

## BIOMECHANICS & SPORTS

### Very Short Answer Type Question (1 Mark Each)

Q.1 What do you mean by sports Biomechanics?

Ans. Sports Biomechanics is the study of forces and stresses of human movement & their effect on athletics. performance and safety.

Q.2 What is power?

Ans. The Rate of doing work or using energy is called power. Ex Kicking a football or lifting the weight.

Power= Work done/Time taken to do work.

Q.3 Define work?

Ans. Work refers to an activity involving a force and the Movement in the direction of force. It can also be defined as “the work done by a constant force as the product of force and the distance moved in the direction of the force”.

Work Done = Constant force x Distance moved in the direction of the force.

Q.4 Explain Gravity?

Ans. Gravity is the force of attraction exerted by the earth towards its centre on a body or an object.

Q.5 Define trajectory?

Ans. The flight path followed by a projectile is called it's trajectory. Ex. Throwing a ball into air.

Q.6 Explain one of the most important difference between the Mechanical analysis of walking and running?

Ans. In running a time comes when both the feet are off the ground which is called float phase, while in walking one foot is always in contact with the ground.

Q.7 What is air resistance?

Ans. Resistance is a force, which created by the contact is between the two surfaces. When a projectile moves through the air, the force applied by the air that opposes the motion of the porjectile is called air resistance.

Q.8 Define velocity?

Ans. The displacement covered by an object per unit time is called velocity.

Ex. Time taken in 100m by an athlete.

Velocity = distance / Time

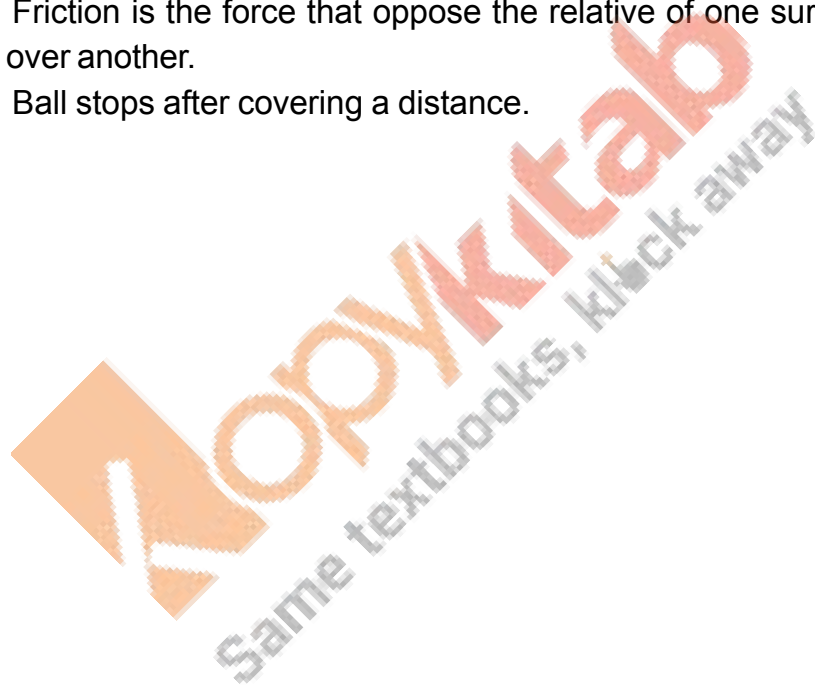
Q.9 What is Energy?

Ans. It is the capacity to perform a work.

Q.10 What is friction?

Ans. Friction is the force that opposes the relative motion of one surface over another.

EX. Ball stops after covering a distance.



## Chapter - 10

### BIOMECHANICS & SPORTS

**Short answer type questions (80 to 90 word) 3 Marks Each.**

Q.1 What is friction? Discuss various types of friction in sports.

Ans. Friction is the force that combats relative motion between the two surface that come in contact. Friction always act in the opposite direction of the applied force.

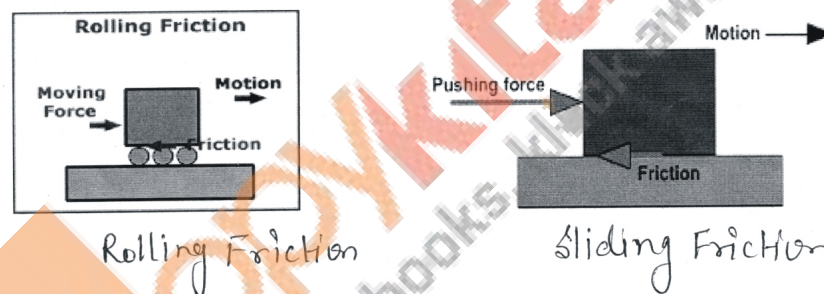
#### **Types of Friction :-**

1. **Static Friction-** The opposite force that comes into play when one body tends to move over the another surface, but the actual motion has not yet stated.

