National Exams May 2017

04-Agric-A1, Animal or Human Physiology

3 hours duration

NOTES

1. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any assumptions made.

2. This is a CLOSED BOOK EXAM. Candidates may use one of two calculators, the Casio or Sharp approved models.

3. Five (5) questions constitute a complete exam paper.
   The first five questions as they appear in the answer book will be marked.

4. Each question is of equal value of 20 marks.

5. Full marks cannot be gained just by getting the "correct" answer. You must also communicate clearly how the problem is solved.

1. Define and briefly explain the following terms:

    a) Homeostasis
    b) Ectothermic
    c) Thermoneutral zone
    c) Photoperiodism

2. Explain the following phenomena:

    a) Mammals and birds generally hunt reptiles and amphibians shortly after dawn.
    b) Animals living in cold regions tend to be large, e.g., polar bears and whales.

3. Thermoregulation is the ability of an animal to maintain its body temperature within a tolerable range. Use a sketch to describe the feedback mechanisms in thermoregulation in **endothermic** animals for both hot and cold conditions. Indicate all the important elements (organs, glands, nerve pathways, etc.) involved in the feedback mechanisms.

4. Name three types of mechanisms that are used by animals for thermoregulation. Give an example for each of the three types of mechanisms, and describe and explain how each mechanism works.

5. A simple approach to partitioning the metabolizable energy in a pig assumes that the metabolizable energy intake ME (MJ/day) is partitioned to the maintenance energy requirement ME_m (MJ/day) and the energy retained for growth ME_g (MJ/day). The energy retained for growth is further split into three components: (i) energy for deposition of carcass lean tissue, (ii) energy for deposition of fat, and (iii) energy for deposition of non-fat visceral components (NFVC). It has been found from experiments that the energetic efficiency is 0.5 for deposition of protein (lean tissue), 0.9 for lipid (fat), and 0.5 for NFVC. The energy content is 39.6 MJ/kg (kg of dry matter, DM) for lipid and 23.7 MJ/kg for protein and NFVC. The typical dry matter content for fat tissue is DM = 90%, carcass lean tissue DM = 22%, and NFVC DM = 22%.

    Determine the amount of energy that is used for growth (ME_g) and the amount for maintenance (ME_m) if a pig consumes 18 MJ/day of metabolizable energy and is growing at a rate that allows it to put on 303 g/day of carcass lean tissue, 87 g/day of fat, and 107 g/day of NFVC.

6. Estimating heat production by animals is important in the design of heating and ventilation systems for animal buildings. Calorimeters are commonly used to measure heat production by animals.

    a) Describe the working principles of a **direct calorimeter** and an **indirect calorimeter** for measuring animal heat production.
    b) If sensible heat production by a 500-kg cow is measured to be 1.5 W/kg (W per kg of body mass) at 10°C ambient temperature and 1.1 W/kg at 21°C, determine the total sensible heat production by 100 cows, each with a body mass of 600 kg and housed in a barn at 15°C.