BTEC

Pearson BTEC Level 3 National in Sport and Exercise Science

Unit 1: Sport and Exercise Physiology

Sample Assessment Materials (SAMs)

For use with Diploma and Extended Diploma in Sport and Exercise Science

First teaching from September 2016 Issue 2

Pearson

BTEC

Pearson BTEC Level 3 Nationals

Write your name here

Surname	Forename

Learner Registration Number | Centre Number | Level 3

Sport and Exercise Science

Unit 1: Sport and Exercise Physiology

Diploma, Extended Diploma

Sample Assessment Materials for first teaching September 2016 onwards

Time: 1 hour 30 minutes

You do not need any other materials.

Total marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and learner registration number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – there may be more space than you need.

Information

- The total mark for this paper is 70.
- The marks for **each** question are shown in grey boxes.
  – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Paper reference
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S50443A

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Turn over ▶

PEARSON

Connor has returned to playing football after a 5 year break from sport. He needs to improve his fitness so takes part in a 3 month fitness training programme. He joined a gym and was given the following weekly training programme:

Monday – 20 minutes continuous running
Tuesday – weight training (upper body)
Thursday – 15 minutes continuous rowing and 15 minutes continuous cycling
Friday – weight training (lower body)
Saturday – 20 minutes continuous running

1 (a) Explain how this fitness training programme would increase the strength of Connor's bones.

3 marks

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After 3 months of taking part in his fitness training programme, Connor's resting heart rate dropped from 86 bpm to 75 bpm.

(b) Explain why Connor's fitness training programme caused a drop in his resting heart rate.

3 marks

Connor uses dumbbells in his weight training sessions.
He has a choice of either 5 kg, 10 kg, 15 kg or 20 kg dumbbells.

(c) Explain **one** way Connor's nervous system can control the force exerted by his muscles to allow him to pick up the different dumbbells.

2 marks

Connor tested his fitness at the start and at the end of his 3-month training programme. His fitness test results showed a clear improvement in his VO_2 max.

(d) Evaluate the effect of Connor's training programme on his cardiovascular and respiratory systems and how this will affect his fitness for playing football.

8 marks

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Total for Question 1 = 16 marks

Harry took part in a cycling event that covered 300 miles. The cycling event was made up of 3 stages.

Stage 1	Daytime ride covering 100 miles across flat terrain
Stage 2	Night ride covering 100 miles across varied terrain
Stage 3	Daytime ride covering 100 miles including long, steep hill climbs and descent

Before each stage of the event Harry ate a healthy meal. When cycling during the event Harry consumed carbohydrate gels at hourly intervals when cycling.

2 (a) Explain why Harry consumes carbohydrate gels during this type of cycle event.

3 marks

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In stage 3 of the cycle event Harry's leg muscles felt very sore during the long hill climbs. The pain soon disappeared when he cycled along a flatter stretch of road at a lower intensity.

(b) Explain why Harry's muscles feel sore when cycling during the hill climbs compared to cycling on the flatter stretches of road.

4 marks

During the hill climbs in stage 3 of the cycle event Harry became breathless and had to stop at the top of each hill, where he continued to breathe deeply for a few minutes.

(c) Explain why Harry continued to breathe deeply after cycling up a steep hill, even though he had stopped cycling.

3 marks

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The climate varied during each stage of the cycle event.

During the daytime rides the weather was hot and sunny with temperatures reaching 31°C.

During the night the temperature dropped to 2°C.

(d) Analyse how thermoregulation allows Harry to maintain his core body temperature whilst cycling in different climates.

8 marks

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Total for Question 2 = 18 marks

Michael used free weight training to improve his strength. He developed his own twelve-week training programme to train all the major muscle groups.

For the first six-week period he trained each muscle group twice a week and for the second six-week period he trained each muscle group three times a week.

He used the 1-repetition maximum (1RM) test to monitor his strength gains and his results are shown in **Table 1**.

Exercise	Week 1	Week 6	Week 12
1RM Squat	90 kg	120 kg	115 kg
1RM Bench Press	75 kg	90 kg	85 kg

Table 1

During weight lifting exercises, the muscular system responds by recruiting muscle fibres to provide the necessary force to lift the weight.

3 (a) State **three** other responses of the muscular system when carrying out a weight training session.

