NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2022

SPORT AND EXERCISE SCIENCE

MARKING GUIDELINES

Time: 3 hours 200 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

QUESTION 1

1.1 1.1.1 C

1.1.2 D

1.1.3 F

1.1.4 E

1.1.5 B

1.1.6 A

1.2

Picture A

[<https://www.google.com/=yoga>, Accessed 14/3/22]

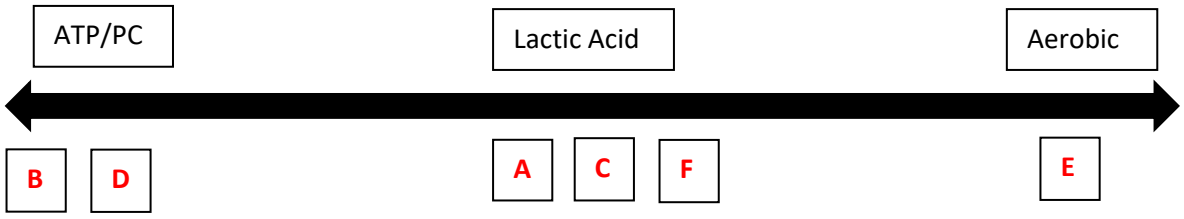
Picture B

[<https://www.google.com/forward+lunge+on+a+pad>, Accessed 14/3/22]

Picture C

[<https://www.google.com/20partnerbalances>, Accessed 14/3/22]

