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**TOTAL
MARKS**

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NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2020

SPORT AND EXERCISE SCIENCE

EXAMINATION NUMBER

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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. **All the questions must be answered on the question paper.**
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. TWO blank pages (pages 35 and 36) are included at the end of the question paper. If you run out of space for a question, use these pages. Clearly indicate the question number of your answer should you use this extra space.

FOR MARKER'S USE ONLY

Question	1	2	3	4	5	6	7	Total
Marks	31	15	52	26	36	20	20	200
Obtained								

QUESTION 1

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

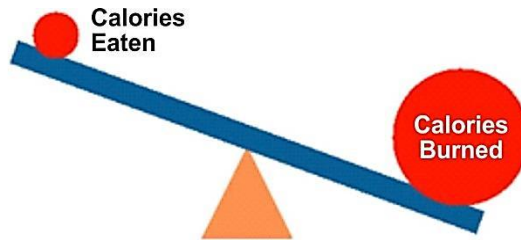
COLUMN A	COLUMN B
1.1.1 Hostile aggression	A Is measured in terms of millilitres of O ₂ used per kilogram of body weight.
1.1.2 Sagittal plane	B Moves about a particular point called the axis of rotation.
1.1.3 Laminar flow	C For every action there is an equal and opposite reaction.
1.1.4 VO ₂ max	D A locomotor skill.
1.1.5 Linear motion	E A body continues at a state of rest or uniform velocity unless acted upon by an external force.
1.1.6 Newton's third law	F Blood returning to the heart.
1.1.7 Jumping	G The main motive is to harm an opponent and cause injury.
1.1.8 Angular motion	H All parts move in the same direction.
1.1.9 Venous return	I Smooth flow of air around an object.
1.1.10 Newton's first law	J It divides the body into left and right.

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	

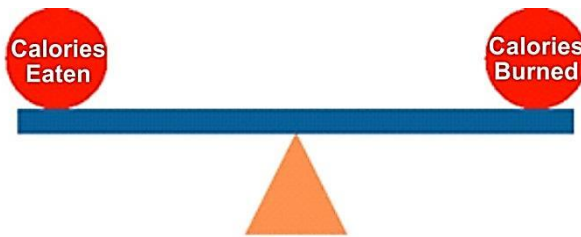
1.2 State what impact the behaviour depicted by each diagram below will have on a person's body weight.

1.2.1



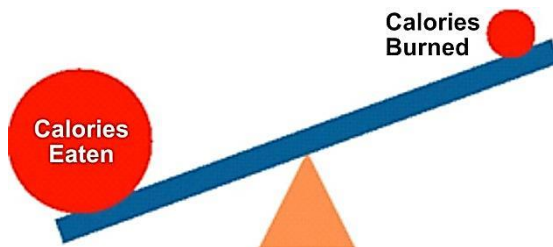
(1)

1.2.2



(1)

1.2.3



(1)

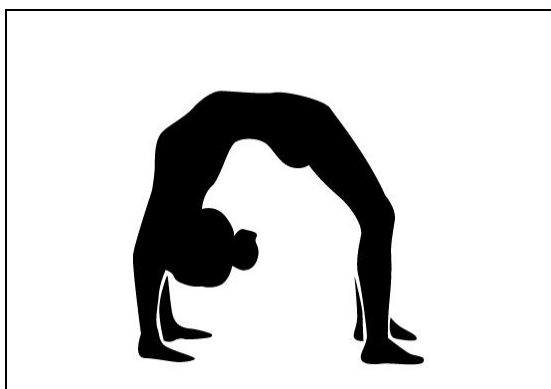
1.3 Provide the correct term for the following descriptors.

Descriptors	Term
1.3.1 A point in the body where two or more bones are connected in a way that allows movement.	
1.3.2 A tough band of fibrous tissue that anchors muscles to a bone and allows movement.	
1.3.3 A muscle that relaxes during movement.	
1.3.4 The volume of air, in litres, that you breathe per minute.	
1.3.5 The process whereby the muscle walls of the heart get thicker and stronger as a result of training.	
1.3.6 The volume of blood pumped out of the heart by each ventricle in one beat.	

