Answers to Test your knowledge questions

Nelson Physical Education Studies for WA 2A,2B

Chapter 12

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multiple choice

1 C
2 B
3 D
4 D

short answer

5 Fats can produce more ATP than carbohydrates but require more chemical reactions to resynthesize ATP. This happens at a slower rate and also requires larger amounts of oxygen to do so and thus less is available to working muscles.

6a

- Can work at a higher intensity before fatiguing due to H+ accumulation
- Performers can increase the amount or volume of their training before fatiguing
- Able to work at higher intensities and still be working aerobically and hence lead to greater improvements in VO₂ max
- Leads to increases in fat and carbohydrate metabolic processes so more ATP can potentially be generated.

6b The person will be able to work at higher intensities and still call upon most of their ASTP/energy from their aerobic energy system. It also means that they will need to work at even higher intensities before they call upon the anaerobic glycolysis/LA system to increase contribution to ATP production and thus delay fatigue related to this system’s use.

6c Intermittent interval training allows higher intensities to be achieved and recovered from than if the same volume was to be attempted by one continuous session working above the lactate threshold. For example, it is easier to run 6 × 300m interval sprints at 90% max heart rate than it is to run one 1800m sprint at the same intensity (very unlikely).

7a i Anaerobic training methods such as plyometrics, short interval and resistance training focusing on power will see increases in fast-twitch fibre size and hence also increased capacity to store PC.

7a ii Creatine supplementation or eating foods such as red meat, especially lean meat, fish like
tuna and salmon will lead to increased PC synthesis and stores.

7b This will see more energy being derived from the ATP-PC system so its rate is faster than that of the LA system and less slowing down occurs. Additionally the LA system peaks a lot later and contributes less to fatigue experienced at the end of the race.

**essay style**

8 The energy system interplay or continuum involves all three energy systems contributing to ATP production during physical activity but to varying amounts depending on the intensity, duration, availability of oxygen and fuels. At any one stage one energy system will be providing more ATP than the other two and this changes throughout the activity.

**Sporting example: intermittent team sport – netball**

- Netball is characterised by repeated bouts of high-intensity action interspersed with periods of moderate activity and active rest (during play stoppages). When the whistle blows to start play all three systems start contributing, but most energy is derived from the ATP–PC system in the first 3–5 seconds. During the same time the LA system is increasing its contribution to energy production, but is slower than the ATP–PC system due to more complex chemical reactions required to break down glycogen as compared to PC. If efforts above 85% max heart rate last for longer than 5 seconds, the LA system will increase its contribution.

- There is sufficient PC to ‘power’ efforts for up to 10 seconds and following each explosive burst, this will be drained and deplete the ATP–PC system. Restoration of PC will occur at very low intensities, but it is likely that until a 60-plus-second break occurs (quarter/half time or bench), this system will not have adequate opportunities to totally rebuild/restore PC and increasingly high intensity efforts will be driven by the LA system as the match progresses, especially for mobile players such as centres, wing attacks/defence, etc.

- The aerobic energy system only supplies a small portion of the energy needed during these initial intense efforts, but its contribution increases as PC has less time to resynthesise and the game progresses.

- The aerobic system provides most of the energy needed during moderate activity during the game after the 2-minute mark, and it is critical for efficient recovery between play stoppages, during time on the bench and quarter or half time breaks. During a quarter, even if high intensity efforts are required, once the aerobic system has established itself as the major ATP producer (2-plus minutes), it still contributes more to ATP production than the LA system that, despite increasing its contribution, can only produce 1/5–1/7 as much ATP in total as the aerobic system.

For example, at the 5-second stage the contribution from the three systems for a centre might be:

ATP–PC – 90%; LA – 5–7%; aerobic – 3–5%.

At the 2-minute stage the contribution from the three systems for a centre might be:

ATP–PC – 25%; LA – 15%; aerobic – 60%.
• The marathon is a continuous activity that lasts for just over two hours at the elite level. When starting, all three systems supply energy but at a slower rate than that required by someone who is working at a higher intensity such as a netball centre. PC will be used at a slower rate and hence it will peak later, i.e. 8–10 seconds. The LA and aerobic systems are also contributing to ATP production and from the first step increase their contribution, but because the activity will not exceed the lactate inflection point in the early stages, the aerobic system quickly takes over as the major ATP producer.

• During any surges in the race, where the LA system increases its contribution, it still cannot produce the same amount of energy as the aerobic system (2/3 moles ATP compared to 30–36 moles ATP). During surges the LA system isn’t the major ATP provider, rather it is the system that provides the extra energy required to allow an increase in intensity/work output.

• Once PC is depleted it does not have the chance to replenish itself so the ATP–PC contribution is limited to the first few seconds of the race. The aerobic system is not only important to producing ATP during the race but it also plays an important role in breaking down any metabolic by-products that accumulate when the LA system increases its contribution as well as converting any accumulated LA back into glycogen to be used either aerobically or anaerobically.