3 marks

(i) .....

.....

(ii) .....

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(iii) .....

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(b) Explain why the ATP-PC system is used to provide energy to lift the required weights during Michael's strength training sessions.

4 marks

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After 12 weeks Michael reviewed his training programme. He found that after he increased the frequency of his training his strength decreased. Michael revised his programme, reducing the frequency, back to training each muscle group twice a week. This was for a further 6-week period.

He used the 1-repetition maximum (1RM) test to monitor his strength gains and his results are shown in **Table 2.**

Exercise/Week	Week 12	Week 18
1RM Squat	115 kg	130 kg
1RM Bench Press	85 kg	100 kg

Table 2

Overtraining impacted on Michael's ability to lift weights in week 12.

(c) Explain how overtraining would cause Michael's strength to decrease.

3 marks

(d) Analyse the effect of Michael's revised training programme on his muscular and nervous systems

8 marks

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Total for Question 3 = 18 marks

Shivani went on a training course to become a ski and snowboard instructor in Italy. The course lasted for three months and was based at high altitude.

Shivani attended two sessions of 2.5 hours each day. The sessions consisted of mainly aerobic activities.

After the course was complete Shivani returned home, which is at sea level.

4 (a) Explain **one** response of Shivani's cardiovascular system to being at high altitude

4 marks

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(b) Explain **one** adaptation to Shivani's aerobic energy system from taking part in regular sessions at high altitude.

3 marks

Shivani passed her ski instructor examinations and was invited back to Italy the following year to teach skiing and snowboarding.

(c) Explain why Shivani may choose to use a hypoxic chamber at sea level, to promote adaptations to high altitude, before she travelled back to Italy.

3 marks

(d) Evaluate the effect of ski training at high altitude over the three month period on Shivani's fitness for skiing.

In your answer you should refer to adaptations of the cardiovascular and respiratory systems.

8 marks

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END OF EXAM

Total for Question 4 = 18 marks
TOTAL FOR PAPER = 70 MARKS

Unit 1: Sport and Exercise Physiology – sample mark scheme

General marking guidance

- All learners must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Learners must be rewarded for what they have shown they can do, rather than be penalised for omissions.
- Examiners should mark according to the mark scheme, not according to their perception of where the grade boundaries may lie.
- All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks, if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, the mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed-out work should be marked unless the candidate has replaced it with an alternative response.

Specific marking guidance for levels-based mark schemes*

Levels-based mark schemes (LBMS) have been designed to assess the learner's work holistically. They consist of two parts: indicative content and level-based descriptors. Indicative content reflects specific content-related points that a learner might make. Levels-based descriptors articulate the skills that a learner is likely to demonstrate in relation to the assessment outcomes being targeted by the question. Different rows in the levels represent the progression of these skills.
When using a levels-based mark scheme, the 'best fit' approach should be used.

- Examiners should first make a holistic judgement on which band most closely matches the learner response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer in response to the assessment focus/objective and will be modified according to how securely all bullet points are displayed at that band.
- Marks will be awarded towards the top or bottom of that band depending on how they have evidenced each of the descriptor bullet points.

Question number	Answer	Mark
1a	Award **1** mark for identifying how fitness training can increase bone strength and up to **2** additional marks for justifying/rationalising this reason. Credit to a total of **3** marks. Connor's fitness training programme will increase the density of his bones (1) as the additional pressure from running/weight training will stimulate the bones to take up more minerals (1). This will result in an increase in osteoclast activity (to increase the strength of the bones) (1). Accept other appropriate responses.	**(3)**

Question number	Answer	Mark
1b	Award **1** mark for identifying why Connor's training programme caused a drop in resting heart rate and up to **2** additional marks for justifying/rationalising this reason. Credit to a total of **3** marks. This is because aerobic training results in cardiac hypertrophy (1). Therefore, Connor's stroke volume will increase (1) so the heart does not need to pump as many times in order to pump out the same volume of blood (1). Accept other appropriate responses.	**(3)**

