NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2021

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 G

1.1.3 D

1.1.4 F

1.1.5 E

1.1.6 A

1.1.7 B

1.2 1.2.1 A

1.2.2 C

1.2.3 B

1.3

	ATP/PC system	Lactic Acid system	Aerobic system
Source of fuel	• Creatine phosphate • Phospho creatine	• Carbohydrates • Glycogen	Carbohydrates • Fats • Proteins
Duration	• 0 – 10 seconds	With high intensity exercise – • 10 – 180 seconds OR 2-3 minutes With maximal exercise – • 30 seconds	• Longer than 45 seconds OR Unlimited depending on intensity OR 3 min – 1 hr OR 60 – 120 seconds OR More than 2minutes
Byproducts	• none	• Lactic acid	• water • Carbon dioxide / CO_2

1.4

Picture A

Picture B

1.5 1.5.1 (a) The more weight it has

1.5.2 (b) The more drag it is exposed to

1.5.3 (a) Reduce the front area

QUESTION 2

2.1 2.1.1 Accept any one of the following:
Archery
Shooting
Darts
Snooker
Golf
Accept feasible

2.1.2 Accept any one of the following:
Soccer/football
Hockey
Netball
Rugby
Basketball
Cricket
Accept feasible

2.2 Allocate 1 mark for any 3 of the following examples:

- When an opponent is trying to prevent the player from getting free in order to receive a pass it places the athlete under pressure.
- When an opponent is trying to prevent the player from passing the ball to a teammate it places the athlete under pressure.
- When an opponent is trying to prevent the player from scoring a goal it places the athlete under pressure.
- When an opponent is marking/defending the athlete very closely so that they can't get free to receive a pass, it places them under pressure.
- Opponent trying to score and player needs to defend

2.3 **Athlete A:**

Allocate 1 mark for any 5 of the following:

- Athlete needs to understand his/her own responses to stress and be sensitive to their body's signals, i.e. self-awareness.
- Use concentration/focusing skills and mental rehearsal to manage anxiety. The sport the athlete is involved in requires them to be calm so they must manage their anxiety.
- Focusing will enable the athlete to attend to relevant cues of their sport.
- To assist with maintaining optimal arousal, the athlete needs cues to help them focus at the appropriate time.
- This could be a word or phrase that the athlete repeats to themselves at a certain time to refocus.
- A word/phrase will trigger their focus onto the task at hand.
- Set routines will also allow focus. Routine breeds familiarity and helps manage anxiety.
- Deep breathing.
- The crowd are kept quiet so the athlete doesn't need any training regarding this distraction.

- Environmental factors could negatively affect performance, e.g. wind picking up or wind changing direction as this could affect focus and concentration, so the ability to refocus is essential.
- Mental rehearsal will allow athlete A to manage anxiety as it has a calming effect.
- Their ability to focus their attention is severely hampered if arousal levels increase. Perceptual narrowing could result.
- Could refer to coach to get advice, feedback, reassurance (depending on the sport).
- Individual goal setting will motivate.
- Positive self talk will influence feelings, anxiety and influence actions.
- Visualisation will help reduce anxiety.
- Elite athletes use visualisation exercises combined with positive thinking to rehearse their performances.
- Mental imagery/rehearsal helps improve concentration and develops confidence.

Accept feasible

Athlete B:

Allocate 1 mark for any 5 of the following:

- Concentration and focus is also needed and they will also use cues and set routines.

But they will use a strategy to minimise distractions like loud music and spectators.

- They need to focus on teammates and opponents and not be distracted by noise.
- Train to remove distractions e.g. rent a crowd and learn to shut out the noise and crowd movement. Distraction will negatively affect performance of the athlete and the team.
- Use mental rehearsal to manage anxiety.
- During the game the opportunity for mental rehearsal will be limited.
- Team goal setting will motivate all players and help maintain focus.
- Deep breathing
- visualisation