(6)

1.4 In the pictures below, state in which body plane each movement is occurring. Write your answer in the spaces provided.

Picture A



[Source: <<https://www.creativefabrica/gymnastics>>
(Accessed 21/2/20)]

Picture B



[Source: <<https://www.yogajournal.com>>
(Accessed 21/2/20)]

Answers:

Picture A: _____ (1)

Picture B: _____ (1)

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

Picture A



[Source: <<https://mcardlesport.co.uk>> (Accessed 25/2/20)]

(5)

Picture B



[Source: <<https://www.mercurynews.com/>> (Accessed 25/2/20)]

(5)
[31]

QUESTION 2

2.1

Jill is a triathlete who participated in a race involving a 1,5 km swim, a 50 km cycle and a 10 km run. She consumed many calories by eating balanced meals leading up to the event. She ate carbohydrate gels at hourly intervals and drank ample fluids during the race.

2.1.1 How many disciplines make up a triathlon?

_____ (1)

2.1.2 What is the name of an event that involves only two disciplines?

_____ (1)

2.1.3 State which energy system Jill predominantly used to complete the race.

_____ (1)

2.1.4 Why is the energy system provided in your answer to Question 2.1.3 the one that is most used?

_____ (1)

2.1.5 Why did Jill consume carbohydrate gels during the triathlon?

_____ (1)

2.2

The final 5 km of the cycle leg took place on a 5% gradient (a manageable gradient that can cause fatigue over long periods). Towards the end of this, Jill's legs started to feel sore.

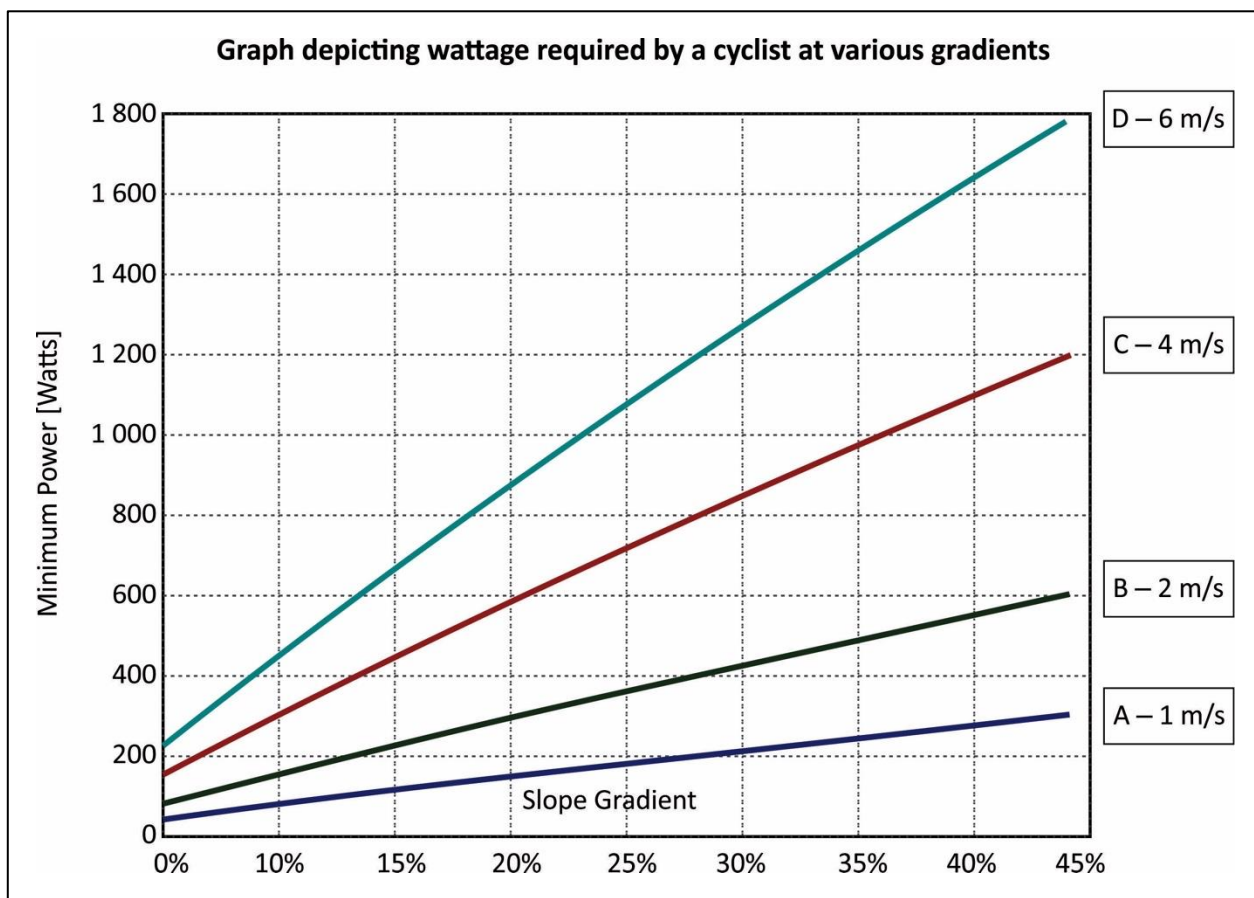
2.2.1 In terms of energy systems, what accounts for Jill's muscle soreness and why did it occur?