1.3



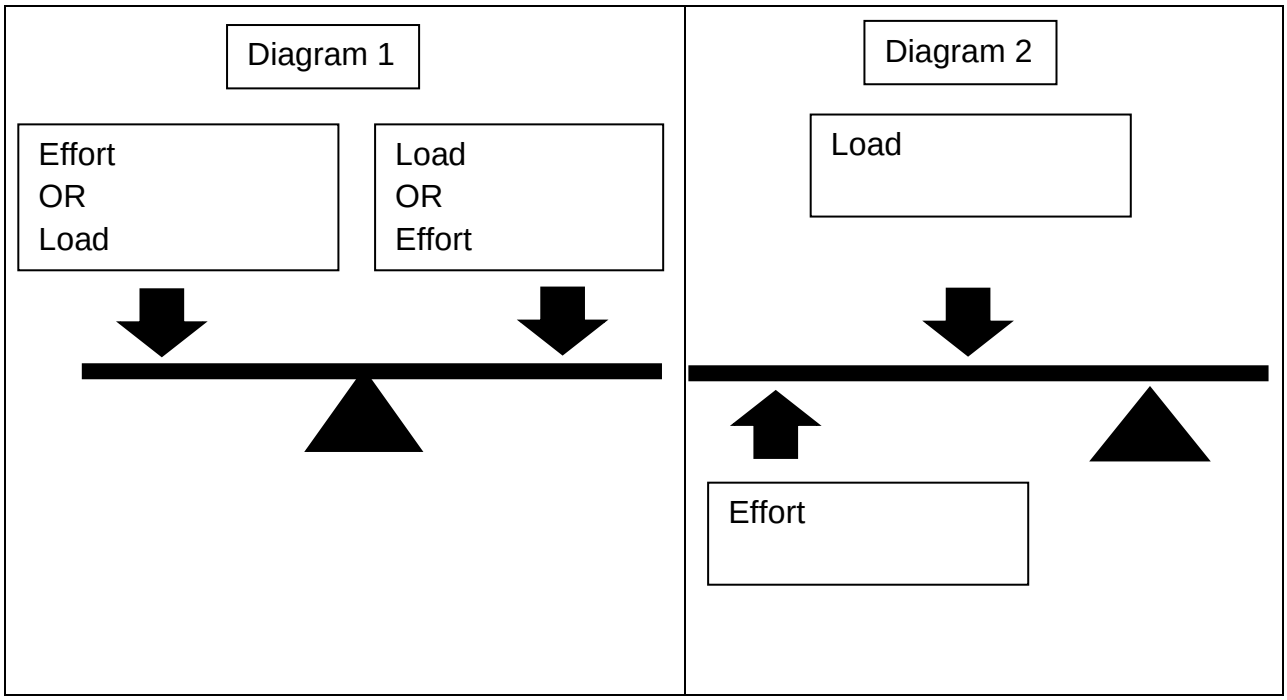
These 2 be any order

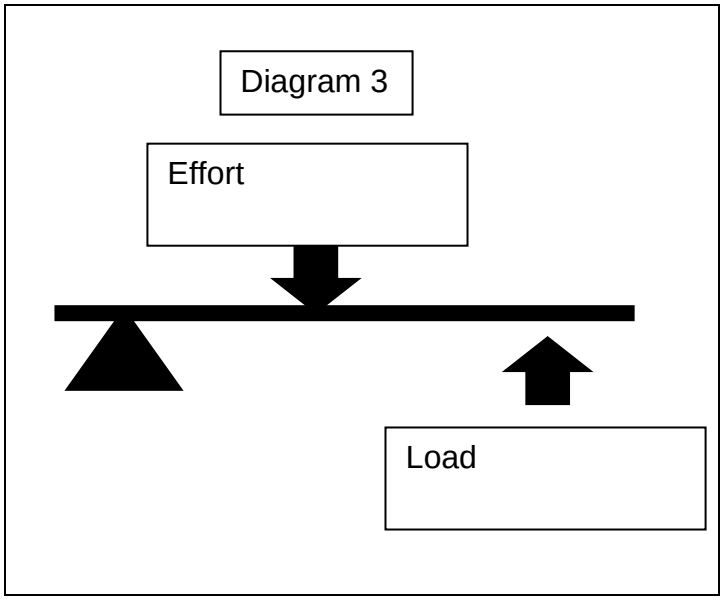
These can be in any order

A

A can also go under Aerobic

1.4 1.4.1





Diagrams 2 and 3 could have the labels reversed but then the answers must match with answers in Question 1.4.2.

1.4.2 (a) 1

(b) 3 or 2 (see bold note above)

(c) 2 or 3 (see bold note above)

1.4.3 A person doing a calf raise. Push-ups
Accept feasible.

1.4.4 The toes/toe joints. Toes

1.4.5 Gastrocnemius or Soleus. Triceps
If pupil says 'calf muscle' then they don't get a mark.

1.4.6 If using calf raises then the load is the body/ body weight
If using push-ups, then the load is also the body
The answer will depend on what exercise the learner provides.

QUESTION 2

2.1 Gastrocnemius

2.2 Accept any 3 of the following points:
- The onset of blood lactate accumulation (OBLA).
- Accumulation of Lactic Acid.
- As more and more lactic acid builds up/accumulates, the pH in the muscles decreases.
- As lactic acid builds up it affects the enzymes involved in glycolysis and causes fatigue and pain.
- Reduction in muscle and liver glycogen and blood glucose.
- No rest

2.3 Allocate 1 mark for each of the following facts:
By lying flat Sagan is reducing his frontal air resistance.
This will allow him to be more aerodynamic.
And therefore faster.

2.4 Answers must relate to cycling, if no mention of cycling or Sagan then can only get 2 marks per energy system.
Allocate 3 marks for the ATP/PC energy system.
Accept any 3 of the following facts:
- The 3 energy systems can be considered a continuum, with one, then the next and finally the third energy system being used to provide ATP/energy for exercise.
- At the start of the race, Sagan will use his ATP/PC system to start moving.
- The ATP/PC system will provide energy for about 10 seconds before it becomes depleted.
- It is during this time that the potential rate for power output is at its greatest.
- This system is important whenever Sagan picks up the pace or works harder – like climbing up a hill.
- Allows quick movements
- Has no by products
- Accept feasible.

Allocate 3 marks for the Lactic Acid energy system.

Accept any 3 of the following facts:
- This system kicks in after the ATP/PC system.
- It provides energy for cycling that lasts longer than 10 seconds but up to 2 minutes.
- A by-product is Lactic Acid.
- Lactic Acid limits Sagan and his performance.
- This system cannot supply energy for long periods of time.
- It provides energy to resynthesise ATP during the 1st 2–3 minutes of high intensity short duration anaerobic activity.
- If the athlete goes flat out to exhaustion, then the LA system will only last up to 30 seconds. BUT if the intensity is lower, then the athlete can exercise for longer (longer duration).
- This system is important whenever Sagan picks up the pace or works harder – like climbing up a hill.
- Accept feasible.