Accept feasible

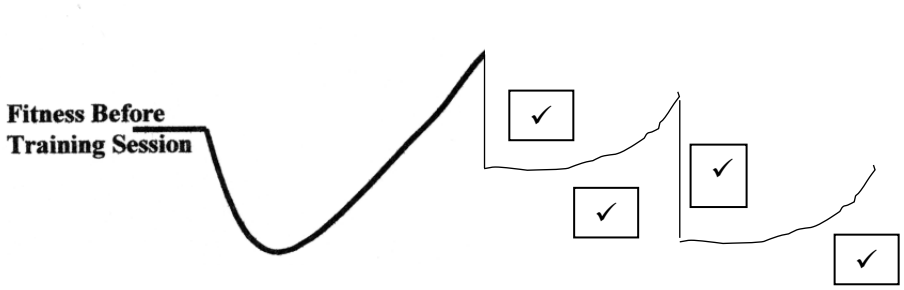
2.4 2.4.1 90

2.4.2 The untrained man's heart is smaller. Or smaller cardiac muscle
Each contraction pushes out less blood than the trained athlete.

2.4.3 The trained athlete's heart has become bigger / stronger / hypertrophied.
Over 1 minute (which is cardiac output) a trained heart will pump more blood.
They MUST mention 1 minute to get the 2nd mark.

2.5 2.5.1 Optimal training – **B**
Under training or incorrect overload – **A**

2.5.2



Allocate 1 mark for the first line going down
Allocate 1 mark for the first curve going upwards
Allocate 1 mark for the second line going down
Allocate 1 mark for the second curve going upwards
Allocate 1 mark for the final point being lower than initial fitness level

2.5.3 Overtraining

QUESTION 3

3.1 3.1.1 28 hours and 30 minutes

3.1.2 Accept any 3 of the following factors:
Shark attack
A barracuda
Jellyfish stings
Attack by 2 seagulls
Small fish eating his skin

3.1.3 Constant movement to stay above the water means that the water close to the skin carries the heat away or causes convection.

3.1.4 Hypothermia

3.1.5 Accept any 6 of the following facts
- Blood vessels at the skin surface narrow/constrict cutting off/reducing blood flow.
- Deeper blood vessels widen/dilate to carry blood away from the skin.
- Vasoconstriction – blood vessels temporarily narrow.
- Vasodilation – blood vessels widen.
- Redistribution of blood
- Sphincters

3.1.6 **Picture A** – Vasodilation
Picture B – Vasoconstriction

3.2 3.2.1 glycogen

3.2.2 Accept any 3 appropriate side effects such as:
Headache
Fatigue
Increased chance of injury
Aching muscles
Energy levels drop
Nausea
Decreased metabolic rate
Depletion of energy stores
Weak

3.3 3.3.1 Mental strength / a strong mind

3.3.2 Heart rate increases
Blood pressure rises
Skin responses
Biochemical release
Tensing of muscles
Increased cardiac output
Increased breathing/hyperventilation
Brain disfunction/confusion

3.3.3 Allocate 2 marks per reaction.
Heart rate increasing
This will allow oxygenated blood to circulate faster to the muscles to tread water.

Blood pressure rising/increasing
It forces heart to work harder to pump blood out to the body.
If too high – could cause headaches, chest pains, difficulty breathing, nosebleed.

Biochemical release
Cortisol or adrenaline or epinephrine
Increases heart rate
Increases blood pressure
Opens airways to lungs
Have more energy / burst of energy
Redistributes blood to muscles

Skin response won't impact on Brett's performance.

Tense muscles
Poor coordination

Breathing increases
Could hyperventilate

QUESTION 4

	Kiara's daily schedule
12 – 6:30am	Sleep
7:00	Breakfast, get ready for school
7:30	Walk to school
7:45	Time with class teacher
8:00	Lessons start
10:00	Morning tea
10:15	Lessons resume
12:15	Lunch, 10 min game of soccer
13:00	Lessons resume
14:30	Walk home
14:45	Play computer games
16:00	Watch TV
18:00	Supper
18:30	Homework
20:00	Shower
20:30	Watch TV
23:00	Sleep

	Megan's daily schedule
12 – 5am	Sleep
5:30	5km jog, then shower
6:30	Breakfast, get ready for school
7:00	Cycle to school
7:45	Time with class teacher
8:00	Lessons start
10:00	Morning tea
10:15	Lessons resume
12:15	Lunch, 30 min game of basketball
13:00	Lessons resume
14:30	Water polo practice
16:00	Cycle home
17:00	Play touch rugby with friends in garden
18:00	Recreational swim in home pool
18:30	Shower and supper
19:00	Homework
21:30	Sleep

