Questions - text book page 77

1) Define the term ‘a balanced diet’.

Answer:
- A balanced diet contains the correct proportions of carbohydrates, fats, proteins, minerals, vitamins, water and roughage needed to maintain good health.

2) Define the term ‘energy balance’.

Answer:
- Energy balance occurs when energy intake is equal to energy expenditure.

3) How can an understanding of the food classifications, illustrated in figure 6.3, assist in the maintenance of an optimal weight for a sports performer?

Answer:
- Figure 6.3 – known as the food pyramid, illustrates the principles of good nutrition with carbohydrates, fruits and vegetables on the bottom representing the bulk of a healthy diet and fats and oils at the top.
- Optimal weight depends on the demands of the sport.
- And so diet must be manipulated accordingly.
- The best fuel food for muscle is carbohydrates (CHO and at the base of the food pyramid) in the form of cereal, beans, pasta, bread etc.
- And so should form the bulk of food eaten by sports performers.
- When CHO intake is too low, the sports performer will experience decreased athletic performance, muscle loss and weight as protein is used for energy, fatigue, nutrient deficiency and irritability.
- Vitamins, minerals and fibre sourced from fruit and vegetables – 5 per day, are needed for essential functions such as metabolic regulation, bone tissue growth, repair and gastrointestinal functioning respectively.
- Protein, sourced from dairy, meat, fish and pulses etc.
- Proteins are needed for tissue maintenance and repair following intense exercise.
- Excess protein is broken down and used as an energy supply.
- In strength and power-based activities, additional protein intake is recommended to maintain muscle bulk and therefore optimal weight.
- Fat intake, sourced from butter, cooking oil and fatty meat should be restricted as fats are stored as triglycerides in adipose tissue.
- And are only converted to glucose later on during aerobic exercise.
- Excess adipose tissue is undesirable for most sports performers.
- Optimal body fat for trained athletes is between 7 and 18% of total body mass.
- However, some sports do require additional weight – for example sumo wrestlers and so would increase fat intake to achieve this goal.
4) How can energy balance assist in controlling obesity?

**Answer:**
- Since energy balance = energy output a neutral energy balance is achieved.
- And as a result a person’s weight remains constant.

**Questions - text book page 79**

1) What are the three main groups of food?

**Answer:**
- Carbohydrates.
- Proteins.
- Fats.

2) Provide recommendations for carbohydrate, fat and protein intake for a cross-country skier and a ski jumper.

**Answer:**
- A cross-country skier would require a diet high in carbohydrates (CHO).
  - In excess of 60% of total diet since this is an aerobic endurance-based activity.
  - Protein intake between 10-15%.
- Ski jumping is an anaerobic power-based activity and so a ski-jumper would require less CHOs (around 60%) and more protein (15-20%) to compensate for increased muscle breakdown that occurs during this activity and higher intensity training programme.
  - Restricted fat intake (20-25%) for both sports.
  - Preferably unsaturated fats.

**Questions - text book page 80**

1) How does dehydration affect heart rate, body temperature and exercise performance?

**Answer:**
- Water loss during exercise increases because as temperature in the body increases, more water is lost with increased sweating.
- Excessive loss of fluid impairs performance as blood plasma volume decreases.
- When dehydration reaches 2% of the body weight, aerobic endurance is notably impaired.
- And heart rate and body temperature increase in response to dehydration.

2) Explain the importance of hydration to an active athlete.

**Answer:**
- Water balance depends on the electrolyte balance.
- But the need to replace lost body fluid is greater than the need to replace lost electrolytes.
- Because sweat is very dilute.
- It is important to drink water at regular intervals during prolonged aerobic exercise.
- To reduce the risk of dehydration.
- And optimise cardiovascular and thermoregulatory functions.

3) How is body water balance maintained during prolonged aerobic exercise?

