2016 VCE Physical Education examination report

General comments

The 2016 Physical Education examination was quite well handled by the majority of students. Many responses were of an exceptionally high standard. Students who were able to correctly apply their understanding and knowledge to the context provided in the question scored highly. However, repeating information provided in the stem of the question was not awarded marks. For example, in Question 12a., stating that both EPO and blood doping are illegal is a similarity; however, this information was provided in the question stem and was therefore not accepted as a response.

Students showed a good understanding of the advantages and disadvantages of methods of measuring physical activity levels in general. It is important that the population group considered is taken into account when identifying these advantages and disadvantages. This was relevant to both Questions 3di. and 9c.; students who addressed the requirements of the questions using correct terminology were rewarded. Students who were able to draw on practical experiences were able to articulate the knowledge gained through these activities in their written responses.

Students used acceptable scientific abbreviations when appropriate. If students wish to use another abbreviation and are unsure if it is appropriate, then they should define the term in the first instance and continue to use the abbreviation in the remainder of their response. Students are also reminded that symbols, such as arrows, are not acceptable without an indication of what the symbol represents.

Students are reminded that a comparison must be made when showing similarities or differences. For example, a difference between blood doping and EPO is that blood doping carries the risk of infection if using donor blood or if blood is stored incorrectly, whereas EPO does not. A similarity between blood doping and EPO is that they both increase the oxygen-carrying capacity of the blood.

Dot points can be useful to provide clear and concise answers; however, when the question asks students to ‘explain’, ‘justify’ or ‘critique’, for example, it is difficult for students to achieve full marks with a response in dot-point format. Teachers and students are reminded that both the key knowledge and key skills are examinable (refer to pages 24–29 of the study design). Students are expected to demonstrate their ability to analyse, apply, compare, contrast, critique, describe, design, evaluate, explain, identify, justify and report (key skills) in addition to understanding the key knowledge.

Differentiating between the psychological and physiological effects of different conditions on the body continues to challenge students. Students are encouraged to read examination questions carefully to ensure that they provide a suitable explanation of the effect (psychological or physiological) asked for in the stem of the question.

Many students provided suitable statements regarding the benefits of an increased in lactate inflection point (LIP) for a distance runner, such as the body’s ability to produce ATP aerobically at higher intensities. However, students’ knowledge appeared to be superficial, with few being able to demonstrate a thorough understanding of how this occurs. Students incorrectly associated lactate tolerance with an increase in LIP. Teachers are reminded to refer to the advice on LIP published on the VCAA website via the Physical Education study page.

Where data was provided, many students demonstrated skills in reading, interpreting, analysing and evaluating the information and ensuring that the data was incorporated to support their response. Students were not awarded full marks for questions stating that data must be used (Questions 7e. and 13a.) if this was not evident in their response.

Teachers and students are reminded that the correct and examinable version of Australia's Physical Activity and Sedentary Behaviour Guidelines are outlined in the amendment to the *VCE Physical Education Study Design*, available on the VCAA website.

Specific information

Note: Student responses reproduced in this report have not been corrected for grammar, spelling or factual information.

This report provides sample answers or an indication of what answers may have included. Unless otherwise stated, these are not intended to be exemplary or complete responses.

The statistics in this report may be subject to rounding errors resulting in a total less than 100 per cent.

Section A – Multiple-choice questions

The table below indicates the percentage of students who chose each option. The correct answer is indicated by shading.

Question	% A	% B	% C	% D	Comments
1	2	22	62	14	
2	14	12	9	64	
3	92	2	1	6	
4	6	1	1	92	
5	72	19	1	7	
6	7	5	87	2	
7	5	38	54	3	The only chronic adaptation specific to the aerobic system was an increase in mitochondria (option C). Students incorrectly associated an increase in lactate tolerance with an increase in the body's ability to produce ATP aerobically at increased exercise intensity.
8	56	18	11	14	
9	94	2	2	3	
10	37	57	6	1	The intensity of a training session will determine the predominant energy system used.
11	4	60	32	3	
12	22	9	8	61	

Question	% A	% B	% C	% D	Comments
13	46	4	41	9	The question asked students to determine the chronic adaptation shown in the graph. The only information provided was oxygen consumption and heart rate. The trained athlete is shown to have a decreased resting heart rate (option C) and lower oxygen consumption for a given heart rate. The graph did not show any change in stroke volume.
14	59	13	14	14	
15	1	92	4	2	

Students handled the multiple-choice section of the examination reasonably well.

