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TOTAL MARKS

NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2023

SPORT AND EXERCISE SCIENCE

EXAMINATION NUMBER

Time: 3 hours 200 marks

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

1. This question paper consists of 38 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 38) 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	39	41	61	28	11	20	**200**
Obtained							

QUESTION 1

1.1 Match the term in column A to a description in column B. Write only the letter of your chosen description in the answer grid below.

COLUMN A	COLUMN B
1.1.1 Aerobic capacity	A When lactate clearance is no longer able to keep up with lactate production.
1.1.2 Stroke volume	B The amount of blood leaving the ventricle on each heartbeat.
1.1.3 Vasodilation	C The blood vessels narrow resulting in reduced blood flow.
1.1.4 Venous return	D The increase in the internal diameter of blood vessels.
1.1.5 OBLA	E The measure of the amount of oxygen the body can consume during all-out, intense endurance exercise.
1.1.6 Vasoconstriction	F The return of blood to the heart via venules and veins.

ANSWERS:

1.1.1	
1.1.2	
1.1.3	
1.1.4	
1.1.5	
1.1.6	

(6)

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

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

[<https://www.google.com/q=yoga+poses+on+1+foot> Accessed 26/4/2023]

(1)

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

[<https://www.google.com/search?q=bird+dog+exercise> Accessed 26/4/23]

(1)

1.3 Outline **AND** shade in the Base of Support in each of the following pictures.

Picture A

[<https://www.google.com/plank+with+1+arm+lifted> Accessed 26/4/23]

(5)

Picture B

[<https://www.google.com/tricep+exercises+on+pilates+ball> Accessed 26/4/23]

(5)

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

Picture A (hammer curls)

[<https://www.google.com/hammer+curls:cross+body> Accessed 26/4/23]

1.4.1 State what the load is.

_____

(1)

1.4.2 What muscle(s) are providing the effort?

_____

(2)

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

_____

(1)

1.4.4 Place the fulcrum on the picture below.

(1)

Examine Picture B below and answer the questions that follow.

Picture B (ball pike)

[<https://www.skimble.com/exercises> Accessed 4/1/23]

1.4.5 State what the load is.

_____

(1)

1.4.6 What muscle(s) are providing the effort?

_____

(2)

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

_____

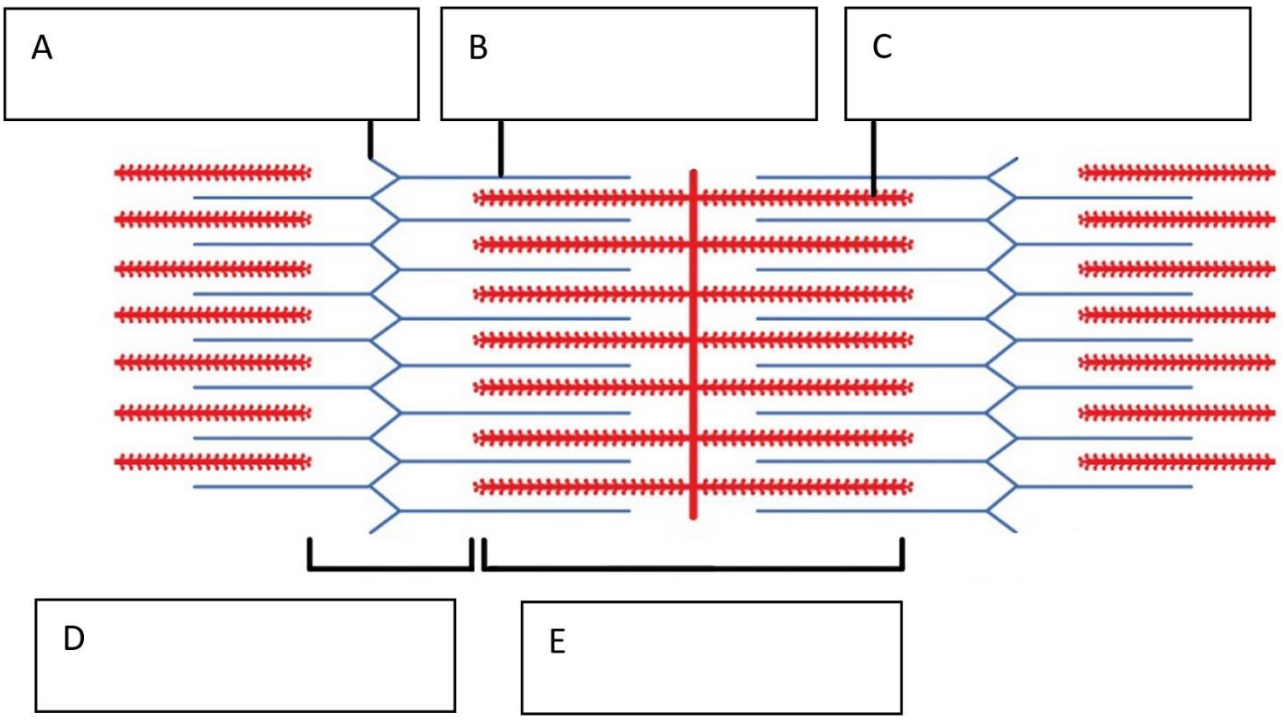
(1)