(2)

2.2.2 Why would Jill lean over the handlebars when going uphill?

(2)

2.2.3 Study the graph below and use it to answer the questions that follow.



[Source: <<https://www.google.co.za/percent+gradient+hill>> (Accessed 21/2/20)]

- (a) Which line – A, B, C or D – will result in Jill cycling the fastest?

(1)

- (b) What power wattage would Jill need to use should she wish to maintain a speed of 1 m/s on a 40% gradient?

(1)

- (c) What percentage of the slope gradient is the cyclist pedalling up when using 600 W at 4m/s?

(1)

2.3

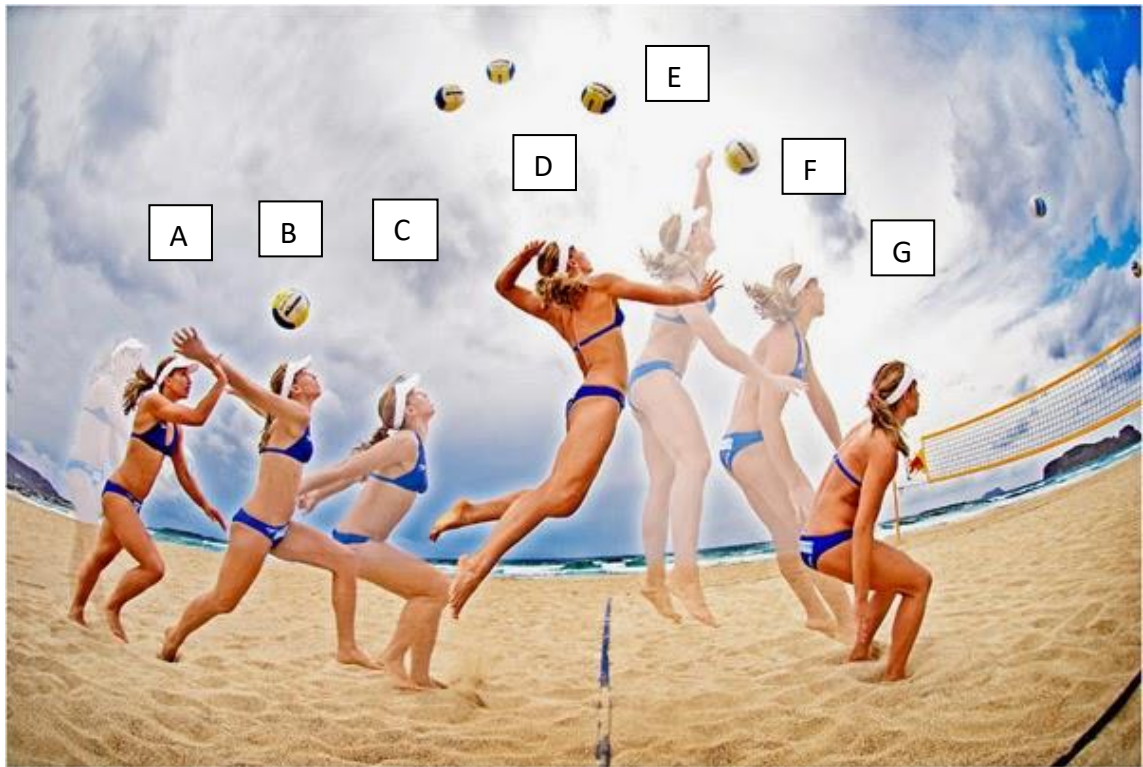
After 6 km of the running stage, Jill had to run up a steep gradient for 200 m. At the top of the hill she felt out of breath and had to slow down while breathing deeply for a few minutes.