Section B – Short-answer questions

Question 1

Question 1a. was not well handled by students, reflecting a limited understanding of Australia's Physical Activity and Sedentary Behaviour Guidelines. Question 1b. was answered well, although it is important to note that 'type' is not a training principle and was not awarded marks. In Question 1c., for two marks, students were required to identify that an increase in intensity was needed and provide an example of how this could be achieved.

Question 1a.

Marks	0	1	Average
%	77	23	**0.2**

Doing any physical activity is better than doing none. If you currently do no physical activity, start by doing some and gradually build up to the recommended amount.

Question 1b.

Marks	0	1	Average
%	16	84	**0.9**

- frequency
- intensity
- specificity

Question 1c.

Marks	0	1	2	Average
%	23	44	32	**1.1**

Overload could be achieved by increasing the intensity of the run by running faster and further in the same time, or running up hills, running on sand, etc., in the same time.

Question 2

Students were able to list suitable examples of cardiovascular adaptations in Question 2a. The explanation of how this change leads to an increase in aerobic fitness (Question 2b.) was more challenging for many students.

Question 2a.

Marks	0	1	2	Average
%	12	35	53	**1.4**

Suitable answers included:

- cardiac hypertrophy (increased size and/or thickness of the ventricle wall)
- increased cardiac output at maximal intensity
- decreased resting heart rate
- decreased submaximal heart rate
- increased stroke volume
- increased blood volume
- increased plasma
- increased haemoglobin
- increased capillarisation
- increased a-vO_2 difference
- decreased systolic blood pressure
- increased high-density lipids.

Question 2b.

Marks	0	1	2	Average
%	27	21	52	**1.3**

Aerobic adaptations to training lead to an increased ability to deliver oxygen-rich blood to the working muscles more efficiently. For example, increased haemoglobin increases the oxygen-carrying capacity of the blood.

Question 3

In Question 3b., which required students to critique the use of the LaunchPad program to increase the physical activity levels of children, students needed to identify the main point of the initiative (to develop children's fundamental movement skills to improve confidence and competence) and relate this to the correct level of the social-ecological model (individual). They then needed to provide further evidence of how this related to the broader context (increasing physical activity levels of children) and then evaluate the strengths and weaknesses of the program (what is useful, what are the problems, what could be done better), make a decision (i.e. reasons why this program is unlikely to be successful) and support the decision with evidence. Most students were unable to demonstrate the ability to critique. Students who listed the four components of the social-ecological model and provided an example at each level were not awarded marks for this question.

Question 3c. was not well answered as responses needed to link to the LaunchPad program/gymnastics specifically to be awarded marks.

Question 3a.

Marks	0	1	Average
%	12	88	**0.9**

Individual

Question 3b.

Marks	0	1	2	3	4	Average
%	20	22	32	16	10	**1.8**

- It is not clear that LaunchPad addresses all four components of the social-ecological model and is likely not to be successful unless individual, social environment, physical environment and policy factors are addressed.
- LaunchPad targets the individual level to increase fundamental movement skills (confidence and competence).
- It may address the social environment level (influence of people, society and organisations) through teams/groups participating and culture of activity; however, this is not clear.
- It may address the physical environmental level if LaunchPad is provided at school or in physical environments for the children.
- It may influence policy level if it is school policy to complete.

Question 3c.

Marks	0	1	Average
%	61	39	**0.4**

- built environment and natural environment (for example, providing equipment to schools, sporting spaces, access to facilities)
- posters and prompts to undertake activity (for example, gymnastics posters or LaunchPad program posters)
- provide or organise on-site physical activities for students (for example, LaunchPad out of class time), facilities to enable physical activity such as access to gym facilities or equipment out of class time (for example, after school)
- more sporting facilities at the school, open spaces for activity, covered open spaces for activity, providing teaching with resources for LaunchPad, providing medals for participation

Question 3di.

Marks	0	1	2	Average
%	5	24	71	**1.7**

- Advantages: easy to complete; cost is suitable for small or large groups; detailed information on context of activity; provides frequency, duration, and intensity; provides type
- Disadvantages: social desirability; misrepresentation; inaccuracy of recall; subject burden; reactivity; not suitable for children (requires a proxy to complete)

Question 3dii.

