NUTR 3210 Fundamentals of Nutrition

Midterm Exam
February 17, 2011

Examiner: L. Robinson

Name: _____

Student ID #: _____

This exam has 50 multiple choice questions worth 1 mark each.

Please read the following instructions carefully:

1) Please enter your **name**, **student ID number** and **E-mail ID** on the computer card provided.

2) Please read each question carefully. You must choose one of the given choices for each question.

3) **All answers MUST be recorded on the computer card.** Please note that your computer card answer is the only answer that will be considered in the determination of your grade.

1. Ruminant animals derive a significant (60-80%) amount of their energy from:
   a. microbial production of glucose as a result of starch digestion in the rumen
   b. microbial production of short chain fatty acids as a result of fibre fermentation in the rumen
   c. microbial production of oxaloacetate that is then used in the synthesis of glucose
   d. both a and b
   e. both b and c

2. Lactate is synthesized in muscle cells. Which of following best describes what will happen to this muscle-derived lactate:
   a. it will be used in muscle cells to make glucose for use by the exercising muscle
   b. it will be used in muscle cells to make glycogen for carbohydrate storage
   c. it will be used in muscle cells to make glucose that will then aid in the maintenance of blood glucose levels
   d. it will be transported from the muscle cells to the liver where it can be converted to glucose

3. Reassembly of lipid digestion products in the intestinal mucosal cell produces primarily:
   a. mixed micelles
   b. chylomicrons
   c. low density lipoproteins
   d. very low density lipoproteins

4. In addition to the generation of large amounts of energy, the Krebs cycle is critical for:
   a. the entry of substrates into anabolic pathways, such as gluconeogenesis
   b. production of NADPH to be used in fatty acid biosynthesis
   c. a and b
   d. none of the above (because the Krebs cycle is only important for ATP generation)

5. A human female weighs 60 kg. Using the equation discussed in class that is based on metabolic body weight and Kleiber's Law, the basal metabolic rate for this individual is approximately:
   a. 1617 kcal
   b. 4200 kcal
   c. 3150 kcal
   d. 1509 kcal

6. What do glycogen and amylopectin have in common?
   a. both are polysaccharides that are entirely linear in their structure
   b. both are composed entirely of glucose molecules
   c. both contain β-1,4 glycosidic bonds
   d. a and b only

7. Complete combustion of 2 g of protein would be expected to yield:
   a. 11.3 kcal
   b. 8.0 kcal
   c. the same amount of heat as complete combustion of 2 g of digestible carbohydrate
   d. the same amount of heat as complete combustion of 2 g of fat
   e. none of the above (because you would need to know the amount of nitrogen being oxidized in order to correctly answer this question)

8. Which of the following may explain potential health benefits of soluble fibre?
   a. it leads to a lowering of blood cholesterol (via a mechanism that involves bile acid excretion)
   b. it speeds up glucose absorption following a meal, thereby providing a faster source of energy to the muscle
   c. it promotes a slower increase in blood glucose following a meal
   d. a and c
   e. b and c

9. A fatty acid has a heat of combustion of 6 kcal/g and an apparent digestibility of 96%. What is the approximate metabolizable energy of this fatty acid (assume that urinary nitrogen loss is 0 kcal/g)?
   a. 9.4 kcal/g
   b. 5.8 kcal/g
   c. 9.0 kcal/g
   d. 6 kcal/g (i.e. it would be the same as the heat of combustion)

10. The term "macronutrients" includes:
   a. all organic nutrients
   b. digestible carbohydrates, but not fibre (fibre is excluded because it is indigestible)
   c. all organic nutrients and water
   d. all organic nutrients except the vitamins

11. Which of the following is false?
   a. acid is secreted by the proventriculous
   b. acid is secreted by the abomasum
   c. the caecum is a critical site of short chain fatty acid production in birds
   d. fermentation in the large intestine provides a greater proportion of the absorbed energy-yielding nutrients for a horse than for a dog.

12. The Van Soest method is useful for determining:
   a. types of fibre
   b. types of digestible disaccharides (e.g. sucrose)
   c. crude fat, but not individual fatty acids
   d. nitrogen (that can then be used to calculate the protein content)

13. Which of the following is absorbed by the small intestine and taken directly to the liver by the portal circulation?
   a. amylose
   b. cholesterol
   c. sucrose
   d. none of the above

14. The most abundant lipid of the low density lipoprotein is:
   a. triglyceride
   b. phospholipid
   c. cholesterol
   d. eicosanoids

15. Which enzyme is found in the lumen of the human small intestine?
    a. pancreatic amylase
    b. cholesterol esterase
    c. lactase
    d. both a and b
    e. all of the above

