Chapter 4:Dynamics-II

For your information (NBF)

Rotational motion is the turning or spinning motion of an object about an axis that passes through it. Axis of rotation is a line about which rotation takes place. This line remains fixed during rotational motion, while the other points of the body move in circles about it. It may be a pivot, hinges or any other support. The axis of rotation for earth and helicopter rotor spinning.

Can you tell?(NBF)

Why applying force along the hinges does not produce rotation in a door?

Ans: When you apply a force along the hinge of a door, it does not produce rotation (torque) because there is no moment arm or lever arm in that direction. The moment arm is the perpendicular distance from the pivot point (in this case, the hinge) to the line of action of the force. When you push or pull along the hinge, the moment arm becomes zero, resulting in zero torque.

Do you know? (Cantab)

If two children of different weights sit on opposite ends, the heavier child will go down, and the lighter one will go up. However, if the lighter child sits farther from the center (pivot), the seesaw can balance. This is because the torques from both sides are balanced, even if the forces (weights of the children) are different. No rotation is produced when torque balances each other.

Science Tidbits (NBF)

However moment arm 'd' and force 'F' is not always perpendicular, in this situation we have to extend the line of action of force applied 'F' and take the moment arm 'd' as perpendicular distance from the axis of rotation to the line of action of force.

Past to Present (Cantab)

The mechanical calculator was invented in the 17th century. The device was used for addition and subtraction. Figure 6.9 shows a mechanical calculator from the 1950s The device makes use of the turning effects of forces to work. The crank handle is turned to create a turning force that rotates the pin-wheels and other components perform the basic mathematical functions. Today, we have electronic calculators that are smaller, lighter and easier to use.

Important Information (Cantab)

Torque has the same effect in rotational motion as force has in linear motion. Force produces acceleration in linear motion whereas torque produces acceleration in rotational motion.

CAN YOU TELL? (NBF)

Is there any difference between centre of mass and centre of gravity? When would the centre of mass of the object be different from its centre of gravity?

The centre of mass and centre of gravity of an object are the same when the object is in a uniform gravitational field. However, if the object is in a non-uniform gravitational field, such as

near a massive object like a planet or moon, the COM and COG can differ. This occurs because the gravitational force acting on different parts of the object can vary in strength and direction.

Examples of when COM and COG might differ include:

A spacecraft in orbit around a planet: The COM is at the centre of the spacecraft, but the COG is slightly displaced towards the planet due to the stronger gravitational force.

An object on an inclined plane: The COM is at the centre of the object, but the COG is slightly displaced down the incline due to the component of gravity acting along the incline.

Key Facts (Cantab)

Forces influence motion, and when applied at different positions on a body, they can cause a turning effect, known as a moment. For a body in balance, its centre of gravity must be directly above or below the pivot point, ensuring that the net movement due to gravity is zero.

Do you know? (Cantab)

Application of Principle of Moment

The electro principle of moments is used to reduce effort the fslic num located close to the load. This arrangement means a smaller effort can be made to the handles, further from the fulcrum, to lift a relatively larger load due to the dans freeing the fulcrum, which creates a greater turning effect or moment.

Do you know? (Cantab)

You can lean over and touch your toes without falling over only if your center of gravity is above the area bounded by your feet.

Point to Ponder (National Book Foundation)

Does wider tyres increase friction and thus road grip of our car?

seems intuitive that wider tyres will provide more friction, however, the friction is same for manow and wide tyres of same weight. It is because friction does not depend on the area of Compact. The wider tyre simply spreads the weight of the car over more surface area thereby leaving heat and wear.

Similarly treads (traction) on tyres also does not increase friction. These treads are much larger compared to microscopic roughness which lock the contact surfaces together and produce friction while sliding. The treads are made in the tyre only to displace water from the road to avoid skidding. Many racing cars use tires without treads because they race on dry days.

Important Information (Cantab)

Friction results from surface irregularities and mutual attractions (stickiness) between atoms in the surfaces of sliding objects. Even surfaces that appear to be smooth have irregular surfaces when viewed at the microscopic level.

Important Information (Cantab)

It is tempting to think of friction as an unhelpful force that slows movement, but friction can be helpful too. Without friction between surfaces, there would be no grip and it would be impossible to walk, run, or cycle. However, the boot is on the other foot for skiers, snowboarders, and skaters, who minimize friction to slide.

Do you know? Cantab

between the fire and the ground is nearly the same whether the mus Dove of the greater contact area is to reduce heating and wear

Ball bearings:

Do you know? (Cantab)

The axle of a wheel, ball bearings reduce friction between the turning parts. The balls state as the wheel turns, making the surfaces slide more easily. They are lubricated with oil.

Quiz(National Book Foundation)

Two satellites are following one another in the same circular orbit. If one satellite tries to catch another (leading one) satellite, can it be done by increasing its speed?