1.4.8 Place the fulcrum on the picture below.

(1)

1.5 Label parts A–E on the diagram of a sarcomere below, using the words provided in the box.

Myosin
Actin
I band
A band
Z line



[<opentextbc.ca> Accessed 7/4/23]

(5)

1.6 The following questions relate to energy systems. Circle the most correct answer to each question.

1.6.1 Which energy system provides energy for 0–10 seconds?

Aerobic Lactic Acid ATP/PC

(1)

1.6.2 Which energy system provides energy for 60 seconds–3 minutes?

Aerobic Lactic Acid ATP/PC

(1)

1.6.3 Which energy system provides energy for 3 minutes or longer?

Aerobic Lactic Acid ATP/PC

(1)

1.6.4 Which energy system uses oxygen?

Aerobic Lactic Acid ATP/PC

(1)

1.6.5 What fuel does the Lactic Acid energy system use?

Carbohydrates stored as glycogen in muscles

Creatine phosphate stored in muscles

(1)

1.6.6 Which one of the following sports predominantly uses the Lactic Acid system?

High Jump 10 km running 400 m sprint

(1)

[39]

QUESTION 2

Examine the source provided below and use it to answer the questions that follow.

Nobody prepared me for the let-down
Said Conrad Stoltz, one of South Africa's leading triathletes.

'I was 28 years old and had been a pro-triathlete since high school.' He said triathlon 'found' him at the age of 13. 'The thing that made me fall in love with triathlon at 13 was that compared to my over-coached primary school track career, the adventure of first becoming a swimmer, and then a cyclist and then a runner was so attractive.'

I had 10 years where my whole life was aimed at going to the Olympics. Coming from the 2000 Sydney Olympic Games, where he led on the bike section of the Olympic triathlon event, Conrad Stoltz finished 20th.'

'But nobody prepared me for the let-down – the post-Olympic trauma – where you've built up to this thing for so long, and then suddenly it's done. The low after that is terrible. And even sponsorships after the Games were a struggle. After the Olympics, nobody wants to stick around. I think I was only bringing in R4 400 a month back then.'

'I literally struggled with motivation – motivation to train – for a long time. My coach told me to get my passion back. I knew I wanted to go to America because there is good money in triathlons there. And then I read about an event called the XTERRA – never the same course, sometimes swimming in the sea and other times in a lake – it was always going to be different.'

Stoltz decided triathlons would be his 'bread and butter' but XTERRA would be the fun, the hobby. He left his mountain bike in South Africa and would just borrow a bike wherever he ended up in an event that needed one. He did several XTERRA events. He didn't win all the races but scored enough points to win the USA series overall and a cheque for $10 000.

[Adapted from *Bicycling* magazine, issue 6/2022]

2.1 How many years did Stoltz 'prepare' for the Sydney Olympic Games?

_____

(1)

2.2 Name the three disciplines that make up a triathlon.

_____

_____

_____

(3)

2.3 In what country did the 2000 Olympic Games take place?

(1)

2.4 State three reasons why an athlete could experience post-Olympic trauma.

(3)

2.5 Provide two possible reasons why sponsorship after the Olympic Games is difficult to find.

(2)

2.6 What factor attracted Stoltz to XTERRA?

(1)

2.7 Athletes should select a diet best suited to the activity they are involved in. Compare the type of diet that a triathlete like Stoltz would follow to that of a track athlete.

