Please paste the barcoded label here

TOTAL MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2024

SPORT AND EXERCISE SCIENCE

EXAMINATION NUMBER

Time: 3 hours 200 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 36 pages. Please check that your question paper is complete.
2. **Answer all questions on the question paper and hand it in at the end of the examination. Remember to write your examination number in the space provided above.**
3. Read the questions carefully.
4. Use the total marks awarded for each question as an indication of the detail required.
5. It is in your own interest to write legibly and to present your work neatly.
6. One blank page (page 36) is included at the end of the question paper. If you run out of space for a question, use this page. Clearly indicate the number of your answer should you use this extra space.

FOR MARKER'S USE ONLY

Question	1	2	3	4	5	6	**Total**
Marks	28	34	46	26	46	20	**200**
Obtained							

IEB Copyright © 2024

QUESTION 1

1.1 Match each term in Column A to its correct definition in Column B. Write only the letter of your chosen description in the answer grid below.

COLUMN A		COLUMN B	
1.1.1	Macro-cycle in training	A	Provide a slower, more sustained release of glucose.
1.1.2	Patellofemoral Pain Syndrome	B	Senses tension.
1.1.3	Plantar fasciitis	C	Senses stretches and the speed of stretches.
1.1.4	Meso-cycle in training	D	An enzyme that links chains of glucose together.
1.1.5	Golgi tendon organ	E	Overuse injury found between the kneecap and the thigh bone.
1.1.6	High glycaemic foods	F	An intermediate block of training.
1.1.7	Ketogenic diet	G	Foods causing rapid delivery of carbohydrates into the bloodstream.
1.1.8	Glycogen synthase	H	A long term training plan.
1.1.9	Low glycaemic foods	I	High fat, low carbohydrate food.
1.1.10	Muscle spindles	J	A painful inflammation of a thick fibrous tissue in the foot.

ANSWERS:

1.1.1	
1.1.2	
1.1.3	
1.1.4	
1.1.5	

1.1.6	
1.1.7	
1.1.8	
1.1.9	
1.1.10	

(10)

IEB Copyright © 2024

1.2 The following pairs of pictures have had their base of support shaded in. For each pair, select which picture is shaded correctly. Place a tick in the box of the correct picture.

1.2.1 **Picture A** **Picture B**





[<https://www.google.com/search yoga+poses> Accessed 24/2/24]

(1)

1.2.2 **Picture A** **Picture B**





[<https://www.video.ontheedgefitness.com> Accessed 24/2/24]

(1)

IEB Copyright © 2024

1.3 Outline **AND** shade the base of support in each of the following pictures.

Picture A



[<https://www.google.com/rhythmic+gymnastics+ball+skills> Accessed 1/3/24]

(5)

Picture B



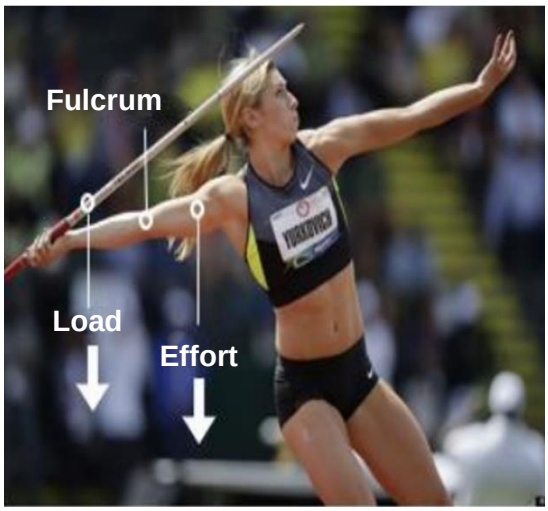
[<https://www.google.com/olympics.curling> Accessed 24/2/24]

(5)

IEB Copyright © 2024

1.4 Examine Picture A below and answer the questions that follow.

Picture A (javelin throw)



[<https://www.gyansanchay.csjmu.ac./2022/05/lever.pdf> Accessed 24/2/24]

1.4.1 What class/order of lever is occurring in this exercise?

_____

(1)

1.4.2 Provide a reason for your answer to Question 1.4.1 above.

_____

_____

(1)

IEB Copyright © 2024

1.5 Examine Picture B below and answer the questions that follow.

Picture B (butt kick)



[<https://www.wikihow.com/Do-Butt-Kicks> Accessed 24/2/24]

1.5.1 State what the load is.

_____

(1)

1.5.2 What muscle is exerting the most effort?

_____

(1)

1.5.3 What class/order of lever is occurring in this exercise?

_____

(1)

1.5.4 Indicate the position of the fulcrum on the picture below.



[<https://www.wikihow.com/Do-Butt-Kicks> Accessed 24/2/24]

(1)
[28]

IEB Copyright © 2024

QUESTION 2

Read the source below and answer the questions that follow.