Explain why Jill needed to breathe deeply even though she had slowed down significantly.

(3)
[15]

QUESTION 3

3.1 Use the picture below to explain force summation when a force is applied to a volleyball when spiking the ball.



[Source: <<https://www.google.com/volleyball spike>> (Accessed 28/9/20)]

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

- 3.2 Draw a force summation graph showing force over time when serving a volleyball with an overhead service.

Place the following body parts on the graph in the correct order.

trunk	legs	hand
shoulder	arm	wrist



(13)

- 3.3 What advantage does a tall volleyball player have during a match?

(3)

3.4 What techniques would a volleyball player use to increase either the spike height of release or a service height of release?

(2)

3.5 Explain the relationship between reaction time and performance in a sport like volleyball.

(2)

3.6 How could anticipation affect the relationship between reaction time and performance?

(4)

3.7 Describe the air pressure changes that occur around a volleyball that is served with topspin.

[illegible]

(6)

3.8 Use the diagram below to indicate the following factors when a volleyball is served with a backspin:

- rotation of the ball
- air pressure above the ball
- air pressure below the ball
- velocity above the ball
- velocity below the ball

Direction the ball is being served



[Source: <<https://www.cartoon-volleyball.html>Irpinning>
(Access 26/2/20)]

(5)

3.9 Complete the Tuckman's model of group dynamics below.

Name: Performing
Description: Group members use each other's strengths. Function as a united team.

Name: _____

(1)

Description: _____

(2)

Name: _____

(1)

Description: _____

(2)

Name: _____

(1)

Description: _____

(2)

[52]

QUESTION 4

Study the pictures below and then answer the questions which follow.

Picture A Sprint kayak



[Source: <<https://www.google.co.za/canoe+sprint+boat>> (Accessed 25/2/20)]

Picture B Sprint kayak



[Source: <<https://www.olympic.org/canoe-sprint>> (Accessed 25/2/20)]

Picture C Rowing boat



[Source: <<https://www.google.co.za/wooden+boat>> (Accessed 25/2/20)]

Picture D Rowing boat



[Source: <<https://www.google.co.za/people+in+rowing+boat>> (Accessed 25/2/20)]

4.1 Explain how design modifications to the carbon fibre kayak reduce resistance.

(5)

4.2 Compare the air resistance in pictures B and D.

(4)

4.3 What class / order of lever is being used in picture D?

(1)

4.4 State what the load is in picture D.

(1)

4.5 Draw the fulcrum onto picture D.

(1)

4.6 State where the effort is coming from in picture D.

(1)

4.7 Explain and apply Newton's first and third laws of motion to the rower in picture D.

Newton's first law:

(2)

Application of law:

(2)

Newton's third law:

(2)

Application of law:

(2)

- 4.8 Outline the *all-or-none law* when applied to the arm and shoulder muscles of a sprint canoeist.

