Biomechanics and Sports

1. Identify the factor which decreases equilibrium. (2024)

(a) Larger base

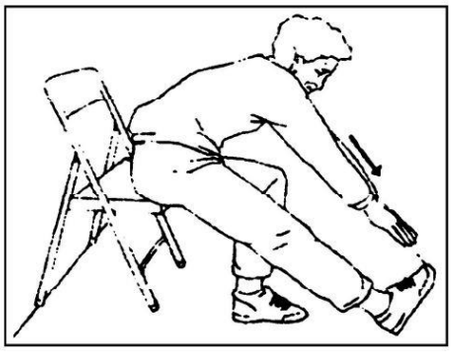
(b) Greater weight

(c) Lower centre of gravity

(d) Higher centre of gravity

Ans. (d) Higher centre of gravity

2. Which functional fitness component of senior citizens is determined in the test shown below? (2024)



(a) Physical Mobility

(b) Upper Body Flexibility

(c) Lower Body Flexibility

(d) Upper Body Strength

Ans. (c) Lower Body Flexibility

3. Which of the following test determines the upper body strength of a senior citizen? (2024)

(a) Chair Stand Test

(b) Back Scratch Test

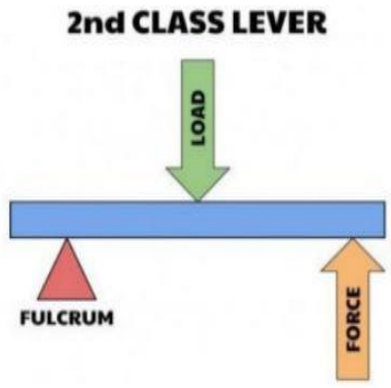
(c) Arm-Curl Test

(d) Chair sit and Reach test

Ans. (c) Arm-Curl Test

4. Describe the second class lever with suitable example from sports. (2024)

Ans. Second Class lever: It has the load resistance between the fulcrum and the force. So, there is always mechanical advantage as force arm is always greater than resistance arm.



Example: Full body push up/Wheel barrow/ wall climbing/ taking off for a jump/pushing against starting blocks in sprints

5. Mention any two types of friction by giving suitable examples from sports. (2024)

Ans. Types of Friction:

Static friction: Weightlifting, Holding the parallel bar

Sliding friction: Ice hockey, ice skating,

Rolling friction: Rolling of the football, cricket ball, tennis ball

Air friction: Riding a bicycle, skydiving

Water friction: Swimming in water, diving

6. What is Balanced Diet? What is the significance of pre and post competition meals for an athlete? Explain. (2024)

Ans. A Balanced diet consists of all the essential food elements i.e. Proteins, Carbohydrates, Vitamins, Fats, minerals and water in correct proportion.

OR

A Balanced diet contains an adequate amount of all the nutrients required by the body to grow, remain healthy and be disease free.

Importance of pre competition meals for an athlete

1. The focus is to fuel up muscle glycogen stores to provide /obtain energy. Therefore, meal should have moderate proteins, low fat, low fibre and high carbohydrate containing food.

2. Proper hydration is must to control fatigue, hunger.

3. It should be light to provide athlete a comfortable gastro intentional state for sports performance.

4. Pre competitive meal should be taken about 2-4 hour before competition.

5. New food/food with known allergies should be avoided.

Importance of post competition meals for an athlete

1. The main focus is on recovery of body and reduce chances of injury.

2. Fluids lost during competition have to be replenished.

3. Carbohydrates store i.e. muscle glycogen have to be refilled.

4. Electrolytes i.e. sodium, potassium chloride lost during competition have to be recovered.

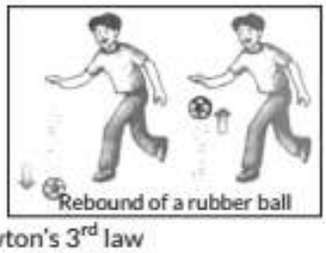
5. Within two hour of completion of event a balanced meal including carbohydrates and good quality proteins should be eaten by the athlete.