16. Which of the following are non-carbohydrate precursors for the synthesis of glucose in the liver?
    a. 18:2 ω-6 (or n-6)
    b. glycerol
    c. fructose
    d. glycerol and stearic acid (since stearic acid is not a dietary essential fatty acid)
    e. galactose

17. A non-essential nutrient is defined as a chemical that is synthesized in the body in sufficient amounts to meet the needs of an animal or human for one or more physiological functions.
    a. true
    b. false

18. In humans, protein and non-digestible carbohydrate have the same metabolizable energy value.
    a. true
    b. false

19. Lactose is:
    a. a disaccharide containing the D isomer of glucose
    b. produced by humans as an intermediate in the digestion of dietary amylopectin
    c. hydrolyzed by a brush border enzyme in monogastric animals, although it can also be absorbed by the small intestine without hydrolysis
    d. none of the above

20. Which of the following is true with respect to adult humans?
    a. carbohydrates composed of glucose molecules linked with β1,4 bonds are insoluble but are well digested by enzymes found in the brush border membrane of ruminant animals
    b. carbohydrates composed of glucose molecules linked with α1, 4 and α1,6 bonds are well digested in the small intestine of monogastric animals
    c. pectins are digested by bacteria in the large intestine (of all species discussed in class) yielding monosaccharides that are then absorbed
    d. b and c

21. Important functions of the essential fatty acids include:
    a. the role of arachidonic acid as a substrate in the production of eicosanoids
    b. the role of docosahexaenoic acid as a substrate in the production of eicosanoids
    c. the role of linoleic acid in preventing dry, itchy and flaky skin in humans and animals
    d. a and c
    e. all of the above

22. Which of the following has a function most similar to the stomach of a human?
    a. the rumen and reticulum
    b. the crop
    c. the abomasum
    d. the omasum

23. The non-protein RQ provides information about the types of macronutrients being catabolized.
    a. true
    b. false

24. The fatty acid 18:3 ω-3 (or n-3) is an essential nutrient in humans.
    a. true
    b. false

25. Total parenteral nutrition (TPN) refers to long term feeding through a vein. In the early days of development of TPN, some new nutrient deficiencies were discovered, and new components were subsequently added to TPN. Which of the following statements about the addition of fatty acids to TPN is correct?
    a. children lacking linoleic acid in TPN will have poor vision
    b. the omission of α-linolenic acid from TPN will cause dry, itchy skin
    c. the omission of α-linolenic acid from TPN may impair brain development in young patients
    d. a and c

26. Which of the following regarding apparent and true digestibility is correct?
    a. the equation to calculate apparent digestibility takes into account protein secretions that occur in the small intestine
    b. apparent digestibility considers nutrient production by bacteria in the large intestine
    c. the equation to calculate true digestibility takes into account fecal nutrients derived from non-dietary sources
    d. a and c

27. The energy released during bomb calorimetry of a food is called:
    a. available energy
    b. thermic effect of food
    c. metabolizable energy
    d. gross energy

28. If one serving of a food contains 6 g protein, 8 g sugars, 4 g fat, and 12 g starch, the weight of the nitrogen free extract is:
    a. 20 g
    b. 30 g
    c. 8 g
    d. 12 g

29. In the brush border of the human small intestine, maltase hydrolzyes:
    a. the α-1,4 bond between two glucose molecules
    b. maltose, to yield equal amounts of glucose and galactose
    c. maltose, to yield equal amount of glucose and fructose
    d. the α-1,6 bond between two glucose molecules

30. Which of the following is absorbed from the large intestine of monogastric species?
    a. a fatty acid with a chain length of 4 carbon atoms
    b. amylose
    c. stearic acid (18:0)
    d. none of the above

31. Which compound is the major chemical form of lipids in adipose tissue?
    a. phosphatidylcholine (since it is important for cell membrane structure)
    b. triglyceride
    c. chylomicron remnant
    d. diglyceride
    e. very low density lipoprotein

32. Which of the following is true?
    a. cellulose is a linear polymer of β-1, 4 linked D-glucose
    b. pectin is both a dietary fibre and a functional fibre
    c. amylose is susceptible to hydrolysis by an enzyme found in the saliva of humans
    d. all of the above

33. Linoleic acid (18:2 $\Delta^{9, 12}$) must be supplied in the human diet because:
    a. humans can only synthesize saturated fatty acids
    b. humans can't synthesize monounsaturated fatty acids
    c. humans can't make a double bond at the Δ^{12} position of a fatty acid
    d. a and b
    e. b and c