(6)

2.8 Explain why an endurance athlete would follow a ketogenic diet.

(1)

2.9 Describe the effect that eating a high GI snack would have on an athlete.

(3)

2.10 Provide two negative impacts on an athlete should they not consume enough carbohydrates.

- _____
- _____

(2)

2.11 Describe the following two stages of the LTAD model:

Stage 3: Learn to train

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(5)

Stage 5: Train to compete

(5)

2.12 Do you think Stoltz followed a long-term athlete development (LTAD) programme? Substantiate your answer.

(2)

2.13 Match each of Newton's Laws to an action applied to triathlon and to the description of the law. Use the answer grid below.

Number of Newton's Law	Action applied to Triathlon	Description of Newton's Law
1st	A When swimming crawl, the athlete pushes the water backwards and the water, in turn, pushes the person with an equal force in the forward direction.	A When a force acts on an object, the rate of change of momentum experienced by the object is proportional to the size of the force and takes place in the direction in which the force acts.
2nd	B The triathletes on the starting line before a race, will be still, not moving.	B For every action there is an equal and opposite reaction.
3rd	C The harder the cyclist pushes on the pedals, the bigger the force and the greater the acceleration.	C A body continues at a state of rest or uniform velocity unless acted upon by an external force.

Answer Grid:

Number of Newton's Law	Action	Description of Newton's Law
1st		
2nd		
3rd		

(6)
[41]

QUESTION 3

Examine the data provided below and use it to answer the questions that follow.

PERIODISATION PLANNING FOR AN ELITE NETBALL TEAM

Months	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Competitions												
Periodisation	Pre-season			In-Season					Finals	Post-season		
Macrocycles	Basic conditioning		Specific conditioning	Unloading					Peaking	Transition		
Speed	Developing running speed			Maintain running speed						Maintain low level speed		
Endurance	Develop aerobic capacity			Maintain aerobic capacity						Maintain low level		
Flexibility	Develop flexibility			Maintain flexibility						Maintain flexibility		
Agility	Develop agility			Maintain agility						Maintain agility		
Skill	Improve specific skills			Continue to develop skills under pressure and game play situations						Improve basic skills		
Psychology	Establish goal setting			Stimulate strategies to achieve goal					Increase motivation	Decide on next goal		
% Training time:										No training		
Conditioning	50	40	30	20	20	20	20	30	20		60	70
Skill	30	30	40	40	40	40	30	20	20		40	30
Tactical	20	30	30	40	40	40	50	50	60		0	0
Training load	100% 80% 60%											

3.1 What is the main purpose of periodisation?

_____

_____

_____

(2)

3.2 List the three phases of periodisation.

_____

_____

_____

(3)

3.3 Explain why the training in the plan concentrates on developing the various fitness components early in the season.

(3)

3.4 Provide an example of a 'specific skill' needed for netball.

(1)

3.5 Explain the importance of 'developing skills under pressure and game play situations'.

(4)

3.6 Refer to the row labelled Psychology in the table:

3.6.1 In pre-season phase, the athletes 'establish goal setting'. Provide an example of a goal that a netball player might set.

(1)

3.6.2 Provide a strategy that could be used to achieve the goal provided in Question 3.6.1.

(1)

3.7 Interpret and account for the data provided in the shaded row on the table.

(12)

3.8 Flexibility training is essential in netball.

Name the two most important joints that require flexibility in netball.

_____

_____

(2)

Provide reasons why these joints require flexibility in netball.