8.1 Newton's Law of Motion and its Application in Sports

MCQ

1. Mechanical analysis of Javelin thrown by Neeraj Chopra will be done under
   (a) Biology (b) Biomechanics
   (c) Physiology (d) Anatomy.
   (Term-I, 2021-22)

2. Which Netwton's law of motion is depicted through the picture?


Rebound of a rubber ball

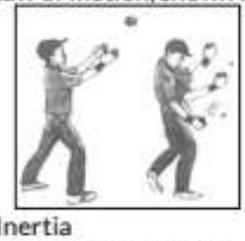
   (a) Newton's 3rd law
   (b) Newton's 2nd law
   (c) Newton's 1st law
   (d) Newton's 1st and 2nd law *(Term-I, 2021-22)* Ap

3. Which Netwton's law of motion is depicted through this picture?

   (a) Newton's 1st law of motion
   (b) Newton's 2nd law of motion
   (c) Newton's 3rd law of motion
   (d) Both (a) and (b) *(Term-I, 2021-22)* Ap

4. Heading the football into opposition goal post through a corner kick is an example of
   (a) Newton's 1st law of motion
   (b) Newton's 2nd law of motion
   (c) Newton's 3rd law of motion
   (d) Both (a) and (b). *(Term-I, 2021-22)*

5. Identify the law of motion, shown in the illustration:



   (a) Law of Inertia
   (b) Law of Action and Reaction
   (c) Law of Acceleration
   (d) Both (b) and (c) *(Term-I, 2021-22)*

6. Physical education teacher of XYZ school explained how Newton's law of motions are used in sports. She explained while dribbling in Basketball, how the laws can be helpful.
   Which law of motion is shown in picture?

   (a) Law of Inertia
   (b) Law of Acceleration
   (c) Law of Action and Reaction
   (d) Both (a) and (b) *(Term-I, 2021-22)* Ap

7. In general sports biomechanics is a quantitative based study and analysis of professional athletes and sports activities. It explains how and why the human body moves in the way that is does.
   Following are the importance of biomechanics, except.
   (a) Improvement in training
   (b) Improvement in equipment
   (c) Improvement in performance
   (d) Improvement in aesthetic *(Term-I, 2021-22)* Ev

8. The Law of acceleration is also known as _____.
   (a) Law of inertia
   (b) Law of action and reaction
   (c) Law of momentum
   (d) Boyle's law *(2020)* R

9. Bio-mechanics helps in which of the following ?
   (a) In improving technique
   (b) In improving designs of sports equipment
   (c) In improving performance
   (d) All of these *(2020)*

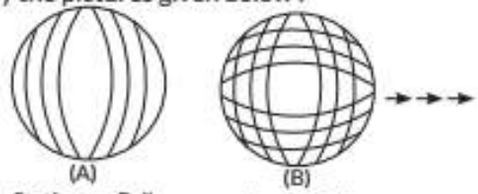
VSA (1 mark)

10. What do you mean by 'Kinesiology'? *(2018)* R

11. Which field of study in sports is called 'Biomechanics'? *(2018)*

SA (3/4 marks)

12. Study the pictures given below :


(A) Stationary Ball (B) Moving Ball

Based on above study and your knowledge, answer the following questions.

(i) Which law of motion will be applied to initiate motion of the ball as depicted in the illustration (A)?

(ii) In illustration (B) which force is acting upon the ball to slow it down?

(iii) Which law of motion will determine the quality of bounce ?

(iv) _____ of an object directly depends upon the mass of the object and net force applied on it.

(2023)

13. "When a cricket ball is moving with a certain velocity, the player has to apply retarding force to bring the ball at rest in his hands." Which Newton's Law is applied in this illustration? *(2023)* Ap

14. With suitable examples explain the application of Newton's law in sports. *(2020)*

OR

Write about the Newton's Laws of Motion and briefly discuss about their application in sports.

(Delhi 2019)

8.2 Equilibrium-Dynamic and Static and Centre of Gravity and its Application in Sports

MCQ

15. Centre of Gravity is the average location of an object's _____.

(a) Weight (b) Force

(c) Resistance (d) Velocity *(2023)* U

16. Movement possible in Ball and Socket joint are :

(a) Rotation (b) Flexion

(c) Extension (d) All of the above.

(2020)

8.3 Friction and Sports

MCQ

17. The force of friction depends upon

(a) Nature of surface of contact

(b) Material of objects in contact

(c) Both (a) and (b)

(d) None of the above. *(2020)* U

VSA (1 mark)

18. Define Friction and name its types. *(Delhi 2017)*

LA (5 marks)

19. What is Friction? Write the advantages and disadvantages of friction by giving suitable examples from sports. *(2023)*

OR

What are the various types of friction? How is friction advantageous or disadvantageous in the field of games and sports? Explain with suitable example.