Marks	0	1	2	Average
%	6	29	65	**1.6**

Subjective

- proxy report
- recall survey/questionnaire

Objective

- pedometer
- accelerometer

- direct observation

Question 4

In Question 4a., few students achieved full marks. The question required an understanding of the characteristics of the energy systems and an ability to determine what is the same and what is different between the aerobic and anaerobic process of ATP production. While some students were able to state that an increase in LIP results in being able to work aerobically at higher intensities (Question 4c.), many students contradicted this statement in the second part of their answer by going on to say that the athlete would be able to tolerate the lactate that accumulated. When ATP is produced aerobically there is no significant increase in the lactate that is accumulated as it is removed at a similar rate to which it is being produced. The role of oxidative enzymes was not well understood by students.

Question 4a.

Marks	0	1	2	3	4	Average
%	25	20	25	20	9	**1.7**

Similarities

- In both systems, glycogen is broken down into glucose to provide the energy to resynthesise ADP and Pi to produce ATP.
- Both reactions produce pyruvic acid.
- Both produce by-products.

Differences

- The aerobic system produces ATP in the presence of oxygen and the anaerobic system produces ATP without oxygen.
- In the aerobic system in the presence of sufficient oxygen, pyruvic acid is converted to CO_2, H_2O and ATP, whereas in the anaerobic system with insufficient oxygen, pyruvic acid is converted to lactic acid.
- The aerobic pathway produces ATP at a much slower rate than the anaerobic pathways, which produce ATP at a faster rate.
- The aerobic pathway produces a higher yield of ATP than the anaerobic pathways, which produce a lower yield of ATP.

Question 4b.

Marks	0	1	2	Average
%	30	40	30	**1**

The athlete would have an increased contribution from their anaerobic systems and metabolic by-products would start accumulating at a higher rate than they can be metabolised.

OR

- increase in ventilation
- increase in respiratory rate
- increase in heart rate
- plateau in stroke volume and tidal volume above aerobic training zone
- increase cardiac output
- increased redistribution of blood flow
- increased recruitment of fast-twitch fibres
- decreased substrates (CP, glycogen)

Question 4c.

Marks	0	1	2	Average
%	31	39	31	**1**

The athlete would be able to continue to work using the aerobic system, producing ATP aerobically at a higher intensity. This would allow the athlete to run at a faster pace, without exceeding LIP or accumulating metabolic by-products.

Question 4d.

Marks	0	1	2	Average
%	72	17	10	**0.4**

- increases the rate of oxidation of nutrients (carbohydrates and fats) for ATP production
- increased ability to oxidise fats and carbohydrates, which allows ATP to be produced aerobically at higher intensities

Question 5

In Question 5a., for full marks, students needed to show the correct application of the Physical Activity Guidelines for adults. Students showed limited knowledge of the purpose of the conditioning phase of a training session (Question 5b.).

Question 5a.

Marks	0	1	2	3	4	Average
%	9	9	18	32	33	**2.7**

The program needed to show:

- Frequency: 5–7 days
- Duration/time: 150–300 minutes
- Intensity: moderate intensity activity

OR

- Duration/time: 75–150 minutes
- Intensity: vigorous intensity activity
- Type: muscle-strengthening activities at least twice a week

Question 5b.

Marks	0	1	2	3	Average
%	7	16	49	28	**2**

- Warm-up: whole-body activity to increase heart rate and prepare the body for exercise, warm up muscles to avoid injury. Prepare psychologically for the training.
- Conditioning phase: to develop the fitness component that the training aims to develop (for example, strength, aerobic capacity, flexibility)
- Cool-down: same activity at a lower intensity to return body to pre-exercise levels, removal of waste products, speed up recovery, reduce venous pooling, reduce the risk of DOMS, etc.

Question 6

Many students understood that carbohydrate loading increases muscle glycogen but were unable to provide detail of the process of carbohydrate loading. In Question 6b., many students confused a high-carbohydrate diet with high GI foods and discussed an increased rate of absorption rather than the increased amount of muscle glycogen.

Question 6a.

Marks	0	1	2	Average
%	35	47	17	**0.8**

While tapering, the athlete consumes a high-carbohydrate diet in the previous 2–6 days prior to competition. Carbohydrate loading maximises the muscle glycogen stores and therefore prolongs the use of carbohydrates and delays the use of body fats, which are slower to break down for ATP resynthesis.

Question 6b.