- _____

_____

_____

(1)

- _____

_____

_____

(1)

3.9 Account for the gradual increase in training load in January.

_____

_____

_____

_____

_____

_____

_____

_____

(6)

3.10 What is the correct term for 'gradual increase in training load'?

_____

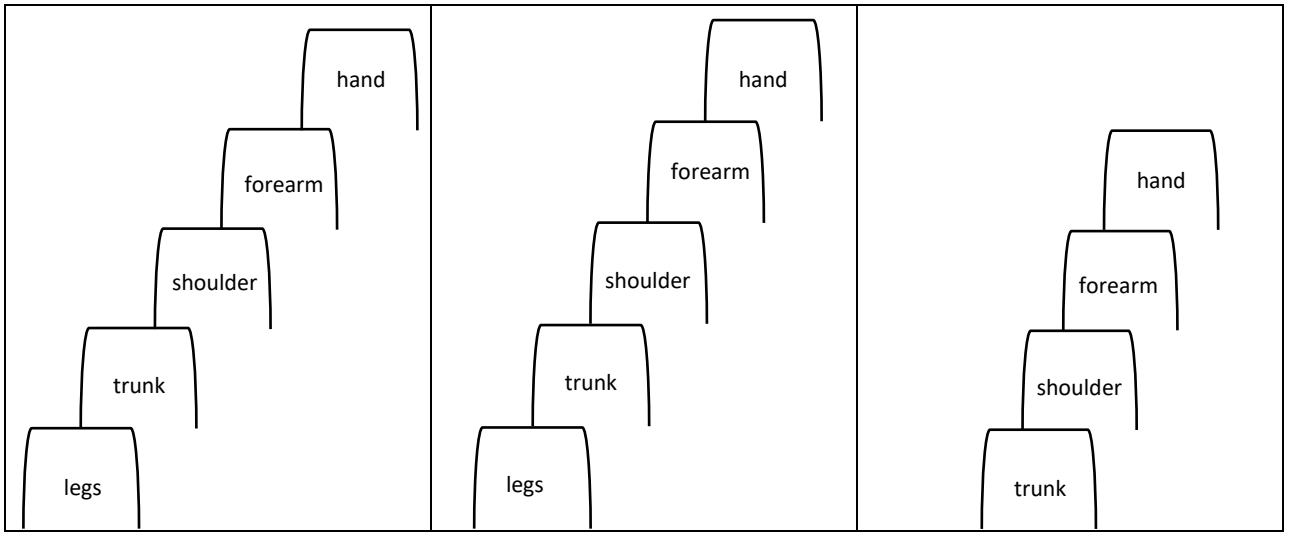
(1)

3.11 Explain why there are differences in training load percentage between periods February – March and the period mid-April to the end August.

(6)

3.12 An athlete is going to execute a forceful and accurate shot at goal when playing netball. Use the pictures provided below to answer the questions that follow.

Picture 1 **Picture 2** **Picture 3**



3.12.1 Explain what is meant by the term 'force summation'.

(3)

3.12.2 Which of the provided pictures correctly depicts force summation?

(1)

3.12.3 Provide reasons for your answer to Question 3.12.2

(3)

3.12.4 Explain the error(s) in the pictures not chosen.

(4)

3.13 Describe three adaptations to the heart as a result of the netball players' training season.

(3)

3.14 Explain how the increase in the number of capillaries in the lungs would assist a netball player.

(3)
[61]

QUESTION 4

Examine sources A, B and C provided in this question and use them to answer the questions posed.

Source A

SailGP – the F1 on water

SailGP is an international sailing competition using high performance foiling catamarans, where teams compete across a season of multiple grands prix around the world. An event entails six races over a weekend and brings together the best skippers in the world. The series has attracted more teams, more races and the competition has become more intense. 'As we build our calendar out, like any other sport, in between races they will be looking for rest and just recover,' he said. Talk to the drivers, however, and crews said they were feeling the strain of the expanded schedule. Robertson, the Canadian driver says, 'There's a new level of fatigue within the team,' adding that it could be tough for them to travel home between events. 'That's having to be managed pretty severely, and to be honest, I don't think we've quite got it right yet,' he said.