4.1 Walk to and from school
Soccer

4.2 35–40 minutes
15 min walk to school; 10 min soccer; 15 min walk home

4.3 Accept any 3 of the following:
Join sports team at school
Watch less TV
Play less computer games
Go for a run
Play a sport for longer at lunch time
Take longer route to school
Jog to school instead of walking

4.4 If reason not feasible, then no mark for yes or no
Yes
she is playing a lot of sport in 1 day
There is an imbalance between stress and rest

OR

No
There is adequate rest between each activity

Progressively overloading the body stimulates bone growth and strengthens the ligaments and tendons / Repeated days of training can be considered a positive 'stress' because the adaptations caused by training improve the body's ability to deliver O_2, produce energy and contract muscles.

4.5 Megan
Accept any 4 of the following:
She exercises more
which means that she has a bigger and stronger heart.
A stronger heart can pump out more blood with each contraction.
This means that the heart doesn't need to beat as often which results in a lower resting heart rate.
Frank Starling mechanism.

4.6

Accept any 15 of the following facts BUT all 3 systems must be referred to:

The cardiovascular system

- Responds to increased demands of exercise.
- The response to exercise is directly proportional to the muscles' oxygen demands and oxygen uptake.
- Megan's form of exercise (aerobic exercise) gets her heart rate elevated so that oxygenated blood can be pumped to the muscles.
- She is fit therefore has a higher VO_2 max values.
- She can exercise more intensely than Kiara who is not as well conditioned.
- Her heart has adapted by becoming bigger and stronger.
- The cardiac muscle that surrounds the heart hypertrophies, resulting in thicker, stronger walls and therefore increases in heart volume.
- The area that changes the most is the left ventricle – the part that pumps the blood to the body. A bigger and stronger heart can pump more blood per beat.
- A larger stroke volume allows the heart to pump slower.
- Cardiac output (Q) increases to supply the increased demand for O_2 from her working muscles.
- Decreased Resting Heart Rate.
- More red blood cells which improves her body's ability to transport oxygen to the muscles.
- Arterial walls become more elastic. This allows the arteries to tolerate changes in blood pressure.
- More capillaries develop in the muscles and around the heart and lungs. This allows more efficient gaseous exchange of Oxygen and Carbon Dioxide.
- Hypertrophy
- Increased Stroke Volume
- A more efficient and healthy heart – bradycardia