Swimmer Michael Phelps' diet in his build up to the Olympic Games

Before the Beijing Olympics in 2008, Phelps said he was 'chowing down on an insane 12 000 calories a day, approximately 4 000 calories a meal'. He later said that this could have been an exaggeration, but he was still eating a lot.

Breakfast was egg sandwiches loaded with all the fixings, ranging from cheese to fried onions to mayonnaise. After that, he would eat chocolate chip pancakes, French toast, a five-egg omelette, and a bowl of oats. Lunch would include a couple of ham and cheese sandwiches, energy drinks and lots of pasta. For dinner, he would eat a whole pizza and another huge bowl of pasta.

Amazingly, he thrived on this diet, winning an all-time record of eight gold medals.

By 2012 and the Rio Olympics, though, his meal plan had calmed down. He still ate a lot of calories and dinner was often two plates loaded with food. On this diet, he won four gold medals and two silver medals, making him the most decorated Olympian ever.

[Adapted from: <businessinsider.com> Aug 2016 issue]

2.1 Prior to the 2008 Olympic Games, how many calories did Phelps eat on a daily basis?

_____

(1)

2.2 Provide three possible effects that Phelps' diet could have on a sedentary person.

- _____
- _____
- _____

(3)

2.3 Which food group is the main fuel for energy?

_____

(1)

IEB Copyright © 2024

2.4 List three dishes included in Phelps' diet that contain the food group identified in Question 2.3 on page 7.

- _____
- _____
- _____ (3)

2.5 Explain why Phelps would eat so much of this specific food group.

_____

_____

_____

_____

(3)

2.6 Why should Phelps eat low GI foods before exercise AND high GI foods post exercise?

_____

_____

_____

_____

_____

(2)

2.7 What are the consequences for athletes who do not consume sufficient carbohydrates?

_____

_____

_____

_____

_____

_____

(4)

IEB Copyright © 2024

2.8 There is one important food group lacking in Phelps' diet.

2.8.1 Name the food group.

_____

(1)