34. Which of the following is true?
    a. resistant starch is susceptible to hydrolysis by an enzyme found in the lumen of the small intestine (i.e. not the brush border membrane)
    b. pectins and B-glucans are types of soluble fibre
    c. adsorptive ability of a fibre refers to the ability of a fibre to hold water and to create a viscous solution
    d. b and c
    e. all of the above

35. Which of the following is true?
    a. a chylomicron remnant carries a smaller amount of triglyceride than a chylomicron
    b. chylomicron remnants are removed from the blood circulation by the liver
    c. chylomicrons transport dietary-derived lipids
    d. all of the above

36. Which of the following can be absorbed (the type of transport here is not relevant) across the mucosa of the small intestine?
    a. glucose
    b. free fatty acids
    c. lactose
    d. a and b
    e. a, b and c

37. Amylase (from various sources in the body) is sufficient to complete the digestion of starch in monogastric animals.
    a. true
    b. false

38. In an indirect calorimetry experiment you determine that Sam consumes 380 L of oxygen and produces 272 L of carbon dioxide. Which of the following is true:
    a. the majority of the energy Sam is expending can be attributed to lipid oxidation
    b. the majority of the energy Sam is expending can be attributed to carbohydrate oxidation
    c. the majority of the energy Sam is expending can be attributed to protein oxidation
    d. Sam's RQ is >1 (and we didn't discuss the substrate utilization in this metabolic situation)

39. The conversion of pyruvate to acetyl CoA:
    a. produces NADH and carbon dioxide
    b. will be less likely to occur if ATP availability is high
    c. requires 4 different vitamins
    d. all of the above

40. The only lipoproteins in the body that contain any cholesterol are LDL and HDL.
    a. true
    b. false

41. Which of the following is used to transport triglycerides in the body?
    a. albumin (but only when the fatty acids in the triglyceride are 2, 3 or 4 carbons in length)
    b. very low density lipoprotein
    c. chylomicron
    d. b and c

42. When linoleic acid is metabolized to 20:4 n-6 in the body the carbons are provided by:
    a. carbon dioxide
    b. 18:3 n-3
    c. acetyl CoA
    d. none of the above

43. In the overnight period (assuming you are sleeping and not eating) in humans:
    a. acetyl CoA is a main substrate for gluconeogenesis
    b. glycogenolyis in the liver is the major provider of glucose to the blood
    c. dietary carbohydrate from the most recent meal continues to supply tissues with glucose
    d. none of the above

44. You have just consumed a large high kcalorie meal at your local fast food establishment. Your glycogen stores have been filled and your body is primarily interested in the storage of nutrients for later use. In this situation, the fatty acids used to synthesize triglycerides in adipocytes in adipose tissue may come from:
    a. VLDL delivery of triglycerides to the adipocyte
    b. glucose
    c. chylomicron delivery of triglycerides to the adipocyte
    d. a and c
    e. all of the above

45. Heat increment of feeding can be added to metabolizable energy to yield net energy
    a. true
    b. false

My son and daughter love to eat Whole Grain Goldfish Crackers. One serving size (as stated on the Nutrition Facts label) contains 5 g total fat (including 1 g saturated fat, 2 g polyunsaturated fat and 0 g trans fat), 19 g total carbohydrate (including 2 g dietary fibre and 1 g sugars) , 4 g protein and 250 mg of sodium. Assume this information is on a wet weight basis. Use this information to answer the following 4 questions about this food item:

46. The quantity of metabolizable energy that derives from polyunsaturated fat in one serving of the food is approximately:

a. 4 kcal
b. 45 kcal
c. 18 kcal
d. 9 kcal

47. One component of the nitrogen free extract that is included on this Nutrition Facts label is:

a. protein
b. saturated fat
c. sugars
d. dietary fibre

48. In a proximate analysis of these crackers, sodium would be found in the fraction called:

a. moisture because sodium is soluble in water
b. nitrogen-free extract because sodium does not contain nitrogen
c. ash because sodium is inorganic
d. none of the above

49. If you exclude any contribution from dietary fibre to the quantity of metabolizable energy, what is the quantity of metabolizable energy provided by one serving of these crackers?

a. 137 kcal
b. 144 kcal
c. 129 kcal
d. 164 kcal

50. An experiment using the total collection method produced the following data: Dry matter intake = 500 g, feces = 60 g, crude fat content of dry matter intake = 45%, crude fat content of feces = 20%. What is the apparent digestibility of the fat in the diet?

a. 88%
b. 98.6%
c. 94.6%
d. 92%

YOU MUST ANSWER QUESTION 51!

51. What is the letter at the bottom of this page?

a. if your paper has an “a” then answer “a” for question 51 on the computer card
b. if your paper has a “b” then answer “b” for question 51 on the computer card
c. if your paper has a “c” then answer “c” for question 51 on the computer card