2. “Static friction is the friction that is present when two bodies are static. This kind of friction can stop from moving on a path.

**Dynamic friction-** The opposing force that comes into play when one body is actually moving over the surface of another body. Dynamic friction may be of two types.

1. **Rolling friction-** The opposing force that comes into play when one body is actually rolling over the surface of another body.  
For example, hockey / cricket ball is hit.



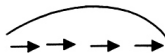
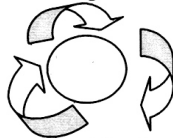
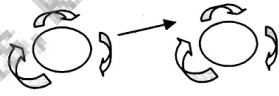
2. **Sliding friction-** The opposing force that comes into play when one body is actually sliding over the surface of the other body. For example-Ice skating.

Q.2 Differentiate between Linear and Angular motion?

Or

Describe the two type of motion in sport?

Ans. Motion means “a change of position of a body and consists of the upsetting the equilibrium of a body”.

LINEAR MOTION	ANGULAR MOTION
<p>When a body moves in a straight line, from one point to other in the same direction, is called Linear motion.</p> <p>Linear Motion is measure in feet, meters, km etc.</p> <p style="text-align: center;">→ → → → →</p> <p>Linear Motion is two types:</p> <p>1) <b>Curve linear motion</b> :- When body travels on a curved path. Exp. shot put</p> <p style="text-align: center;"></p> <p>2) <b>Rotatory motion</b>;-It is the movement which occurs when the axis of the body fixed, causing it to move around that particular point when the force is applied to it Example:- While running leg is fixed with hip joint but move forward with rotator motion.</p>	<p>When a body rotates it turns about an axis, this rotation of the body is called angular motion.</p> <p style="text-align: center;"></p> <p>It is measured in degrees.</p> <p>Angular motion is of two types.</p> <p>1. <b>Visible Axis</b>;-It is that type which can be seen for Example – Hammer throw.</p> <p>2. <b>Invisible</b>;- An imaginary axis is that which cannot be seen. The axis is the centre of the gravity of the body. For Example—A ball rotated in the air.</p> <p style="text-align: center;"></p>

Q.3 What is energy? Explain about kinetic energy & Potential Energy.  
Or

Differentiate between kinetic energy & Potential energy?

Ans. The energy is the capacity to do work. There are two types of

**Energy**:- Kinetic Energy:- It is defined as energy possessed by a body as a result of motion.

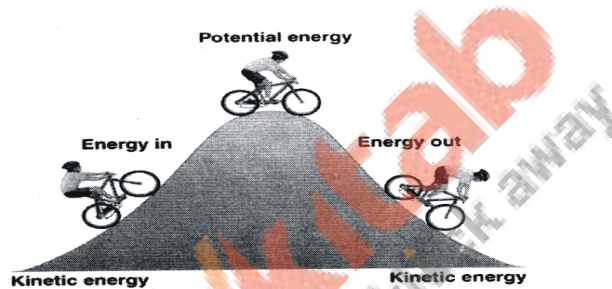
**For Example**:- If a javelin is in linear motion at its fullest speed, its kinetic energy will be more. When it is slow, it loses its kinetic energy. When it touches the ground, it has no kinetic energy. Kinetic energy also depends on the mass or a thing.

**Kinetic Energy = 1/2 mass x velocity (1/2 mv<sup>2</sup>)**

**Potential Energy:-** It is energy which is stored up in a body because of its position.

**For Example:-** When a basketball is thrown upward, it gains in height. The movement of a ball comes to an end. It means the ball gets potential energy whereas kinetic energy goes away, when the basketball after reaching a certain height stops, its kinetic energy reduces to zero and the basketball has only potential energy.

**PE = Mass x Gravitational Force x Height of the body from the ground (mgh).**



Q.4 Differentiate between Running and walking?

RUNNING	WALKING
<ul style="list-style-type: none"> <li>I. Running is a process, in which both feet are off the ground.</li> <li>II. There is a double swing phase and the swing phase is longer.</li> <li>III. The linear and angular velocity of lower limbs is faster.</li> <li>IV. Running requires greater range of motion.</li> </ul>	<ul style="list-style-type: none"> <li>I. Walking is a process, in which at least one foot remains in contact with the ground.</li> <li>II. There is longer stance phase whereas swing phase is shorter.</li> <li>III. The linear and angular velocity of lower limbs is slower.</li> <li>IV. Walking requires lesser range of motion.</li> </ul>

Q.5 Is friction advantageous or disadvantageous in the field of games and sports? Give your Comments with examples.