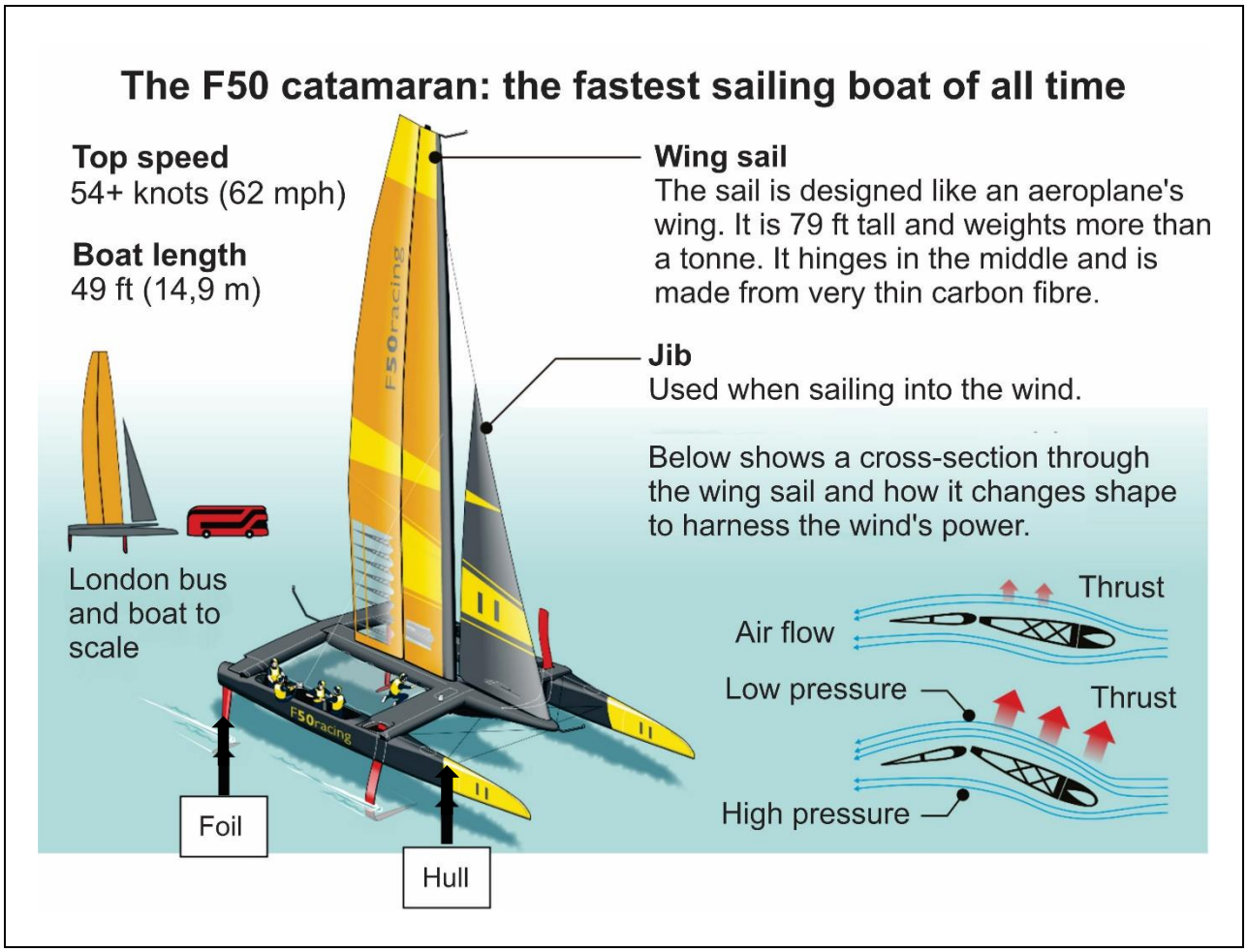
Drivers say that with more of these catamarans traveling at speeds of approximately 80 km per hour, packed onto the racecourse, it has become more of a challenge for them to avoid collisions.

Catamaran = a multi-hulled boat with two parallel hulls of equal size

[<https://www.google.com/sail+gp+foilsc>]

SailGP's foiling catamarans are identical. All boats are upgraded with new equipment at the same time, and all upgrades and repairs are handled by one company which works with each team's technical group. Also, everyone has access to one another's data, video and communications from races, which can help teams increase their knowledge and become competitive faster. The result is a level field that shifts evenly as the boats, and the racing, evolve.

Source B



[<https://www.google.com/sailgp+boats+the+same+as+america%27s+cup>]

Source C

The Blistering Speed of SailGP

The catamarans use wings, not sails, and hydrofoils help the boat fly over the water. The boats that most people race are considered fast at nine knots: screaming at 15. That's about 16 to 18 km/hr.

