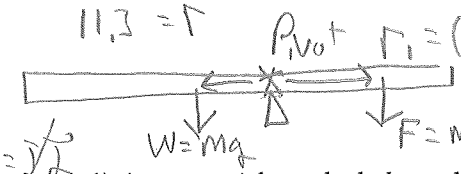


Name KEY

15 Questions Exam 3

1) A meter stick can be balanced by placing a support at the 50.0-cm mark. If a mass of 50.0 g is attached to the stick at at the 90.0-cm mark, the stick can be balanced by placing a support at the 61.3-cm mark. What is the mass of the meter stick? NOTE: The 'g' here is grams.

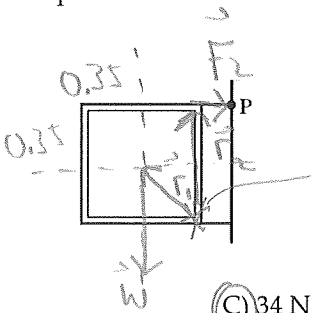
A) 32.6 g B) 178 g C) 73.4 g D) 89.7 g (E) 127 g

2) A golf club exerts an average force of 1000 N on a 0.045-kg golf ball which is initially at rest. The club is in contact with the ball for 1.8 ms. What is the speed of the golf ball as it leaves the tee?

A) 45 m/s B) 50 m/s C) 35 m/s D) 30 m/s (E) 40 m/s

3) A uniform sign is supported at P as shown in the figure. If the sign is a square 0.7 m on its side and its mass is 7.0 kg, what is the magnitude of the horizontal force that P experiences?

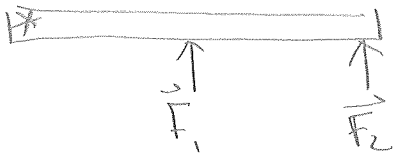
HINT: Take the axis of rotation to be at the lower right corner of the square. Solve for the force acting horizontally on the upper right corner of the square.



A) 24 N B) 98 N (C) 34 N D) 0 N

4) Two equal forces are applied to a door. The first force is applied at the midpoint of the door; the second force is applied at the doorknob. Both forces are applied perpendicular to the door. Which force exerts the greater torque?

A) both exert equal non-zero torques
B) the first at the midpoint
C) both exert zero torques
(D) the second at the doorknob
E) additional information is needed

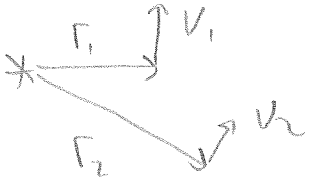


5) A fan is turned off, and its angular speed decreases from 10.0 rad/s to 6.3 rad/s in 5.0 s. What is the magnitude of the angular acceleration of the fan?

A) 0.37 rad/s^2 B) 11.6 rad/s^2 (C) 0.74 rad/s^2 D) 0.86 rad/s^2 E) 1.16 rad/s^2

6) Two children are riding on a merry-go-round. Child A is at a greater distance from the axis of rotation than child B. Which child has the larger tangential speed?

A) Child B
B) They have the same zero tangential speed.
(C) Child A
D) They have the same non-zero tangential speed.
E) There is not enough information given to answer the question.



$\vec{I} = -1 \times 10^4$ *

7) A 1000-kg car is traveling at 20.0 m/s toward the north (let that be the +y direction). During a collision the car receives an impulse of 1.00×10^4 N•s toward the south. What is the velocity of the car after the impulse is applied to the car?

A) 10.0 m/s south
B) 0.00 m/s
C) 20.0 m/s north
D) 10.0 m/s north ✓
E) 30.0 m/s north

$\vec{p}_{initial} = 1000 * 20\,\hat{j} = +20\,000\,\hat{j}$

$\vec{p}_{final} = 1000\,v_f\,\hat{j}$

$\vec{I} = \Delta\vec{p}$

$-1 \times 10^4 = 1000\,v_f - 20000 \quad \therefore v_f = +10$ *

8) Consider a solid sphere of radius R and mass M rolling without slipping. At any instant during the motion, which form of kinetic energy is larger, translational or rotational?

A) Rotational kinetic energy is larger.
B) Translational kinetic energy is larger.
C) Both are equal.
D) You need to know the speed of the sphere to tell.
E) You need to know the acceleration of the sphere to tell.

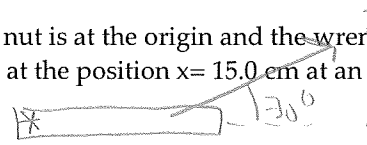
$KE_{trans} = \frac{1}{2}mv^2$

$KE_{rot} = \frac{1}{2}I\omega^2 = \frac{1}{5}mv^2$

$I = \frac{2}{5}mR^2 \qquad \omega^2 = \frac{v^2}{R^2}$

This is larger

9) A wrench is acting on a nut. The nut is at the origin and the wrench extends from the nut along the +x axis. A force of 150 N acts on the wrench at the position x= 15.0 cm at an angle of 30.0°. What is the torque the wrench exerts on the nut?



$\tau = (0.15)(150)\sin(30) = 11.3$ (CCW)

A) 1949 N•m B) 11.3 N•m ✓ C) 19.5 N•m D) 2250 N•m E) 22.5 N•m

10) If the torques on an object add up to zero, _____.