(5)
[26]

QUESTION 5

Examine the sources below that all relate to a Kenyan runner's attempt to break the world record for the 42,2 km marathon. Use them to answer the questions that follow.

Source A

The 34-year-old from Kenya, who is unparalleled in the marathon, further cemented his legacy by running 42,2 km faster than anybody in history, finishing the time trial event in 1:59:40. He held a sub-2:50 per kilometre pace for the distance. Kipchoge, who has already run the fastest legal time in history, has claimed success would be comparable to putting a man on the moon or scaling Everest.

- On Saturday morning in Vienna, Austria, Eliud Kipchoge became the first person to break two hours in the marathon as part of the INEOS 1:59 Challenge.
- He finished in 1:59:40 averaging a pace of 2:50 per kilometre.
- It will not count as an official world record because standard competition rules for pacing and fluids weren't followed.

Just how likely was this? When researchers from Australia crunched data from marathon world records over the past 60 years, they concluded that there was a 10% likelihood that the two-hour mark would fall in May of 2032, and just a 5% chance it would happen by 2024.

[The Mail on Sunday 5 October 2019]

Source B**THE SHOE**

At £240 a pair, you would expect the Nike ZoomX Vaporfly to be helpful to runners. The manufacturers claim that the carbon fibre plate results in less oxygen being used by the runner and that the foam layer in the sole helps absorb energy and then transfers it back as the foot hits the ground.



[Source: <<https://q=shoes+eliud+kipchoge>> (Accessed 27/2/20)]

Source C

The right food

In preparing for the attempt, the organisers created a window (October 12 to October 20) when the run could take place. This uncertainty meant Kipchoge's food preparations couldn't begin early. "Because they've not had a specific day when they're going to run, they've had to delay the nutritional strategies they're going to implement before they race."

Before he started at 8.15 am on October 12, Kipchoge will have been increasing the amount of carbohydrates in his diet. Muscles rely on carbs, stored in the body as glycogen, to produce force and, thus, power running. If the body runs out of carbohydrates, it will start burning fat to fuel an athlete – a process that's not as efficient and fat is often in short supply in the bodies of elite athletes.

The majority of the carbs Kipchoge consumed during the run was taken in through drinks.

During another marathon Kipchoge experimented with small drinks (around 50 ml) every few kilometres to keep a constant supply of fuel going into his body.

[Source: <<https://www.wired.co.uk/article/eliud-kipchoge-ineos-159-marathon>> (Accessed 27/2/20)]

Source D



Source E**It took 43 of the world's fastest runners to break the two-hour marathon barrier**

Eliud Kipchoge became the first man ever to break the two-hour marathon barrier. The superhuman feat was made possible by a team of 42 other runners, representing some of the best athletes in the world.

To reduce aerodynamic resistance for Kipchoge, event organisers decided there would be a group of five pacemakers running in front of him in a V formation. Kipchoge would run behind them, with two more runners following behind.

The pacers worked in teams, rotating in twice during each of the course's 9,6-km laps. An electric car preceded the runners, projecting a system of lasers to show where the pacers should run. There was a special arrangement of runners, who surrounded Kipchoge in order to lower the air resistance as much as possible. The superior performance of this formation was confirmed by wind tunnel tests.

In long-distance running, aerodynamics plays an important role. The so-called 'rabbits' not only serve as pacemakers but also keep the favourites out of the wind. A single rabbit can reduce the air resistance on the second runner by 50%. The formation in which these rabbits run determines the total reduction in air resistance that can be achieved.

Against everyone's expectations, the formation of a reversed V with five rabbits in front of the athlete and two behind him, turned out to be the most optimal variant. This reduced Kipchoge's air resistance on paper by 85% compared to a runner without rabbits.

Counter-intuitive

The formation may seem counter-intuitive, but the explanation is logical. "The rabbits have to endure a higher air resistance due to the flow resistance of the funnel, which keeps the athlete Kipchoge out of the wind. In cycling, typically a triangle formation is used at the head of the peloton. This is a good formation when you want to minimise the air resistance for everyone in the group as much as possible. However, for this marathon record, it is only about minimising the air resistance for Eliud Kipchoge, not for the rabbits. Then this reversed V is superior."