**Answer:**
- The intensity of the physical activity, environmental temperature and humidity determine the amount of water loss through sweating with associated sodium loss.
- Water balance depends on the electrolyte balance.
- But the need to replace lost body fluid is greater than the need to replace lost electrolytes.
- Because sweat is very dilute.
- It is important to drink water at regular intervals during prolonged aerobic exercise.
- To reduce the risk of dehydration.
- And optimise cardiovascular and thermoregulatory functions.
- Drink 150ml to 300 ml of fluid about 30 minutes before exercise.
- Drink water at regular intervals during activity. For example, up to a litre of water per hour spread over 15 minute intervals during exercise in hot humid conditions.
4) Distinguish between isotonic and hypertonic drinks?

Answer:
- An isotonic sports drink consists of a dilute liquid that do not exceed 7% glucose concentration.
- Matching the same concentration levels of blood glucose.
- A hypertonic sports drink consists of much higher levels of glucose of up to 20%.

5) What are the potential benefits of sports drinks?

Answer:
- Sports drinks are designed to supplement energy, fluid and protein needs of the athlete.
- Hypotonic sports drinks are designed to quickly replace fluids lost through sweating as they are low in carbohydrates at around 4% glucose.
- They are very popular with athletes who need fluid without the boost of carbohydrate.
- Isotonic sport drinks contain concentrations of salt and glucose (between 5-7%) that match the same levels of concentration as in the blood.
- Both hypotonic and isotonic sports drinks are an important source of energy during exercise as they reduce the risk of dehydration.
- During recovery, hypertonic drinks contain much higher levels of glucose – up to 20%.
- This highly concentrated drink is used to replenish depleted glycogen stores.
- And should be drunk as soon as the exercise period has been completed.

Questions - text book page 81

1) What is creatine?

Answer:
- Creatine is a natural substance found in skeletal muscle.
- Stored as phosphocreatine (PC).

2) What type of athlete would benefit from taking a creatine monohydrate supplement?

Answer:
- Since energy derived PC is anaerobic and explosive, power athletes such as weight lifters, sprinters, gymnasts and throwers would benefit from taking creatine monohydrate supplement.

3) Identify the advantages and disadvantages of using a creatine monohydrate supplementation?

Answer:
Advantages:
- Increase in PC stores, thereby delaying alactic/lactic threshold.
- Which means that athlete can apply maximum power for longer.

Disadvantages:
- Associated muscle cramps.
- Weight gain.
- Heat-related symptoms such as dehydration.
- Renal stress.
Questions - text book page 83

1) Figure 6.12 shows the influence of dietary carbohydrate on muscle glycogen stores. Give examples of types of food that are high in carbohydrates.

**Answer:**
- Cereal, potatoes, bread, pasta, biscuits, cake.

2) What is meant by the terms depletion and repletion within the concept of carbo-loading?

**Answer:**
- **Depletion** occurs when the diet and exercise is manipulated to reduce levels of liver and muscle glycogen stores.
- Achieved by athlete reducing CHO intake and increasing exercise programme.
- Following depletion, **repletion** occurs when athlete consumes a high CHO diet, with light exercise or rest.
- In terms of carbo-loading, the body reacts to glycogen depletion by vigorously increasing muscle and liver glycogen content to above normal levels.

3) What are the benefits of taking a sports drink immediately after exercise?

**Answer:**
- Replenishment of body fluids.
- Replenishment of blood glucose and muscle and liver glycogen stores.
- Replenishes sodium levels.

Exam style questions - text book pages 85 - 86

1) Figure 6.13 shows the daily energy intake (kCal) of elite male and female endurance, strength and team sport athletes.

a) Account for the differences in the daily intake for males and females ranged between 2900 and 5900 kCal. 3 marks

**Answer:**
- The difference between males and females can be accounted for by size difference.
- And so values per kg of body mass would be similar.
- Females have lower basal metabolic rate of when compared with males, because they have less fat-free tissue.

b) Give reasons why cyclists competing in the Tour de France require a daily intake of up to 25000 kjoules. 3 marks

**Answer:**
- The Tour de France is a gruelling endurance cycling race, organised over three weeks.
- This race includes mountain and flat stages, and time trials.
- Each stage taking several hours to complete.
- Hence the daily energy expenditure of each competitor is very high.

