PHYS 105 · Chapter 10: Rotation

Final-Exam Review — questions from PSU past final exams (Terms 182 – 242)

Constant: g = 9.81 m/s² · The source of each question is shown in [brackets].

Part 1: Multiple-Choice Questions (20)

Indicate the answer choice that best completes the statement or answers the question.

10.1 Rotational Variables

Q1. *The angular velocity of an object is negative when the object is:* **[Final 232]**

A *rotating clockwise*
B *rotating counterclockwise*
C *not rotating*
D *rotating at constant speed*

Q2. *A compact disc rotates at 210 revolutions per minute (rpm). What is its angular speed in rad/s?* **[Final 221]**

A *11.0 rad/s*
B *22.0 rad/s*
C *45.3 rad/s*
D *69.1 rad/s*

Q3. *An electric motor turns at 601 rpm. What is its angular speed in rad/s?* **[Final 231]**

A *62.9 rad/s*
B *72.8 rad/s*
C *101 rad/s*
D *222 rad/s*

Q4. *Express an angular speed of 44 rpm in rad/s.* **[Final 232]**

A *4.61 rad/s*
B *276 rad/s*
C *420 rad/s*
D *44 rad/s*

Q5. *An object rotates at 800 revolutions per minute (rpm). What is its angular speed ω?* **[Final 241]**

A *14.0 rad/s*
B *1600 rad/s*
C *83.8 rad/s*
D *98.2 rad/s*

Q6. *A bike wheel takes 3 seconds to complete one revolution. What is the wheel's angular speed?* **[Final 222]**

A *2.09 rad/s*
B *1.28 rad/s*
C *3.37 rad/s*
D *0.84 rad/s*

10.2 Constant Angular Acceleration

Q7. *A wheel rotates at an initial speed of 33 rpm and comes to a complete stop in 20 seconds. Calculate its angular acceleration α.* **[Final 242]**

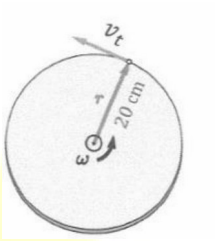
A -11π rad/s²
B 11π rad/s²
C $-11\pi/200$ rad/s²
D $11\pi/200$ rad/s²

10.3 Linear and Angular Variables

Q8. *A ventilation fan has blades of radius 25 cm rotating at 20 rpm. What is the tangential speed of each blade tip?* **[Final 242]**

A *0.52 m/s*
B *2.0 m/s*
C *5.0 m/s*
D *20 m/s*

Q9. *An object moves on a circular path of radius 20 cm. If its tangential speed increases uniformly from 0 to 25 m/s in 0.50 s, find its angular acceleration α.* **[Final 241]**



A *250 rad/s²*
B *150 rad/s²*
C *100 rad/s²*
D *500 rad/s²*

Q10. *What is the centripetal acceleration of an object rotating on a circle of radius 8 cm at an angular speed of ω = 15 rad/s?* **[Final 241]**

A *15 m/s²*
B *64 m/s²*
C *28 m/s²*
D *18 m/s²*

Q11. *The Moon moves around the Earth with an angular speed of 2.65×10^{-6} rad/s. The Earth–Moon distance is 384,400 km. Find the centripetal acceleration of the Moon.* **[Final 232]**

A *2.4×10^{-6} m/s²*
B *1.83×10^{-20} m/s²*
C *2.7×10^{-3} m/s²*
D *3.8×10^{5} km/s²*

10.6 Torque

Q12. *If a non-zero net torque is applied to an object, the object will experience:* **[Final 232]**

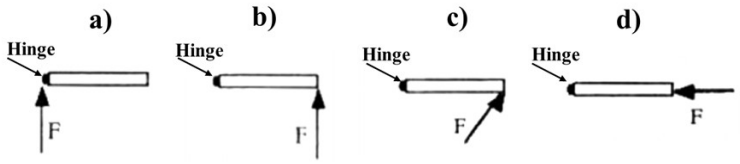
A *a constant angular velocity*
B *an angular acceleration*
C *a constant moment of inertia*
D *an increasing moment of inertia*

Q13. *In which case shown below does the applied force F create the largest torque on the door?* **[Final 241]**



A *Case a*
B *Case b*
C *Case c*
D *All are the same*

Q14. *In which case shown below does the applied force F produce the largest torque on the door? (Door viewed from above, hinge on the left.)* **[Final 242]**