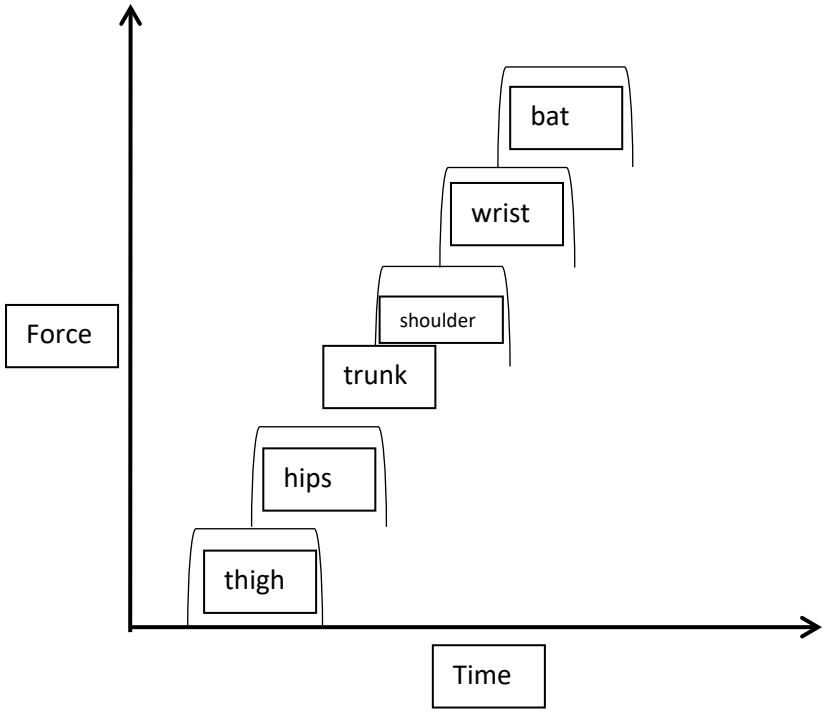
The respiratory system

- Responds when challenged with the stress of exercise.
- Pulmonary ventilation increases almost immediately.
- Increases in CO_2 production, increases in body and blood temperatures causes further increases in pulmonary ventilation.
- At higher intensities, the respiratory rate also increases.
- Lungs (capacity/volume) increase their ability to expand enabling a greater quantity of air to move in and out.
- The strength and endurance of the diaphragm and intercostal muscles improves.
- More capillaries are formed in the lungs over time allowing more blood to flow in and out of the lungs.
- This improves the uptake of oxygen as there is a greater surface area for blood to bind with haemoglobin.
- The numbers of alveoli in the lungs increase to enable more gas exchange to occur.
- The exchange of oxygen and carbon dioxide improves / gaseous exchange
- Aerobic fitness training tends to improve the efficiency of the body's tissues at absorbing O_2 and removing CO_2.
- Increase in the amount of air taken in with each breath.

Musculo-skeletal system

- Muscles will adapt to a new workload and should grow stronger.
- Slow twitch muscle fibres will increase in size.
- There are more and bigger mitochondria.
- Tendons thicken which means they can withstand greater muscular force.
- Muscles also become more flexible and can contract with greater force.
- Muscles can store more glycogen.
- The amount of myoglobin within skeletal muscle increases.
- The muscles, bones and ligaments become stronger to cope with the additional stresses and impact put through them.
- More synovial fluid will be produced.
- Synovial fluid becomes less viscous.
- Range of Motion / Movement will increase.
- Increase in the uptake of minerals in the bones.
- Bone mineral density increases.

QUESTION 5



Allocate 1 mark for each axis being correctly labelled (2 marks)
Allocate 1 mark for each body part in the correct order (6 marks)
Allocate 1 mark for each segment being accurately placed (5 marks)

[13]

QUESTION 6

6.1 6.1.1 Accept any 4 of the following facts:

- As the diver presses down on the board = action force
- The board pushes back on the diver's feet = reaction force
- This propels the diver upwards into the air.
- The diver will keep his centre of gravity over his feet / base of support while doing the hurdle step.
- Arms will swing forward and upwards creating some air resistance.
- As the arms swing upwards and over the head – this will raise the centre of gravity slightly.
- Forward momentum is converted into upward momentum.

Accept any other feasible facts.

6.1.2 Accept any 4 of the following facts:

- Diver tucks limbs in towards the bellybutton / Centre of Gravity.
- The tuck increases the rotation of the body.
- The tuck decreases the air resistance.
- Angular momentum / rotational momentum results.
- By pulling legs and arms closer to the point of rotation, the moment of inertia decreases and the angular velocity increases.

- A tighter tuck means a faster rotation.
- As the body changes shape so the position of the centre of gravity will shift.
- Centre of gravity could be found in the gap caused by the tucked position if it isn't a tight tuck, i.e. centre of gravity is outside the body.

Accept any other feasible facts.

6.1.3 Accept any 4 of the following facts:

- Diver points toes and straightens legs to get a clean water entry with as little water resistance as possible.
- Aim is to get the whole body through the hole made by the hands to get as little water displacement / water resistance as possible.
- Diver straightens body – limbs move further away from centre of gravity. This decreases rotation and slows diver down.
- As the body changes shape so the position of the centre of gravity will shift.
- By opening the body there is greater air resistance.

Accept any other feasible facts.

6.2 Newton's First Law: 'a body continues at a state of rest or uniform velocity unless acted upon by an external force'
OR
'an object will remain at rest or in uniform motion in a straight line unless acted upon by an external force'

Application of law:
When the diver is standing on the board preparing to jump, they are at rest. No motion occurs because the forces are balanced. If the diver stands quietly on the board, all the forces and the board are balanced so neither the diver nor the board move.

Newton's Second Law:
Newton's Second Law – '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.

