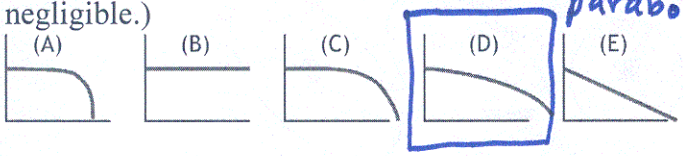
ISP 209 Exam #1

1/ What force or torque maintains the 24-hour rotation of the Earth?
(A) force of gravity
(B) force of angular momentum
(C) gravitational torque of the sun and moon
(D) inertial torque
(E) no force nor torque

no force, just inertia

2/ Throw a stone as hard as you can horizontally. Which curve below describes the motion of the stone after it leaves your hand? (Air resistance is negligible.)



parabola

3/ A man working on a roof at a height of 15 m drops a nail over the edge. Calculate the time for the nail to fall to the ground.
(A) 1.63 s (B) 1.75 s (C) 1.84 s
(D) 1.47 s (E) 1.91 s

$D = \frac{1}{2} g t^2$

4/ For the nail in Question 3, calculate the speed when the nail hits the ground.
(A) 17.2 m/s (B) 16.3 m/s (C) 12.7 m/s
(D) 13.6 m/s (E) 18.4 m/s

$v = gt$

5/ Galileo's ideas in physics were rejected by the Aristotelian philosophers, because …
(A) Galileo was not qualified to criticize Aristotle
(B) The philosophers were not willing to test their theories by experiments
(C) Aristotle's philosophy had been proven for centuries
(D) Galileo relied on mathematics instead of philosophy.
(E) Galileo was a dangerous heretic.

Instead they relied on "common sense" and "philosophy"

$F = ma$, $a = \frac{\Delta v}{\Delta t}$

6/ In a drag race, a car accelerates from 0 m/s to 40 m/s in 3 seconds. The mass of the car is 800 kg. Calculate the force on the car as it accelerates.
(A) 9,450 N (B) 12,800 N
(C) 8,540 N (D) 11,200 N (E) 10,700 N

7/ A small steel sphere (mass m = 20 grams) is dropped into a bottle of molasses. It will descend through the molasses with constant velocity. Which statement best describes the force F on the sphere?
(A) The force F is proportional to m, so F is small because m is small.
(B) The force F is less than mg because the molasses slows the motion.
(C) The force F is equal to 0.
(D) The force F is less than mg because of friction, but F is not 0 so the ball descends.

constant velocity → force is 0.

8/ A satellite in a geosynchronous orbit is at distance $r = 6.62\,R$ from the center of the Earth, where R = radius of the Earth = 6.4×10^6 m. The weight of the satellite on the surface of the Earth would be 981 N. Calculate the force of gravity on the satellite in orbit.
(A) 22.4 N (B) 23.5 N (C) 24.7 N
(D) 21.5 N (E) 25.3 N

$F \propto \frac{1}{r^2}$

9/ In a ballistics test, a bullet is shot into a wood block. The bullet slows and stops in the wood; the block is knocked forward. Compare the forces:
(A) The bullet exerts a greater force than the block, because the bullet is moving before it strikes the block.
(B) The block exerts a greater force than the bullet, because the block is much heavier. Newton's
(C) The two forces have the same magnitude. 3rd
(D) More information is needed to compare the forces, depending on the speed and mass of the bullet. law
(E) The bullet does not exert a force because it penetrates into the wood.

10/ In a ballistics test, a bullet is shot into a wood block and comes to rest imbedded in the wood. The block is knocked forward, with a speed that is measured. Data for the test are listed below. Calculate the speed of the bullet before it strikes the block. [Hint: Momentum is conserved.]

$(M+m)V_2 = mv_1$

Mass of the block	0.50 kg
Mass of the bullet	0.01 kg
Final speed of the block	2.0 m/s

(A) 85 m/s (B) 121 m/s (C) 93 m/s
(D) 116 m/s (E) 102 m/s

11/ In which year was Galileo's trial for heresy?
(A) 1492 (B) 1543 (C) 1564
(D) 1633 (E) 1642

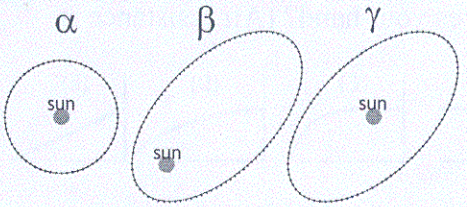
12/ The mean distance from the sun to the Earth is 1 AU (astronomical unit). The period of revolution of the planet Uranus around the sun is 84 years. Calculate the mean distance from the sun to Uranus.
(A) 19.2 AU (B) 20.2 AU (C) 21.4 AU
(D) 18.6 AU (E) 21.9 AU

$T^2 = a^3 \Rightarrow a = T^{2/3}$

13/ The asteroid ***Eros*** was discovered in 1898. The parameters of its orbit are r_1 = perihelion distance = 1.133 AU, and r_2 = aphelion distance = 1.783 AU. Calculate the period of revolution of Eros around the sun.
(A) 1.54 yr (B) 1.45 yr (C) 1.83 yr
(D) 1.76 yr (E) 1.67 yr

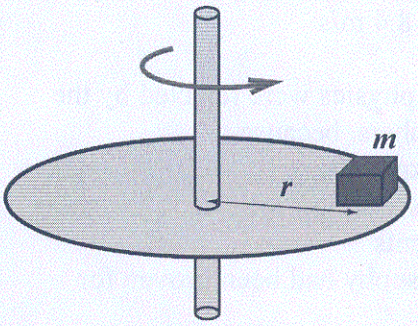
$T^2 = a^3$
$T = a^{3/2}$

14/ Which curve or curves (shown below) could be the orbit of a ***comet***?
(A) α or γ (B) α, β, or γ (C) β only
(D) β or γ (E) γ only



orbit is an ellipse with sun at one focal pt.

15/ A block (mass m = 1 kg) sits on a rotating disk (radius r = 1 m) as shown below. The period of revolution of the disk is 1 s. Calculate the frictional force between the block and the disk surface, if the block does not slide on the surface.
(A) 34.9 N (B) 39.4 N (C) 43.9 N
(D) 42.7 N (E) 47.2 N



$F = ma = m\,v^2/r$
and $v = \frac{2\pi r}{T}$