Question number	Answer	Mark
1c	Award 1 mark for identifying how Connor's nervous system can control the force exerted by the muscles and **1** additional mark for justifying/rationalising how this allows muscles to contract with varying degrees of strength. Credit to a total of **2** marks. Connor could recruit smaller/fewer motor units when he wanted to lift 5 kg (1) this would reduce the number of muscle fibres contracting thereby reducing the force of the contraction (1). Connor's muscle spindles will detect any change in the length of the muscle when he is lifting a heavy weight (1) and send information to the central nervous system so that more motor units can be recruited if necessary to lift the weight (1). Accept other appropriate responses.	**(2)**

Question number	Indicative content
1d	Answers will be credited according to the learner's demonstration of knowledge and understanding of the material using the indicative content and level descriptors below. The indicative content that follows is not prescriptive. Answers may cover some/all of the indicative content but should be rewarded for other relevant answers. Cardiovascular system: • the continuous training sessions have effectively put the cardiovascular and respiratory systems under increased pressure causing them to adapt to the elevated training loads • Connor's cardiovascular system will have adapted, his increased stroke volume reducing the need for the heart to beat so many times thus slowing the cardiac cycle • this will give Connor a greater heart rate range to utilise when playing football, giving him a greater maximal cardiac output • it means oxygen transported to his muscles is more efficient and his recovery time will be reduced. Respiratory system: • Connor's respiratory muscles will increase in strength, contributing to an increased vital capacity to increase the volume of air moving into and out of the lungs • capillarisation around the alveoli and in the muscles will increase the efficiency of gaseous exchange • this means that Connor will be able to better utilise the increased oxygen coming into the body (through increased lung volumes) to sustain aerobic energy production for longer so he is able to play football for sustained periods • Connor's increased ability to utilise oxygen breathed into the body will mean that more oxygen is available to break down lactic acid • this delays OBLA/lactate threshold so that he can complete multiple sprints throughout the game of football • the delay of OBLA/lactate threshold is a result of Connor's increased VO_2 max, i.e. the maximal amount of oxygen Connor is able to utilise per minute, so we can see that Connor's continuous training sessions resulted in an increased VO_2 max, increasing Connor's fitness for football.

Level	Mark	Descriptor
Level 0	**0**	No rewardable material
1	**1-3**	Demonstrates isolated elements of Knowledge and Understanding Few of the points made will be relevant to the context in the question Limited evaluation which contains generic assertions leading to a conclusion that is superficial or unsupported.
2	**4-6**	Demonstrates some accurate Knowledge and Understanding Some of the points made will be relevant to the context in the question, but the link will not always be clear Displays a partially developed evaluation which considers some different aspects leading to a conclusion which considers some different competing points, although not always in detail.
3	**7-8**	Demonstrates mostly accurate Knowledge and Understanding Most of the points made will be relevant to the context in the question, and there will be clear links Displays a developed and logical evaluation which clearly considers different aspects leading to a conclusion which considers different competing points in detail.

Question number	Answer	Mark
2a	Award **1** mark for identifying why Harry would take on carbohydrate gels during a long distance cycle event and up to **2** additional marks for justifying/rationalising their use. Credit to a total of **3** marks. Harry will only have limited stores of carbohydrate (in his muscles) (1) therefore he will need more carbohydrate for energy to complete each stage of the event (1), as by having more energy available through carbohydrates he will be able to cycle each stage faster (1). Accept other appropriate responses.	**(3)**

Question number	Answer	Mark
2b	Award **1** mark for identifying why Harry's leg muscles feel sore going uphill and up to **3** additional marks for justifying/rationalising that reason. Credit to a total of **4** marks. The production of lactate/hydrogen ions will make Harry's legs feel sore (1) if there is insufficient oxygen available/Harry's need to respire anaerobically due to the hill climb (1) there will be an increase in the acidity in the muscle cells (1). However, once on the flatter stretch Harry will return to aerobic respiration so the lactate/hydrogen ions can be removed from the cells (reducing muscle soreness) (1). Accept other appropriate responses.	**(4)**

Question number	Answer	Mark
2c	Award **1** mark for identifying why Harry continued to breathe deeply after cycling up each steep hill, and up to **2** additional marks for justifying/rationalising his need for an increased breathing rate. Credit to a total of **3** marks. In order to complete the high intensity hill climb Harry would produce energy anaerobically (1) so after stopping cycling he will breathe deeply in order to repay the oxygen deficit (1) and remove the lactate produced (1). Accept other appropriate responses.	**(3)**