A) the object is at rest.
B) the object cannot be rotating, but might have a translational motion.
C) the object could have a translational acceleration but it could not be rotating.
D) the forces on the object also add up to zero.
E) the object could be rotating and have a translational accleration.

Not all forces will produce torques about a given axis.

$\sum\vec{\tau} = I\vec{\alpha} = 0$

$\therefore \alpha = 0$

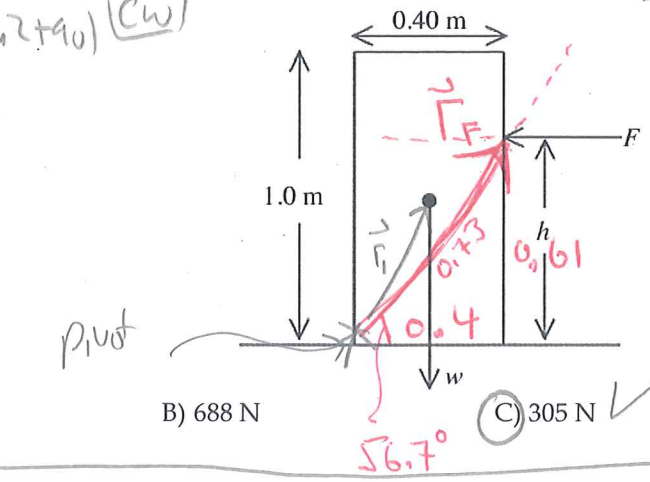
Says nothing about translational motion.

Could be static rotational equilibrium (OR) dynamic rotational equilibrium

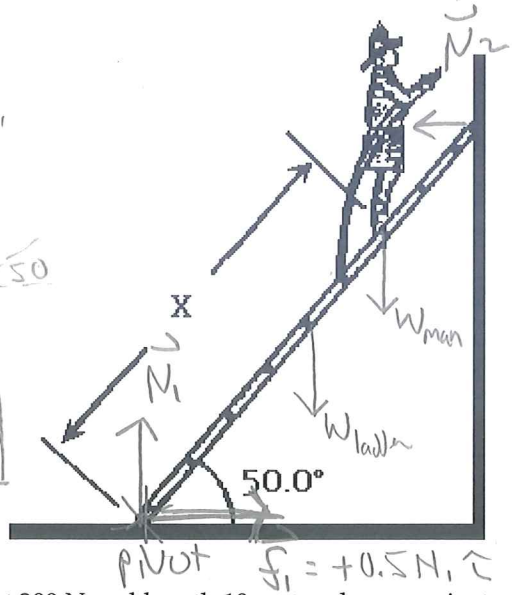
NOTE: this is EXACTLY how we used these terms for $\sum F = ma = 0$

11) In the figure, a uniform rectangular crate 0.40 m wide and 1.0 m tall rests on a horizontal surface. The crate weighs 930 N, and its center of gravity is at its geometric center. A horizontal force *F* is applied at a distance *h* above the floor. If *h* = 0.61 m, what minimum value of *F* is required to make the crate start to tip over? Static friction is large enough that the crate does not start to slide.

HINT: Take the axis of rotation to be the lower left corner of the crate.



A) 763 N B) 688 N C) 305 N ✓ D) 413 N



12) In the figure, a ladder of weight 200 N and length 10 meters leans against a smooth wall (no friction on wall). A firefighter of weight 600 N climbs a distance x up the ladder. The coefficient of friction between the ladder and the floor is 0.5. What is the maximum value of x if the ladder is not to slip?

HINT: Sum the torques about an axis of rotation located at the bottom of the ladder. Then apply the translational form of the 2nd law.

A) 6.28 m ✓ B) 6.04 m C) 8.44 m D) 3.93 m E) 5.00 m

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13) A solid disk is released from rest and rolls without slipping down an inclined plane that makes an angle of 25.0° with the horizontal. What is the speed of the disk after it has rolled 3.00 m, measured along the inclined plane?

A) 4.07 m/s B) 6.29 m/s C) 3.53 m/s D) 5.71 m/s E) 2.04 m/s

14) If a constant net torque is applied to an object, that object will _____.

A) having a decreasing moment of inertia.
B) rotate with constant linear velocity.
C) rotate with constant angular velocity.
D) rotate with constant angular acceleration.
E) having an increasing moment of inertia.

$\sum \vec{\tau} = I\vec{\alpha}$

constant $\Rightarrow$ would mean constant

15) A wheel accelerates from rest to 59 rad/s at a rate of 74 rad/s^2. Through what angle (in radians) did the wheel turn while accelerating?

A) 24 rad ✓ B) 30 rad C) 19 rad D) 48 rad

(1) $\theta(t) = \frac{1}{2}(74)t^2 = 37t^2$

(2) $\omega(t) = 74t$

@ $t = t_1, \omega_1 = 59, \theta_1 = ?$

(2) $\Rightarrow 59 = 74t_1$

$\therefore t_1 = 0.80$

(1) $\Rightarrow \theta_1 = 37(0.8)^2 = 23.5$ radians ✓