This print-out should have 14 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering. The due time is Central time.

Math review for vectors 06

03:10, trigonometry, numeric, > 1 min, normal.

001

Consider the two vectors $\vec{M} = (a, b) = a\,\hat{\imath} + b\,\hat{\jmath}$ and $\vec{N} = (c, d) = c\,\hat{\imath} + d\,\hat{\jmath}$, where $a = 4$, $b = 4$, $c = -1$, and $d = 1$. a and c represent the x-displacement and b and d represent the y-displacement in a Cartesian xy co-ordinate system.

Note: $\hat{\imath}$ and $\hat{\jmath}$ represent unit vectors (*i.e.* vectors of length 1) in the x and y directions, respectively.

What is the value of the scalar product $\vec{N} \cdot \vec{N}$?

002

What is the value of the scalar product $\vec{M} \cdot \vec{N}$?

Torque About the Origin

11:05, trigonometry, numeric, > 1 min, normal.

003

A particle is located at the vector position

$$\vec{r} = (1\text{ m})\,\hat{\imath} + (3\text{ m})\,\hat{\jmath}$$

and the force acting on it is

$$\vec{F} = (3\text{ N})\,\hat{\imath} + (2\text{ N})\,\hat{\jmath}.$$

What is the magnitude of the torque about the origin? Answer in units of N m.

004

What is the magnitude of the torque about the point having coordinates $[a, b] = [(0\text{ m}), (6\text{ m})]$? Answer in units of N m.

Vector Product 03

03:11, trigonometry, numeric, > 1 min, normal.

005

Given: Two vectors

$$\vec{A} = A_x\,\hat{\imath} + A_y\,\hat{\jmath}$$

and

$$\vec{B} = B_x\,\hat{\imath} + B_y\,\hat{\jmath},$$

where $A_x = -3$, $A_y = 4$, $B_x = 2$, and $B_y = 3$.

Find the z component of $\vec{A} \times \vec{B}$.

006

Find the angle between $\vec{A}$ and $\vec{B}$. Answer in units of °.

Flagpole Tip Breaks Off

11:06, trigonometry, numeric, > 1 min, normal.

007

A ball having mass 3 kg is fastened at the end of a flagpole that is connected to the side of a tall building at point P . The length of the flagpole is 4 m, and it makes an angle 1.0472 rad (60°) with the horizontal.

The acceleration of gravity is 9.8 m/s^2 .

If the ball becomes loose and starts to fall, determine the magnitude of its angular momentum after 10 s about P. Neglect air resistance.

Momentum of Airplane

11:06, trigonometry, numeric, > 1 min, normal.

008

An airplane of mass 900 kg flies level to the ground at a constant speed of 175 m/s relative to the Earth. An observer on the ground along the path of the plane sees the plane a distance 11033.8 m away at an angle above the horizontal of 65 °.

What is the magnitude of the airplane's angular momentum relative to a ground observer directly below the airplane? Answer in units of kg m^2/s.

Momentum of Moon

11:06, trigonometry, numeric, > 1 min, normal.

009

There is a moon orbiting an Earth-like planet. The mass of the moon is 7.35×10^{22} kg, the center-to-center separation of the planet and

the moon is 384000 km, the orbital period of the moon is 27.3 days, and the radius of the moon is 1740 km.

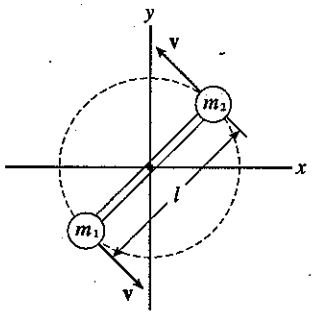
What is the angular momentum of the moon about the planet? Answer in units of $\mathrm{kg\,m^2/s}$.

Rotating Weighted Rod

11:07, trigonometry, numeric, > 1 min, normal.

010

A light, rigid rod $l = 1$ m in length rotates in the xy plane about a pivot through the rod's center. Two particles of masses $m_1 = 8$ kg and $m_2 = 3$ kg are connected to its ends.



Determine the angular momentum of the system about the origin at the instant the speed of each particle is $v = 2$ m/s. Answer in units of $\mathrm{kg\,m^2/s}$.

Serway CP 08 46

11:10, trigonometry, numeric, > 1 min, normal.

011

Halley's comet moves about the Sun in an elliptical orbit, with its closest approach to the Sun being 0.59 A.U. and its greatest distance from the Sun being 35 A.U. (1 A.U. = the Earth-Sun distance). The comet's speed at closest approach is 54 km/s.

What is its speed when it is farthest from the Sun, assuming that its angular momentum about the Sun is conserved? Answer in units of km/s.

Slingshot Momentum

11:06, trigonometry, numeric, > 1 min, normal.

012

At a certain instant the position of a stone in a sling is given by $x = 1.7\ \mathrm{m}\,\hat{\imath}$. The linear momentum $\vec{\mathbf{p}}$ of the stone is $12\ \mathrm{kg\,m/s}\,\hat{\jmath}$.

Calculate the magnitude of its angular momentum: $\vec{\mathbf{L}} = \vec{\mathbf{r}} \times \vec{\mathbf{p}}$ Answer in units of $\mathrm{kg\,m^2/s}$.

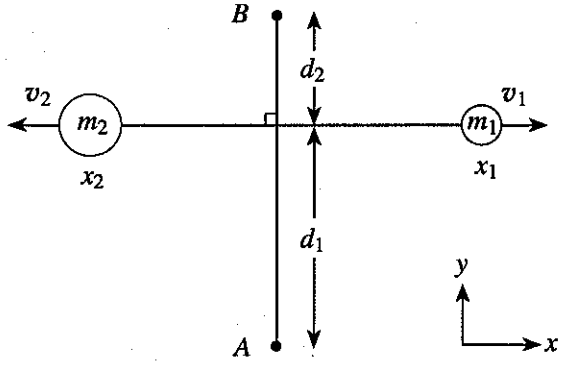
Total Angular Momentum

11:07, trigonometry, numeric, > 1 min, normal.

013

Two particles move in *opposite* directions along a straight line. Particle 1 of mass $m_1 = 25$ kg at $x_1 = 25$ m moves with a speed $v_1 = 30$ m/s (to the right), while the particle 2 of mass $m_2 = 75$ kg at $x_2 = -20$ m moves with a speed $v_2 = -25$ m/s (to the left).

Given: Counter-clockwise is the positive angular direction.



What is the total angular momentum of the system about the z-axis relative to point A along y axis if $d_1 = 15$ m? Answer in units of $\mathrm{kg\,m^2/s}$.

014

What is the total angular momentum of the system about the z-axis relative to point B along y axis if $d_2 = 25$ m? Answer in units of $\mathrm{kg\,m^2/s}$.