c) Why do female body builders have the lowest daily energy intake? 2 marks

**Answer:**
- Bodybuilding is the use of progressive resistance exercise to control and develop one’s physique of extreme muscle hypertrophy.
- Because training is predominantly strength-based, consisting of short high intense bouts of exercise, the energy requirements are less when compared with other female sports such as running or playing a game, as illustrated on figure 6.13.
1) d) How can a negative energy balance ultimately compromise an athlete’s potential to train and complete. 3 marks

**Answer:**
3 marks for 3 of:
- A negative energy balance occurs when energy output is greater than energy input.
- This means that more energy is used (via exercise in the case of a sports performer) than is eaten as food.
- And over time leads to a bodyweight reduction.
- Due to loss of muscle protein as protein is broken down and used as a supplementary energy supply.
- Symptoms such as lack of energy (due to low muscle and liver glycogen content), tiredness and inability to complete training sessions and prepare for competitions are experienced by the athlete.
- Athlete is more likely to suffer from stress fractures as body becomes vulnerable to impact of training sessions.
- Overall a negative energy balance will negatively affect training and competitive performance.

2) The ideal precompetition meal should maximise muscle and liver glycogen storage and provide glucose for intestinal absorption during exercise. How can these goals be achieved? 4 marks

**Answer:**
• Eat light complex CHO such as pasta or wholemeal bread.
• Eat fruit, such as a banana, containing complex CHO.
• Small amounts of glucose as supplied in an isotonic sports drink or energy gel.
• To be consumed 3 to 4 hours prior to exercise/competition period.
• These foods contain very little fat and fibre to facilitate gastric emptying and minimise gastrointestinal distress.
• So good absorption of glucose to muscle and liver glycogen stores.

3) An athlete is competing in a decathlon (consisting of 10 track and field events) over a period of two days.

a) What nutritional advice would you give this athlete during and between the events in order to achieve an optimal performance. 6 marks

**Answer:**
6 marks for 6 of:
- Plan and practice a proposed diet/fluid intake that would nutritionally support the nutritional needs for a decathlon.
- During and between events, keep fat intake low and focus on slow-release (low GI) carbohydrates such as wholemeal bread and bananas.
- That can help even out blood glucose levels and support muscle and liver glycogen levels.
- Use energy gels and energy bars that top up blood glucose levels quickly.
- Drink water at regular intervals to remain hydrated. More fluid intake is needed in hot, humid conditions.
- Drink sports beverages, such as isotonic sports drinks, between events, thus providing a continued source of carbohydrates to the body.
- Plus added sodium, potassium and caffeine, available in some products.
- Help to improve electrolyte balance and overall performance.
- Watch out for hyperhydration or excessive water intake.
- Check colour of urine – it should be pale yellow or nearly clear.

b) At the end of day one, how could this athlete replenish his glycogen reserves? 4 marks

**Answer:**
4 marks for 4 of:
- Eat to recover.
- Have a meal as soon as possible following the end of day one. The body has a two hour window immediately following exercise, during which it is more effective in restoring muscle and liver glycogen levels.
- A meal consisting of an equal ratio of carbohydrates and protein is the best choice.
- Avoid meals with a high fat content, as fat slows digestion and delays the delivery of much needed nutrients to your muscles.
- Suggestions for meals include protein shakes, eggs and orange juice, tuna fish sandwiches, bananas, low fat yogurt and oatmeal with fresh fruit.
- In addition, eat 50 grams of carbohydrates every two hours to continue the rate of restoring the depleted glycogen stores.
4) Identify some of the benefits of taking commercially prepared liquid meals. 3 marks

Answer:
- Offer well-balanced nutritive value.
- Contribute to fluid needs.
- Are rapidly absorbed.
- Leave little residue in the digestive tract.

5) Table 6.5 provides information on exercise intensity and duration. Information on the appropriate fuel foods for action has been omitted.

