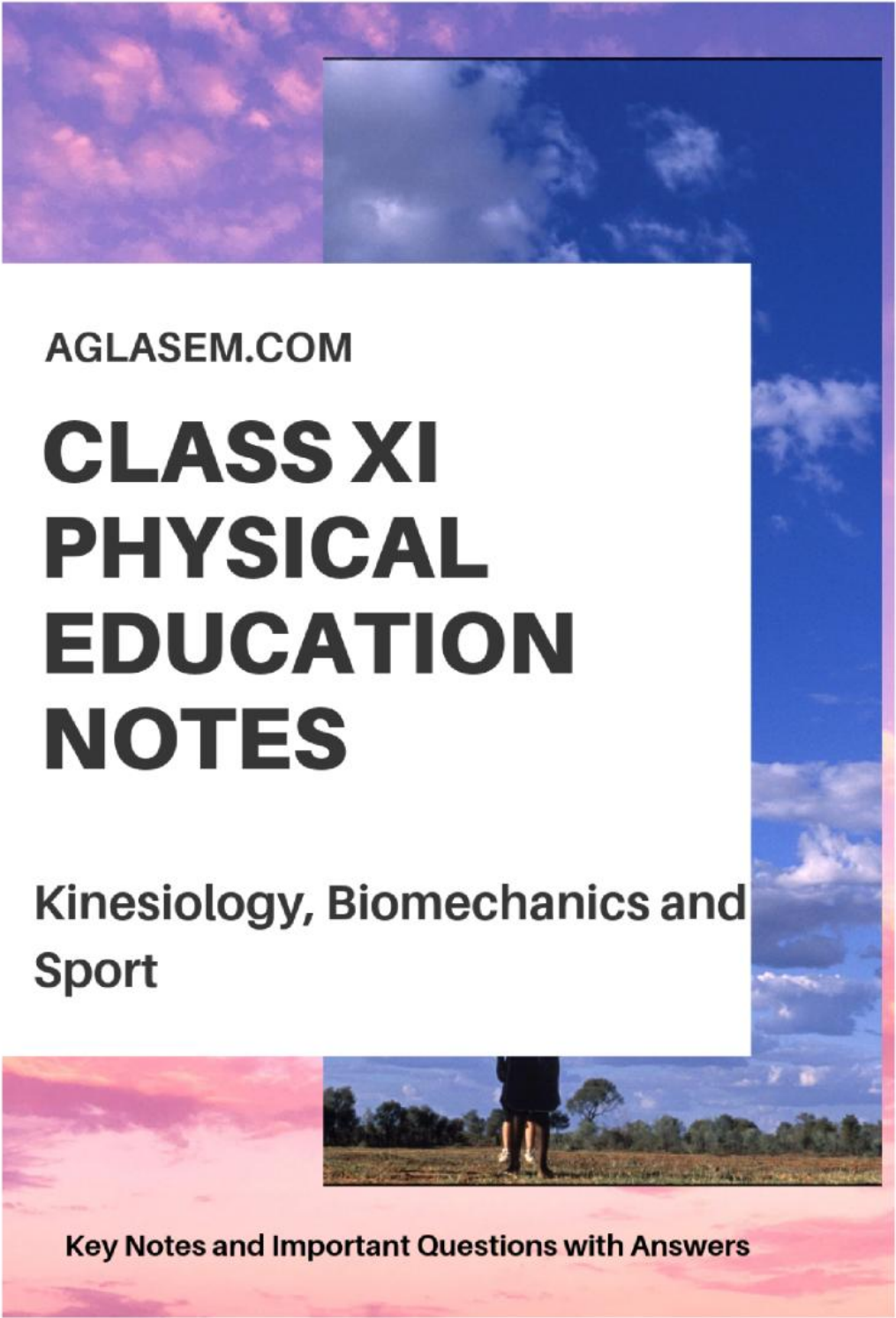




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CLASS XI PHYSICAL EDUCATION NOTES