Then came the F50 catamaran, with 24 metre wings instead of sails and hydrofoils that lift the boats above the friction of the water, reaching incredible speeds, as they seemingly fly above the ocean. The physics behind hydro foiling are essentially the same as the physics of flying. Water flows above and below the foil in the same way that air flows above and below an airplane wing, creating a pressure difference that generates lift, ultimately pushing the foil up and out the water. And, by lifting the boat out of the water, drag from the hull is significantly reduced, allowing boats to hit previously-unheard-of speeds.

The crew member helping make that happen is called the flight controller, who manipulates the elevations and angles of the left and right hydrofoils. In SailGP lingo, the controller can fly the boat higher or lower. Higher is faster, but riskier because it also gets the boat closer to a nosedive.

And if that wasn't enough, when the F50 maneuvers and tacks into the wind, the crew needs to run across to the second hull on the other side of the boat and do everything from the opposite side. 'Swapping sides is probably one of the most challenging things on the boat when you're going at high speeds,' says USA captain Spithill. 'The only way I could describe it would be honestly getting on the roof of a car blindfolded and someone driving a rally course.'

Crew members are attached to the boat with mountain climbing harnesses, and they have access to spare air in case of a capsize. They wear impact vests and helmets, and the team leader communicates with all of them by way of headsets, so they can hear their instructions above the wind.

All these improvements work towards making the boat moving significantly faster. At the top-end of the F50's speed range, the water begins to boil and bubble around the foils – this is a phenomenon known as 'cavitation'. Cavitation increases drag and reduces lift. The foils are therefore constructed with carbon fibre, producing a thinner section which has less resistance at high speeds. Drag has been further reduced as the lower section of the rudders are manufactured with high-strength stainless steel, and there are different size rudders and sails that can be used depending on the wind speed to ensure the racing remains of the highest quality.

On-board cameras deliver point-of-view racing while on-board microphones give race fans the sensation they are on the race boat, as they listen in on the winning tactical calls.

As SailGP is a one-design class, all teams use the same equipment in every race. Any performance difference is due to the skill of the crew. This is the huge benefit of one-design racing, and serves to promote close, exciting racing with an unpredictable outcome.

4.1 Explain why it is important that all teams use identical boats and equipment.

(2)

4.2 Provide three reasons why SailGP is considered to be spectator friendly.

(3)

4.3 Provide evidence that a risk assessment was conducted in the SailGP series.

(4)

4.4 Source A states that there is fatigue being experienced by the teams.

4.4.1 List three negative side effects of fatigue.

(3)

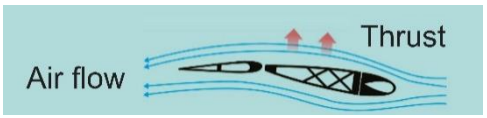
4.4.2 Explain how each of the three listed symptoms of fatigue would affect the athlete's performance.

(3)

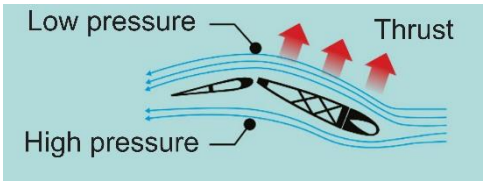
4.5 Describe what is occurring in the pictures below and how it impacts the catamaran.

Cross sections through the wing sail and how it changes shape to harness the wind's power

Picture A



Picture B



(5)

4.6 Describe the water flow around the catamaran's foils and the impact this has on the boat.

(4)

4.7 Why does a boat that is higher out of the water create more risk?

(2)