Allocate 3 marks for the Aerobic (Oxidative) energy system.
- Reaching the Aerobic system means that Sagan had to first use the other 2 systems.
- Sagan can only get into the Aerobic system when the heart and lungs are providing enough oxygen to working muscles to produce ATP aerobically.
- The aerobic system needs oxygen to burn the carbs and fats and there is no lactic acid build up, so there is no effect on performance.
- When cycling, the aerobic system is the primary power producer from standing still to the point that your cardiovascular system cannot utilise oxygen.
- Accept feasible.

2.5 Allocate 3 marks for ability to increase tolerance:
Repeated sessions of anaerobic training will overload the LA system and increase the body's tolerance to lactic acid.
Repeated sessions of anaerobic training will increase the body's stores of glycogen. This delays the effect of OBLA and prolongs the LA system threshold by delaying fatigue.
Accept feasible.

Allocate 1 mark for impact on performance:
This allows Sagan to work at higher intensities for longer periods.
It can also allow Sagan to carry out a higher percentage of repeated sprints before muscle fatigue occurs.
Accept feasible.

2.6 Allocate 1 mark for any 15 of the following facts:
Physiologically the body reacts to the amount of O_2 available.
Respiratory/Pulmonary ventilation:
breathing rate increases because the body is reacting to hypoxia (lower concentration of O_2 in arterial blood).
Even while at rest Sagan will be breathing faster.
Sagan could start to hyperventilate – this increases tidal volume *(the volume of air breathed in or out per breath).*

- Circulatory and cardiac
  The sympathetic nervous system releases hormones that alter cardiac function.
  Increase in heart rate for a few days
  No change in stroke volume

- Blood volume
  Within the 1st few hours of arrival at altitude, plasma volume begins to decrease.
  This is caused by respiration water loss.
  And increased urinary production.
  Initially the loss of plasma results in an increase in the hematocrit (the % of the blood volume consisting of red blood cells).
  Over a few weeks at altitude the reduced plasma will return to normal if the athlete drinks enough fluid.
  The body reacts by increasing cardiac output.
  During acclimatisation to altitude cardiac output decreases gradually and eventually return to close to 'normal'.
  RHR decreases gradually and eventually return to close to 'normal'.
  Blood pressure temporarily increases slightly

- Blood/tissue adaptations
  The blood increases the amount of erythrocyte and haemoglobin concentration.
  Hypoxia causes the kidneys to release the hormone EPO which produces more erythrocytes.
  Iron stores drop / anaemic

- Metabolic responses to altitude
  Altitude increases the basal metabolic rate.
  Appetite declines which also impacts food intake.

- Muscular structure adaptations
  Hypoxia stimulates capillary growth.
  There is an increased capillary network around the muscles.
  Therefore, there is better extraction of O2 from the blood.
  If Sagan stays at altitude for a long time there is a decrease in muscle fibre surface, i.e. fibre gets smaller.
  This could mean that the distance between the capillary blood and the centre of the muscle fibre is less = improved O2 diffusion into the muscle.
  This could mean that there is less muscle mass and therefore less force can be exerted = not so good for power cycling.

2.7 Accept any one of the following:
Live High, Train Low (LHTL).
Rest and sleep in a nitrogen tent.
Breathe through a nitrogen mask intermittently.
Rest and sleep in a personal barometric chamber.
Stay high and train hard with oxygen.
Live in a nitrogen house.

2.8 2.8.1 An athlete does not need lots of O_2 to throw a discus so it will be easier to throw because with less air resistance the projectile will fly further OR with less air resistance to 'push' against the discus the discus will travel further.

2.8.2 Thinner air means less air resistance so athletes who jump against air will perform better at high-altitude because there is less air to push against. They should jump further.

2.9 Allocate 1 for each sport listed
Any aerobic event, e.g. long distance running or cycling. Squash
Accept feasible.
Allocate 1 mark for each reason.
Thinner air means less oxygen, so the pace of hard endurance training and competition which depends on high rates of oxygen consumption gets slower at altitude. Aerobic events (where breathing is important like long distance running, cycling) will be negatively affected at altitude.
Fatigue quicker

Accept tennis and badminton if the reason is:
With thinner air, the ball/shuttlecock flies further. If the athlete does not use less power when hitting, then the ball or shuttlecock with go out of the court

QUESTION 3

3.1 Accept any 4 of the following facts:
Bad use of force summation:
Not using full body.
Only using the throwing arm and forearm.
Not using full range of motion.
By starting with hand in front of body, limited the force that can be produced.
Muscles not able to generate maximal force output.Accept feasible.