[Source: <<https://qzbreaking-marathon-barrier->> (Accessed 27/2/20)]

5.1 How long, on average, did it take Kipchoge to run one kilometre?

(1)

5.2 What advantage do Kenyan endurance runners have over most other long-distance runners?

(3)

5.3 Did researchers expect Kipchoge to succeed in his record attempt? Substantiate your answer.

(2)

5.4 List TWO reasons why the record attempt is not officially recognised.

(2)

5.5 Explain the role of a pacemaker in a running event.

(3)

5.6 How did the formation used by the pacemakers differ from the formation normally used in the Tour de France?

(2)

5.7 By how much did the formation used in Kipchoge's attempt reduce his air resistance?

(1)

5.8 What was the purpose of the car in front of the running group AND why was an electric car used?

(2)

5.9 Explain how the shoes that Kipchoge wore could assist him in his record attempt.

(2)

5.10 Long-distance runners commonly suffer from an injury that Kipchoge's shoes could possibly prevent. Name this injury.

(1)

5.11 What is Kipchoge's main source of energy when running long distances?

(1)

5.12 What is the reason for Kipchoge consuming small quantities of carbohydrates during the marathon?

(1)

5.13 Why was Kipchoge unable to 'carbo load' effectively?

(1)

5.14 Why would a long-distance athlete not want to start burning fat instead of carbohydrates?

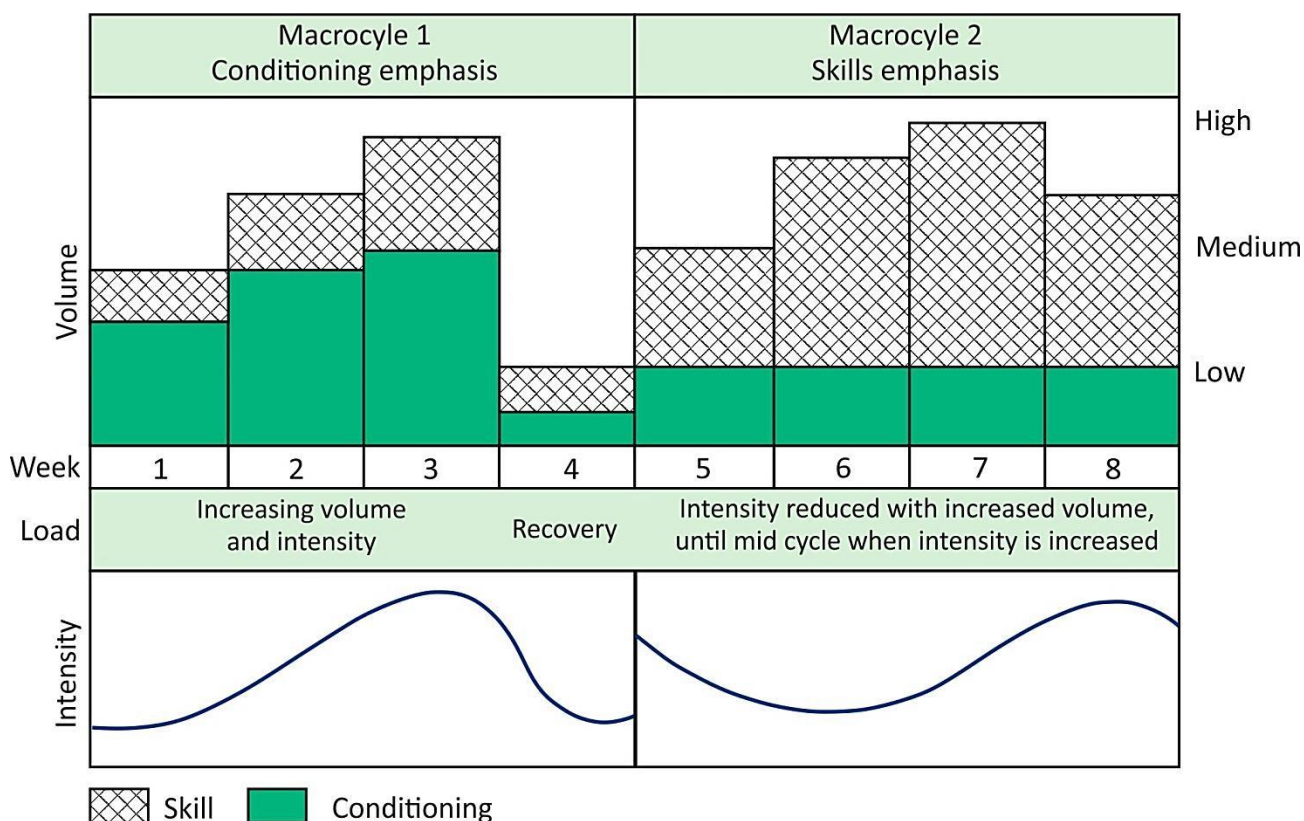
(2)