2.8.2 Why is this food group especially important to an athlete like Phelps?

_____

_____

_____

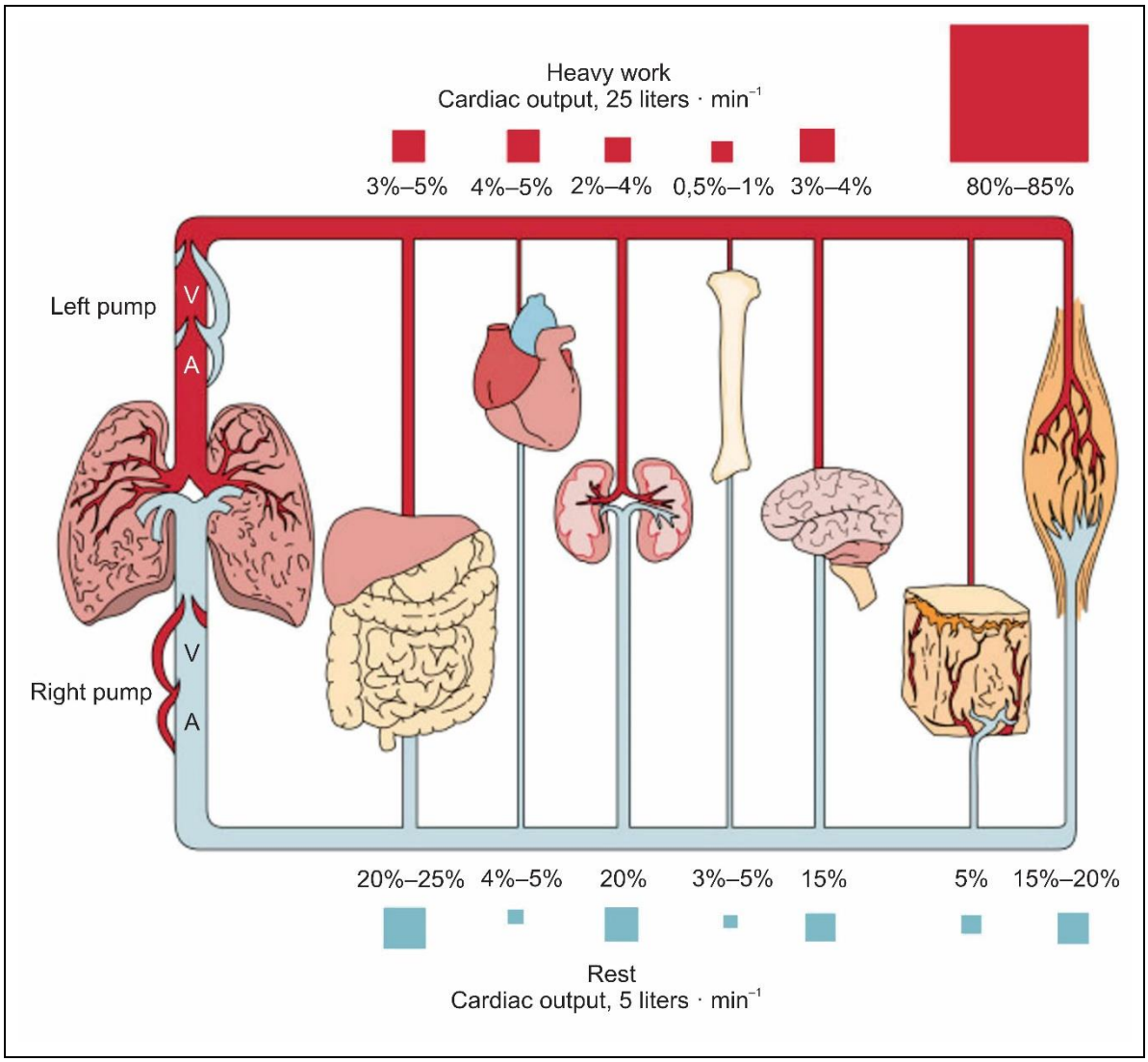
_____

_____

(2)

IEB Copyright © 2024

2.9 Examine the picture below and use it to answer the questions that follow.



[<https://www.thoracickey.com/cardiopulmonary-stress-testing> Accessed 22/2/24]

2.9.1 Complete the table below regarding blood flow to organs.

	Percentage of blood flow at rest	**Percentage of blood flow when doing heavy work**
Kidneys		
Brain		
Muscles		

(6)

IEB Copyright © 2024

2.9.2 Using the mechanism of the vascular shunt, explain how blood redistribution changes when an athlete moves from rest to training. Refer to the picture provided.

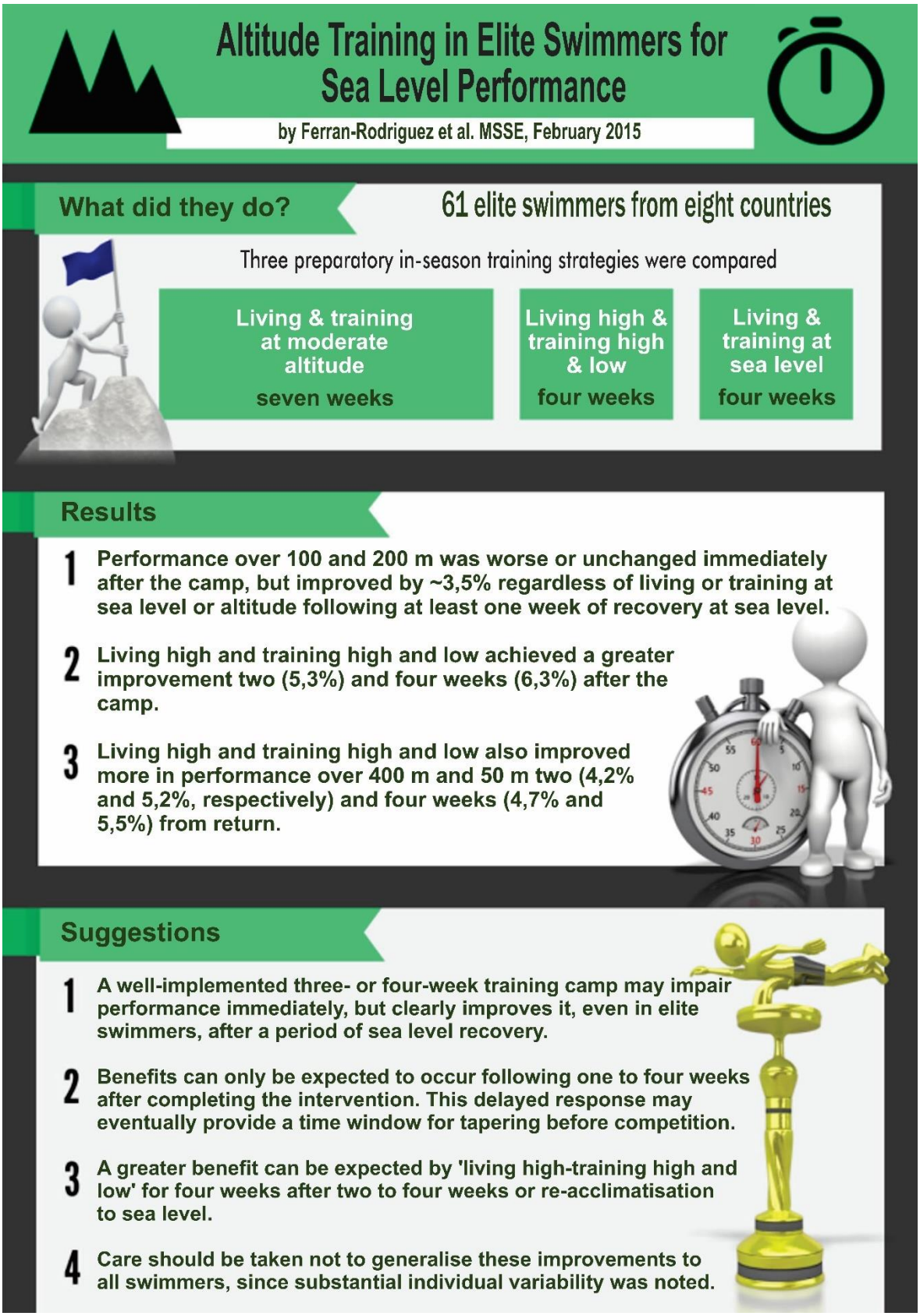
(8)
[34]

