

Multiple Choice Questions in Human Physiology

With Answers and Comments

IAN C. RODDIE

WILLIAM F. M. WALLACE

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IAN C. RODDIE
D.Sc., M.D., F.R.C.P.I.

*Dunville Professor of Physiology, The Queen's University of Belfast, and
Consultant in Physiology to the
Northern Ireland Eastern Health & Social Services Board*

WILLIAM F. M. WALLACE
B.Sc., M.D., F.R.C.P.

*Professor of Applied Physiology, The Queen's University of Belfast, and
Consultant in Physiology to the
Northern Ireland Eastern Health & Social Services Board*

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PREFACE

In this book our aim has been to base the questions on those aspects of Physiology which have most relevance to medical practice and enjoy wide general acceptance. Thus, it is hoped that the questions will be useful to medical, dental and science undergraduates taking courses in human physiology and to postgraduate medical students reading for higher examinations. We have tried to avoid excessive detail in the way of facts and figures; in general those which are included are of value in medical practice.

In preparing for this third edition, we have again thoroughly reviewed all questions. About half have been modified—many to a minor extent—to increase their clarity and usefulness. Four questions have been deleted and 61 new questions added. In particular, questions involving the use of diagrams, introduced in the second edition, have been doubled in number to nearly 10% of the total. We feel that such questions are particularly useful in testing high levels of understanding and manipulation of physiological concepts and data.

Each question consists of a common stem giving rise to four branches. The stem and a single branch together constitute an independent statement to be judged “true” or “false” by the reader. Care has been taken that the statements in any question are not mutually exclusive. Therefore, four independent decisions are required to answer each question. This system has the advantage of simplicity and brevity over most other forms of multiple choice question.

The questions are grouped in ten sections to cover the various physiological systems. Each section is divided into two parts, *basic physiology* and *applied physiology*. *Applied* questions require an elementary knowledge of medical problems but are designed so that the answers may be deduced mainly by making use of basic physiological knowledge.

We are indebted to colleagues for suggesting questions and to all who have commented on previous editions. We would also like to pay tribute to the consistent courtesy and professional skill of our publisher Mr Douglas Luke.

September, 1983

I.C.R.
W.F.M.W.

HOW TO USE THE BOOK

A stimulus to fill gaps in knowledge

The purpose of this book is to help students to revise their Physiology, to prepare for examinations and to use physiological concepts in their continued self-education at undergraduate and postgraduate level. It has been our experience that students who *understand* the Physiology they learn have little difficulty in remembering it, whereas those who learn in a parrot fashion are unlikely to do well in examinations or to make good use of their knowledge subsequently. The problem is that some students think they understand a subject as they read it, though their subsequent performance shows that this has not been so. The statements in this book are presented to the student who is revising so that he can test his understanding while he is revising from the notes or textbook of his choice. By committing himself to an opinion during revision the student has an opportunity to confirm his correct impressions and, when he is mistaken, to pursue the matter until he understands why he went wrong. Comments are given with most answers to reinforce the correct answer.

It is not pretended that Physiology is merely a collection of true or false statements, or that the statements in this book are all 100 per cent true or false for all time. However, we hope that most students will find, on investigation and reflection, that most of the statements in our book can reasonably be classified as true or false.

Using the masking frame

Two masking frames are provided inside the back cover (one in reserve—as with physiological functions—see the last question in the book!)

1. Open the book at the desired section and *immediately* cover the upper answers on the right-hand page with the frame.
2. Slide frame to right until the 3 columns on right-hand page are just exposed.
3. Mark in the right hand of the 3 columns T (True) or F (False) for each part of each question. *Committing yourself to a written verdict is an important part of the exercise.* All, some or none of the 4 parts of each question may be true. It is important to remember that every word counts in a multiple choice question. Questions which appear to be “catches” should fail to catch if this is remembered.
4. Slide frame downwards to expose answers and comments for first question.
5. When answering the questions for the second time slide frame to right

until only 2 columns are exposed. Note particularly those questions which you have answered wrongly on both occasions. You may wish to answer the questions and check the answers one part at a time when first using the book and answer and check a complete question at a time subsequently.

6. Always try to understand why you were wrong (or right) and, if necessary, refer to a textbook or your tutor. If you feel, after due consideration, that a question is confusingly worded or that the answer is wrong, the authors would be most grateful if you would write to them about it.

Scoring your answers

The main purpose of this book is to assist understanding of Physiology, but if you wish to assess your progress, the following method may be applied.