5.15 Using your knowledge of drag, resistance, drafting and friction, explain how all of these factors impacted on Kipchoge's performance.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

QUESTION 6

Below is a graph depicting netball-training periodisation. Examine the data and answer the questions that follow.



[Source: <<https://sites.google.com/site/netballtrainingstevens/>> (Accessed 25/2/20)]

- 6.1 Account for the big volume in conditioning taking place in the first three weeks of the training program.

(2)

- 6.2 Why would the coach include skills training at the start of the season?

(2)

6.3 Explain the data depicted in week 4 **AND** provide reasons for it.

[illegible]

6.4 Interpret the data in weeks 5 to 8.

[illegible]

6.5 State what occurs to the following when an arm muscle contracts during a netball pass and the sliding filament theory comes into play:

6.5.1 The I band:

_____ (1)

6.5.2 The H zone:

_____ (1)

6.5.3 The A band

_____ (1)

6.6 Name the thin contractile protein filament.

_____ (1)

6.7 Name the thick contractile protein filament.

_____ (1)
[20]

QUESTION 7

Examine the information provided in the sources below, as well as in the rubric. Use these to write an essay of 1–1½ pages on the following topic:

Technology in sport: positive or negative?

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.

ESSAY RUBRIC

	0 mark	1 mark	2 marks	3 marks	4 marks	Possible mark (20)
Use of sources	No reference to sources.	Reference made to one source only	References made to 2 sources	References made to 3 sources	Source detail very close to full potential	4
Quality of content X 2	Little or no content relevance.	Significant important information missing AND Facts not related closely to the topic AND Some serious factual errors.	Some vital information missing OR many irrelevant facts OR errors affecting the quality of the essay.	Sufficient facts provided. Most information is relevant, appropriate and accurate	Many facts provided. All information is relevant, appropriate and accurate	8
Use of own knowledge/ experience	No own knowledge provided	A few facts and information provided from own knowledge/ experience	Includes some facts and information from own knowledge/ experience	Includes facts and information from own knowledge/ experience	Includes many facts and information from own knowledge/ experience	4
Quality of argument	Question not answered. Missed the point	Flawed in all respects	Flawed in 2 respects	Flawed in one respect	Decision clearly stated and supported by essay. Reasoning/logic very clear. Argument is not repetitive. Argument is succinct/not long-winded or rambling.	4

Source A**A changing world**

The world of sport is continually changing over the years, and the use of technology is just one of those areas that have made an impact on many sports in the modern day.

Making changes to a sport, with the inclusion of new technologies, has often caused controversy. One criticism of the use of technology is that it can slow down the speed of the game, but on the other hand for many people it makes watching it more enjoyable to see the correct decisions being made. If a new technology is available, and shown to be accurate, then it should be used so that the correct decisions can be made. It is only fair to the players and teams that the right decisions are made.