Application of law:
The force applied to the diving board is equivalent to the mass of the diver multiplied by the diver's acceleration. The board pushes up on the diver, this gives the force, and propels the diver to accelerate into the air.
The acceleration of the diver is proportional to the force acting on the board.

6.3 Allocate 1 mark per thought process.
Possible responses are:

- Get into a relaxed state of mind.
- Use clear images using the senses, e.g. hear the crowds, feel the water.
- Focus on parts of performance that need improvement, e.g. body position when entering the water.
- See yourself performing skills perfectly.
- See yourself coping with a challenge in a positive way, e.g. distracted while doing hurdle step.

6.4 There must be a comparison otherwise no more than half marks can be awarded.

Rugby players need a high percentage of carbohydrates.
Similarly, a diver also needs carbohydrates but possibly not as much as a rugby player.
Allocate 1 mark for the reason:
A rugby match lasts at least 90 minutes while a dive lasts a few seconds but during a competition they will perform more than 10 dives over several hours.

A rugby player should eat a lot of wholegrain carbohydrates – cereal, breads, fruit, dairy as well as potato, pasta. However, a diver needs to watch their weight so they will eat specially selected carbohydrates.
Allocate 1 mark for the reason:
Both athletes – To fuel muscles and help with muscle growth but diver will be more selective in what they eat to ensure no weight gain.

Rugby player – Protein rich foods, e.g. lean meat, chicken, fish, eggs whereas the diver will eat lean protein.
Allocate 1 mark for the reason:
To help with muscle growth and muscle repair.

Rugby player needs healthy fats – unsaturated fats like oily fish, avocado, nuts, olive oil. The diver also needs healthy fats but will eat less and be more selective.
Allocate 1 mark for the reason:
Fats provide energy for both but could lead to an increase in weight in the diver / the diver needs to remain light so they need to avoid very fatty foods.

Both need to eat fruit and vegetables.
Allocate 1 mark for the reason:
They provide antioxidants and fibre for immune health.

The following answers could also be accepted:
Rugby players (forwards) need to be heavy and strong because of their involvement in scrums and tackles whereas a diver needs to be small, lean, flexible, well-muscled and strong.
Both athletes need to ensure that they drink more fluids when eating carbs.

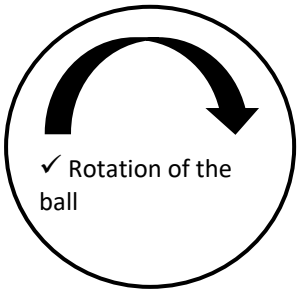
Also accept reference to pre-competition:
A diver is doing twists and somersaults, so stomach comfort is important. They need foods that are light and easy to digest, (avoid spicy foods) while a rugby player would eat enough carbs as well as some protein to sustain him throughout the match. Both would eat 3–4 hours ahead of time. A rugby player would only be able to eat at half time or drink something when there is a long break in play. Whereas a diver can eat and drink during the course of the day long competition.

QUESTION 7

Top spin

Direction the ball is travelling

✓ high air pressure
✓ slow/low velocity. Slow/low air speed

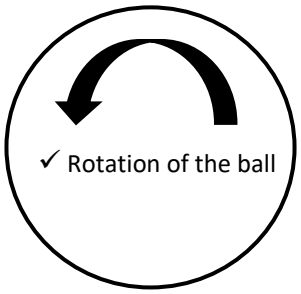


✓ low air pressure
✓ fast/high velocity. Fast/high air speed

Back spin

Direction the ball is travelling

✓ low air pressure
✓ fast/high velocity. Fast/high air speed



✓ high air pressure
✓ slow/low velocity. Slow/low air speed

QUESTION 8

ESSAY RUBRIC

	0 mark	1 mark	2 marks	3 marks	4 marks	Possible mark (20)
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. No examples provided.	Some vital information missing OR Many irrelevant facts OR Errors affecting the quality of the essay. No examples provided or examples are not integrated into the discussion.	Sufficient facts provided. Most information is relevant, appropriate and accurate. Real-life examples integrated into the discussion.	Content is detailed. All information is relevant, appropriate and accurate. Real–life examples integrated into the discussion.	8
Use of own knowledge/ experience X 2	No own knowledge provided.	Very few facts and little information provided from own knowledge/ experience.	Includes some facts and information from own knowledge / experience but not integrated well into the discussion (add on).	Some facts and information from own knowledge / experience integrated into the discussion.	Many facts and much information from own knowledge / experience integrated into the discussion.	8
Quality of discussion	The discussion is meaningless.	Flawed in all respects.	Flawed in 2 respects.	Flawed in one respect.	Discussion is consistently focussed, clear and concise (not longwinded or rambling or repetitious). Flow is logical.	4

Some possible examples.