IEB Copyright © 2024

QUESTION 3

Examine Sources A and B provided in this question and use them to answer the questions that follow.

SOURCE A



[<https://www.ylmsportscience.files.wordpress.com> Accessed 25/2/24]

IEB Copyright © 2024

The questions below refer to Source A.

3.1 How many swimmers were involved in this study?

_____

(1)

3.2 List the three training strategies compared in this study.

- _____
- _____
- _____

(3)

3.3 What was the immediate impact of the training camp on the swimmers' times?

_____

_____

(1)

3.4 What was the impact on the swimmers' times after a one-week recovery period?

_____

_____

(1)

3.5 Which training strategy was the most successful?

_____

(1)

3.6 Provide evidence that this training strategy (answered in Question 3.5) was the most successful.

_____

_____

_____

_____

_____

_____

_____

_____

(4)

IEB Copyright © 2024

3.7 Provide three factors from Source A that parents and swimmers should remember when following an altitude training camp.

(3)

IEB Copyright © 2024

SOURCE B

Altitude Cycling Training Camp – The Results!

A group of athletes attended a six-week training camp that included the following activities:

Cycling training and weight training sessions were conducted in a high-altitude hypoxic room or using a pod.

Source B1

CYCLING PERFORMANCE – 15 sessions
Overall improvements



FTP 9,7%

Peak power 11,1%

3 Min power 12,9%

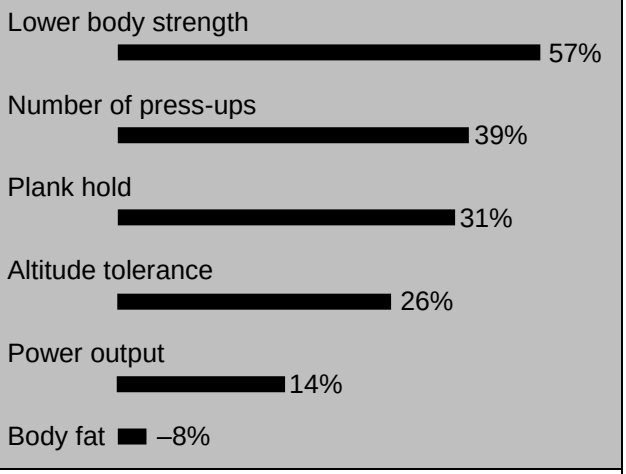
Fatigue Index 22,6%

FTP = Functional Threshold Power
The highest average power a person can sustain for one hour.
Fatigue Index = Measure of endurance

Source B2



GENERAL FITNESS
Overall improvements



Pod sessions = passive sessions in which the user wears an oxygen mask and is exposed to intermittent short bursts of mountain air, alternated with normal air.

The questions below refer to Source B.

3.8 Provide the highest and lowest overall improvement in general fitness.

Highest: _____
(2)

Lowest: _____
(2)

IEB Copyright © 2024

3.9 Explain and provide evidence proving that the cycling sessions were successful in terms of performance improvements.

(8)

3.10 Why was there an 8% loss in the athletes' body fat?

(2)

3.11 What precautions could the athlete take to prevent this loss in body fat?

(2)

IEB Copyright © 2024

3.12 Explain the benefits of the overall general fitness improvements to a cyclist.

(10)

IEB Copyright © 2024

The following questions do not necessarily relate to the sources.

3.13 Describe the physiological adaptations to blood when an athlete stays at a high altitude.

(4)

3.14 Why would a tennis player struggle more when playing at high altitude?

(2)
[46]

IEB Copyright © 2024

QUESTION 4

Examine the source provided in this question and use it to answer the questions that follow.