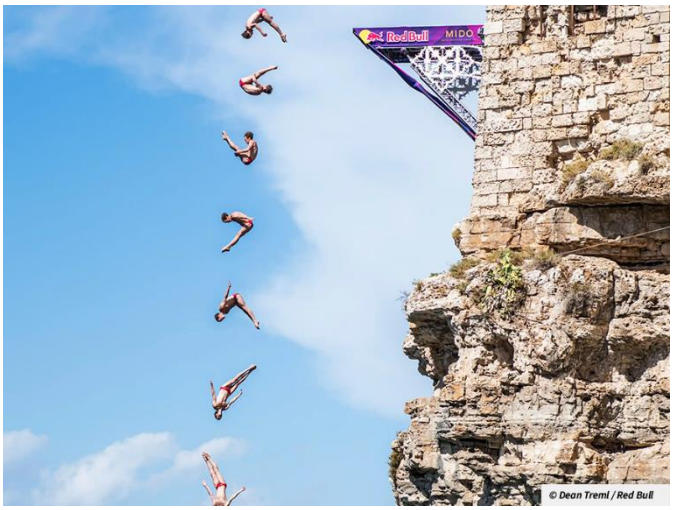
4.8 What could cause surface drag on a catamaran and what impact would surface drag have on the catamaran?

(2)
[28]

QUESTION 5

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

Inside the mind of the Lionel Messi of diving



***Exquisite twists**: In 2019 Hunt was the first world-series diver to receive perfect marks.*
Gary Hunt has dominated the world of cliff-diving for over a decade — yet he remains incredibly relaxed and appears to have no ego.

One by one, the competitors mounted the diving board overlooking the sea in Turkey. All had amazing routines, but when Gary Hunt's turn came, he pulled off something extraordinary: a triple somersault with four twists. A rival said it was 'the most difficult dive ever done'.

In pool diving, the highest board is 10 m above the water. Cliff divers go to 27 m — the height of an eight-storey building.

Though they are only in the air for three seconds, they reach a speed of 80 km/h. Going in head-first is too risky, so they need to break the water with their feet.

But Gary Hunt is a natural. He has won the world series 11 times and been runner-up three times.

What astonishes people is that he seems not to care about being a famous athlete. He is surprised when people recognise him in the street. He trains hard in the gym and has an intense desire to win. And before each dive, he appears relaxed and in control.

[Adapted from *The Day*, 23/2/23]

5.1 What made Gary Hunt so exceptional in 2019?

_____

_____

_____

(1)

5.2 What height do cliff divers use for competition?

_____

(1)

5.3 Why it is necessary for the divers to enter the water feet first?

(2)

5.4 Draw and label the inverted U hypothesis using the axis given below.

(6)

5.5 On the diagram you have drawn in Question 5.4, indicate with an asterisk* where Gary Hunt's arousal level would be when competing.

(1)
[11]

QUESTION 6

Examine the information provided in sources A, B and C on pages 33 and 34. Use it to write an essay of 1–1½ pages on the following topic:

An athlete competing year-round at an elite, competitive level will experience strain not only to their body but also to their mind. Modern sports are extremely competitive and performance levels are constantly improving and reaching higher levels. As a result, elite athletes are often susceptible to sport burnout.

Discuss the various factors and conditions that can lead to sport burnout and the impact of burnout on the mind and body. Also explore how athletes and their coaches can identify, monitor and manage burnout.

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.

Source A

Gymnastics star retires to focus on happiness

British gymnast Ellie Downie has decided to retire at 23. Protecting her mental health: Ellie Downie has faced hard times in the last few years.

It is a huge moment for the young gymnast. At just 23 years old, British star Ellie Downie has announced she is hanging up her leotard. She is still only young, but Downie has already had a long career. She started gymnastics when she was three. At 15, she won a bronze medal in the European Championships. Next, she went to the 2016 Olympic Games. But now, she has decided to quit. 'After a really tough last few years I've made the decision to prioritise my mental health and happiness,' she said.

[*The Day* 25/1/23]

Source B

Nadal 'mentally destroyed'

Rafael Nadal says he is 'mentally destroyed' after his Australian Open title defence came to an end in the second round. The Spaniard struggled with a left hip problem as he fell to a 6-4 6-3 7-5 defeat by American Mackenzie McDonald. The 36-year-old said he was carrying the injury before the match, but the pain had been 'nothing like today'. 'I really hope that it doesn't put me out of the court for a long time,' Nadal said. 'It's not only the recovery. It's all the amount of work that you need to put together to come back at a decent level.'

Speaking at his post-match news conference, the 22-time Grand Slam champion said he felt he 'cannot move' after his earliest exit at a Grand Slam since the 2016 Australian Open, when he was eliminated in the first round. '[I] just can't say that I am not destroyed mentally at this time, because I will be lying,' he said.