Marks	0	1	2	3	Average
%	23	35	30	12	**1.3**

By having a high-carbohydrate diet the athlete can restore their muscle glycogen to higher levels in comparison to a low-carbohydrate diet. This would influence their training as the athlete on the high-carbohydrate diet would be able to access glycogen stores for longer during training, which results in quicker energy release.

Question 7

In Question 7a., many students failed to identify a health-related fitness component. Students demonstrated a strong understanding of psychological strategies to enhance concentration in Question 7b. Student responses that included correct terminology, a thorough understanding of the work and rest variables, and how intensity, distance, duration and rest periods can be manipulated to allow the focus of interval training to be altered were rewarded with full marks in Question 7c. Few students were able to demonstrate an understanding of why the lactate levels for intervals B and C in the graph were higher than those for A. An example of an appropriate work-to-rest ratio was required for full marks.

Question 7a.

Marks	0	1	2	Average
%	38	15	46	**1.1**

Suitable answers included:

- Flexibility: an increased range of motion of the hip joint is required to perform the action shown and clear the hurdle.
- Body composition: power-to-weight ratio is important for sprinters; therefore, maximising strength while maintaining low body fat levels is desirable.
- Anaerobic capacity: an increase in the capacity of the anaerobic systems would allow ATP to continue to be produced at a fast rate for longer, decreasing the reliance on the aerobic system.

Question 7b.

Marks	0	1	2	Average
%	13	20	67	**1.6**

The following strategies were appropriate when described in relation to increased concentration.

- Cue words: reciting key phrases to oneself to maintain focus on important aspects
- Meditation: remaining centred in the present to concentrate on the job at hand
- Stress Inoculation Training or Simulation to help sustain attention during distractions
- Using imagery/visualisation and self-talk to refocus when distracted
- Controlled breathing: allows for refocusing
- Goal-setting: focus on a specific skill
- Biofeedback: using the feedback from the device in training to recognise tensions and implement strategies pre-race to correct tensions

Question 7c.

Marks	0	1	2	3	Average
%	21	26	29	24	**1.6**

- Interval training uses repeated bouts of moderate- to high-intensity exercise (work) with periods of rest.
- The length and intensity of the work periods and the length of the rest periods can be changed to reflect the energy system being trained.
  For example, > 1:1 aerobic energy system
  1:3 – 1:2 anaerobic glycolysis
  1:7 – 1:3 ATP-CP system

Question 7d.

Marks	0	1	2	3	Average
%	4	12	13	71	**2.5**

A: ATP-PC or anaerobic glycolysis

B: anaerobic glycolysis

C: aerobic

Question 7e.

Marks	0	1	2	3	Average
%	33	32	27	9	**1.1**

- The intensities of the intervals in A and B are higher than in C.
- The increased blood lactate levels indicate the increased intensity; for example, 9 mmol/L for B and 13 mmol/L for A.
- Increased blood lactate levels are associated with use of the ATP-PC and anaerobic glycolysis systems.

Question 8

Students were not awarded full marks if the justification for the fitness component included the name of the fitness component in the answer. For example, ‘Balance is required because a jockey needs to balance on the horse.’ In Question 8c., students commonly suggested that Athlete 1 was more suited to the 200 m and Athlete 2 the 100 m, failing to recognise that the 100 m and 200 m events are predominately anaerobic and require strength, power and speed, characterised by a higher percentage of type II fibres (fast-twitch) and greater leg strength (1 RM).

Question 8a.

Marks	0	1	2	Average
%	13	28	59	**1.5**

Suitable answers included:

- Body composition, as horse riding has weight requirements, so jockeys must have a low total body mass to meet the weight criteria.
- Balance, as the jockey must maintain equilibrium on the horse while it is moving at high speeds.
- Flexibility is required as a full range of motion at the hip joint and shoulder joint is required to ride with correct technique.
- Muscular endurance (legs) is required to hold position of the horse over an extended period of time.
- Coordination is required to ride, position, whip and respond to external stimulus (other riders).

Question 8b.

Marks	0	1	2	Average
%	22	40	38	**1.2**

Suitable answers included:

- age
- cross-sectional area (muscle size)
- speed of contraction/type of contraction
- muscle fibre type
- fibre arrangement
- muscle length/tension/angle
- fibre length: muscle length ratio
- training status
- injury status.

Question 8c.