The Role of Physics in Golf



[<https://www.golfdistillery.com/club-parts/grooves/> Accessed 22/2/24]

The part of the golf club that has had the greatest impact on the amount of spin that can be generated on the golf ball is the club head grooves. Spin is created from the friction between the club head and the ball upon impact. These grooves allow the club and ball to create greater friction and, in turn, generate more spin. Recently, the organisation in charge of golf rules decided to place greater restrictions on the number of grooves allowed on club heads and the depth of the grooves. Players had been using clubs with grooves deep enough that even when hitting balls out of the rough, they were able to generate significant spin on their balls. The organisation felt shots out of the rough should be more difficult, so they decided to limit the depth of grooves.

When swinging a golf club, there are a variety of factors in the mechanics of the swing that in turn influence the spin generated on the golf ball. This spin affects the flight the ball will take in the air. One type of spin that golfers use on the ball is backspin. Backspin is generated when the bottom of the golfclub-head impacts the backside of the ball with a downward force. This contact causes the ball to compress, and the friction between the club head and ball results in the backward spin. The amount of downward force that is applied through the swing dictates the amount of spin on the ball. Backspin is used by golfers to control the roll on the ball after it lands and helps golfers hit their balls closer to the hole.

Today, there are thousands of different types of golf balls that players choose to play with. Perhaps the most important element of the golf ball is its dimples on the outer shell. Dimples are extremely important for reducing the drag the ball has while in the air. They create turbulence next to the surface of the ball and create layers of air around the ball.

[<https://www.large.stanford.edu/courses/> Accessed 24/2/24]

4.1 According to the above source, what causes the spin on a golf ball?

_____

(1)

IEB Copyright © 2024

4.2 Refer to the statement below to answer the following questions.

> 'The amount of downward force that is applied through the swing dictates the amount of spin on the ball.'

[<https://large.stanford.edu/courses/> Accessed 24/2/24]

4.2.1 State which of Newton's Laws is represented in the statement.

_____

(1)

4.2.2 Provide a definition or explanation of this Law.

_____

_____

(2)

4.3 Explain the scientific reasoning behind the design of dimples on a golf ball.

_____

_____

_____

_____

_____

_____

(3)

4.4 Why do grooves on a golf club create more friction?

_____

_____

_____

(1)

4.5 Why did the golf-governing organisation change the rule about grooves in golf club heads?

_____

_____

_____

_____

(2)

IEB Copyright © 2024

4.6 Explain what the following terms mean with respect to airflow around a golf ball.

4.6.1 *Laminar flow*

(3)

4.6.2 *Turbulent flow*

(3)

4.7 On the pictures below, draw lines indicating laminar and turbulent airflow.

Laminar flow

Direction of travel



Turbulent flow

Direction of travel



(4)

IEB Copyright © 2024

4.8 Explain Bernoulli's Principle applied to a golf ball when it is hit with a slice.

[A slice is a ball that curves towards the player's dominant hand.]

(6)
[26]

IEB Copyright © 2024

QUESTION 5

Examine the source provided in this question and use it to answer the following questions.

Mo Farah versus Usain Bolt

As part of his charity, the Mo Farah Foundation, Mo Farah has challenged the world 100 m champion, Usain Bolt, to race over a distance that would not suit either runner. Mo Farah was the Olympic champion in 5 000 m and 10 000 m, while Usain Bolt was the Olympic champion in 100 m and 200 m.

[<https://www.sportsscientists.com> Published 6/8/2013]

5.1 What makes these two athletes similar?

_____

(1)

5.2 What would be an ideal distance for these athletes to ensure the challenge is fair? Provide a reason for your answer.

_____

_____

_____

_____

(2)

5.3 Name each athlete's predominant energy system when competing at the Olympic Games.

- Mo Farah

_____

(1)

- Usain Bolt

_____

(1)

IEB Copyright © 2024

5.4 Describe the physiological adaptations to the respiratory system due to aerobic training.

(6)