Better use of force summation:
Has transferred body weight forward a bit.
Use more body segments
Transfer forces from large muscles to smaller muscles
Accept feasible.

3.2 Accept any 2 of the following:
Use torso.
Bring frisbee closer to left shoulder to maximise range of motion.
Get power from legs.
Twist from waist.
Run up or take a big stride Start by using feet and legs (quadriceps and gastrocnemius).
Release of breath on throw
Follow through
Change the grip
Lean forward
Accept feasible.

3.3 Shortening the lever arm when bending the elbow allows the lever arm to generate force.
It allows quicker rotation.
The arm is then lengthened when the arm straightens/ longer lever
Having a racquet in the hand further lengthens the lever.
This maximises the speed at the end of the lever, i.e. the racquet.
This also increases the speed and force of the ball/ velocity
Increase distance between effort and joint

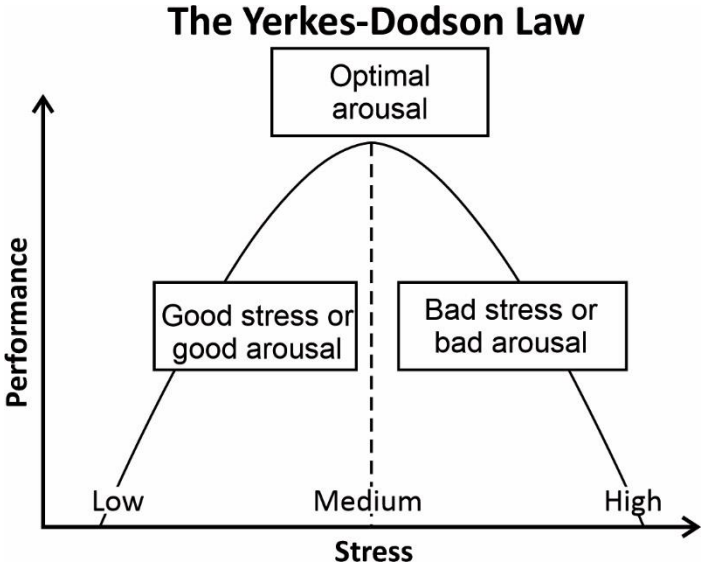
3.4 Shortening and lengthening the lever when moving plus doing this is in a co-ordinated way will ensure that force produced by each joint is not lost.

QUESTION 4

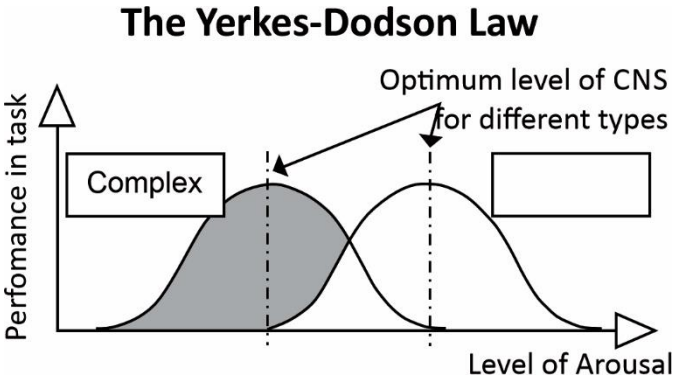
4.1 Complete the table below relating to arousal in sport.

Level of arousal	Example of sport or activity
Sports or activities needing higher arousal levels.	Example 1: Weightlifting; sprint running; rugby tackle, soccer Swimming, cycling, gymnastic vault (Large muscle group activities) Accept feasible Example 2:
Sports or activities needing lower arousal levels.	Example 1: Golf putt, target shooting, snooker, darts, archery, chess; ballet Accept feasible Example 2:

4.2 4.2.1

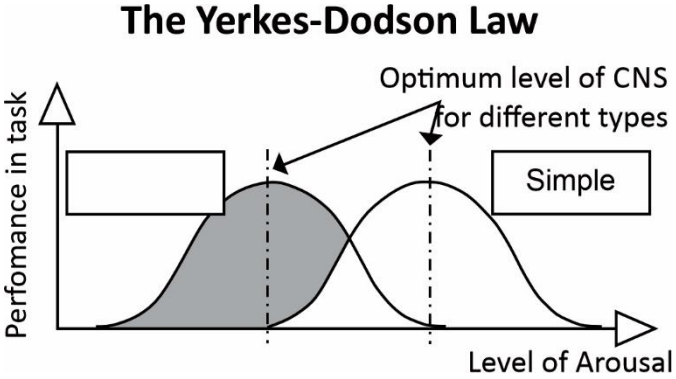


4.2.2



4.2.3 Allocate 1 mark for 1 example
Gymnast
Cricket
Tennis
Throwing discus
hockey
(high level of coordination and control needed)

4.2.4



4.2.5 Allocate 1 mark for 1 example
Dribbling a ball
Running
Swimming
Cycling
Accept feasible

4.2.6 Complex task:
requiring concentration – many sub-routines which must be performed in the correct sequence and at the right time OR They need to be aroused enough to perform well but not too aroused so that they lose focus.
Simple task requiring:
a fairly high level of aggression. They need to psych themselves up to a higher level in order to perform well.

4.2.7 Allocate 1 mark for method and 1 mark for explanation

Complex task:

- Athlete might listen to soft, calm music to keep them calm.
- Progressive Muscle Relaxation:
  This involves the deliberate contraction of muscles followed by a greater relaxation.
  - Self-Directed Relaxation:
    Relies on the athlete's ability to isolate and relax individual muscle groups.
  - Deep Breathing: This has calming effects on the mind as well as physiological effects such as reducing heart rate.
  - Positive self talk
  - Mental imagery/visualisation
  - Accept feasible

A complex task needs the athlete to have a clear mind and the ability to focus on finer details.

Simple task:

Allocate 1 mark for method and 1 mark for explanation.

Simple task:

- Athlete might listen to loud, fast music which gets the adrenaline flowing.
- High energy self-talk, e.g. 'I've got this!'
- Move around – jump up and down.
- High energy body language, e.g. Slapping your thighs.
- Intense breathing, do several hard exhales.
- Watch/listen to inspiring talks
- Accept feasible.

A simple task needs an 'aggressive' attitude, lots of energy needed.

4.3 Allocate 1 mark for explaining 'arousal'.
Arousal is a physiological state of preparation for an activity caused by anxiety.

Allocate 1 mark for explaining impact of arousal on performance.
Is often linked to good performance.
Over arousal will have a negative effect on performance.

Allocate 1 mark for explaining 'anxiety'.
Anxiety characterised by nervousness, fear and apprehension.

Allocate 1 mark for explaining impact of anxiety on performance.
Performance drops.

QUESTION 5

5.1 An athlete eats 50%/half carbohydrates compared to the 25% /quarter consumed by non-athletes.
Main food is carbohydrates
OR
An athlete eats 50% / half carbohydrates while a non-athlete eats 50%/half fruit and vegetables.
Main food is fruit and vegetables

5.2 Allocate 1 mark for commenting on the athlete.
Allocate 1 mark for commentating on the non-athlete.
Accept any one of the following responses:
Athletes need more carbohydrates as they need more energy whereas a non-athlete doesn't require as much energy.
Carbohydrates delay fatigue for the athlete. The non-athlete will not be fatigued as they are not being active.
Carbohydrates are regarded as the main source of fuel for energy needed by an active athlete. Non-athletes do not need as much fuel as they are not being active.

5.3 Ketogenic diet / Keto

5.4 30 minutes – 35 minutes

5.5 Allocate 2 marks to softball/baseball and 2 marks to swimmers.
Softball and baseball players need to focus on strength and power so they need more protein to build up their muscle.
A softball/baseball game involves stop-and-start activities and is not as physically taxing.

Swimmers need to eat more calories due to the intensity of the workouts.
They would need a very high carbohydrate, high energy and high calorie diet.
The swimmer is moving all the time at a constant speed.
Accept feasible

5.6 Allocate 1 mark per response
How big you are/athlete's size/weight
How much muscle you have
The type of exercise /energy expenditure/intensity/sport played
Gender
Age
If athlete is trying at lose or gain weight

5.7 ¼ OR 25% fourth

5.8 Allocate 1 mark for any 5 of the following facts:
- Pre-hydration is the period leading up to an event.
- A healthy person will consume approximately 1,8 litres of fluids daily. An athlete may adjust this as the event approaches.
- Hydration means consuming fluid during the competition, using either water or sport drinks with electrolytes or carbohydrate elements.
- Rehydration is just as important to return fluids to their optimal levels.