1. Answer 25 questions (4 items per question) or the equivalent by marking them "T" or "F". Do not refer to the answers and comments until you have completed all 25 questions. If you have no idea of the answer (so that tossing a coin would literally be your only way of reaching a decision), leave a blank. If you have some idea of the subject you are, in general, more likely to guess correctly than wrongly. A reasonable time for the 25 questions is 50 minutes.
2. Score 1 for each correct answer.
- 1 for each incorrect answer.
0 for each blank.

The negative marks for incorrect answers are necessary to allow for the fact that random guessing of the answers will result in approximately equal numbers of correct and incorrect answers.

3. The following is a very approximate assessment of your knowledge based on the authors' experience with medical, dental and science students. Naturally this assessment refers to your first attempt only.

50-60	fair
60-70	good
70-90	excellent
90-100	outstanding

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BODY FLUIDS

BASIC PHYSIOLOGY

1. Blood group antigens are

- attached to the surface of red blood cells
- found in the plasma
- found in the serum
- found in the whole blood

2. Total body water

- is about 60% of body weight in the average adult male
- is about 50% of body weight in the average adult female
- is about 40% of body weight in the average adult male
- is about 30% of body weight in the average adult female

3. The production of erythropoietin in the body is stimulated by

- low oxygen levels in the blood
- the kidneys
- the liver
- the spleen

4. If a person has group O blood

- he can receive blood from any group
- he can only receive blood from group O
- he can only receive blood from group A
- he can only receive blood from group B

5. A child who has group B blood

- will not have any antibodies in his blood
- will have anti-A antibodies in his blood
- will have anti-B antibodies in his blood
- will have both anti-A and anti-B antibodies in his blood

1. Extracellular fluid differs from intracellular fluid in man in that:

- (a) it has a greater volume
- (b) it has a lower tonicity
- (c) its anions are mainly inorganic
- (d) it has a higher sodium: potassium molar ratio.

2. Blood group antigens are:

- (a) attached to the haemoglobin molecule
- (b) inherited characteristics carried by the autosomes
- (c) inherited as recessive characteristics
- (d) sometimes found in tissues other than blood.

3. Total body water:

- (a) forms a smaller percentage of body weight in fat persons than in thin
- (b) can be measured by an indicator dilution technique using deuterium oxide as the indicator
- (c) comprises half to two-thirds of body weight in young adults
- (d) is a smaller proportion of body weight in men than in women.

4. The breakdown of erythrocytes in the body yields:

- (a) iron, most of which is excreted in the urine
- (b) the pigment bilirubin which is conjugated in the liver to bilirubin glucuronide
- (c) amino acids which are available for general use
- (d) erythropoietin, thereby regulating the further production of erythrocytes.

5. If a person has group B blood:

- (a) he may have the genotype AB
- (b) his father might have group O blood
- (c) his children will have either group B or group O blood
- (d) and his wife also has blood group B, all their children will have blood group B or O.

1.
 - (a) F cells contain half to two-thirds of body water
 - (b) F if this were the case, water would be drawn by osmosis into the cells
 - (c) T the principal extracellular anions are chloride and bicarbonate; inside cells the principal anions are proteins and organic phosphates
 - (d) T extracellular ratio around 30:1; intracellular about 1:10.

2.
 - (a) F they are part of the red cell membrane
 - (b) T
 - (c) F they are mendelian dominants
 - (d) T they are sometimes present in saliva.

3.
 - (a) T fat contains relatively little water compared with other tissues
 - (b) T deuterium oxide (heavy water) can exchange with total body water
 - (c) T the percentage tends to fall with age
 - (d) F women, by carrying relatively more fat, have a lower average proportion of water than men.

4.
 - (a) F most of the iron is retained for further use
 - (b) T the conjugated bilirubin is then excreted in the bile
 - (c) T from the globin portion of haemoglobin
 - (d) F erythropoietin is not a breakdown product of erythrocytes; its formation is related to the oxygen carrying capacity of the blood (detected by the kidney).

5.
 - (a) F if this were the case he would be group AB
 - (b) T in which case he would have inherited O from his father and B from his mother to have the genotype BO
 - (c) F it depends on the mother's contribution
 - (d) T both parents, if homozygous, will contribute B or if heterozygous, will contribute B or O.

6. Blood platelets are important in stopping bleeding in that:

- (a) they can release lipids which have a role in the clotting process
- (b) the bleeding time tends to increase when the platelet count is low
- (c) on exposure to collagen they become sticky and adhere together
- (d) a fall in the platelet count prolongs the clotting time before the bleeding time is affected.