IEB Copyright © 2024

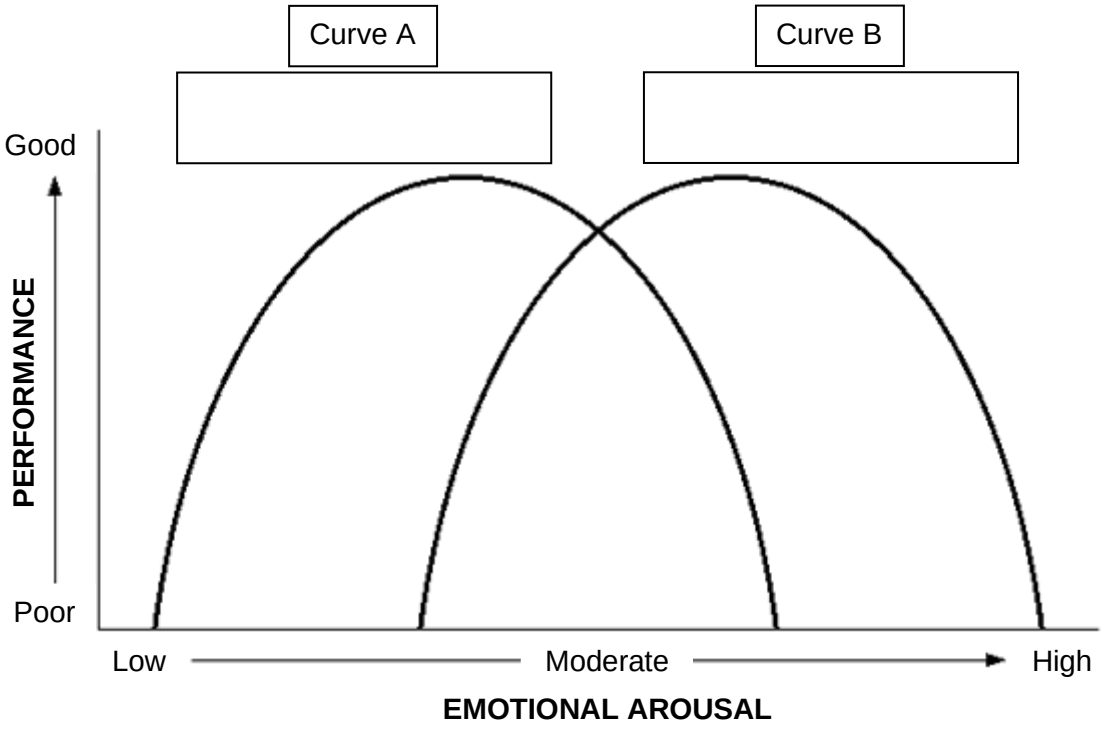
5.5 Explain the All or None Law as applied in Usain Bolt's leg muscles as he explodes from the starting blocks.

(7)

IEB Copyright © 2024

5.6 Both athletes need to be at optimal arousal levels when competing at the Olympic Games.

Examine the Yerkes and Dodson graph below and answer the questions that follow.



[<https://www.exrx.net/Psychology/InvertedU> Accessed 24/2/24]

5.6.1 Indicate on the graph above which curve best represents the arousal level of Mo Farah and which curve best represents the arousal level of Usain Bolt.

(2)

5.6.2 Explain why each specific curve represents the emotional arousal for these athletes.

(4)

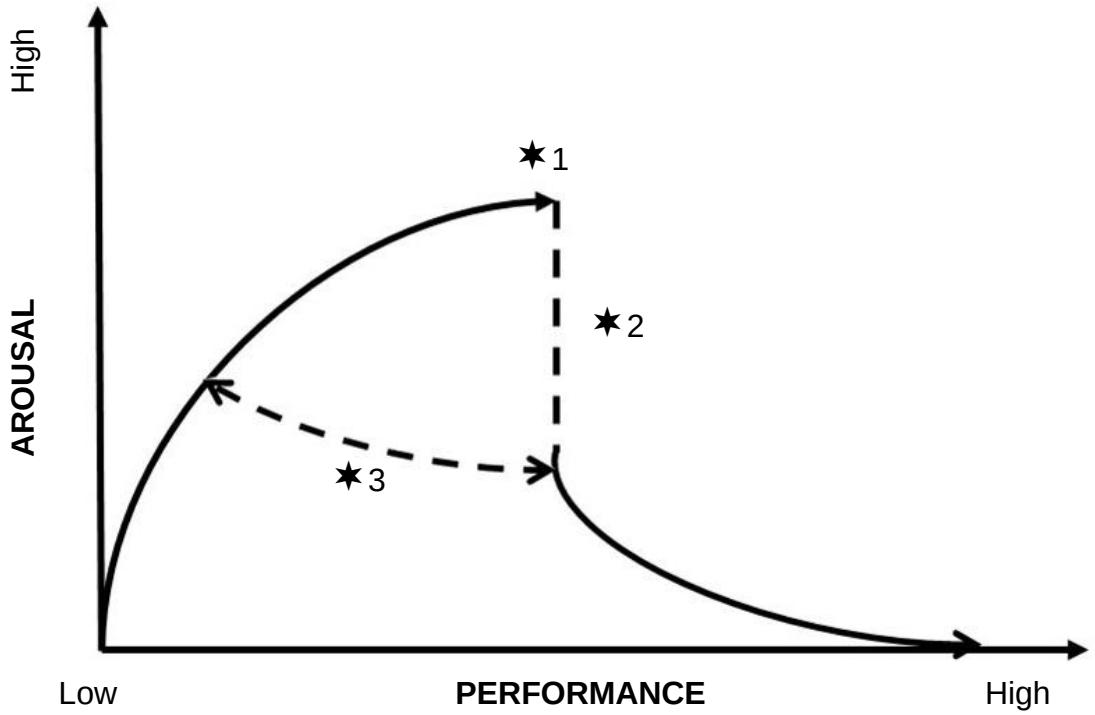
IEB Copyright © 2024

5.6.3 Name three consequences of over-arousal in an athlete during competition.

- _____
- _____
- _____

(3)