Ans. No. if the speed of the satellite is somehow increased, its radius will also increase and it will be unable to catch up to the leading satellite.

OR

No, increasing the speed of the chasing satellite will not allow it to catch the leading satellite. In fact, increasing the speed of the chasing satellite will cause it to move to a higher orbit, which will actually increase the distance between the two satellites.

To catch the leading satellite, the chasing satellite needs to decrease its speed, which will cause it to move to a lower orbit and gradually close the distance between the two satellites. This is because the lower orbit has a shorter circumference, allowing the chasing satellite to catch up with the leading satellite.

Important Information (Cantab)

Comet: A comet is a small celestial body in the solar system that, when passing close to the sun, heats up and begins to release gases, a process called outgassing. This produces a visible atmosphere or coma, and sometimes also a tail. These phenomena are due to the effects of solar radiation and the solar wind acting upon the nucleus of the comet. Comet nuclei are composed of an amalgamation of rock. dust, water ice, and frozen gases such as carbon dioxide, carbon monoxide, methane, and ammonia.

Chapter 5 : Pressure and Deformation in Solids

Do you know? (Cantab)

Bending occurs when forces act perpendicular to the length of the object whereas twisting occurs when forces act parallel to surfaces of the object.

Key Facts (Cantab)

- A change of shape caused by forces is called a deformation.
- Changing the shape of an object requires two or more forces acting in different directions.
- The type of deformation an object undergoes depends on the direction of the forces and where they act on the object.

Key Facts (Cantab):

- Applying a force to a spring causes it to extend or contract.
- The increase in length of an object is known as its extension.
- The extension of a spring is directly proportional to the force applied.
- The elastic limit is the maximum limit to which a material can be stretched or compressed without permanently changing its shape. Beyond this point, the material will not return to its original form when the force is removed.

Key facts (Cantab)

Do you know that the gradient of the linear part of the force-extension graph for a spring is equal to spring constant.

Do you know? (Cantab)

Robert Hooke, one of England's greatest scientists, was the first to propose a wave theory of light and the first to describe the cell (for which he became known as the father of microscopy). As an artist and surveyor, he helped Christopher Wren rebuild London after the great fire in 1666. As a physicist, he collaborated with Robert Boyle Hooks's death, Isaac Newton became president of the Royal Society, and he jealously destroyed everything he could of Hooke's work. No paintings or likenesses of Robert Hooke survive today.

Key Facts (Cantab)

- 1. Increasing the area reduces the pressure, which can be useful in some situations.
- 2. Reducing the area can be useful if you need a large pressure.

Do you know? (Cantab)

Although the weight of both blocks is the same, the upright block exerts greater pressure against the table.

Do you know? (Cantab)

Walking on mud:

Some animals need to travel across mud, sand or other soft surfaces. Wading birds need their flat feet to reduce the pressure on the ground. This means that they do not do so much when they have to walk over a soft surface.

Do you know? (Cantab)

Pressure and Bikes:

Bicycles made for riding on streets have thin tires. Bicycles made for riding on dirt or mud have thick tires to distribute weight (force) over a large area to reduce the pressure.

Expected SLO Question:

Air is pumped out of a sealed can using a vacuum pump. Explain how this experiment is an application of atmospheric pressure.

Ans: Before the air was pumped out, the pressure inside the can was equal to that outside (atmospheric) pressure. As the air is pumped out, a partial vacuum of very low pressure forms inside the can and immediately the external atmospheric pressure crushes the can. It will only happen if the material of the car is thin or flexible.

Expected SLO Question: How does a suction cup get its sticking power?

Ans: A suction cup adheres to surfaces through atmospheric pressure. When the cup is pressed against a surface and the air inside is expelled, a vacuum is created between the cup and the surface. The external atmospheric pressure then pushes the cup against the surface, creating a tight seal and providing the sticking power.

Point to Ponder (National Book Foundation)

Why is it difficult to cook food at high altitudes?

Ans: As altitudes increase and atmospheric pressure decreases, the boiling point of water decreases. To compensate for the lower boiling point of water, the cooking time must be increased. Turning up the heat will not help cook food.

Key Facts (Cantab)

The atmosphere. Air is more compressed at sea level than at higher altitudes. Like feathers in a huge pile, what is at the bottom is more squashed than what is nearer the top. 1 atm 101.3 kPa

Do you know? (Cantab)

The weight of bearing down on a I m surface at sea level is about 100,000 N surface at sea level is about 10 Nm or about 100 kPa.

Important Information (Cantab)

A bar equals 100,000 pascals and standard atmospheric pressure is about 29.92 inches of mercury and 101.3 millibars. Both bars and inches of mercury are units to express atmospheric pressure in different measurement systems-metric and imperial respectively