**Kinesiology, Biomechanics and
Sport**



Key Notes and Important Questions with Answers

Unit - 9

Kinesiology, Biomechanics and Sports

- ✍ 9.1 Meaning and importance of kinesiology and Biomechanics in Physical Education and sports
- ✍ 9.2 Lever and its types and its application in sports
- ✍ 9.3 Equilibrium – Dynamic and static, centre of Gravity and its application in sports
- ✍ 9.4 Force – Centrifugal and centripetal and its application in sports
- ✍ 9.5 Introduction to buoyancy force

9.1 (a) Meaning of Kinesiology

Kinesiology is the study of human or non-human movement. Kinesiology is the study of human and animal body movements, performance, and function by applying the sciences of Bio-mechanics, anatomy, physiology, psychology, and neuroscience.

9.1 (b) BIOMECHANICS

Biomechanics is derived from Greek words. Bio-means living things and mechanics is field of physics. Thus, it is branch of science, which deals with the forces related to body movements.

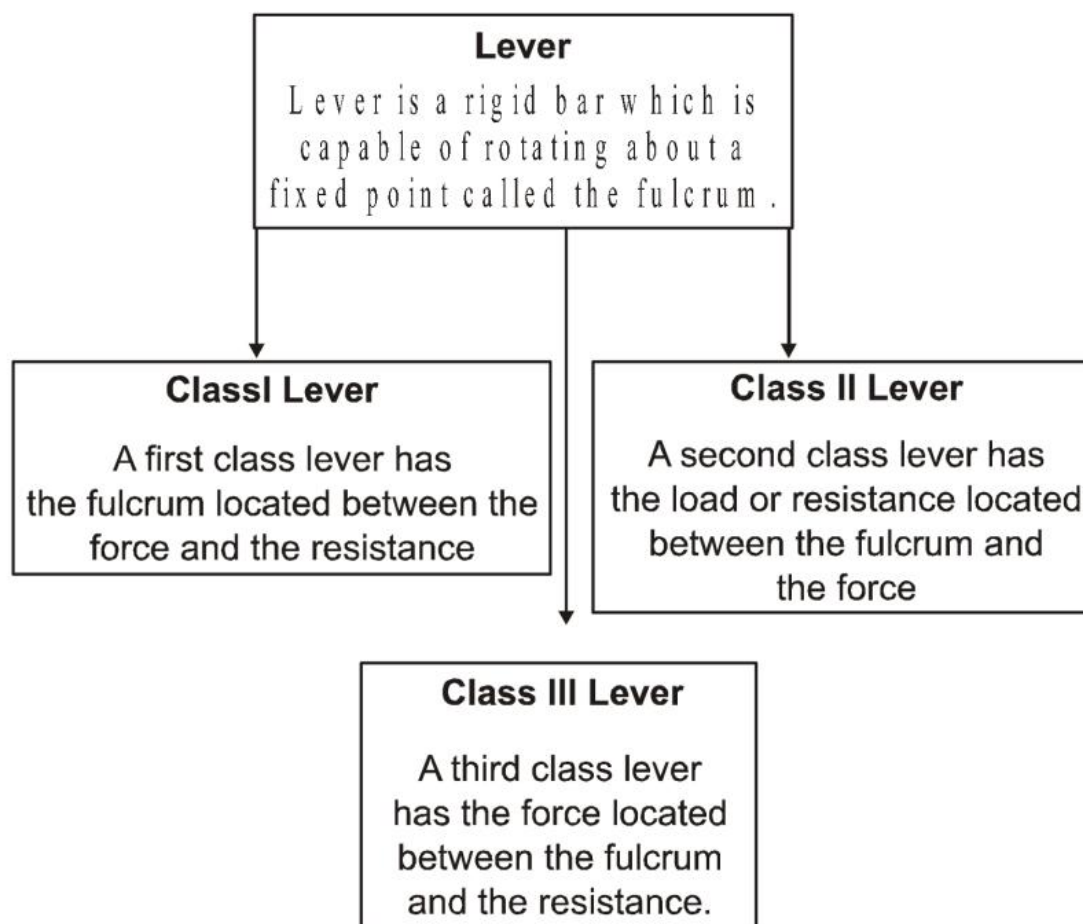
Biomechanics is defined as The systematic study of the mechanics of body joints.

