Physics 195 Name _____
Final Test - 120 Points

You need to complete **six 5-point problems** and **six 10-point problems**.
Cross off one 5-point problem and one 10-point problem.

1. A jet plane lands with a speed of 95.0 m/s and can accelerate at a maximum rate of -7.80 m/s^2 as it comes to rest. (a) From the instant the plane touches the runway, what is the minimum time interval needed before it can come to rest? (b) Can this plane land on a small tropical island airport where the runway is 755 m long? Show it. **(5 points)**

Answer box

2. Kathy Kool buys a sports car that can accelerate at the rate of 5.00 m/s^2. She decides to test the car by racing with another speedster, Stan Speedy. Both start from rest, but experienced Stan leaves the starting line 1.00 s before Kathy. Stan moves with a constant acceleration of 3.70 m/s^2, and Kathy maintains an acceleration of 5.00 m/s^2. (a) Find the time it takes Kathy to overtake Stan. (b) Find the distance she travels before she catches him. (10 points)

Answer box

3. While exploring a cave, a spelunker starts at the entrance and moves the following distances. She goes 75 m north, 250 m east, 105 m at an angle 30° north of east, and 165 m south. Find the resultant displacement from the cave entrance. **(5 points)**

Answer box

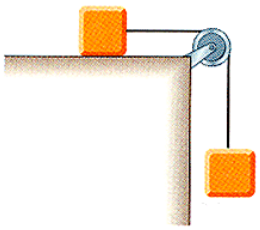
4. In a local bar, a customer slides an empty beer mug down the counter for a refill. The bartender is momentarily distracted and does not see the mug, which slides off the counter and strikes the floor at distance 1.75 m from the base of the counter. The height of the counter is 2.5 m. With what speed did the mug leave the counter? **(5 points)**

Answer box

5. A placekicker must kick a football from a point 36.0 m from the goal, and half the crowd hopes the ball will clear the crossbar, which is 3.05 m high. When kicked, the ball leaves the ground with a speed of 22.0 m/s at an angle of 48.0° to the horizontal. (a) By how much does the ball clear or fall short of clearing the crossbar? (Enter a negative answer if it falls short.) (b) Does the ball approach the crossbar while still rising or while falling? !0 points)

Answer box

6. A 4.00 kg object placed on a frictionless, horizontal table is connected to a string that passes over a pulley and then is fastened to a hanging 9.00 kg object. Find the magnitude of the acceleration of the two objects and the tension in the string. **(5 points)**

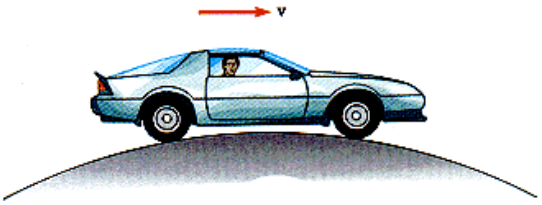


Answer box

7. A 4.50 kg block starts from rest at the top os a 32.0° incline and slides a distance of 3.75 m down the incline in 1.20 s. Find a) the magnitude of the acceleration of the block. B) the coefficient of kinetic friction between block and plane. C) the friction force acting on the block and d) the speed of the block after it has slid 3.75 m. (10 Points)

Answer box

8. We will study the most important work of Nobel laureate Arthur Compton. Compton designed a speed bump and had it installed. Suppose that a 1800 kg car passes over a bump in a roadway that follows the arc of a circle of radius 19.0 m. What force does the road exert on the car as the car passes the highest point of the bump if the car travels at 31.5 km/h?
(5 points) *Sum the Forces*.

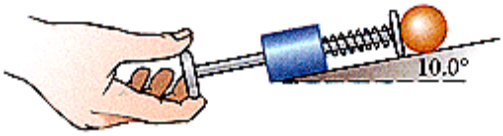


Answer box

9. A block of mass 2.50 kg is pushed 7.30 m along a frictionless horizontal table by a constant 16.0 N force directed 30.0° below the horizontal. (a) Determine the work done on the block by the applied force. (b) Determine the work done on the block by the normal force exerted by the table. (c) Determine the work done on the block by the gravitational force. (d) Determine the total work done on the block. (10 points)

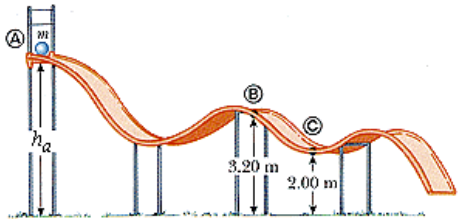
Answer box

10. The ball launcher in a pinball machine has a spring that has a force constant of 1.20 N/cm. The surface on which the ball moves is inclined 10.0° with respect to the horizontal. If the spring is initially compressed 5.50 cm, find the launching speed of a 70 g ball when the plunger is released. Friction and the mass of the plunger are negligible. (10 Points)