Question number	Indicative content
2d	Answers will be credited according to the learner's demonstration of knowledge and understanding of the material using the indicative content and level descriptors below. The indicative content that follows is not prescriptive. Answers may cover some/all of the indicative content but should be rewarded for other relevant answers. Thermoregulation: • thermoregulation is the process the body uses to maintain core body temperature • this means it remains in homeostasis so that body functions can continue at an optimum rate so that Harry can continue to function efficiently, maintaining his cycling performance • Harry's core body temperature will be maintained through convection, conduction, radiation and evaporation • the hypothalamus controls thermoregulation, issuing signals to the relevant areas of the body to control temperature • the core temperature should remain at 37 °C regardless of the external weather conditions during the cycling event. During hot and sunny weather/31 °C: • when Harry is exercising, especially during the hill climbs at high intensity his temperature will increase, coupled with the hot weather, so the body has mechanisms in place to help him reduce heat • when Harry is cycling in hot temperatures he will sweat more to reduce his temperature, as the sweat evaporates it cools the skin • this could result in dehydration, therefore he would need to take on sufficient liquid to maintain hydration during the race • the capillaries close to the surface of his skin will vasodilate, increasing blood flow so heat can be lost through radiation • by wearing breathable clothing that will help keep him cool. During cold weather/2 °C: • however, even though exercise generates heat, if the external temperature is too cold, like it is on stage 2 during the night ride, Harry will need to try to reduce heat loss • during the night ride when temperatures are low, Harry's body will stop sweating and vasoconstrict the capillaries close to the skin • the body can also use thermogenesis to increase heat in cold conditions by increasing the metabolism, which increases the heat your body can make • Harry can also aid the process by wearing appropriate clothing during the cycle event • by layering up for the evening ride he can reduce heat loss, and as he gets warmer due to the exercise he can remove one or more of the layers.

Level	Mark	Descriptor
Level 0	**0**	No rewardable material
1	**1-3**	Demonstrates isolated elements of Knowledge and Understanding Breaks the situation down into component parts and a few of the points made will be relevant to the context in the question Limited analysis which contains generic assertions rather than interrelationships or linkages
2	**4-6**	Demonstrates some accurate Knowledge and Understanding Breaks the situation down into component parts and some of the points made will be relevant to the context in the question Displays a partially developed analysis which considers some interrelationships or linkages but not always sustained
3	**7-8**	Demonstrates mostly accurate Knowledge and Understanding Breaks the situation down into component parts and most of the points made will be relevant to the context in the question Displays a developed and logical analysis which clearly considers interrelationships or linkages in a sustained manner

Question number	Answer	Mark
3a	Award **1** mark for each stated response of the muscular system to a weight training session. Credit to a total of **3** marks. • Increased blood flow to the muscle tissues. • Muscle fibre micro-tears. • Increase in temperature of the muscles. • Increase in muscles pliability. Accept other appropriate responses.	**(3)**

Question number	Answer	Mark
3b	Award **1** mark for identifying why the ATP-PC system is used to provide energy when lifting weights and up to **3** additional marks for justifying/rationalising its use. Credit to a total of **4** marks. The ATP-PC system provides energy for powerful muscular contractions quickly (which Michael would need for strength training) (1) as heavy weights need to be lifted a few times (1). This means there will be enough energy provided by the ATP-PC system to complete the limited number of reps in the set (1) and as the system resynthesises quickly the energy stores can be replenished (in the short recovery period Michael will take between sets before he continues with his training) (1). Accept other appropriate responses.	**(4)**

Question number	Answer	Mark
3c	Award **1** mark for identifying why overtraining would cause Michael's strength to decrease and up to **2** marks for justifying/rationalising that reason. Credit to a total of **3** marks. Michael's muscles are not given enough time to adapt to the training between sessions (1) which means the muscle fibres do not repair from the micro-tears (1). As they are still damaged from the previous training session Michael is not able to train to the same level as before (1). Accept other appropriate responses.	**(3)**