Table 6.5 – fuel and exercise

<table>
<thead>
<tr>
<th>exercise intensity</th>
<th>exercise duration</th>
<th>fuel used</th>
</tr>
</thead>
<tbody>
<tr>
<td>maximal sprint</td>
<td>short</td>
<td>carbohydrate</td>
</tr>
<tr>
<td>low to moderate</td>
<td>moderate - up to 2 hours, e.g. jogging</td>
<td>carbohydrate and fat equally</td>
</tr>
<tr>
<td>severe</td>
<td>prolonged - e.g. cycling</td>
<td>less carbohydrate and more fat</td>
</tr>
</tbody>
</table>

a) Complete the third column to show which fuel foods supply the glycogen needed as exercise intensity and duration change. 3 marks

Answer:
See table 6.5 above.

b) Why is carbohydrate a much faster fuel (energy) source when compared with fat utilisation? 2 marks

Answer:
2 marks for 2 of:
- Carbohydrates are absorbed as glucose in the small intestine.
- And transported around the body to provide an immediate energy source.
- Although fat provides twice the energy yield of carbohydrates, fats are absorbed as fatty acid and glycerol, stored as triglycerides in adipose tissue.
- And then converted to glucose in the liver.
- And so there is a delay in fat conversion of 20 minutes minimum before fat becomes a usable energy fuel food.

6) High-fat diets, as an ergogenic strategy for sports performance, have been used by athletes for endurance and ultra-endurance sports. Discuss. 6 marks

Answer:
6 marks for 6 of:
- Eating a low-carbohydrate, a high-fat diet increases fat reserves and can force the body to adapt to burn fat more efficiently.
- Body fat reserves represent a relatively abundant fuel substrate even in the leanest of athletes even with low body fat percentages of 10%.
- Yielding twice the energy yield of carbohydrates.
- And so fat becomes a valued secondary fuel food as the exercise duration increases.
- Endurance athletes can exercise at a higher submaximal exercise level from improved fat oxidation.
- Thereby conserving glycogen stores, a physiological adaptation called ‘glycogen sparing’.
- Excess fat reserves are detrimental to most sport performance due to increased body mass.
- Which can have a negative effect on sport performance.
- For optimal competition performance, the athlete needs a combination of adequate fuel stores from CHO and fats in relation to the demands of his or her event.
6) What are the benefits of adding a small amount of sodium to a rehydration beverage? What is the effect of hyperhydration on sodium functioning within the human body? 3 marks

**Answer:**
1 mark for:
**Benefits of adding a small amount of sodium:**
- Sodium is an electrolyte, and it helps regulate the amount of water that’s in and around your cells.

2 marks for 2 of:
- Drinking too much water during endurance sports causes the sodium in the body to become diluted.
- When this happens, the body’s water levels rise, and cells begin to swell.
- With an associated reduction in urine production.

7) Why is water considered an important nutrient to the human body, and why might a person who is exercising need extra amounts of it? 4 marks

**Answer:**
2 marks for 2 of:
**Function of water within the human body:**
- Water makes up 72% of muscle weight and 50% of adipose tissue.
- The human body uses water in all its cells, organs, and tissues to help regulate its temperature and maintain other bodily functions.

2 marks for 2 of:
**Why might a person who is exercising need extra amounts of it?**
- During exercise more water is produced during tissue respiration.
- And is transported to the skin where sweating occurs.
- More water must be consumed to replace the amount lost.
- Since excess loss of fluids impairs performance.

8) a) Discuss how a balanced diet could be manipulated to increase an athlete’s glucose reserves prior to a marathon race. 6 marks

**Answer:**
- **Carbo-loading** (or glycogen loading) before the event (modern method).
- This consists of tapering of training, whilst eating 50% CHO diet.
- Partially depletes glycogen stores.
- Therefore energy levels are not compromised.
- And glycogen synthase activity is increased (enzyme responsible for converting glucose to glycogen).
- Then, gradually increase CHO intake to 70% of diet, with light training.
- Day of rest and 70% CHO diet.
- Repletes glycogen stores on day of marathon.
- Taking in isotonic fluids during the event will top up blood glucose levels during the event.

b) Carbohydrates are used as an energy source during both aerobic and anaerobic conditions. It is therefore beneficial that an elite athlete’s stores of carbohydrate are at a maximum before competition day. Discuss the advantages and disadvantages of glycogen loading. 4 marks

**Answer:**
**Advantages:**
- Enhanced glycogen stores in muscle and liver.
- Overall effect is for overall times in aerobic activities beyond 90 minutes to improve significantly.

