1. D An object that experiences 120 revolutions per minute experiences 2 revolutions per second; in other words, it rotates with a frequency of 2 Hz. We have formulas relating frequency to angular velocity and angular velocity to linear velocity, so solving this problem is simply a matter of finding an expression for linear velocity in terms of frequency. Angular and linear velocity are related by the formula , so we need to plug this formula into the formula relating frequency and angular velocity:

2. D Frequency and angular velocity are related by the formula , and angular velocity and angular acceleration are related by the formula . In order to calculate the washing machine’s acceleration, then, we must calculate its angular velocity, and divide that number by the amount of time it takes to reach that velocity:

3. B You need to apply the right-hand rule in order to solve this problem. Extend the fingers of your right hand upward so that they point to the 0-second point on the clock face, and then curl them around so that they point downward to the 30-second point on the clock face. In order to do this, you’ll find that your thumb must be pointing inward toward the clock face. This is the direction of the angular velocity vector.

4. D The torque on an object is given by the formula , where F is the applied force and r is the distance of the applied force from the axis of rotation. In order to maximize this cross product, we need to maximize the two quantities and insure that they are perpendicular to one another. Statement I maximizes F and statement III demands that F and r be perpendicular, but statement II minimizes r rather than maximizes it, so statement II is false.

5. C The torque acting on the pendulum is the product of the force acting perpendicular to the radius of the pendulum and the radius, . A free-body diagram of the pendulum shows us that the force acting perpendicular to the radius is . Since torque is the product of and R , the torque is .

6. D The seesaw is in equilibrium when the net torque acting on it is zero. Since both objects are exerting a force perpendicular to the seesaw, the torque is equal to . The 3 kg mass exerts a torque of N · m in the clockwise direction. The second mass exerts a torque in the counterclockwise direction. If we know this torque also has a magnitude of 30g N · m, we can solve for m :

7. E The rotational equivalent of Newton’s Second Law states that . We are told that N · m and I = 1/2 MR 2, so now we can solve for :

8. B At the top of the incline, the disk has no kinetic energy, and a gravitational potential energy of mgh . At the bottom of the incline, all this gravitational potential energy has been converted into kinetic energy. However, in rolling down the hill, only some of this potential energy becomes translational kinetic energy, and the rest becomes rotational kinetic energy. Translational kinetic energy is given by 1 /2 mv 2 and rotational kinetic energy is given by 1 /2 I 2. We can express in terms of v and R with the equation = v/R , and in the question we were told that I = 1/2 mR 2. We now have all the information we need to solve for v :

9. B This is a conservation of momentum question. The angular momentum of the rock as it is launched is equal to its momentum after it’s been launched. The momentum of the rock-basket system as it swings around is:The rock will have the same momentum as it leaves the basket. The angular momentum of a single particle is given by the formula L = mvr . Since L is conserved, we can manipulate this formula and solve for v :Be sure to remember that the initial mass of the basket-rock system is 250 kg, while the final mass of the rock is only 200 kg.

10. C Angular momentum, , is a conserved quantity, meaning that the greater I is, the less will be, and vice versa. In order to maximize angular velocity, then, it is necessary to minimize the moment of inertia. Since the moment of inertia is greater the farther the mass of a body is from its axis of rotation, we can maximize angular velocity by concentrating all the mass near the axis of rotation.