Source B**Eliud Kipchoge achieves his moon-landing moment**

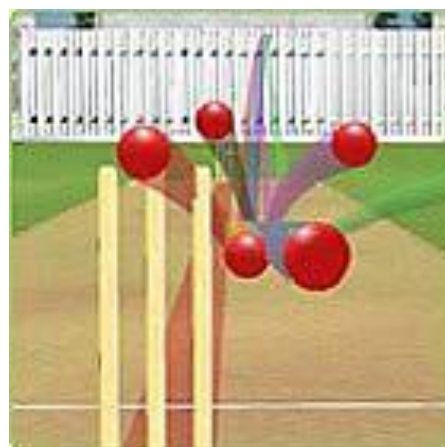
The greatest marathon runner of all time Eliud achieved a jaw-dropping time of 1:59:40.2 to secure his moon-landing moment.

He was supported by a world-class team including an electric pace car complete with futuristic lasers and a fabulous team of world-class pacemakers, featuring some of the best athletes in the world.

"From the first kilometre today, I was really comfortable. In my heart and my mind, I hoped to run under two hours and make history. I hoped to leave a positive message to the whole world that no human is limited."

Source C**Hawk-Eye Technology**

Hawk-eye is the name of a computer and camera system which traces a ball's trajectory. It is being used in international cricket and tennis, and many other sports are also looking at making use of this technology. The system is also being trialled in soccer as part of the goal line assessment. The Premier League of Football in the UK has agreed to the introduction of goal-line sensors after being given approval by football's rule-makers. The Hawk-Eye uses a camera taking 600 frames a second on the goal-line; the information is analysed by computer and sent to the referee's headset or a device on his wrist. In 2015, Hawk-Eye technology was also used by rugby officials at the Rugby World Cup to improve decision-making by the television match official (TMO) and also assist with player safety.



[Source: <<http://www.leoisaac.com/sportman/>> (Accessed 20/2/20)]

Source D

Technology in Sport:

Since the invention of the World Wide Web at the end of the 1980s, technology has quickly become a key component of everyday life. In today's world, most offices and workplaces rely on the internet for both communication and commerce – and it would be fair to say that most people would now struggle without websites like Google, MSN and YouTube.

In almost any capacity, technological advancements have enhanced lives; both in terms of business and leisure. One of the areas of particular interest is sport – and with good reason. With so much money involved, there has been a mass increase in pressure on officials to get key decisions correct and that is but one area where technology comes into play.

You nowadays see technology in some shape or form in most sports. In fact, tech has become so prominent and important to the game that we now come to expect gadgets and slow-motion video to determine important outcomes, such as the scoring of a try in a Six Nations contest or whether Roger Federer just hit the winner at Wimbledon.

It would be fair to say that sport fans, players and coaches are now very much reliant on technology to help them out and that can only be a good thing. In American football, the officials adopt an "all scoring plays are reviewed" policy; and that works great.

The tricky part was actually incorporating technology – and still is, with new inventions. In rugby, they have the video referee for tries and potential foul play, a system which seems to work out perfectly. Meanwhile, the famous Hawkeye system is used in both tennis and cricket. It's a very fast piece of software that barely causes disruption to fans and players.

[Source: <<https://www.solveyourtech.com/technology-sport-positive-negative/>> (Accessed 28/2/20)]

Source E

Some people decry the use of technology to improve sports performance but in reality it is inevitable. The research and development of sport apparatus and apparel is an industry in itself which creates opportunity for investment and employment.

Sporting equipment is continually undergoing research and development to improve sporting performance. Some of the best examples include:

- Full-body swim wear, made of polyurethane, made a huge impact in the 2008 Olympics, only to be banned a year later because it was too obviously making a difference to sporting performance.
- Kevlar fibre (five times stronger than steel yet lighter) used in the manufacture of sails, bicycle tires, football boots, tennis rackets, helmets, body armour and more.

[Source: <<http://www.leoisaac.com/sportman/>> (Accessed 20/2/20)]

[illegible]

[illegible]

[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.**

[illegible]

[illegible]