal V}^{-1} \text{ mol}^{-1})[+0.1 - (-0.32) \text{ V}] = -46(0.42) \text{ kcal mol}^{-1} = -19 \text{ kcal mol}^{-1}$$

$$\# \text{ ATP} = -19 \text{ kcal mol}^{-1} / (-7.3 \text{ kcal mol}^{-1} \text{ ATP}^{-1}) = 2.6$$

2 ATP can be potentially produced (Lecture 8; D pp. 247-248)