Nadal was trailing by a set and a break when he pulled up with the injury, taking a medical timeout towards the end of the second set before continuing. He said he had considered stopping all the time because he was in pain and mentally exhausted. 'Just try your best until the end,' added Nadal. 'That's the philosophy of the sport. That's the essence of the sport by itself. I tried to follow that during all my tennis career.' This is the latest in a series of physical and emotional problems for Nadal, who admitted he had no feeling in his left foot during his victory at the French Open last year.

He said it was his love of the sport that keeps him going amid the injury setbacks. 'It's a very simple thing: I like what I do,' he said. 'I like playing tennis. I know it's not forever. I like to fight for the things that I have been fighting for almost half of my life or even more. When you do things that you like to do, at the end of the day, it's not a sacrifice'.

[Adapted from *The Day* 25/1/23]

Source C

Simone Biles: 'It's basically life or death'
Tuesday, 28 September 2021

Is fame a curse? In a painfully honest new interview, the record-breaking gymnast explains why her controversial decision to back out of four Olympic finals was the right one.

It was on the fifth day of the Olympic gymnastics at Tokyo that everything went wrong. Simone Biles was in the middle of a vault when she had an attack of 'the twisties' – a mental block which makes gymnasts unable to tell where they are in the air and lose control of their bodies. Worst of all, she had no idea how she was going to land. It was, she says, 'the craziest feeling ever'.

Although she completed her routine safely, she knew at once that she had to withdraw from the event. 'My perspective has never changed so quickly from wanting to be on a podium, to wanting to be able to go home, by myself, without any crutches,' she explains in an interview for New York magazine. 'It's so dangerous, it's basically life or death. It's a miracle I landed on my feet. If that was any other person, they would have gone out on a stretcher.'

Her decision to back out of four finals rocked the world of sport. Instead of the six gold medals she had been expected to win, she left Tokyo with one silver and one bronze. Her decision to focus on her mental health was widely applauded, though some critics accused her of simply buckling under pressure.

She compares her experience to suddenly going blind. 'One morning, you wake up, you can't see… but people tell you to go on and do your daily job as if you still have your eyesight. You'd be lost, wouldn't you?' Not that it happened entirely out of the blue. Because of the pandemic, nothing felt quite right when she arrived in Tokyo. Her family could not be there to cheer her on; nor could the large crowds she was used to. She felt increasingly nervous and, despite her coaches' help, unable to perform properly:

'I was not physically capable. Every avenue we tried, my body was like, "Simone, chill. Sit down. We're not doing it." And I've never experienced that.' As the most successful gymnast ever, she was under constant pressure to fulfil the expectations of her parents, her coaches, her fans and the media.

She is now spending time with her family and friends, and taking part in an exhibition tour, but not competing. Of her decision to withdraw at Tokyo, she says: 'Everybody asks, "If you could go back, would you?" No: I wouldn't change anything because everything happens for a reason. And I learned a lot about myself – courage, resilience, how to say no and speak up for yourself.'

[*The Day* 28/9/21]

ESSAY RUBRIC

	0 marks	1 mark	2 marks	3 marks	4 marks	Possible mark (20)
Use of sources	No reference to sources.	Only 1 source referred to. Poorly integrated.	Not all sources used but those used were integrated.	Full use of sources but not fully integrated or expanded on.	Full use of all sources integrated into discussion with understanding.	4
Content relevance	No content relevance.	Little content provided and not integrated into discussion.	Some content provided but not integrated into discussion.	Some of the content provided is relevant and integrated into the discussion.	All the content provided is relevant and integrated into the discussion.	4
Use of own knowledge **X2**	No own knowledge provided.	Some facts and information given beyond the sources.	Some own knowledge provided but not integrated into the discussion.	Response shows evidence of own knowledge integrated into discussion.	Response shows substantial use of own knowledge and is well integrated into discussion.	8
Quality of discussion	Missed the point.	Little linkage evident. Reasoning correct but hard to follow.	Some linkage evident. Reasoning correct.	Compelling with regular linkage.	Reasoning is very clear and succinct. Flow is logical.	4

[20]

Total: 200 marks

ADDITIONAL SPACE (ALL QUESTIONS)

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