According to wikipedia, "biomechanics is the study of structure and function of biological system of humans.

9.1 (c) IMPORTANCE OF BIOMECHANICS IN SPORTS

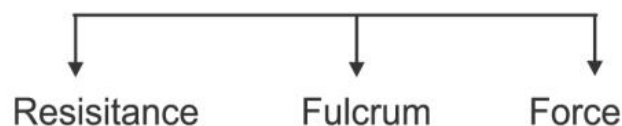
- Improve performance in sports
- Improvements in technique.
- Development of sports equipments.
- Helps in understanding human body.
- Knowledge of safety principles.
- Helps in research work.
- Creates confidence in player.
- Helps in maintaining healthy body.
- Increase the popularity of sports.

9.2 LEVERS - ITS TYPES AND ITS APPLICATION IN SPORTS



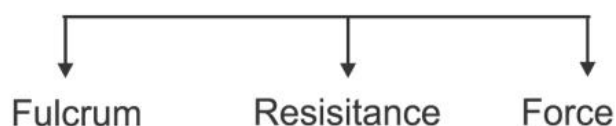
- **Class I Lever** : A first class lever has the fulcrum located between the force and the resistance.

Example: See saw, a pair of scissors, cycle bracket etc.



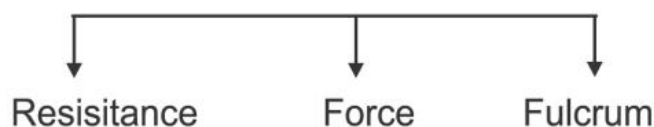
- **Class II Lever** : A second class lever has the load or resistance located between the fulcrum and the force.

Example: Punching machine, calisthenics and straight push-ups etc.



- **Class III Lever :-** A third class lever has the force located between the fulcrum and the resistance.

Example:- - Base ball bat, tennis racket, and boat paddles etc.



9.3 **Equilibrium :- DYNAMIC AND STATIC AND CENTER OF GRAVITY AND ITS APPLICATION IN SPORTS**

Equilibrium :- It is defined as a state of balance or a stable situation, where opposite forces cancel each other out and where no changes are occurring.

Types of Equilibrium

- (i) **Dynamic Equilibrium :-** It is the balance of the body during movement.
- (ii) **Static Equilibrium :-** Dynamic stability is a balance of the body during its rest or stable position.

Or

Static equilibrium is when the centre of gravity is in a stable position.

GUIDANCE PRINCIPLES TO DETERMINE THE DEGREE OF STABILITY

1. Broader the base, greater the stability.
2. Lower the centre of gravity, higher the stability
3. When the body is free in the air, if the head and feet moves then hips help move up and vice-versa.
4. Body weight is directly proportional to stability.

Centre of gravity :- Centre of gravity is that point in a body or system around which its mass or weight is evenly distributed or balanced and through which the force of gravity acts. The centre of gravity is fixed, provided the size and shape of the body do not change.

9.4 **Force - CENTRIFUGAL AND CENTRIPETAL AND ITS APPLICATION IN SPORTS**

Force - Force can be define as a push or pull by one body acting upon another. Force is a product of mass and acceleration of an object or person.

$$F = mxa$$

TYPES OF FORCES

1. Centripetal force
2. Centrifugal force
3. Gravitational force
4. Frictional force
5. Static force

IMPORTANCE AND APPLICATION OF FORCE IN SPORTS

1. Helps to move:
2. Stops the moving objective.
3. Helps to accelerate.
4. Helps in throwing object.
5. Helps to lift the object.
6. Helps to pull the object.

9.5 Introduction of Buoyancy

The Buoyancy refers to a force that arise from the pressure exerted on an object by a fluid.

The buoyancy force always points upwards because the pressure of a fluid increases with depth.

The buoyant force on an object can be calculated using the Archimedes principle.