Ans. Friction is usually called necessary evil. It means it is essential in the life and we cannot do any work without it.

**Advantage of friction:-**

- a. **Keeps the object at position :-** by friction, the object can be placed at position and shaped.
- b. **Helps to move:-** Friction forces help to move the object Ex: running or walking. With friction of feet/ shoes on the surface, helps to speed.
- c. **Frictional force helps** to move the object in the speed. For Example :- Spikes are used by the athletes to run fast.
- d. **Hold or grip an object:-** With the help of friction the ridges of skin of our fingers and palm enable us to grab hold objects. For example- In badminton the players use grip to hold it.
- e. **Produce heat:-** The law of conservation of energy states that the amount of energy remain constant. Thus, the energy that is due to friction in trying to move the object is really convert into heat energy.

**Disadvantages of friction:-**

- a. **Wear and tear of object:-** due to friction, there is wear and tear of object. Lubrication is used to allow the parts to move easier, moreover, prevents wear and tear.
- b. **Wastage of Energy:-** Excess of friction means extra energy, thus energy is being wasted.

- c. **Slow down the speed:-** In the roller skating, Rolling shoes and smooth surface are used to minimize friction.
- d. **Makes movement difficult :-** Friction can make the job more difficult when one has to move the other object. Excess friction can make it difficult to slide a box across the floor, walk through deep snow.

**Q.5** Mr. Vinay is a physical education teacher in a govt. school and he was a renowned national level long jumper during his teenage. Mahesh is also a long jumper & his landing is improper. So he lost his position. Mahesh went to Mr. Vinay to seek help Mr. Vinay gave him proper scientific technique tip to follow correct body posture while landing & also motivated to utilize the same jump consistent practice. After the one year of training mahesh won gold medal in the Inter Zonal Athletic Meet.

- I. What was the problem facing by Mahesh body?
- II. State the qualities of Mr. Vinay as a coach?
- III. Explain the role of coach in the life of a sports man?

Ans.(i) He was facing problem in landing technique of Long Jump/  
Mahesh was facing the problem of improper Landing in his long jump event so he didn't win any medal in the athletic meet.

(ii) Mr. Vinay has following qualities.  
1. Good motivate, 2, Dutifulness, 3. Knowledge of scientific techniques or mastery in skill, 4. Helping attitude, 5. Good co-ordination.

(iii) As a coach he can play in two different areas :-

- i. Information feed back, implementation in respective field of skill.
- ii. Suggest, refer, engage with field experts.



## Chapter - 10

### BIOMECHANICS & SPORTS

#### Long Answer Type Questions (150 to 200 words) (5 mark each)

Q.1 What is projectile ? Explain the factors affecting projectile trajectory

Or

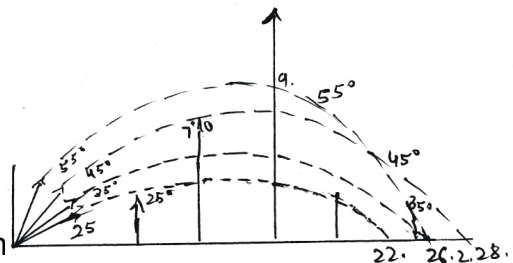
Write in brief that how angle of projection, height of release speed of release, gravity and air resistance affect projectile trajectory.

Ans. An object thrown into the space either horizontally or an acute angle under the action of gravity is called a projectile. There are force which act on a projectile-gravitational force and air two resistance. Air resistance of an object varies greatly and it depends on the object's particular shape and the atmospheric conditions in which the object is released.

Trajectory - The path followed by a projectile.

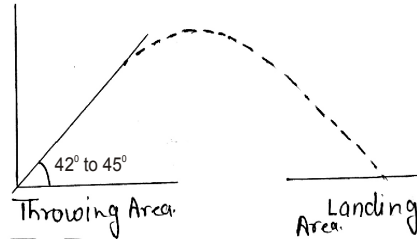
**The factor affecting Projectile Trajectory are mentioned below.**

- Angle of projection:-** An object which is projected at different angles covers different distance. When it is projected or released at angle of  $25^\circ$ , making it a parabolic path and covers lesser distance. When it is released at angle of  $42^\circ$  &  $45^\circ$ , makes a parabolic path and covers. Maximum distance. So the distance covered by an object (Shot Put, Hammer, Javelin, Discus etc. depends on th