(AI 2017)

8.4 Projectile in Sports

MCQ

20. Which of the following is NOT the factor affecting projectile trajectory ?

(a) Gravity (b) Angle of Release

(c) Buoyant Force (d) Air Resistance

(2023) R

CBSE Sample Questions

8.1 Newton's Law of Motion and its Application in Sports

MCQ

1. Who gave Laws of motion?

(a) Galileo (b) Pascal

(c) Newton (d) Darwin

(Term-I, 2021-22) R

2. Which law amongst the given ones is known as the First law of motion?

(a) Law of inertia (b) Law of reaction

(c) Law of momentum (d) Law of acceleration

(Term-I, 2021-22)

3. Starting a throwing event in athletics is an example of which law of motion?

(a) First law of motion

(b) Second law of motion

(c) Third law of motion

(d) First and third law of motion

(Term-I, 2021-22)

4. Two statements are given below labelled as Assertion (A) and Reason (R). Choose the correct alternative in the context of these statements.

Assertion (A): "A change in the acceleration of an object is directly proportional to the force producing it and inversely proportional to its mass".

Reason (R): Lighter mass will travel at a faster speed.

(a) Both (A) and (R) are true, but (R) is not the correct explanation of (A).

(b) Both (A) and (R) are true and (R) is the correct explanation of (A).

(c) (A) is true, but (R) is false.

(d) (A) is false, but (R) is true. *(Term-I, 2021-22)*

5. 

Physical education teacher of ABC school was teaching the students about Newton's Laws of Motion. While explaining he showed the students this picture and tried to explain how there is a difference in the speed of an object due to their weight. Can you name the Law?

(a) Newton's First Law of Motion
(b) Newton's Second Law of Motion
(c) Newton's Third Law of Motion
(d) Action Reaction *(Term-I, 2021-22)*

6. Rishi who was studying in class XII is a science stream student. During his Physical Education class, he got confused how Newton's laws of Motion are useful in sports and how they can be applied in sports. But his teacher explained these laws with help of examples from sports which proved to be very helpful for him swimming is the best example of which law of motion?

(a) Law of inertia
(b) Law of acceleration
(c) Law of reaction
(d) Both (a) and (c) *(Term-I, 2021-22)* Ap

SA (3 marks)

7. State Newton's laws of motion and explain their implications in Sports of your choice. *(2020-21)*

ANSWERS

Previous Years' CBSE Board Questions

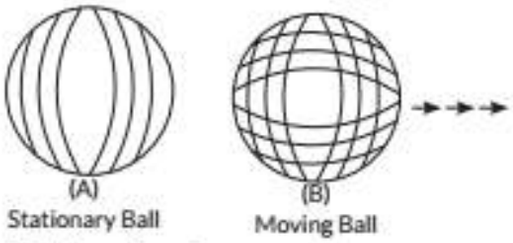
1. (b) : Biomechanics
2. (a) : Newton's 3rd law
3. (d) : Both (a) and (b)
4. (d) : Both (a) and (b)
5. (d) : Both (b) and (c)
6. (c) : Law of Action and Reaction
7. (d) : Improvement in aesthetic
8. (c) : Law of momentum
9. (d) : All of these

10. Kinesiology is the branch of physiology of physiological process and anatomy of human body with respect to movement. It is a science dealing with inter relationship of physiological process and anatomy of human body with respect to movement.

Related Theory

- In 1854, the word 'Kinesiology' was coined by Carl August Georgil. Professor at the Royal Gymnastic Central Institute in stockholm. It means "Movement-study". The basic premise of Kinesiology is that the body has its own healing energy and is doing its best to care for itself, but sometimes needs a little help to achieve this state.

11. Biomechanics is the study of internal and external forces and their effects on living system or athlete.

12. 

(i) First law of motion
(ii) Friction
(iii) Newton law of action and reaction
(iv) Acceleration

13. A cricket player does so because the cricket player increases the time during which the high velocity of moving ball decreases to zero. Thus the acceleration of the ball is decreased and therefore the impact of catching the fast moving ball is also reduced in this case Newtons second law is applied on it. Newton's second law state that rate of change in acceleration of an object is directly proportional to the force producing it and inversely to its mass.

14. Law of Inertia : A body at rest will remain at rest and a body in motion will remain in motion at the same speed and direction unless and until acted upon by an external force. *e.g.* Throwing an object in the air comes down due to gravitational force.

- A ball rolling on the ground stops or changes its direction due to the friction with the ground.