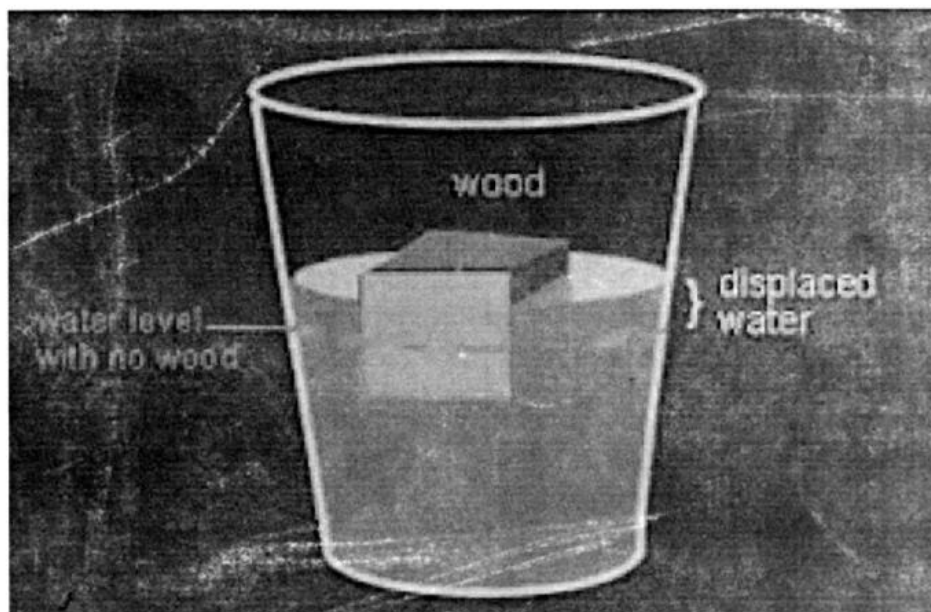
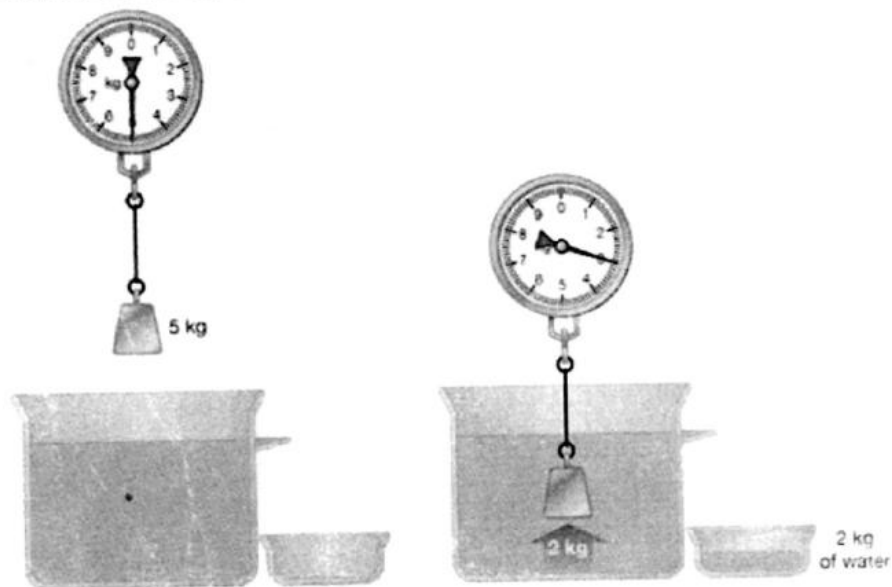
Types of Buoyancy

Positive Buoyancy : The object or person floats upward in the water or remains floating on the water or remain floating on the surface.