5.7 The graph below illustrates the Catastrophe Theory, where an athlete experiences a drastic drop in performance. Refer to the graph to answer the questions that follow.



[<https://www.google.com/arousal+in+sport> Accessed 24/2/24]

5.7.1 Which reference point (depicted with a ✶) indicates the optimal level of performance?

_____

(1)

5.7.2 Use the provided graph and points of reference on page 27 to explain this theory. Use basketball to assist in your explanation.

(12)

IEB Copyright © 2024

5.8 The table below depicts Usain Bolt's blood lactate levels. Refer to the table to answer the questions that follow.

Bolt's blood lactate level at rest	**Bolt's blood lactate level after completing a 400 m sprint**
1,2 mmol/kg of muscle	20 mmol/kg of muscle

5.8.1 At which point are Bolt's muscles more acidic?

_____

(1)

5.8.2 What are the implications of this increased acidity?

_____

_____

_____

_____

(1)

5.8.3 Why is it advantageous for an athlete to have a higher lactate threshold?

_____

_____

_____

_____

(3)

5.8.4 What form of exercise is advisable to return blood lactate to resting levels?

_____

(1)
[46]

IEB Copyright © 2024

QUESTION 6

Examine the information provided in the sources that follow. Use this information to write an essay of 1–1½ pages on the following topic:

Discuss the impact of technology (both positive and negative) on sport performance.

To answer this question, you are expected to:

- examine the source material carefully and use the information in the sources to best develop your essay;
- integrate your own relevant sport science knowledge;
- use real-life examples where applicable;
- make use of the rubric to shape your response.

IEB Copyright © 2024

SOURCE A

Smart mouthguards to help with head injury detection in Six Nations

Players in this year's Six Nations will use instrumented mouthguards to help medics detect incidents that require off-field head injury assessments, Six Nations Rugby said on Friday.

Players will be provided with custom-fitted mouthguards that deliver in-game alerts to the medical team to indicate whether a pitch-side assessment is necessary.

'Six Nations Rugby, its Unions and Federations are focused on driving the game-wide commitment to prioritise player welfare and innovate in this area,' Julie Paterson, director of rugby at Six Nations Rugby, said.

'[It is] to ensure we are using the latest technology and enhancing our processes where relevant, to protect the players.'

[<https://www.espn.co.uk/rugby/story/smart-mouthguards-help-head-injury-detection-six-nations> Accessed 22/2/24]

SOURCE B

COACH QUERIES NEW TECH

'Smart' mouthguards cost Scotland brief loss of a second player in successive Six Nations games.

Scotland coach Gregor Townsend has queried the use of 'smart' mouthguards after briefly losing a second player in successive Six Nations matches as a result of a head injury assessment induced by the implementation of the new technology.

Under the World Rugby rollout, players wear mouthguards fitted with sensors that measure 'head acceleration events.' Matchday medical staff monitor the mouthguards for alerts and can remove players from the game.

Scotland are believed to be the only Six Nations team to have been affected so far, with hooker George Turner going off in the 1st half against France, while fellow front-row forward Zander Fagerson exited in the 7th minute. Townsend was asked if the players left because of the mouthguard reading and he replied, 'Yes, it was, and I saw the tackle. It was just a normal tackle. I think we have to really watch what we're doing here by trusting technology that's not been proven.'

[*The Witness*, Feb. 2024]

