PHY 2053 Final Exam Review

1. The speed of sound is measured to be 342 m/s on a certain day. What is this in km/h?

2. A commuter backs her car out of her garage with an acceleration of $1.40\ m/s^2$.
   (a) How long does it take her to reach a speed of 2.00 m/s?
   (b) If she then brakes to a stop in 0.800 s, what is her deceleration?

3. (a) Calculate the height of a cliff if it takes 2.35 s for a rock to hit the ground when it is thrown straight up from the cliff with an initial velocity of 8.00 m/s.
   (b) How long would it take to reach the ground if it is thrown straight down with the same speed?

4. Suppose a pilot flies $40.0\ \text{km}$ in a direction 60^{o}north of east and then flies $30.0\ \text{km}$ in a direction 15^{o} north of east as shown in **Figure 3.61**. Find her total distance R from the starting point and the direction θ of the straight-line path to the final position.

5. A ball is thrown horizontally from the top of a 60.0-m building and lands 100.0 m from the base of the building. Ignore air resistance.
   (a) How long is the ball in the air?
   (b) What must have been the initial horizontal component of the velocity?
   (c) What is the vertical component of the velocity just before the ball hits the ground?
   (d) What is the velocity (including both the horizontal and vertical components) of the ball just before it hits the ground?

6. Suppose two children push horizontally, but in exactly opposite directions, on a third child in a wagon. The first child exerts a force of 75.0 N, the second a force of 90.0 N, friction is 12.0 N, and the mass of the third child plus wagon is 23.0 kg. (a) Calculate the acceleration.

7. A toboggan slides down a hill and has a constant velocity. The angle of the hill is 10.0° with respect to the horizontal. What is the coefficient of kinetic friction between the surface of the hill and the toboggan?

8. A skier with a mass of 62 kg is sliding down a snowy slope. Find the coefficient of kinetic friction for the skier if friction is known to be 45.0 N.

9. A mass of 108 g is hanging from two massless ropes attached to the ceiling. One rope makes an angle of 50° with the ceiling, while the other makes an angle of 29°. Find the tensions in the two ropes.

10. (a) A 22.0 kg child is riding a playground merry-go-round that is rotating at 40.0 rev/min. What centripetal force must she exert to stay on if she is 1.25 m from its center?

11. (a) What is the radius of a bobsled turn banked at 75.0° and taken at 30.0 m/s, assuming it is ideally banked?
    (b) Calculate the centripetal acceleration.

12. (a) Calculate the centripetal force exerted on a 900 kg car that negotiates a 500 m radius curve at 25.0 m/s. (b) Assuming an unbanked curve, find the minimum static coefficient of friction, between the tires and the road, static friction being the reason that keeps the car from slipping (see Figure 6.12).

13. What is the acceleration due to gravity on the surface of the Moon? (Mass of the Moon = 7.35 x 1022 kg, Radius of the Moon = 1.74 x 106 m)

14. How much work is done on the lawn mower by the person in Figure 7.2
    (a) if he exerts a constant force of 75.0N at an angle 35º below the horizontal and pushes the mower 25.0m on level ground?

15. (a) Calculate the force needed to bring a 950-kg car to rest from a speed of 90.0 km/h in a distance of 120 m (a fairly typical distance for a non-panic stop).
(b) Suppose instead the car hits a concrete abutment at full speed and is brought to a stop in 2.00 m.

16. (a) How high a hill can a car coast up (engine disengaged) if work done by friction is negligible and its initial speed is 110 km/h?

17. (a) What is the mass of a large ship that has a momentum of 1.60×10^9 kg · m/s, when the ship is moving at a speed of 48.0 km/h?

18. A bullet is accelerated down the barrel of a gun by hot gases produced in the combustion of gun powder. What is the average force exerted on a 0.0300-kg bullet to accelerate it to a speed of 600 m/s in a time of 2.00 ms (milliseconds)?

19. What is the velocity of a 900-kg car initially moving at 30.0 m/s, just after it hits a 150-kg deer initially running at 12.0 m/s in the same direction? Assume the deer remains on the car.

20. A 0.240 kg billiard ball that is moving at 3.00 m/s strikes the bumper of a pool table and bounces straight back at 2.40 m/s (80% of its original speed). The collision lasts 0.015 s.
    (a) Calculate the average force exerted on the ball by the bumper.
    (b) How much kinetic energy in joules is lost during the collision?

21. The two children shown in Figure 9.10 are balanced on a seesaw of negligible mass. (This assumption is made to keep the example simple—more involved examples will follow.) The first child has a mass of 26.0 kg and sits 1.60 m from the pivot.
    (a) If the second child has a mass of 32.0 kg, how far is she from the pivot?
    (b) What is Fp, the supporting force exerted by the pivot?

22. Two children push on opposite sides of a door during play. Both push horizontally and perpendicular to the door. One child pushes with a force of 17.5 N at a distance of 0.600 m from the hinges, and the second child pushes at a distance of 0.450 m. What force must the second child exert to keep the door from moving? Assume friction is negligible.

23. Suppose a teenager puts her bicycle on its back and starts the rear wheel spinning from rest to a final angular velocity of 250 rpm in 5.00 s.
    (a) Calculate the angular acceleration in rad/s2.
    (b) If she now slams on the brakes, causing an angular acceleration of 87.3 rad/s2, how long does it take the wheel to stop?

24. During a very quick stop, a car decelerates at 7.00 m/s2
    (a) What is the angular acceleration of its 0.280-m-radius tires, assuming they do not slip on the pavement?
    (b) How many revolutions do the tires make before coming to rest, given their initial angular velocity is 95.0 rad/s?
    (c) How long does the car take to stop completely?
    (d) What distance does the car travel in this time?
    (e) What was the car's initial velocity?

25. A soccer player extends her lower leg in a kicking motion by exerting a force with the muscle above the knee in the front of her leg. She produces an angular acceleration of 30.0 rad/s2 and her lower leg has a moment of inertia of 0.750 kg.m2. What is the force exerted by the muscle if its effective perpendicular lever arm is 1.90 cm?

26. Consider a person who spins a large grindstone by placing her hand on its edge and exerting a force through part of a revolution as shown in Figure 10.17. In this example, we verify that the work done by the torque she exerts equals the change in rotational energy.

(a) How much work is done if she exerts a force of 200 N through a rotation of 1.00 rad(57.3º)? The force is kept perpendicular to the grindstone's 0.320-m radius at the point of application, and the effects of friction are negligible.

(b) What is the final angular velocity if the grindstone has a mass of 85.0 kg? (c) What is the final rotational kinetic energy? (It should equal the work.)