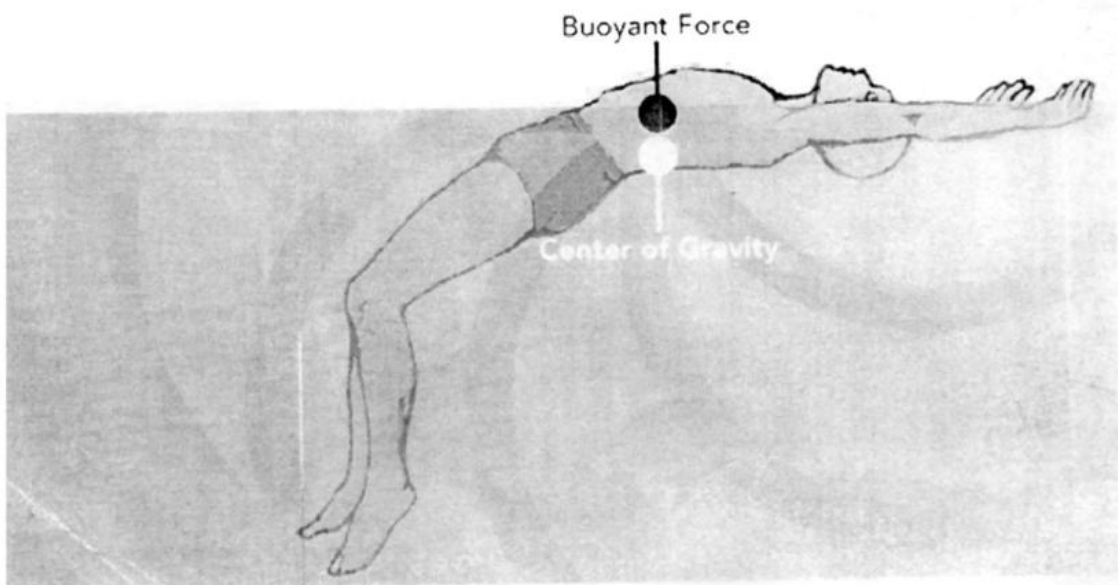
Negative Buoyancy : The object or person sinks downwards in the water or remains at the bottom.

Neutral Buoyancy : The objects or person neither sinks downwards nor floats upwards but remains suspended in the water at a single depth.

Archimedes' principle



Archimedes principle states that what the upward buoyant force that is exerted in a body immersed in a fluid, whether fully or partially submerged, is equal to the weight of the fluid that the body displaces, and acts in an upward direction at the centre of mass of the displaced fluid.



MODEL QUESTIONS AND ANSWERS

VERY SHORT ANSWER QUESTION (30 WORDS -1 mark)

Q.1 Define the term biomechanics.

Ans. Biomechanics is defined as systematic study of mechanics of body joints. According to Wikipedia, "Biomechanics is the study of the structure and function of biological system of humans"

Q.2 What is a lever?

Ans. Lever is a rigid bar which is capable of rotating about a fixed point called the fulcrum.

Q.3 What do you understand by equilibrium?

Ans. Equilibrium is defined as a state of balance or a stable situation, where opposite forces cancel each other out and where no changes are occurring.

Q.4 What are the different types of equilibrium?

Ans. There are two types of equilibrium. Dynamic equilibrium and static equilibrium.

Q.5 What is a force?

Ans. Force can be defined as a push or pull by one body acting upon another. Force is a product of mass and acceleration of an object or person.

Q.6 What is center of gravity?

Ans. Center of gravity is that point in a body or system around which its mass or weight is evenly distributed or balanced and through which the force of gravity acts.

Q.7 Why do we lean forward while climbing up a hill?

Ans. We lean forward while climbing up a hill to keep the center of gravity low to maintain stability.

Q.8 Which type of lever is used while we curl our biceps?

Ans. Class III lever is used while we curl our biceps.

Q.9 Who will have greater stability?

- a. A fat person or a thin person of same height?
- b. A girl standing in stand at ease position or a girl standing on one leg?

Ans. a. A fat person.

- b. A girl standing in stand at ease position.

SHORT ANSWER QUESTION5 (GO WORDS-3 MARKS)

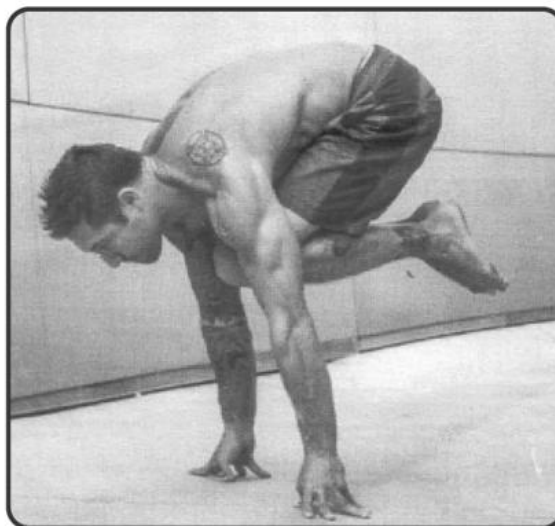
Q.1. Explain dynamic equilibrium.