7. Bilirubin:

- (a) is a steroid pigment
- (b) travels from red cell breakdown sites to the liver dissolved in plasma in an unbound form
- (c) contains iron
- (d) is necessary for the digestion and absorption of fat in the intestines.

8. Monocytes:

- (a) originate from precursor cells in the lymph nodes
- (b) are phagocytic
- (c) may migrate from the blood into the tissues
- (d) can manufacture certain immunoglobulins (IgM).

9. Erythrocytes:

- (a) are responsible for the major part of blood viscosity
- (b) contain carbonic anhydrase
- (c) generate energy from glucose so that oxygen may combine with haemoglobin
- (d) swell up and burst when suspended in hypertonic saline (e.g. three times normal).

10. Human plasma albumin:

- (a) makes a greater contribution to the colloid osmotic pressure of the plasma than does globulin
- (b) is freely filtered at the renal glomerulus
- (c) behaves as an anion at the pH of blood
- (d) is involved in the carriage of carbon dioxide in the blood.

- 6.
- (a) T this is part of the intrinsic blood clotting process
 - (b) T due to impaired platelet plugging
 - (c) T vascular leaks may be thus sealed by platelet plugs
 - (d) F very few platelets are required to initiate the clotting process.
- 7.
- (a) F it is a porphyrin pigment derived from haem
 - (b) F it is bound to plasma protein
 - (c) F iron has been removed from the haem in the formation of bilirubin
 - (d) F the bile salts, not the bile pigments are involved in fat digestion and absorption.
- 8.
- (a) F they originate from precursor cells in the bone marrow
 - (b) T they can ingest dead granulocytes
 - (c) T where they may become scavenger cells (macrophages) in the connective tissue
 - (d) F immunoglobulins are manufactured by the lymphocyte series.
- 9.
- (a) T blood viscosity increases exponentially as the haematocrit rises
 - (b) T it catalyses the reaction $\text{H}_2\text{O} + \text{CO}_2 \rightleftharpoons \text{H}_2\text{CO}_3$
 - (c) F energy is generated from glycolysis to maintain the electrochemical gradients across their membranes
 - (d) F they shrink (crenate) in hypertonic saline; they swell in hypotonic saline (e.g. one-third normal).
- 10.
- (a) T firstly there is more albumin, secondly it has a lower molecular weight
 - (b) F only a small proportion is filtered and this is reabsorbed by the tubular cells
 - (c) T the isoelectric point for albumin is on the acid side of neutrality so that negative COO^- groups predominate at blood pH (7.4)
 - (d) T as carbamino compound: $-\text{NH}_2 + \text{CO}_2 \rightleftharpoons \text{NH}.\text{COOH}$.

11. Neutrophil granulocytes:

- (a) are the most numerous leucocytes in blood
- (b) have a life span of about 120 days
- (c) are formed mainly in the spleen
- (d) contain actin and myosin filaments.

12. Bleeding from a small cut in the skin:

- (a) is normally diminished by local vascular spasm
- (b) ceases within about 5 minutes in normal people
- (c) will be prolonged if factor VIII (antihaemophilic globulin) is absent
- (d) is likely to be greater if the skin is warm than if it is cold.

13. Antibodies:

- (a) are all proteins
- (b) are not formed in response to exposure to antigen in early fetal life
- (c) tend to be produced in larger quantities in response to the second than in response to the first exposure to antigen
- (d) which circulate as free immunoglobulins are produced mainly by the B lymphocyte series.

14. Red cells in human peripheral blood vessels:

- (a) include about 1% from which the nucleus has not been extruded
- (b) include about 1% reticulocytes, i.e. cells which have a reticular pattern when appropriately stained
- (c) are distributed randomly in the stream of blood
- (d) travel at a slower velocity through venules than through capillaries.

15. Lymphocytes:

- (a) form 1-2% of the white cell count
- (b) are motile
- (c) can be transformed by a suitable stimulus into plasma cells
- (d) can not cross the capillary wall.