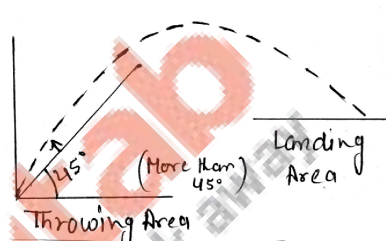


2. **Projection height relevant to the landing surface:-**

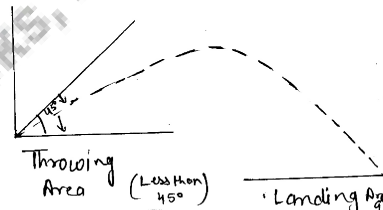
If the projection height and landing surface are equal the thing should be release/thrown at an angle of  $42^\circ$  to  $45^\circ$  it cover maximum distance.



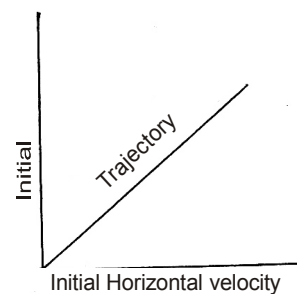
If the level of landing surface is more than projection height the angle shall be increased i.e. should be more than  $45^\circ$ . So things cover a maximum distance.



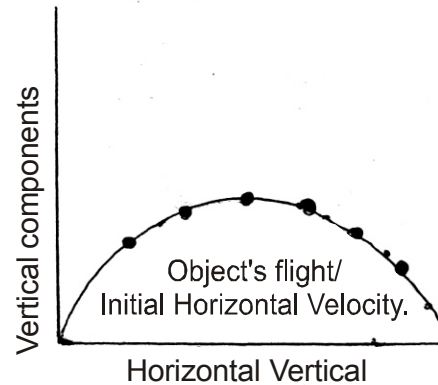
If the level of Landing surface is less than projection height the angle of projection should be decreased. I.e. should be less than  $45^\circ$ . The things cover maximum distance. So the distance of horizontal depends upon the relevancy of projection height and landing surface.



3. **Initial velocity:-** The distance covered by an object depends on the initial velocity of the projectile. If the initial velocity is more, the object covers maximum distance. And if the initial velocity is less the object covers less distance.



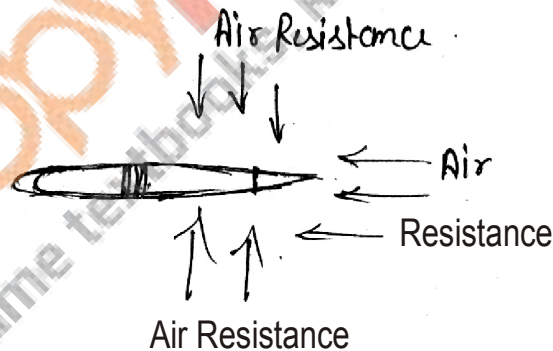
4. **Gravity:-** It is the force of attraction exerted by the earth towards the object's. A Leaner object, if projected will have longer elivation in companison to a light weight object with the same force. Gravity affects a projectile as it decreases the height of the force of gravity acts on



the object to stop its upward movement and pulls it back to earth. Limiting vertical component of the projectile.

5. **Air Resistance:-**

When a projectile moves through the air, it is slow down by air resistance, Air resistance decrease the horizontal component of projectile. The effect of air

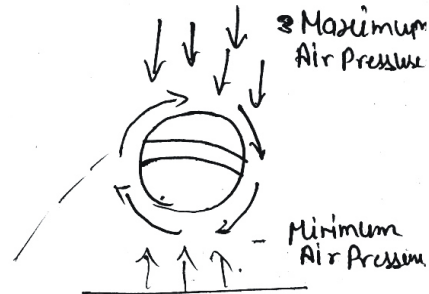


resistance is very small but it increase the horizontel component of air resistance acting on a projectile mass surface of the object. Following factors - Surface of the object volume, mass & speed related to the amount of air resistance of a projectile.

6. **Spin:-** The amount and direction of spin acting on a projectile

will directly effect the distance travelled or covered by a projectile.

The main reason behind this fact is the air pressure acting on the object.



- Upper air pressure is maximum on the object.
- Lower air pressure is maximum on the object.

Q.2 Discuss the mechanical analysis of walking in details?

Or

With the help of mechanical analysis of walking, state how it can enhance or develop the performance of an athlete? Explain the phases of mechanical analysis of walking?