- For optimal performance, the water and electrolyte contents should remain as constant as possible therefore it is important to drink fluids.
- Don't drink too much otherwise will suffer from hyponatremia.
- Energy drinks or sports drinks are specially formulated/designed to help people rehydrate during or after exercise.
- Drink an isotonic drink – when the demand for fluid is high AND the demand for carbs is also high.
- Drink a Hypotonic drink as it will quickly replace fluids lost by sweating. Hypertonic drinks are suitable as a recovery drink post-activity, after intense or sustained exercise or before an event.
- 500ml 2–3 hours before
- 240ml 30 minutes before

Accept feasible

5.9 There are many top elite athletes who are vegetarian.
e.g., Lewis Hamilton, Serena Williams, Venus Williams, Alex Morgan, Novak Djokovic.

QUESTION 6

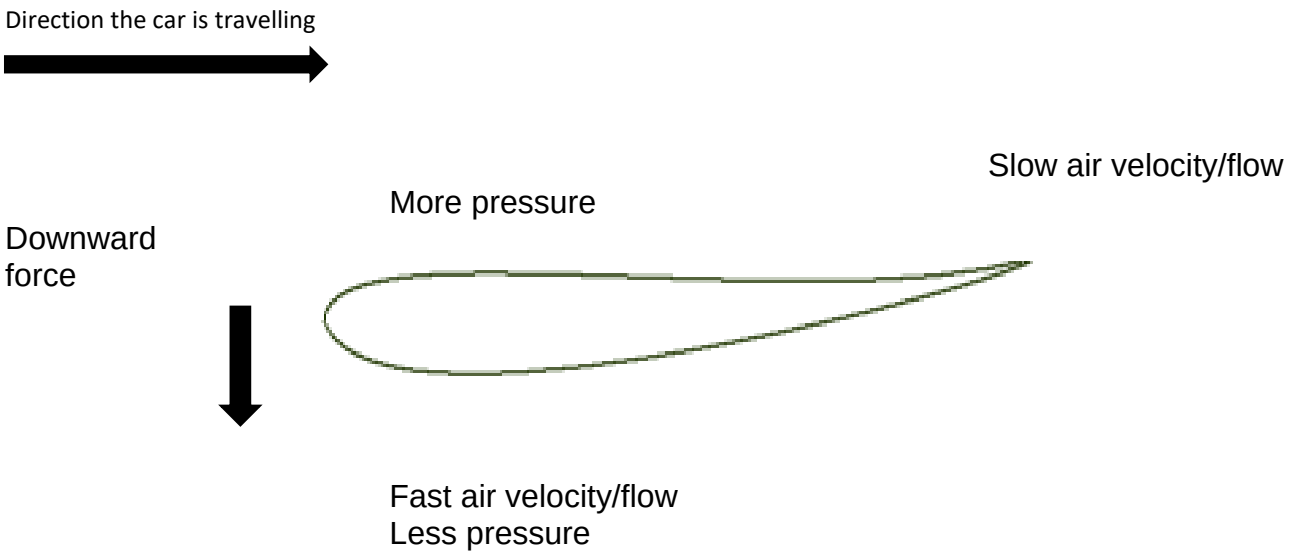
6.1

Number of Newton's Law	Action	Description
6.1.1 1st	C	iii
6.1.2 2nd	A	ii
6.1.2 3rd	B	i

6.2 6.2.1 Allocate 1 mark for each of the following facts:

- The cars have rear spoilers/wings fitted and these are angled so that the lift force acts in a downward direction.
- Air flows quicker under the rear wing.
- This means there is less/low pressure underneath.
- Air flows slower on top of the rear wing.
- This means there is more/high pressure on top.
- This allows the car to 'stick' to the track OR Motor racing uses downward lift force.
- Air flows through the car

6.2.2



6.2.3 Allocate 1 mark for any 5 of the following facts.

- The covers heat the tyres.
- When the race starts the tyres are the perfect temperature to grip the road.
- To get the tyres up to optimum operating temperature.
- The tyre becomes 'stickier' as opposed to smooth and slippery.
- Heating allows the rubber to provide superior grip on the tar which allows better performance.
- Friction provides the force to accelerate, stop or change the direction of the car.
- Warm tyres also keep the tyre pressure at the correct level.
- The higher the pressure meaning the car will be slightly raised and stiffer to drive.

