Quizzes (Fall 2021)

PHYS 203A: College Physics

Due date: At 12:30 PM before each class, on D2L

Instructions

- Assessment of quizzes does not look for correctness. Instead, it expects you to be critical and creative.
- The questions are often left open ended. Thus, it is not recommended to spend more than ten minutes on a question. You are encouraged to ponder about it though.
- After completion, scan the pages as a single PDF file, and submit the file on D2L (under Assessments → Assignments).

Questions

(**Q-0817:**) The following video titled 'Powers of Ten' is a 1977 educational film describing the relative scale of the universe, by Charles and Ray Eames.

https://youtu.be/0fKBhvDjuy0

Can you imagine a length smaller and larger than the ones mentioned in the video?

(**Q-0819:**) Is area of a rectangle a scalar quantity or a vector quantity? Is time a scalar quantity or a vector quantity?

(**Q-0824:**) The position of an object moving in a straight line as a function of time is plotted in Figure 1. The slope of the curve in the position-time graph at 3.0 hours is zero. Thus, the velocity of the object at 3.0 hours is zero. Is the acceleration of the object at 3.0 hours zero? If so, explain. If not, why not?

(**Q-0826:**) The kinematic equations are independent of mass. Thus, the time taken to fall a certain distance is independent of mass. The following BBC video captures the motion of a feather and a bowling ball when dropped together inside the world's biggest vacuum chamber.

https://www.youtube.com/watch?v=E43-CfukEgs

This does not imply that it is impossible to determine the mass of planets by observing their motion in the sky. Why not?

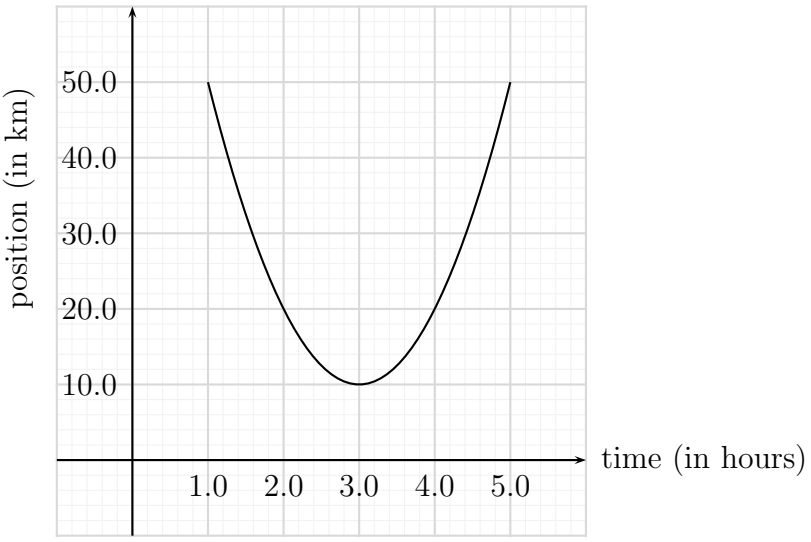

Figure 1: Problem Q-0824.

(**Q-0831:**) The following video by National Science Foundation, USA,

https://youtu.be/HB4ws7RoA3M

clarifies how the vertical and horizontal components of velocity change on the trajectory of a projectile motion.

(a) What is the vertical component of velocity at the highest point in projectile motion?

(b) What is the horizontal component of velocity at the highest point in projectile motion?

(c) What is the speed (magnitude of velocity) at the highest point in projectile motion?

(**Q-0902:**) The following video by National STEM Centre, United Kingdom,

https://youtu.be/z8S0_SHqoeY

demonstrates a counterintuitive feature in projectile motion. Next, ponder the following. In a room devoid of air a stuntman and a bullseye (target) are released from rest from the same height simultaneously. During the fall, the stuntman throws a ball horizontally towards the target. Is the ball expected to hit the target? If yes, explain. If not, why not?

(**Q-0907:**) The following video by Mythbusters

https://youtu.be/ZH7GpYJoptU

shows how a soccer ball shot backwards from a car with a velocity opposite to the velocity of the car falls. What is the relative velocity of the ball with respect to the truck right after it is fired?

(**Q-0914:**) The following video by North Carolina School of Science and Mathematics

https://youtu.be/MdrcyJN7Ie4?t=76

asks a question at time 1:16 minutes concerning spring scales. If you hang two equal masses on the two ends of a spring scale, what will the spring scale measure? What if the masses are not equal? Here are the related videos:

Part 1: https://youtu.be/gO2iwVG8OgA
Part 2: https://youtu.be/MdrcyJN7Ie4
Part 3: https://youtu.be/YTPOEKHEBXY

(**Q-0916:**) Newton's third law states that for every action there is an equal and opposite reaction. The following video by Video From Space

https://youtu.be/ZkVU-bj9bDk

demonstrates this in the International Space Station. Why did Astronaut Mark Vande Hei not accelerate significantly when he pushed on the basketball?