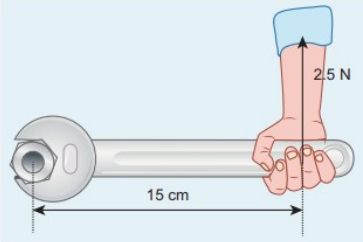


A *Case a*
B *Case b*
C *Case c*
D *Case d*

Q15. *A door is 90 cm wide. A tangential force of 2 N is applied at its edge (away from the hinges). Calculate the torque that opens the door.* **[Final 231]**

A *2 Nm*
B *1.8 Nm*
C *180 Nm*
D *2.2 Nm*

Q16. *A 2.5 N force is applied perpendicular to the handle of the spanner, 15 cm from the center of the nut, as shown. Find the torque exerted by the force.* **[Final 221]**



A *37.5 Nm*
B *0.375 Nm*
C *16.7 Nm*
D *0.2 Nm*

Q17. *(Same spanner.) A torque of 0.375 Nm is produced by a force applied perpendicular to the handle, 15 cm from the center of the nut. Find the force.* **[Final 232]**

A *15 N*
B *2.5 N*
C *0.025 N*
D *0.056 N*

Q18. *A 120 N force in the +x direction is applied perpendicular to the top end of a 12 m stick standing vertically. What is the magnitude of the torque about the bottom end of the stick?* **[Final 222]**

A *520 Nm*
B *720 Nm*
C *760 Nm*
D *1440 Nm*

Static Equilibrium

Q19. *The conditions for static equilibrium are:* **[Final 222 · Final 241]**

A $\Sigma F = 0$
B $\Sigma \tau = 0$
C *Both of the above*
D *None of the above*

Q20. *If the net force on an object is zero and the net torque on it is zero, then:* **[Final 221 · Final 232]**

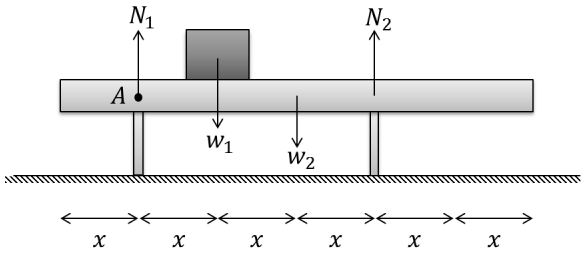
- **A** *the object is in translational equilibrium only.*
- **B** *the object is in static equilibrium.*
- **C** *the object has a constant acceleration.*
- **D** *no forces act on the object.*

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Part 2: Problems (3)

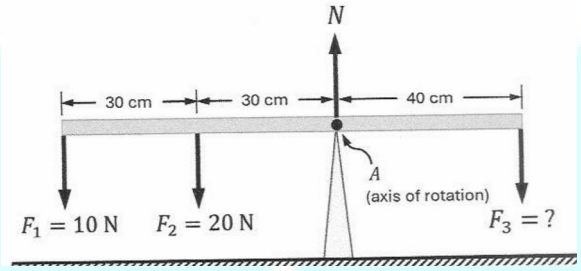
Solve the following problems and show your work in detail.

Problem 1. *A block of mass $m_1 = 4$ kg rests on a uniform plank of mass $m_2 = 8$ kg. The plank is supported by two pillars, as shown, where $x = 0.5$ m. The system is in equilibrium. Take the axis of rotation at the left pillar (point A).* **[Final 182]**



a) *Determine the normal forces N_1 and N_2 exerted on the plank by the pillars.*

Problem 2. *A horizontal ruler stick of negligible mass is supported at point A and is in static equilibrium under three forces: $F_1 = 10$ N, $F_2 = 20$ N and an unknown force F_3, as shown.* **[Final 241]**

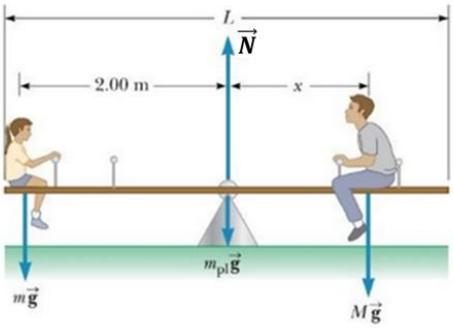


a) *Calculate the net torque caused by F_1 and F_2 about the axis at point A.*

b) *Use rotational equilibrium about A to find F_3.*

c) *Determine the normal force N at point A.*

Problem 3. *A woman of mass m = 55.0 kg sits at the left end of a seesaw — a plank of length L = 4.00 m and mass m_{pl} = 12.0 kg, pivoted at its midpoint.* **[Final 242]**



a) *Calculate the torque caused by the woman's weight about the pivot.*

b) *Find the distance x from the pivot at which a man of mass M = 75.0 kg must sit to balance the seesaw.*

c) *Find the normal force exerted by the pivot on the seesaw.*

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