

PHYSICS 191
FINAL EXAM
1995

1. Kirby throws a baseball at an angle of 40° from horizontal, and it lands 60 m away. If he makes an identical throw except at 45° , how far will the ball go?
2. A 2100 kg truck is going East at 12 m/s. It turns North and continues at 11 m/s. What are the magnitude and direction of the change in the truck's momentum?
3. What is the maximum speed for a car to go without sliding around a highway curve of radius 140 m, if the tires and road have a static coefficient of friction of 0.3?
4. Bill, who is running North at 5 m/s, has a completely inelastic collision with Jill who is running South at 5 m/s, and they continue South at 1 m/s. What is Bill's mass m_B in terms of Jill's mass m_J ?
5. If $\mathbf{A} = 3\mathbf{i} + 5\mathbf{j} - 2\mathbf{k}$ and $\mathbf{B} = \mathbf{i} - 2\mathbf{j} - 3\mathbf{k}$, what is the angle between \mathbf{A} and \mathbf{B} ?
6. A sled starts from rest and slides 100 m downward along a hill sloped at 30° below horizontal. It acquires a speed of 20 m/s. How much work was done by friction on the sled?

7. What is the period of oscillation of a 2 kg mass hanging on a spring, if the mass stretches the spring 8 cm when hanging at rest?

8. The coefficient of friction between Teflon and scrambled eggs is about 0.04. What is the smallest angle from horizontal that will cause the eggs to slide across the bottom of a Teflon skillet?

9. A 250 gram basketball hits the floor with a speed of 20 m/s, and rebounds upward at an initial speed of 16 m/s. What impulse acts on the ball during its contact with the floor?

10. A gallon is equivalent to $3.785 \times 10^{-3} \text{ m}^3$, and a meter equals 3.281 ft. How thick is a layer of paint if a gallon of paint covers an area of 460 ft^2 ?

11. Estimate the gravitational force between a small dog and cat 2 m apart.

12. A 10 kg mass is on a frictionless 30° incline, and attached to a 5 kg mass hanging by a string over a pulley, as shown. What will be the acceleration of the masses?

13. The tub of a washing machine is spinning at 5 rev/s. When the lid is lifted, the tub comes to rest in 3 sec. How many revolutions does the tub make while slowing to a stop?

14. A rock is dropped from a 100-m tall building. How much time does it take to fall the last 50 m?

15. The letter E is constructed using four meter sticks: one vertical, three horizontal. Determine the location of the center of mass of the letter.

16. A 700 kg car is travelling at 60 km/hr on a level road. The brakes are used to reduce the car's kinetic energy by 2000 J. What will be the car's reduced speed?

17. What would be your gravitational acceleration at a distance of 2 Earth radii above the *surface* of the Earth?

18. Sue sells seashells by the seashore. From her shop she sees 7 shiny shells 6 steps South, and 6 small shells 7 steps Southwest. How many steps is it from the 7 shiny shells to the 6 small shells?

19. A simple pendulum of length 75 cm is released from an angle of 25° . What will be its speed at the bottom of its swing?

20. A 5 kg sled is dragged 70 m along a horizontal road at constant speed by a rope which exerts a force of 4 N at an angle of 20° above the horizontal. How much work is done on the sled by the rope?

21. An elevator and its load have a combined mass of 1500 kg. Find the tension in the supporting cable if the elevator is accelerating downward at 3 m/s^2 .

22. The letter T is formed from two meter sticks of mass m . What is its rotational inertia for an axis through the bottom end, perpendicular to the plane of the T?

23. A crazed gnat is buzzing around with a position vector $\mathbf{r} = 3t\mathbf{i} + 4t^2\mathbf{j} - t^3\mathbf{k}$. What is the bug's speed at $t = 2$?

24. A bowling ball is used as a pendulum, with the axis of rotation being tangent to the surface of the ball. What is the period of small oscillations of this pendulum?

25. Boris is riding his bike in downtown St. Joseph, approaching a 10 m wide intersection at 3 m/s. When he is 7 m away, the traffic light turns yellow, and it will be red in 4 s. What acceleration does Boris need to hurry across the intersection before the light turns red?