QUESTION 7

7.1 I

7.2 H

7.3 Allocate 2 marks per bullet until 10 marks are reached.

There MUST be a comparison OTHERWISE ONLY 5 marks awarded

- Golgi tendons attach where the tendon attaches to a muscle fibre (where muscles and tendons join) whereas muscle spindles are found in the muscle bed.
- There can be about 5–25 muscle fibres connected with each Golgi tendon organ but muscle spindles are made up of about 3–10 small muscle fibres (called intrafusal fibres).
- The Golgi tendon organs (GTOs) are found inside a small capsule through which a small bundle of tendon fibres pass whereas muscle spindles are made up of specialised muscle fibres that lie parallel to the regular muscle tissue and are encased in a sheath of connective tissue.
- Golgi tendon senses tension but a muscle spindle detects change in muscle length as well as the velocity/speed of the lengthening.
- Golgi tendon reduces the amount of force/inhibits tension in the activated muscle while the muscle spindle can stop the muscle from lengthening (stretching) too much and too fast.
- Golgi tendon gives feedback to the CNS about the amount of force a muscle is producing and the muscle spindle helps the nervous system know how joint angles are changing and where the different body parts are located.
- Golgi tendon is a sense organ that receives information from the tendon while muscle fibres contract, ends of the muscle spindle come close together, stimulating the sensory / afferent nerves which then passes on electrical impulses to the CNS.

7.4 Allocate 2 marks for the Golgi tendon organ.
Golgi tendon – If a muscle produces too much force & there is a risk of injury, the CNS sends an electrical impulse/signal back to the muscle so it will stop contracting & will relax.
Can have negative impact if the impulse 'kicks' in too quickly. Causes 'muscle quiver' in weight lifting
Allocate 2 marks for the muscle spindle.
Muscle spindle – When you stretch and feel that you are at the endpoint of your stretch, the message the spindle is sending is a reflex arc signal telling you not to stretch any further.
Muscle spindles also help protect the muscle from injury due to the muscle lengthening too much and too fast.

Characteristic	Golgi tendon organ	Muscle spindle
Location	In tendons where a muscle 'joins' a bone	Interspersed among muscle fibres
Stimulus	Increase in muscle tension	Increase in muscle length and the speed of the stretch
Response	Inhibits tension in stretched muscle Initiates tension in antagonist muscle	Inhibits tension in antagonist muscle Initiates rapid, reflex contraction of stretched muscle
Overall effect	Promotes relaxation in a muscle developing tension	Inhibits stretch in a muscle being stretched

QUESTION 8

Examine the information provided in the Source Material Booklet. Use it to write an essay of 1–1½ pages on the following topic:

The quality and quantity of resources available to disabled people will affect their participation in physical activity and the likely success of competitive athletes.

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 and Exercise Science knowledge.
- Use real-life examples where applicable.
- Make use of the rubric to shape your response.

ESSAY RUBRIC

	0 marks	**1 mark**	**2 marks**	**3 marks**	**4 marks**	**Possible mark (20)**
Decision	No decision made	Decision clearly stated	Decision clearly stated and supported by essay			2
Reference made to sources	No reference to sources	Reference made to half the sources	All sources referred to			2
Use of sources	Sources not expanded on at all	Attempt at expanding on one or more sources		Sources expanded on but not well integrated	Source expanded on AND well integrated	4
Content relevance and quality of discussion × 2	No content relevance Missed the point	Little content relevance or linkage of thought evident	Some content relevance but not well integrated into discussion	Most information is relevant and integrated into discussion	All information is relevant and well integrated into the discussion Flow is logical	8
Use of own knowledge	No own knowledge provided	Few facts and information given beyond the sources	Some facts and information given beyond the sources	Some facts and information given beyond the sources AND integrated into the discussion	Many facts and information given beyond the sources AND integrated into the discussion	4

Total: 200 marks