- 11.
- (a) T they comprise 60–70% of circulating leucocytes
 - (b) F they survive for 1–2 weeks at the most
 - (c) F they are formed in the bone marrow from undifferentiated cells
 - (d) T this may be related to their motility.
- 12.
- (a) T vascular smooth muscle contracts because of local damage; serotonin from platelets may contribute to vasoconstriction.
 - (b) T this is the upper limit of the normal “bleeding time”
 - (c) F bleeding time is independent of clotting time (which will be increased in this case)
 - (d) T since warmth dilates cutaneous blood vessels.
- 13.
- (a) T manufactured by the ribosomes in plasma cells
 - (b) T this *immunological tolerance* prevents the fetus forming antibodies which would react with its own proteins
 - (c) T this phenomenon is known as sensitisation
 - (d) T the cellular immunity which is responsible for graft rejection is produced mainly by the T lymphocyte series.
- 14.
- (a) F nucleated red blood cells are not seen in normal peripheral blood
 - (b) T these are the most immature cells normally found in peripheral blood
 - (c) F they tend to move away from the wall to form an axial stream
 - (d) F flow is slower in capillaries because their total cross-sectional area is greater.
- 15.
- (a) F 20–40%
 - (b) T in tissue culture they can throw out pseudopodia which can enter other cells
 - (c) T it is in this form that they produce antibody
 - (d) F they can migrate from the blood to the lymphatic capillaries and recirculate back to the blood.

16. The specific gravity of:

- (a) red cells is less than that of the plasma
- (b) plasma is related more to its protein content than to its electrolyte content
- (c) plasma decreases as extracellular fluid volume decreases due to loss of water and electrolytes
- (d) blood is higher on average in women than in men.

17. Blood:

- (a) comprises about 7% of body weight
- (b) comprises a higher percentage of body weight in fat people than in thin people
- (c) volume may be calculated if the plasma volume and the haemoglobin concentration are known
- (d) volume tends to rise when water is drunk.

18. Human cell membranes:

- (a) are more permeable to sodium (atomic weight 23) than to potassium (atomic weight 39)
- (b) are impermeable to fat-soluble substances
- (c) in skeletal muscle have their permeability to glucose altered in the presence of insulin
- (d) consist almost entirely of protein molecules.

19. The viscosity of the blood:

- (a) appears greater when measured in the perfused limb (*in vivo*) than when measured in a glass tube (*in vitro*)
- (b) at 20°C is less than at 37°C
- (c) in veins is greater than that in arteries
- (d) increases if the plasma protein content increases.

- 16.
- (a) F red cells are heavier and hence tend to sediment
 - (b) T plasma proteins (70–80 g/litre) far exceed in weight the electrolytes (about 10 g/litre)
 - (c) F the reverse is true; plasma specific gravity is an indicator of extracellular volume if the protein level is normal
 - (d) F it is higher in men because they have a higher haematocrit.
- 17.
- (a) T e.g. 5 kg (approximately 5 litres) in a 70 kg man
 - (b) F the reverse is true, since fat tissue is relatively non-vascular
 - (c) F it is necessary to know the plasma volume and the haematocrit
 - (d) T the water is absorbed into the blood and reduces its osmolality.
- 18.
- (a) F the reverse is true, perhaps because the hydrated sodium molecule is larger than the hydrated potassium molecule
 - (b) F fat-soluble substances can penetrate cell membranes readily
 - (c) T insulin increases muscle cell membrane permeability to glucose, potassium and other substances
 - (d) F carbohydrate and phospholipid are important constituents.
- 19.
- (a) F the *in vivo* value is considerably lower
 - (b) F it is greater at 20°C (e.g. in cold fingers)
 - (c) T the venous haematocrit is higher than the arterial because some of the fluid is lost from the capillaries and returned by lymphatics
 - (d) T but the contribution of plasma proteins is much less important than that of the red cells.

20. Neutrophil granulocytes:

- (a) are motile
- (b) are confined to the circulation
- (c) contain lysosomes
- (d) are attracted chemically to sites of inflammation.

21. Cerebrospinal fluid:

- (a) is actively secreted by the choroid plexuses
- (b) is the major source of the brain's nutrition
- (c) has the same pH as arterial blood
- (d) is virtually glucose free.

22. Red cells:

- (a) are present in larger numbers per unit volume of blood in men than in women
- (b) in an individual with a red cell count of 5×10^{12} /litre and a haematocrit of 0.45 have a mean volume of 225 fl (1 fl, femtolitre = $1 \mu\text{m}^3$)
- (c) in the above individual have a mean haemoglobin concentration of 33% if the blood haemoglobin level is 15 g/100 ml
- (d) sediment at a rate which is related to their tendency to come together in rouleaux.

23. Antigens:

- (a) are always proteins
- (b) in some cases do not produce a complete response unless a plasma factor "complement" is present
- (c) produce less immune response than normal in animals which have had the thymus removed at birth
- (d) produce a larger antibody response when given as a single whole dose than in two half doses separated by an interval of several weeks.