Law of Acceleration : A Change in the acceleration of an object is directly proportional to the force applied on it and inversely proportional to the mass of the object.
e.g.: A hammer throw will find need more force to throw a hammer of 18 lbs than to throw one of 12 lbs.
Law of Reactions : For every action there is always an equal and opposite reaction.
e.g. : Bounce of the ball on the floor or wall.
While swimming when water pushed backward, body moves forward.

Related Theory

- When rotating, lengthening the radius shows the rotation and shortening the radius increases rotation e.g., a diver rotates faster in "tight tuck position", creating a shorter body radius. A "pike position' produces larger radius.

15. (a) : Weight

16. (d)

17. (c) : Both (a) and (b)

18. Friction can be defined as the resistance to motion between two surfaces that are in contact.

Friction can be Static Friction or Kinetic Friction. Static friction is the friction before an object starts to slide, while Kinetic friction is the friction when the object is actually sliding or rolling; thus kinetic friction can be sliding friction or rolling friction.

19. Friction can be defined as a force that resists motion between two surfaces that are in contact. Friction plays a very important role in many sports.

Friction can be Static Friction or Kinetic Friction. Static friction is the friction before an object starts to slide, while Kinetic friction is the friction when the object is actually sliding or rolling; Thus kinetic friction can be sliding friction or rolling friction.

Friction plays a big role in rolling sports such as tenpin bowling and curling.

Some examples of friction acting in sport are-

A sprinter accelerating on a track. The foot applies a force downwards and backwards into the track. The friction forces of the track resist this causing forward movement (otherwise the sprinter would slip). Friction acts in the opposite direction to the force the foot applies on the track but in the same direction as the movement.

Air resistance

Air resistance is a friction force applied by the air on bodies that are moving through it. The amount of air resistance on a body depends on:

- The velocity the body is traveling at (the faster it goes, the more is air resistance).
- The cross-sectional area (the larger the area, the more air the body has to displace so the higher the air resistance forces).
- The shape and surface of the body (a pointed shape and a stream lined body cuts through the air more easily than a flat one.

Advantages of Friction

- All the grips we make that of exercising equipment, racquets or holding a ball is because of friction.
- Friction plays a very important role in formula one race. The bald tires are warmed so that they have adequate friction and grip the race tract and the race drivers are safe.
- Air resistance plays a very important role in sprints, skiing, cycling and other motion sports.

Disadvantages of Friction

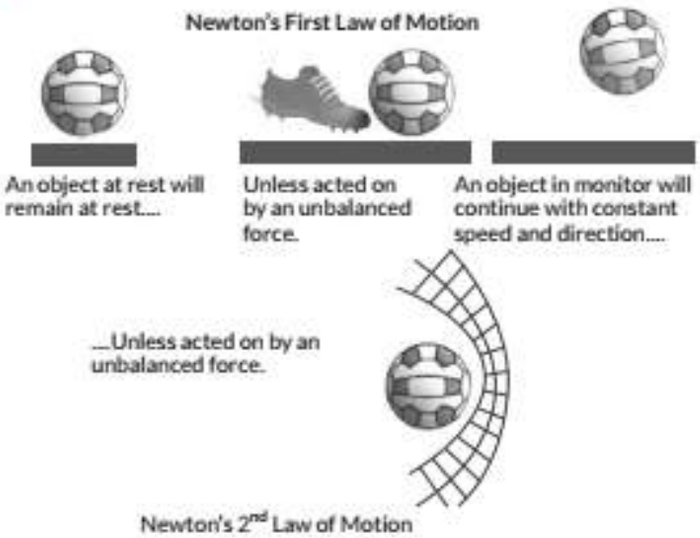
(a) The wear and tear of sporting equipment is because of friction. If there was no friction they would last forever.

(b) Constant friction between our feet and shoes can cause painful blisters.

20. (c) : Buoyant Force

CBSE Sample Questions

1. (c) : Newton (0.80)
2. (a) : Law of inertia (0.80)
3. (a) : First law of motion (0.80)
4. (b) : Both (A) and (R) are true and (R) is the correct explanation of (A). (0.80)
5. (b) : Newton's Second Law of Motion (0.80)
6. (d) : Both (a) and (c) (0.80)
7.



Newton's 2nd Law of Motion

Sports example:

- When hitting a tennis ball, the force of the racquet swing causes the ball to accelerate in the direction of swing force.
- A heavier ball is slower than lighter one.

Newton's Third Law of Reaction

"For every action there is an equal and opposite reaction"

- For every force between two objects there is always an equal but oppositely directed force.
- The normal reaction force is the support force exerted upon an object which is an contact with another stable object.

(3)