A person's approach to health and physical activity will vary depending on a number of individual differences, which in turn influences the choice and amount of involvement.

Gender

A person may be discouraged from certain sports because they don't fit traditional stereotypes, e.g. a girl playing rugby may be seen as 'unfeminine' due to the strong male traditions in the sport.

Culture
Tendency to adopt attitudes and behaviour of a culture to reflect their cultural identity, e.g. often people from South America (e.g. Brazil) enjoy soccer.

Peer
Peers can motivate others by joining them, checking progress and encouraging them to improve. Peers can also discourage others from participating by ridiculing.

Family environment
This is important in determining a person's attitude towards health and activity.
Family's offer support, role models and contacts.

Finance and Income
Money is needed for membership fees as well as products (equipment, health drinks, etc). Finances can limit access to some activities which can lead to them being excluded and feeling rejected. Wealthier people have more choice. Low-income workers tend to take part in less structured activities. This is because they have a high level of physical activity in their jobs and feel they don't need to exercise more.

Education
This will affect people's attitudes towards health and activity. Those who are highly educated are more likely to recognise the importance of health and physical activity and also have a better understanding of the following factors:

- Knowledge of how to perform safe and effective exercise that targets specific physical activity needs (e.g. recovering from injury)
- Accessing health and physical activity resources (e.g. knowing when to seek specialist advice – like get a coach to improve technique)
- Awareness of the health benefits of exercise and dangers of leading an inactive lifestyle
- Nutrition and other lifestyle factors that contribute to overall health (e.g. dangers of smoking and drugs) and there are even societal influences affecting your health. Some of these factors are controlled by the government so it isn't possible to have total control over our health. These factors can contribute to people's sickness and disease.

Pollution
Emissions from factories and vehicles cause respiratory diseases, cancer and serious illnesses.

Recreational facilities
Increased population causes overcrowding and lack of affordable facilities.

Crime
Inadequate security and lighting and fear of using public facilities due to theft and assault discourages people from being active.

Overcrowding
Congestion on roads has increased the difficulty of using transportation around cities. This also discourages people from walking or cycling, because of concerns for safety.

There is an acronym to remember the various sociological influences relating to participation and development → SPEECH

S – **S**ocietal influences from the community, including norms and behaviour expected by the media, government and education.

P – **P**olitical influences. The amount of funding will also impact.

E – **E**conomic influences. Physical geography and people's surroundings including population density, safety and accessibility.

E – **E**thical influences. These are principles that define 'right' and 'wrong' behaviour. This also includes issues relating to equity and disability.

C – **C**ultural influences are the values, beliefs and practices of a group of people, passed from one generation to the next.

H – **H**istoric influences are background issues, traditions and previous experiences. These are also closely linked to cultural influences.

Other factors not provided in sources:

Physical Attributes
This will determine how easy a person finds it to lead and maintain an active lifestyle, e.g. someone with good hand-eye coordination will find racket sports easier to perform.

Body Shape
This can affect the way a person feels about themselves and how they think others perceive them, e.g. a person who has a slender body will probably not be self-conscious when swimming).

Age
Determines amount of time, money and influences a person is exposed to, e.g. a person in their 30's may be 'busy' raising a family and this will restrict their involvement.

Previous experience
Many say that they are influenced by lack of encouragement or are discouraged when participating. People who are encouraged and supported are most likely to continue. Those who experience ridicule or harassment will probably develop a negative attitude. So it is important to support individuals so that they continue to participate.

Access to healthcare
Closure of rural hospitals, over-worked doctors and nurses and increasing costs of healthcare.

Advertising
Media are filled with the advertising of products detrimental to health (e.g. fast foods and alcohol)

Total: 200 marks