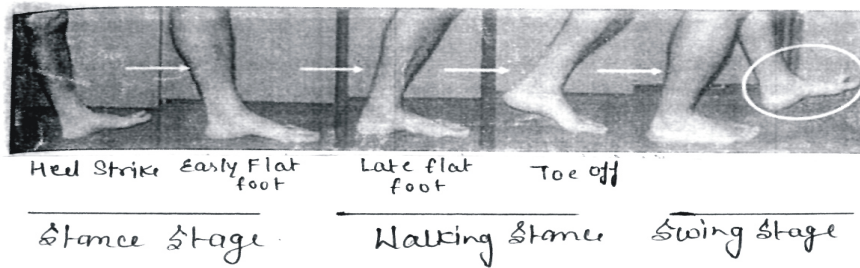
Ans. The mechanical analysis of walking helps to improve the techniques of players and it also instrument for better performance.

1. **Mechanical Analysis of Walking divided into two phases :-**  
Stance phase is the Period, when the foot is on the ground. It is considered that it consists of maximum percentage of walking cycle. For the part of stance phase. Both the feet have a contact with the ground for a period of time. The stance phase of walking is divided into five stages.

- \* **Heel strike:-** This stage begins when the feet first touche the ground and continuous until the complete foot is on the ground i.e. early flat foot stage.
- \* **Early Flat Foot:-** The starting of this stage is that movement when the complete foot is on the ground and early flat foot stage

occurs when the body's centre of gravity passes over the top of the foot. The centre of gravity of the body is located approx. in the pelvic area of the lower spine while walking. The main purpose of this stage is to allow the foot to act as a shock absorber.

- \* **Late Flat Foot:-** An athlete comes into late flat foot stage when his body's centre of gravity passes in front of 'neutral' position. This stage lasts when the heel lifts off the ground. During this stage the foot needs to go from being a shock absorber to being a rigid lever which can help to propel the body in forward direction.
  
- \* **Heel Rise:-** This stage starts when the heel begins to leave the ground. The foot functions as a rigid lever to move the body in forward direction. During this stage of walking, the ground forces that go through the foot are very significant.  
Toe-off : - When the toes leave the ground completely. This stage continues until the beginning of swing phase.
  
- 2. **Swing Phase:-** It occurs when one foot is on the ground and the other one is in the air. Swing phase in walking is shorter than the stance phase. It is divided into three phases.
  
- \* **Initial swings:-** This phase sees the hip extended to  $10^\circ$  and then going into flexion and knee flexed to  $40-60^\circ$  and the ankle changing its position from flexion to neutral.
  
- \* **Mid Swing:-** This phase sees the hip extended to  $30^\circ$ , the knee flexion till  $60^\circ$  and extended approx to  $30^\circ$  and ankle becomes dorsiflexed.
  
- \* **Terminal Swing:-** This phase is the hip flexed till  $30^\circ$  and knee is locked in extension and foot changes its position from dorsiflexed to neutral.



Q.3 What are the different phase of running cycle?

Ans:- Running as essential part of living beings. Running is important in sports also. A good runner will not only be able to defeat it's opponents in running, but would also be able to gain very good takeoff velocity that would help to take a higher or longer jump.

Different phases of running are mentioned below.fkfkfkfk

Running style /phases .	Sprinting	Fast Running-	Jogging
Initial contact	This phase sees the front of the foot the sprinter making contact with the ground. Their heel might or might not touch the ground later depending on their personal running technique.	This phase sees the middle of the foot or the heel of fast runner make contact with the ground .	This phase sees the full foot or the heel of the jogger make contact with the ground
Mid - stance	This phase is very quick and the sprinter's foot is usually in the same position as in the phase of initial contact	This phase is very quick and the fast runner will spend this phase in mid stance – as he pushes through with this foot	in comparison to sprinters and fast runners who use their feet and ankle to move in to the next phase joggers .tend to move their centre of gravity forward to do the same .

Propulsion	This phase sees the hips of sprinter extended back ready to propel him forward for take-off .his arms simultaneously swings at full power to help him	The runner receives propulsion through the big toe with his hips extended back and knee slightly bent .	The jogger will receive propulsion through the big toe .but if the hip of jogger are not fully extended back ,then the propulsion is received from the other toes .The arms of the joggers only move a small amount .
Swing	The non-supporting leg of the sprinter swings high with the knee at almost at an angle of 90	The knee of the non-supporting leg of the faster runner will be lifted , although not as high as that of a sprinter.	The knee of your non-supporting leg of the jogger remains low and only slightly bent ,

Upper body & Arm mechanics in Running - The upper body action provides balance & promotes efficient movement. The balance is maintained by the arm & upper body effectively working in the direct opposition to the legs. The arm & upper body produce a propulsive force during absorption stage. The arm & upperbody also counter balance in mid-section.

### Contact Time