Ans. Dynamic stability is balancing the body during movement. It frequently happens that the line of gravity of an athlete will fall outside the base of support for movement. For example, in a sprint start, the body weight is ahead of the supporting foot but before the body can fall forward the other foot moves ahead to provide support and the process repeats itself. A man carrying heavy bucket in his right hand leans towards his left hand side to maintain equilibrium. While climbing up a hill the climber bends forward so that he does not fall. The equilibrium is maintained by bringing the CG down.



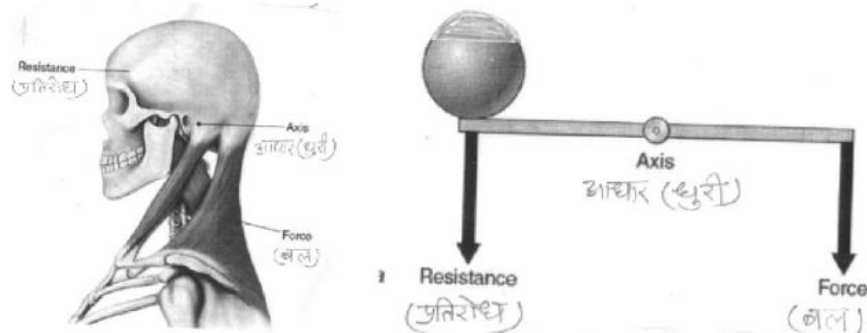
Q.2 What is static equilibrium?

Ans. A body is said to be in stable equilibrium if it comes back to its original position when it is slightly displaced. Static stability is very important in shooting, archery and hand stand in gymnastics, etc. Stable objects generally have wide bases and low CG. Bottom of the ship is made heavy to keep CG as low as possible. This makes the ship stable.

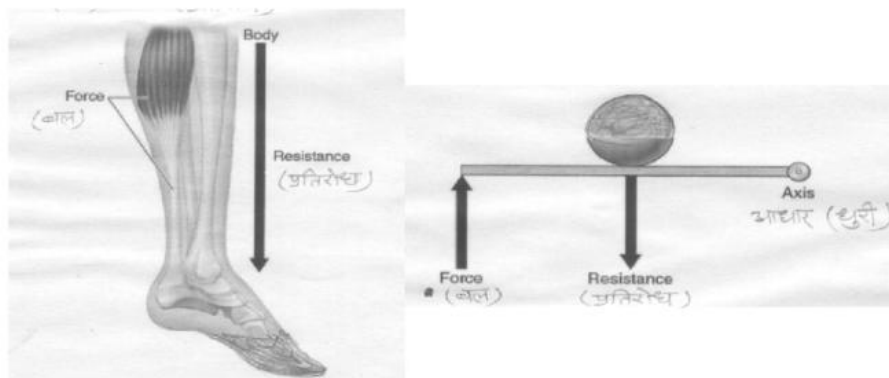


3. Give example of each type of lever which our body uses during various activities.

Ans. Following is the example of class I lever which is used by our body. Our skull is the lever arm and the neck muscles at the back of the skull provide the force (effort) to hit football while we lift our head up against the football (load). When the neck muscles relax, our head nods/hits forward.