Question number	Indicative content
3d	Answers will be credited according to the learner's demonstration of knowledge and understanding of the material using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive. Answers may cover some/all of the indicative content but should be rewarded for other relevant answers. Muscular system: • by reducing the frequency of training, Michael is giving his muscular and nervous system time to adapt to bring about changes necessary to increase strength • provided Michael allows sufficient time for his muscular system to adapt between training sessions, his muscular system will experience hypertrophy • as a result of hypertrophy, Michael's muscles will be able to generate more force due to the increased number of muscle fibres that can be recruited to contract • over time Michael's muscles will adapt to the type of training he is completing • if he is using heavy loads and few repetitions his type IIa muscle fibres will begin to adapt to the anaerobic work, causing them to behave more like type IIx, which means they can produce more force at higher intensity, which will allow him to lift heavier weights. Nervous system: • one adaptation to the nervous system would be improved neural pathway transmission which would increase the efficiency of the signals to target muscles being used in each lift • the increased efficiency of the neural pathways means that that the muscles lifting the weights will become more efficient at moving them so that more weight can be lifted, i.e. Michael becomes stronger • as a result of adaptations to the nervous system it would be possible for Michael to increase recruitment of motor units • motor units respond in a simultaneous fashion to improve force production so he can lift heavier weights.

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2	**4-6**	Demonstrates some accurate Knowledge and Understanding Breaks the situation down into component parts and some of the points made will be relevant to the context in the question Displays a partially developed analysis which considers some interrelationships or linkages but not always sustained
3	**7-8**	Demonstrates mostly accurate Knowledge and Understanding Breaks the situation down into component parts and most of the points made will be relevant to the context in the question Displays a developed and logical analysis which clearly considers interrelationships or linkages in a sustained manner

Question number	Answer	Mark
4a	Award **1** mark for identifying a response of Shivani's cardiovascular system to high altitude and up to **3** additional marks for justifying/rationalising the reason for this response to high altitude. Credit to a total of **4** marks. Shivani would experience tachycardia (1) as she will not be used to being at high altitude so her heart rate will increase (1). It will increase in an attempt to compensate for the lack of oxygen available to the tissues (1) as a result of the reduced partial pressure of oxygen at high altitude (compared to sea level) (1). Accept other appropriate response.	**(4)**

Question number	Answer	Mark
4b	Award **1** mark for identifying an adaptation to Shivani's aerobic energy system as a result of regular skiing sessions at high altitude and up to **2** additional marks for justifying/rationalising the occurrence of this adaptation. Credit to a total of **3** marks. Shivani will have an increased capacity to generate energy aerobically due to her increased ability to utilise oxygen (1), as her body adapts to the lower partial pressure at altitude which means greater oxidation of glycogen (1). Therefore she can use more fat as an energy source for aerobic activity in the session/more glucose can be left in reserve for the more intense parts of the session (1). Accept other appropriate response.	**(3)**

Question number	Answer	Mark
4c	Award **1** mark for identifying a suitable method to promote equivalent adaptations to high altitude whilst still at sea level and up to **2** additional marks for justifying/rationalising the reason why it is a suitable method. Credit to a total of **3** marks. As the chamber has a low partial pressure of oxygen (1) her body will try to compensate by stimulating increased levels of erythropoietin (EPO) (1) so that Shivani's cardiovascular system has an increased ability to carry oxygen (1). Accept other appropriate responses.	**(3)**

Question number	Indicative content
4d	Answers will be credited according to the learner's demonstration of knowledge and understanding of the material using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive. Answers may cover some/all of the indicative content but should be rewarded for other relevant answers. Cardiovascular: • the reduced partial pressure of oxygen initially meant that a reduced amount of oxygen could be utilised by the working muscles, this will have a negative impact on Shivani's performance as she will not have had sufficient oxygen to make energy aerobically, therefore she will have had to have short periods of work and long recovery periods reducing the amount she could ski • to overcome this the cardiovascular system will have adapted, there would be an increase in haemoglobin concentration and red blood cell production so more oxygen could be carried in the blood. Respiratory: • the respiratory system would adapt increasing her lung volumes to that experienced at sea level so even though there is less oxygen in the air in her ski resort, she will be able to take in greater volumes of air to compensate • with increased capillarisation the rate of oxygen diffusion into the blood stream and carbon dioxide removal will also increase • this will give Shivani an increased ability to utilise the reduced amount of available oxygen to compensate for the reduced levels • this means that she can ski for longer periods of time as it is an aerobic sport and she can ski at a higher intensity for longer thus giving her more time to practice her techniques to improve the quality of her skiing.

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