**Disadvantages:**
- Increased body mass due to increased water retention.
- Needed for enhanced glycogen storage.
- During CHO depletion phase decreased energy levels.
- And increased fatigue (if using classic method of carbo-loading).
8) c) How can an athlete’s diet aid the recovery process? 2 marks

Answer:
2 marks for 2 of:
• Quick ingestion of carbohydrates after exercise (2 hour window of opportunity) will speed up recovery.
• Eating foods, such as rice and bananas, that have a high glycemic index.
• To raise blood glucose levels quickly and stimulate greater insulin release needed to convert glucose into glycogen.
• Water needed to rehydrate the body.
• Electrolyte replenishment needed to aid the metabolic process.
• Protein needed to aid tissue damage, repair and growth.

9) Give a brief outline and comment upon the following techniques, which may be employed in the belief that they will enhance sport performance: 12 marks

3 marks for each technique.

a) Whey protein.

Answer:
• Whey protein is a natural protein present in milk and is used as a protein supplement in sports drinks.
• Whey protein contains a branch chain of amino acids which are the first ones to be used during intense training.
• Because it is extremely easy to digest and so can provide instantaneous nourishment to the muscles.
• Whey protein provides the body with these amino acids and in turn they assist with repairing and rebuilding lean muscle tissue.

b) Ginseng.

Answer:
• Ginseng is derived from a root and consumed as tea.
• It is thought to increase mental alertness, boost energy levels, increase VO_{max}, reduce OBLA and boost the immune system.
• There are a limited amount of scientific studies to support these claims.

• Caffeine.

Answer:
• Caffeine stimulates the central nervous system, thereby reducing reaction time.
• Caffeine is used as a substance to promote fat metabolism.
• Thus sparing glycogen reserves during prolonged exercise.
• And reduces adipose tissue in elite performers.
• Benefits are likely to occur across a range of sports, including endurance events, stop-and-go events (e.g., team and racquet sports), and sports involving sustained high-intensity activity.
10) What is an ergogenic aid? Discuss the role which nutritional supplements play in improving performance. 12 marks

**Answer:**

2 marks for definition:
- An ergogenic aid is defined as any means of improving the efficiency.
- And enhancing the quality of sporting performance.

Examples of nutritional ergogenic aids, identifying at least 3 ergogenic aids and giving an explanation for its use:
- **Creatine** supplementation increases PC levels. Thereby enhancing ATP-PC energy system.
- **Glutamine** supplementation reduces the risk of infection by boosting the body’s immune system.
- **Vitamin** supplementation (C and E) act as antioxidants, thereby enhancing recovery from exercise.
- **Isotonic** sports drinks prevent dehydration. And supplement energy reserve.
- **Hypotonic** sports drinks replenish blood glucose levels. And top up glycogen stores after exercise has finished.
- **Caffeine** ingestion increases mental alertness. However, an unregulated supplement industry, and inadvertent cross contamination of supplements with banned substances.

11) The dietary requirements of a power athlete and an endurance-based athlete have similarities and differences. Discuss

**Answer:**

- A balanced diet for both groups of athletes is essential for optimal performance. Consisting of between 10-15% proteins, 20-25% fats and 60-75% carbohydrates. And nutritionally complete to meet the demands of the individual’s training and competition programme. As well as providing nutrients for tissue growth and repair. A tailor-made diet will include the additional nutrient and fluid demands that will enable an athlete to train hard, recover between sessions and maintain ideal body weight.

- The energy requirements between a power and endurance-based athlete will be different because of the differences in the intensity and duration of the training or competition programmes.
- As reflected by the daily energy intake of around 8500 kJ for a female swimmer and around 6000 kJ for a female gymnast.
- **Glycogen** is the most important fuel reserve and the major fuel that supports any type of exercise.
- Hence a high carbohydrate (CHO) diet significantly improves performance for both power athlete and endurance-based athlete.
- However, an endurance-based athlete, such as a marathon runner, would need to consume at least 6-10 grams of CHO per kg of body mass.
- The additional stored carbohydrate provides the critical energy for improved endurance performance. Furthermore, **carbohydrate loading**, used by many endurance-based athletes, is a very effective technique for increasing both muscle and liver glycogen stores.
- **CHO requirement** for a power athlete would be around 4-6 grams of CHO per kg of body mass.
- Thus reflecting a reduced intake as discussed above.