Marks	0	1	2	3	Average
%	24	13	25	39	**1.8**

Athlete 2 is more likely to perform better in the 100 m and 200 m sprint events.

- They have a higher percentage of fast-twitch (type II) fibres, which are more suited to anaerobic activities, and a higher 1 RM, indicating greater leg strength required for sprinting.
- Sprint athletes are likely to have a lower aerobic capacity as this is not the focus of their training or required. Athlete 1 has a higher VO_2 max, which is a characteristic more suited to endurance events.

Question 9

Students were able to clearly identify the components the initiatives targeted in Question 9a. In 9b., students often listed three examples; however, they did not provide an explanation as to why behaviour may not change. A common error in both 9b. and 9c. was for students not to link their response to the context provided in the question (i.e. schoolchildren and bike riding).

Question 9a.

Marks	0	1	2	3	4	Average
%	1	2	8	10	79	**3.6**

- Secure bike racks installed at the school: physical environment
- Bike education taught in Grades 2, 4 and 6: policy/individual
- Meeting points for students en route to school: social
- 40 km/hr zone in surrounding streets: policy

Question 9b.

Marks	0	1	2	3	Average
%	14	13	25	49	**2.1**

The following examples were appropriate to be used in the explanation of why the bike riding initiative may not change the behaviour of students.

- geography – too far from school
- no bike path (safety – have to ride on the road)
- student doesn’t own a bike (low SES/cost)
- can’t ride a bike (no skill/confidence/self-efficacy)
- safety (parents concerned with crime rates of the area)
- weather
- social
- ability/disability – physical capacity to ride a bike
- personal motivation – can’t be bothered to ride to school
- students in Grades prep, 1, 3 and 5 did not have access to the bike education program and therefore do not have the required skills

Question 9c.

Marks	0	1	2	3	4	Average
%	7	9	18	29	36	**2.8**

- Pedometers: good for a large group and useful for detecting change, easy to use, cost-effective for large groups but only measures walking.
- Direct observation: most appropriate for this age group, will provide contextual information but difficult with large groups, labour- and time-intensive and/or are susceptible to reactivity.

Question 10

Students attempted to answer Question 10bii. as a question about energy interplay and failed to consider how the energy requirements were both similar and different for two players participating in the same game of netball. Question 10bi. was not answered well, with the majority of students not receiving any marks. Students are encouraged to perform an activity analysis to determine the information that can be gained from the data collected.

Question 10a.

Marks	0	1	2	3	4	5	Average
%	13	17	27	24	14	5	**2.3**

Students needed to refer to the following similarities and differences in their discussion:

- Both players would require a large contribution from the ATP-PC systems to perform the short, sharp movements involved in the game.
- The centre player would need a larger contribution from the anaerobic glycolysis system throughout the game to continue to perform high-intensity movements as they have fewer rest periods (lower periods of walking and standing still) that would lead to the replenishment of the ATP-PC system in the goal shooter.
- The aerobic system would be important to both players for different purposes. The centre player would require a greater contribution from the aerobic system to continue to move over the whole court (constantly moving). The goal shooter would need a highly trained aerobic system to improve recovery times for the ATP-PC system.

Question 10bi.

Marks	0	1	2	Average
%	62	25	14	**0.5**

Suitable answers included:

- identify the major muscle groups used
- types of muscular contractions
- speed of muscular contraction
- identification of fitness components
- joint actions.

Question 10bii.

Marks	0	1	Average
%	25	75	**0.8**

Example: Chest pass – push up

Answers needed to describe or show a resistance exercise that mimics the movement of the skill identified.

Question 11

Students had a superficial understanding of the physiological and psychological effects of dehydration. A common error was to answer both Questions 11a. and 11c. from a physiological perspective, when Question 11c. required students to respond from a psychological perspective. Students are reminded to read the question carefully.

Question 11a.

Marks	0	1	2	3	Average
%	26	44	23	8	**1.1**

Suitable answers included the following points in the explanation:

- Increased demand is placed on the cardiovascular system to maintain core temperature within a normal range via redirecting blood flow to the skin and increasing sweat rates as a result of vasodilation.
- Elevated skin temperature significantly decreases stroke volume and blood volume, as well as increasing heart rate.
- From vasoconstriction at working muscles this leads to reduced delivery of oxygen and nutrients to the working muscles, which leads to fatigue.
- Glycogen is utilised at a faster rate when core temperature is elevated and this leads to an increase in the production of metabolic by-products, which has implications for exercise performance.