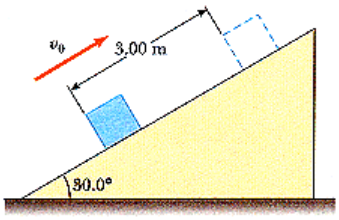
Answer box

11. A particle of mass m = 7.90 kg is released from point A and slides on the frictionless track shown. (h_a = 6.30 m.) (a) Determine the particle's speed at points B and C. (b) Determine the net work done by the gravitational force in moving the particle from A to C. **(5 points)**



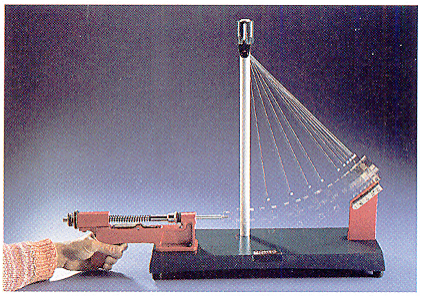
Answer box

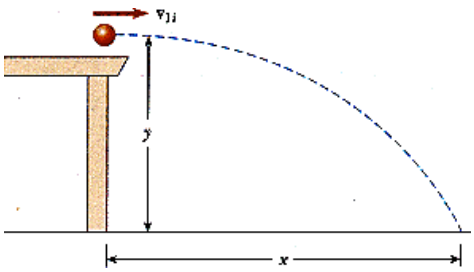
12. A 4.40 kg block is set into motion up an inclined plane with an initial speed of v_0 = 8.50 m/s. The block comes to rest after traveling 3.00 m along the plane, which is inclined at an angle of 30.0° to the horizontal. (a) For this motion, determine the change in the block's kinetic energy. (b) For this motion, determine the change in potential energy of the block-Earth system. (c) Determine the frictional force exerted on the block (assumed to be constant). (d) What is the coefficient of kinetic friction? (10 Points)



Answer box

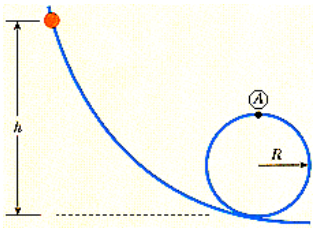
13. A student performs a ballistic pendulum experiment. She obtains the following average data: $h = 8.82$ cm, $m_1 = 69.2$ g, and $m_2 = 263$ g. (a) Determine the initial speed v_{1i} of the projectile. (b) The second part of her experiment is to obtain v_{1i} by firing the same projectile horizontally (with the pendulum removed from the path) and measuring its horizontal displacement x and vertical displacement y. What numerical value does she obtain for v_{1i} on the basis of her measured values of $x = 243$ cm and $y = 75.5$ cm? (10 Points)





Answer box

14. . A bead slides without friction around a loop-the-loop. The bead is released from a height $h = 2.8R$. (a) What is its speed at point A? Answer in terms of R and g, the acceleration of gravity. (b) How large is the normal force on it at this point if its mass is 5.40 g? **(5 points)**



Answer box

You need to do one of the following two problems. Diagram 10 Reasoning 10 Solution 10

1. A car is parked on a steep incline overlooking the ocean, where the incline makes an angle of 32.0° below the horizontal. The negligent driver leaves the car in neutral, and the parking brakes are defective. The car rolls from rest down the incline with a constant acceleration of 4.80 m/s^2, traveling 45.0 m to the edge of a vertical cliff. The cliff is 30.0 m above the ocean. (a) Find the speed of the car when it reaches the edge of the cliff and the time it takes to get there. (b) Find the velocity of the car when it lands in the ocean. (c) Find the total time the car is in motion. (d) Find the position of the car when it lands in the ocean, relative to the base of the cliff.

Diagram 10 Reasoning 10 Solution 10

2. A model airplane of mass 0.680 kg flies in a horizontal circle at the end of a 56.0 m control wire, with a speed of 35.0 m/s. Compute the tension in the wire if it makes a constant angle of 20.0° with the horizontal. The forces exerted on the airplane are the pull of the control wire, the gravitational force, and aerodynamic lift, which acts at 20.0° inward from the vertical.

Diagram 10 Reasoning 10 Solution 10