IEB Copyright © 2024

SOURCE C

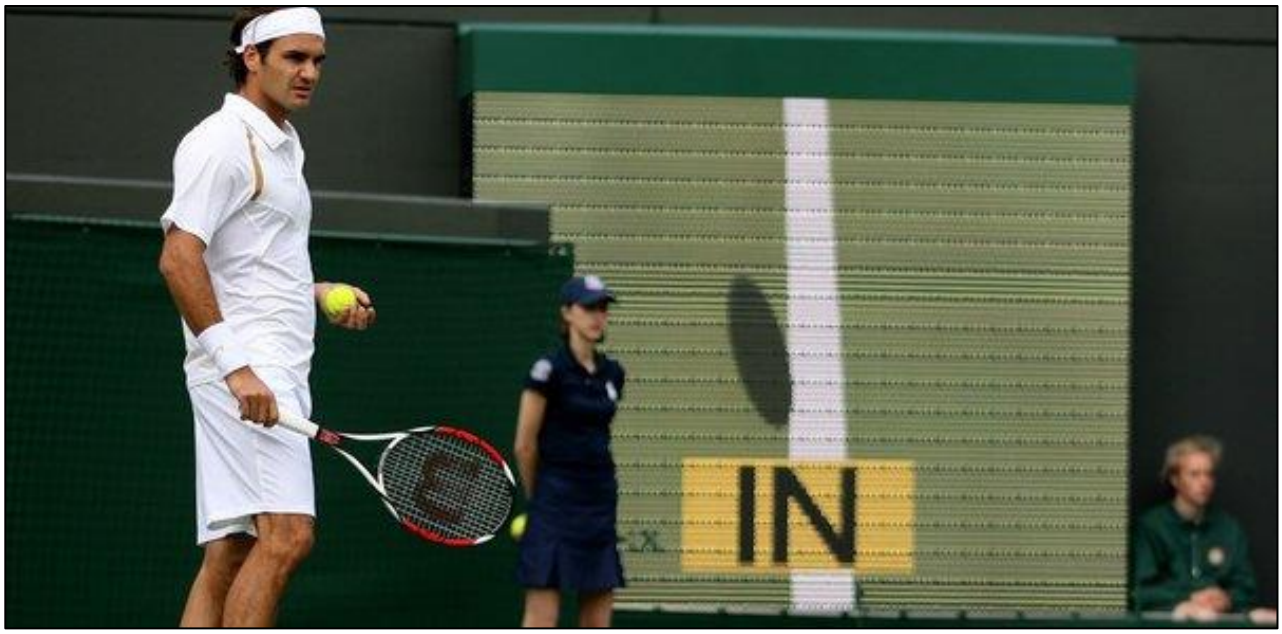
A fitting boot for women footballers

As concern grows over the number of injuries suffered by female soccer players, German sportswear brand Puma sees the Women's World Cup as an opportunity to raise awareness about soccer boots specially designed for women's feet.

Several players have had to miss the tournament due to anterior cruciate ligament ruptures. A higher rate of injuries in the women's game may be due to a reliance on boots designed for men, sport scientists say. A recent report found that up to 82% of female players in Europe experience discomfort when wearing boots. Women often have a lower instep and midfoot than men.

[*Sunday Times*, 30 July 2023]

SOURCE D



[<https://www.what-is-the-most-interesting-and-unique-use-of-technology-in-the-sports-industry> Accessed 25/2/24]

IEB Copyright © 2024

ESSAY RUBRIC

	0 marks	1 mark	2 marks	3 marks	4 marks	Possible mark (20)
Use of sources	No reference made to sources.	Attempted to use sources, BUT no integration.	Not all sources were used, but those used were integrated.	Full use of sources but not fully integrated or expanded on.	Full use of sources integrated into the discussion with understanding.	**4**
Response to question /statement: Positive and negative effects	No attempt made in response to the question/ statement.	Attempted to discuss either positive or negative effects of technology, OR response is weak.	Some content on positive and negative effects were provided but not integrated, OR both negative and positive effects were mentioned with limitations OR either positive or negative superficially discussed.	Some of the content provided is relevant and integrated, AND both the positive and negative effects are mentioned.	All the content provided is relevant, AND the positive and negative effects of technology are fully discussed.	**4**
Use of own knowledge X2	Very few relevant facts and much inaccuracy. Missed the point.	Significant info is missing, AND factual errors, AND lots of irrelevant info is included.	Some info missing, OR errors evident, OR some irrelevant info included.	Response shows sufficient detail that is factually correct and relevant with integration.	Response shows in-depth use of knowledge that is factually correct and relevant with integration.	**8**
Quality of discussion	Missed the point of the discussion.	Reasoning is hard to follow. Rambling and repetitive. Little linkage is evident.	Reasoning is evident, but there is a loss of focus. Repetitive. Thoughts are often weakly linked.	Response is clear, compelling and cohesive, with some minor repetition or loss of focus.	Reasoning (logic) is very clear, response is to the point, cohesive and compelling.	**4**

IEB Copyright © 2024

IEB Copyright © 2024

[20]

Total: 200 marks

IEB Copyright © 2024

ADDITIONAL SPACE (ALL QUESTIONS)

REMEMBER TO CLEARLY INDICATE AT THE QUESTION THAT YOU USED THE ADDITIONAL SPACE TO ENSURE THAT ALL ANSWERS ARE MARKED.

IEB Copyright © 2024