(**Q-0921:**) A tank filled with water is being transported in a truck. The water level in the tank is observed to be flat while the truck is at rest. Will the water level in the tank slope forward, slope backward, or stay flat, when the truck is moving with uniform velocity along a straight road? The following video by Mr. Woodward

https://youtu.be/jakHjtvjT3Q

demonstrates this effect.

(**Q-0923:**) The following video produced by the international television program Curiosity Show, based in Australia,

https://youtu.be/fwpZurI3oDg

demonstrates the effect of friction on moving cars. Since friction is necessary for motion would it be correct to conclude that friction acts in the forward direction, along the direction of velocity?

(**Q-0928:**) Earth rotates around its axis. So, does a flight against the direction of rotation take longer than a flight in the direction of rotation? Check the time of flight from New York City to Los Angeles and from Los Angeles to New York City. Explain.

(**Q-0930:**) Read about the amusement ride Gravitron at

https://en.wikipedia.org/wiki/Gravitron

Look up videos posted on social media of the ride. Briefly explain the physics of the ride.

(**Q-1005:**) The following YouTube video by 3RDFlix

https://youtu.be/eGZWVwcaq0U

describes banking of roads. While taking a turn a car tends to skid outward if it goes too fast, then, do you expect it to slide inward if it goes too slow?

(**Q-1012:**) The normal force is always pointed normal to a surface. What is the work done by a normal force acting on a block of mass sliding down an incline plane? Under what circumstances can a normal force do non-zero work?

(**Q-1014:**) You climb up a stair and return back to where you started. What is the work done by the gravitational force acting on you during the round trip?

(**Q-1019:**) The following video by North Carolina School of Science and Mathematics

https://youtu.be/fdeH6Ksedwk

illustrates the idea of impulse. Similarly, argue why hail (versus water of same size) causes more damage to a surface.

(**Q-1021:**) The following video by North Carolina School of Science and Mathematics

https://youtu.be/ajTyhbvMEAg

explains how stability depends on center of mass. Give an example of an object whose center of mass is outside the object.

(**Q-1026:**) The following video by Khan Academy

https://youtu.be/h5BmWo5_sc8

shows that an arbitrary rotation can be described using a single vector. The direction of the vector represents the axis of rotation, and magnitude of the vector is equal to the amount of rotation about the axis. Are rotations commutative? That is, if you make two independent rotations about, say, perpendicular axes, does the order of rotations matter?

(**Q-1028:**) The following video by Visual Physics

https://youtu.be/WSfQwt2nmkg

describes the definition of torque. Determine the torque due to the normal force while a sphere is rolling on a surface.

(**Q-1102:**) The following video by North Carolina School of Science and Mathematics

https://youtu.be/lk_Pwu7nf1U

describes the role of rotational inertia in balancing acts. In the balancing act of the video which line represents the axis of rotation?

(**Q-1109:**) Inertia associated with translational motion is governed by mass. The rotational inertia is governed by both mass and the radial distribution of the mass about the axis of rotation. The following video by North Carolina School of Science and Mathematics illustrates how the rotational inertia affects rolling motion on an incline,

https://youtu.be/CHQOctEvtTY.

If you roll a raw egg and a hard-boiled egg (of the same mass) down an incline, which of them will reach the bottom of incline first?

(**Q-1116:**) The following video by TED-Ed

https://youtu.be/l5VgOdgptRg

describes how conservation of angular momentum is used in ballet. While spinning on your toes how does your angular velocity change when you pull your arms inward?

(**Q-1118:**) The following video by Spacedock

https://youtu.be/Gu4vA2ztgGM

illustrates the concept of Lagrange points. The James Webb Space Telescope (JWST), scheduled to be launched in 2021, will be the formal successor to the Hubble Space Telescope (HST). Unlike HST, JWST will not orbit Earth. Instead it will be stationed at the $L2$ Lagrange point of the Earth-Sun system. Why is the $L2$ Lagrange point a convenient location for space telescopes?

(**Q-1130:**) The following video by UNSW Physics

https://youtu.be/aN91GyEcB3E

explains escape velocity. Compare the orbital velocity of the International Space Station with the escape velocity of Earth.

(**Q-1202:**) Last lecture for the course. No quiz.