Question 11b.

Marks	0	1	2	Average
%	15	34	51	**1.4**

Suitable answers include:

- hats
- protective clothing
- light-coloured/lightweight clothing
- standing in the shade between points/sitting in the shade at change of ends
- applying ice/wet towels during changes of end
- monitoring urine output.

Question 11c.

Marks	0	1	2	Average
%	41	32	27	**0.9**

- as dehydration increases, there is a gradual reduction in mental performance
- increased perception of how hard the exercise feels
- increased anger, tension, reduced vigour, confusion

Question 11d.

Marks	0	1	2	3	Average
%	8	14	30	48	**2.2**

Water:

- replaces fluids
- is absorbed at the same rate or quicker than sports drinks.

Isotonic sports drinks:

- enhance hydration to help prevent dehydration, rises in core temperature and blood flow to the skin
- provide a supply of energy to the body to prevent glycogen depletion
- replace lost salts to maintain cell fluid balance of electrolytes
- are more palatable to ingest and an athlete will drink more as a result.

The most suitable strategy would be the isotonic sports drinks.

Question 12

Students were challenged by Question 12a., with very few students receiving full marks. Understanding how two practices can lead to the same result and have similar side effects (similarities) and then how they differ (administration of the drug or method, time frame for use and result, etc.) proved to be difficult for many students. Question 12d. was generally answered well by students. However, it is worth noting that legal practices such as altitude training do enhance performance, otherwise athletes wouldn't use them, but they are not seen to violate the spirit of the sport or cause harm to the athlete.

Question 12a.

Marks	0	1	2	3	4	Average
%	23	26	28	17	6	**1.6**

Similarities	Differences
• both increase RBC • both increase haemoglobin mass • both increase oxygen-carrying capacity to working muscles • both practices can cause blood clotting • both have a higher risk of stroke, heart attack or death • both can cause stress on the heart/dehydration • EPO and blood are both naturally produced in the body	• blood doping carries the risk of infection if using donor blood or if blood is stored incorrectly, whereas EPO does not • EPO is quicker through injections, whereas with blood doping it takes a few months for RBC to replenish • blood doping produces a quicker result in improved performance after transfusion in contrast to a synthetic EPO injection • EPO can improve wound healing and blood doping does not • there is a synthetic version of EPO and none for blood doping

Question 12b.

Marks	0	1	2	Average
%	29	17	54	**1.3**

An increase of red blood cells (or haemoglobin) from the EPO enhances the oxygen-carrying capacity of the blood to working muscles and promotes greater aerobic endurance.

Question 12c.

Marks	0	1	2	Average
%	26	23	52	**1.3**

Suitable answers included:

- Altitude training or hypoxic tents would give similar benefits by increased RBC and oxygen-carrying capacity.

- Aerobic training increases the capacity of the cardiorespiratory system to take up, transport and use oxygen.

Question 12d.

Marks	0	1	2	Average
%	29	26	45	**1.2**

- no risk of harm or danger to the health of the athlete
- has been proven to enhance performance but has not been considered to violate the spirit of the sport

Question 13

In 13a., appropriate use of data was required for students to be awarded full marks. Many students misinterpreted the graph and assumed that when the rate of ATP-CP plateaued this indicated steady state, rather than the exhaustion of the stored fuel in the muscle. Most students were able to identify an increase in lactate being associated with anaerobic energy production. In 13b., chronic adaptation needed to be aerobic if it were to assist in an athlete reaching steady state more rapidly.

Question 13a.

Marks	0	1	2	3	Average
%	36	25	23	16	**1.2**

- The energy for muscle action comes directly from the immediate anaerobic breakdown of ATP. This is shown by the rapid rate of depletion of ATP-CP shown in the graph on the left (ATP-CP depleted at a rate of 10–15 mmol × kg/wet weight of muscle)
- ATP-CP depletes and muscle lactate increase (up to 20 mmol × kg/wet weight of muscle) during 0_2 deficit as a result of an increased contribution of the anaerobic pathways.

Question 13b.

Marks	0	1	2	3	Average
%	33	23	28	16	**1.3**

Suitable answers included:

- increase in glycolytic enzymes
- increase in capillary density of the muscle/increase in muscle fibre size
- increase in mitochondria
- increase in myoglobin
- increase in a-vO_2 difference