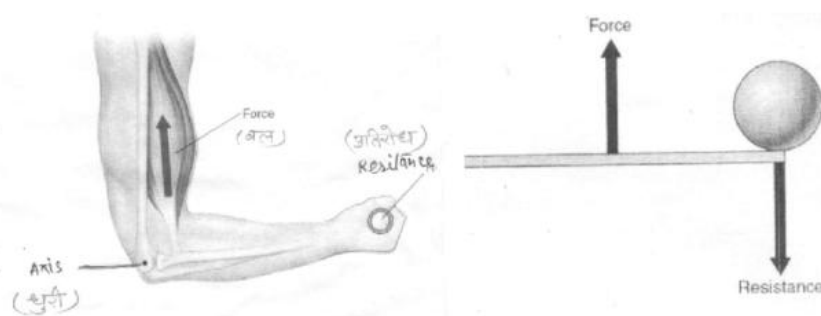


Following is the example of class II lever which is used by our body. Our calf muscles and Achilles tendon provide the effort when the calf muscle contracts. The load is our body weight and is lifted by the effort (muscle contraction).



Resistance

Following is the example of class III lever which is used by our body. The biceps muscle provides the effort (force) and bends the forearm against the weight of the forearm and any weight that the hand might be holding.

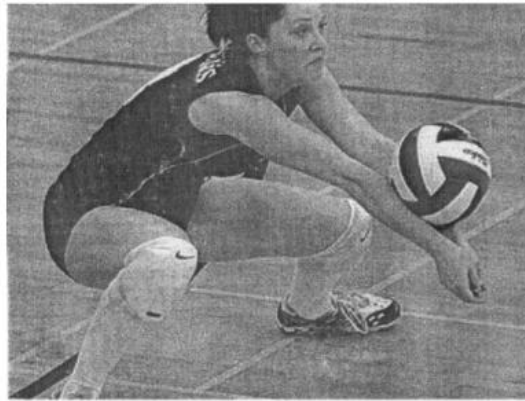


LONG ANSWER QUESTION (15Q WORDS - 5 MARKS)

1. Explain in detail the principle of stability and its uses in sports.

Ans. (i) Broad base of support : for greater stability increase the area of the base and lower the centre of gravity as much as is consistent with the activity involved. Examples:

- (a) a basketball player stops, spreads his feet wide as shoulder line and lowers his CG to dodge the opponent.



- b. Defense position of the player in volleyball.

- c. Wide stance of a golfer.

- d. Tackling position of a player in football.

(ii) Stability is directly proportional to the weight of the body the object or a person with heavy weight will have greater stability as compared to person with less weight. Example: it is difficult to move a heavier person as compared to less heavier person. On the basis of this principle, wrestling, boxing, judo, etc. are organized according to different age groups.



- (iii) Direction of an acting force: to start quickly in one direction, keep the-CG as high as possible and as near as possible to the edge of the base nearest to the direction of intended motion.

Example: The crouched position in starting a race, the CG is kept high by not bending the knees extremely and by keeping the hips high, also the lean of the body is towards the hands so that the weight rests on the hands. From this position, the movement hands are raised from the ground; motion starts by reason of the pull gravity. This pull is added to the force exerted against the starting block by the feet and thus aids in speed.



- (iv) When the body is free in the air, if the head and feet move down, the hips move up and vice versa.

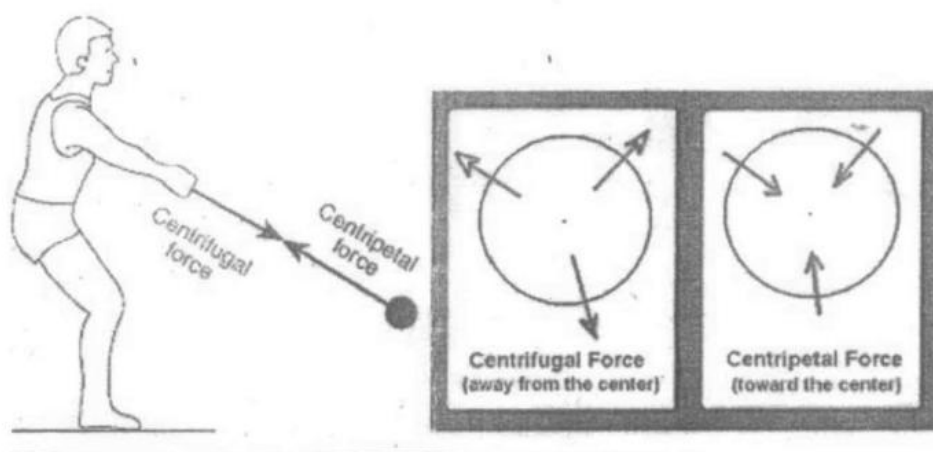
Example:

- a. This principle is applied in the high jump in western or valley roll technique at the take of, the head and one foot is thrust up as high as possible. As the head and one leg clear the bar, they are dropped which raises the hips to clear the bar. As the hips are lowered, the opposite leg is raised to clear the bar.
- b. This is also used in pole vault, hurdles and jackknife, dive in swimming.



2. **What do you know about centripetal force and centrifugal force? Explain its application in sports.**

Ans. Centripetal force: this is the force that pushes or pulls an object towards the axis of rotation in order to make it follow a curve or circular pathway. When a player swings a bat, he applies centripetal force to make that bat follow the arc of swing. Centrifugal force: this is the force that pushes or pulls an object outward from the axis of rotation. This force is equal and opposite of the centripetal force. Centripetal and centrifugal force have innumerable application in sports like, Centripetal force is needed by the player to maintain his grip. If the rotational momentum is more, the centrifugal force could cause the player to lose his grip and the bat may go off the hand. These forces act when a runner takes a sharp bend leans inward to obtain the necessary centripetal force. A cyclist going round the curve leans towards the centre of the curve in order to get necessary centripetal force.



Q.4 Elucidate the importance of biomechanics in sports.

- Ans.** (i) **Improves performance in sports** : principles of biomechanics tell us about right techniques, effective and result oriented posture to get more efficient results by applying minimum muscular force which in turn improves performance in sports.
- (ii) **Improvement in technique**: with the help of biomechanical principles the physical education teacher corrects the mistakes. This helps in improving the game and performance of the player.

- (vi) **Development of improved sports equipment:** the principles of biomechanics are used to modify the sports equipments. For example, T-shirts, studs, spikes, swimming costumes, hockey sticks, different size footballs and low weight helmets for protection
- (iv) **Improve in the training techniques:** a teacher can analyse the player's movement or action with the help of the biomechanical principles. It helps in improving the training techniques.
- (v) **Prevents sports injuries:** it helps to find out the factors or the forces that can lead to the injuries during the game situation. It also helps in prevention of the sports injury.
- (vi) **Helps in understanding human body:** it gives the knowledge of different systems of our body. For example, nervous system, muscular system and skeletal system.
- (vii) **Knowledge of safety principles:** biomechanics gives the understanding to analyse different movements that can harm the player. The teachers remove those unnecessary and harmful movements.
- (viii) **Helps in research work:** biomechanics helps in teaching and learning process, It also helps the teacher to acquire precision and accuracy of movement.
- (ix) **Creates confidence in player:** The player knows that he is executing the movement scientifically with the help of principal of biomechanics. Thus the confidence of the player is enhanced.
- (x) **Helps in maintaining healthy body:** Principles of biomechanics gives deep knowledge about the effect of physical forces and movements over the body as well as the movements which are safe and promotes health. Thus biomechanics helps in maintaining healthy body.
- (xi) **Increases the popularity of sports:** biomechanical principles have brought remarkable improvements in respect of technique, equipment, skill and play fields. It helps in promoting the games and sports in the masses.

Q.5 What is the importance of kinesiology in physical education and sports?

Ans. 1. By following the principles of kinesiology, the coach can guide his fellow contestants to avoid sports injuries while performing.

2. Kinesiology helps the sports coach to get better results from their athletes and is usually helpful in right performance of the sport skill and technique.
3. It enables the physical educators to teach right modes of physical activities to their pupils.
4. Physical educators can impact various activities on the basis of knowledge of kinesiology.
5. Kinesiology helps physical educators and physicians in learning and correcting physical deformities of a person.
6. It enables the coach to provide effective scientific training of players.
7. Kinesiology plays an important role in personality development of a sports person.
8. Kinesiology helps the sports coaches and trainers in the application of their relative methods of coaching efficiently and precisely.