- **Protein requirements** would differ between these two groups of athletes.
  - For an endurance-based athlete the recommended protein intake is 1.2-1.4 grams per kg of body mass.
  - In contrast, for a power athlete the recommended protein intake is 1.4-1.8 grams per kg of body mass.
  - This need for a difference in protein intake is because after heavy resistance training the rate of protein breakdown and resynthesis is greater for the power athlete.

- **Fat intake** should be restricted for both endurance and power athletes, since muscle mass is more powerful than fat.

- **Water intake** before, during and after training or competitions is vital to all sports performers. Since excessive fluid loss can lead to dehydration and reduced performance.
- **Sports drinks** also reduce the risk of dehydration. And provide an important source of energy.
  - And so improve the performance of both endurance-based and power athletes.
  - Elite power and endurance-based athletes supplement their diets with **nutritional ergogenic aids**. Such as **glucosamine**, a herbal supplement that is known to reduce joint inflammation and stiffness. And protein supplements such as **glutamine**, which is known to reinforce the immune system.
  - Thus reducing the risk of infection.
12) A level. Give a brief outline and comment critically upon the effects of glycogen loading on the enhancement of sport performance. 15 marks

**Answer:**

- **Glycogen loading**, also known as carbo-loading, is a method of manipulating an athlete’s diet to maximise the glycogen held in muscle and the liver.
- By raising muscle glycogen stores above their normal resting levels.
- Glycogen loading enables the maximum possible energy to be available for a major endurance event over 90 minutes of continuous activity.
- **Depletion/repletion** technique—traditionally 7 days prior to event such as a marathon race, liver and muscle glycogen stores are depleted.
- Achieved by the athlete eating a reduced intake of carbohydrates (CHO) with a low GI value for 3 days.
- And performing an endurance training session such as a 20 mile run.
- Repletion of glycogen stores occurs with a high GI, CHO-rich diet combined with light exercise or rest for 3 more days just prior to event.
- In terms of the effects of glycogen loading, the body reacts to glycogen depletion by vigorously increasing muscle and liver glycogen content to above normal levels during the repletion phase.

- There are disadvantages in using this dietary regime such as increase in body mass.
- Since more water is needed to store the increased glycogen stores.
- And during the depletion phase many athletes feel weak, depressed and irritable.
- Modern-day athletes prefer a gradual tapering off in training.
- Alongside increased carbohydrate intake again over a period of 7 days.
- This method offers similar ergogenic benefits to those observed in the depletion/repletion method outlined above.
- The advantage of this modern method is that it does not have the glycogen depletion phase and its disadvantages as outlined above.
- The evening prior to global endurance events, such as the London marathon, competitors are invited to pasta parties as a final effort to top up glycogen levels.
- During an endurance event, the effect of reduced muscle glycogen levels begins to be felt at the 1.5 hour mark.
- And so the athlete is advised to consume isotonic drinks and energy gels available at the food stations on the route.
- This fuel intake needs careful planning in order to optimise performance.
- The effect of drinks and gel foods during the event is to top up blood glucose levels that will sustain performance during the latter stages of the event.
- Using glycogen loading techniques before and during an endurance event, a runner’s time would reduce by more than 10 minutes in a 2 hour run.

13) How can an elite athlete assess whether their diet meets the demands of their training and competitive programmes?

**Answer:**

4 marks for 4 of:

- Elite athlete needs to be nutritionally assessed.
- Required to create a dietary log recording all food eaten and portions within an elected time period.
- Required to complete a questionnaire about food habits.
- Required to analyse training and competition demands.
- Checked for body composition to assess ideal body weight.
- Once assessment is completed, a tailor-made diet can be created that meets the specific and dietary requirements of the athlete.