CONTENTS

TYPES OF FORCE

FRICTION

Friction occurs when two surfaces come in contact with one another.

Forces always act in the opposite direction to the motion of the object. Friction resists movement when the object and surface are in contact.

To start an object moving you must apply a force that is greater than the maximum static friction value.

APPLIED EXAMPLE

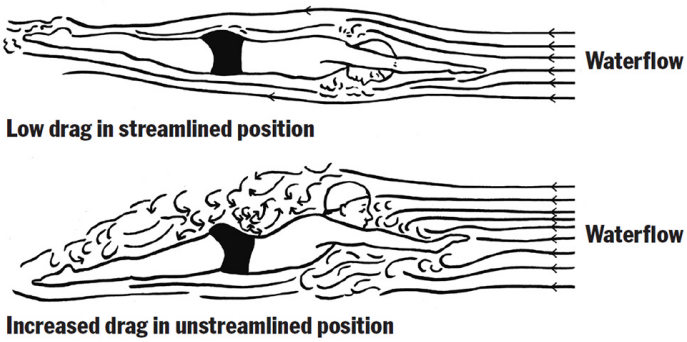
(a) Identify 3 circumstances where a performer tries to increase friction. Explain how this is achieved in each example.

Increasing Friction	**Decreasing Friction**
Studs in a football boot – This helps to increase the friction between the grass and the boot to allow the player to stay balanced and apply force to the ball.	Smooth surface shoes ten pen bowling – This allows the bowler to slide due to decreased friction between the shoe and the floor when bowling the ball. This is important so the knee does not take all of the force when bowling the ball.
Chalk on a gym bar – This helps to increase the friction between the bar and the hands to allow the player to remain a strong grip and exert force to the bar.	French Open clay surface – The smooth clay surface has decreased friction allowing the tennis player to slow momentum gradually when sliding into shots, reducing risk of knee injuries.
Tyres on a motor race car – The grooves in the tyres apply friction to the road surface and allow the car to grip to the road so the car can take the bend at the fastest possible speed.	Ice hockey – The ice has no friction which allows the puck to slide quickly along the surface.

AIR AND WATER RESISTANCE

Drag forces oppose the direction of motion of a body as it moves through air or water.

Affected by cross sectional area (surface area) of a body, speed (drag increases linearly with speed) and air density.



Can you think of any other sports where drag is important?

WEIGHT OR MASS

Many people use the term weight incorrectly in everyday language. For example, a relative may say to you "My weight increased by 2 kgs over the holiday period as I ate too much food." What is wrong with this statement?

The **mass** of an object is the amount of matter in the object. It tells you how many particles you have. Mass is measured in kilograms (kg) and is independent of where you measure it. A wooden block with a mass of 10 kg on Earth also has a mass of 10 kg on the Moon.

However, an object's **weight** can change as it depends on the mass of the object and also the strength of the gravitational force acting on it. Weight is measured in newtons (N) as it is the gravitational force of attraction exerted on an object by the Earth.

Weight = Mass x Gravity

GRAVITATIONAL FORCE

Gravitational forces exist between any two objects with mass and they are forces of attraction (pull).

On earth the gravitational force that causes objects to fall towards the center of the earth.

The acceleration due to gravity is is equal to 9.8 m/sec squared.

Acceleration $= \frac{F}{M}$

INERTIA

The tendency of the body to resist a change in its state of motion (whether at rest or moving) with a constant velocity.

If the force that is applied to an object is not greater than the inertia of an object there will be no change in its motion. Eg: a person may apply a force to a car but the car will not shift if the force is not greater than the inertia of the car.

The relationship between mass and inetia: The amount of inertia an object has is directly related to its mass – the greater the mass, the greater the inertia.

QUESTION 11
Explain why Sumo wrestling is considered one of the greatest sporting examples of strength by referring to the principle of inertia.

MOMENTUM

- The term momentum describes the quantity of motion a particular body of mass has.
- It is a combination of mass and velocity: mass (measured in kilograms) multiplied by velocity (measured in metres travelled per second).
- Momentum = Mass x Velocity (p = m x v)
- The greater an objects mass, the greater the momentum (Eg: When comparing a cricket ball and tennis ball with the same velocity – which would have the greatest momentum?)
- The greater an objects velocity, the greater the momentum (Eg: When comparing a cricket ball hit in a full attacking drive and a cricket ball hit in a forward defense – which would have the greatest momentum?)
- The greater momentum an object has, the harder it is to stop.

QUESTION 12
Watch the 'Cheese rolling' video and describe why injuries are as common by referring to principles of momentum.

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SUMMATION OF MOMENTUM

- When trying to create maximum force or velocity of movement it is important that all body parts involved are coordinated from movement start to movement end.
- Sequence body parts from those closest to the center of gravity to those further away.
- Lager body parts start movement (<u>larger mass, slower velocity</u>), momentum is conserved and passed on to smaller body parts which finish movement with greater speed (<u>smaller mass, greater velocity, fine motor control</u>).
- Eg – Golf Swing: Momentum generated in the lower body is transferred to the hips and trunk, then to shoulders and elbows and finally to wrist.

- Use the large muscles of the thighs and trunk first. These body parts have a large mass but move slower.
- Each body part is then sequentially accelerated, transferring momentum from the large and slow body parts to the lighter faster moving body parts.
- Each body part is stabilised before the momentum is transferred.
- By using as many body parts as possible, the time over which the force is applied is maximised.
- Follow through is important so that the last body part doesn't slow down before the ball is released, kicked or hit.

Summation of momentum applies to timing and coordination of movement between body parts, not just to use larger muscles to produce maximal force. An example of this is a basketball free throw.