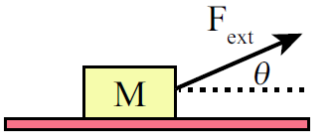
PHY2053 PHYSICS EXAM 1

Name (print, last first): _____ Signature: _____

Given Information:

$g = 9.8$ m/s^2 $G = 6.67 \times 10^{-11}$ Nm^2/kg^2 1 kg = 1000 g 1 m = 100 cm
1 hour = 60 minutes 1 minute = 60 seconds 1 rev = 2π radians π radians = 180°

1. A block of mass $M = 3$ kg slides along the floor while an external force F_{ext} is applied at an upward angle $\theta = 35°$. If the coefficient of kinetic friction between the block and the floor is 0.4, and the magnitude of the acceleration of the block is 1.0 m/s^2, what is the magnitude of the external force?



(1) 14.1 N (2) 3.0 N (3) 11.8 N (4) 14.8 N (5) None of these.

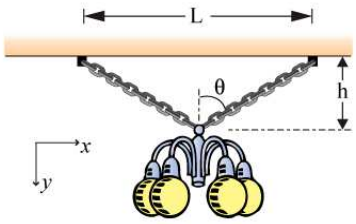
2. A 100-kg boat is floating in the water. The propeller applies a 600 N force to the boat and the water resistance applies a 200 N force against the boat's motion. What is the acceleration of the boat?

(1) 4 m/s^2 (2) 6 m/s^2 (3) 2 m/s^2 (4) 8 m/s^2 (5) None of these.

3. A heavy man's resting weight is 1029 N. He is standing on a scale on an elevator that has a mass (without the man) of 1200 kg. While the elevator is in motion the man's apparent weight reads 1134 N. The tension on the cable supporting the elevator is (in N):

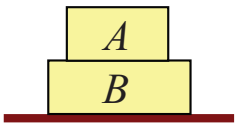
(1) 14,094 (2) 14,634 (3) 13,554 (4) 12,484 (5) 15,184

4. The chandelier in the figure has mass 2.00 kg and is attached to the ceiling by two equal length chains. The tension in each chain is adjusted to be 14.12 N. The angle θ must be:



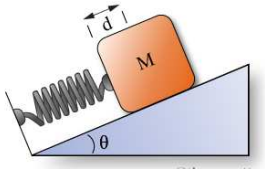
(1) 46.0° (2) 47.0° (3) 48.0° (4) 49.0° (5) 50.0°

5. Near the surface of the Earth, two blocks (A and B) are at rest on a table as shown in the figure. If $M_A = 1$ kg and the magnitude of the normal force exerted by the table on block B is 29.4 N, what is the mass of block B (in kg)?



(1) 2 (2) 3 (3) 4 (4) 5 (5) 1

6. A block of mass 5.00 kg is at rest on a frictionless ramp inclined at θ relative to the horizontal. The spring has a spring constant of 300 N/m. The spring is compressed the distance d = 8.0 cm. The only forces acting on the block are gravity down and the spring force. The closest whole incline angle θ (in degrees) must be:



(1) 29 (2) 24 (3) 38 (4) 20 (5) 31

7. From the edge of the rooftop of a building, a boy throws a stone at an angle of 25° above the horizontal. The stone hits the ground 4.2 s later, 105 m away from the base of the building. Find the final speed of the stone.

(1) 38.1 m/s (2) 27.6 m/s (3) 25 m/s (4) 29.5 m/s (5) None of these.

8. During a baseball game a baseball is struck at ground level by a batter. The ball has an initial speed 38.0 m/s and is struck at an angle of θ degrees. If the ball reaches a maximum height of 19.5 meters above ground, what is the angle with which it was struck? Answer in degrees.

(1) 30.96
(2) 9.46
(3) 21.33
(4) 45.00
(5) −30.96

9. Standing on a bridge, you throw a stone straight upward. The stone hits a stream, 37 m below the point at which you release it, 3.7 seconds later. What is the velocity of the stone after it leaves your hand?

(1) 8.13 m/s (2) 28.1 m/s (3) 5.18 m/s (4) 16.4 m/s (5) None of these.

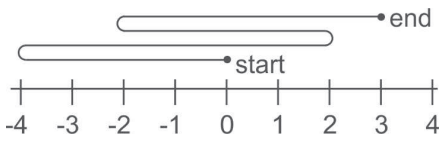
10. A bowling ball is dropped from rest from the top of a 150.2 meter building. In the absence of air resistance, how long will it take the ball to hit the ground? Answer in seconds.

(1) 5.54 (2) 75.10 (3) 7.66 (4) 30.65 (5) 15.33

11. A motorist drives along a straight road at a constant speed of 80 m/s. Just as she passes a parked motorcycle police officer, the officer takes off after her at a constant acceleration, a, and at that same instant the motorist begins to accelerate at a constant rate of $a/3$ (*i.e.,* one-third the acceleration of the police officer). If the driver and the officer maintain their constant value of acceleration, what is the speed of the police officer when he reaches the motorist (in m/s)?

(1) 240 (2) 200 (3) 320 (4) 160 (5) 400

12. A Roomba vacuum picked up at a yard sale charges up fine and runs but turns out to need a new y-control belt. This means that it can only move along one direction, turning around at random times. During testing the vacuum executes the motion shown in the figure (values in meters, m) where the vertical offsets in the path are just for clarity. Its displacement and distance traveled for this excursion are respectively, in that order (in m):

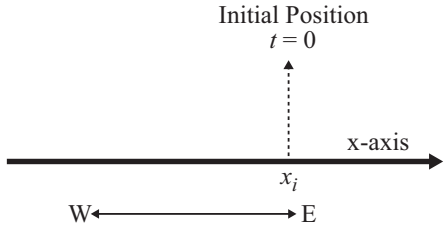


(1) 3, 19 (2) 19, 3 (3) −4, 3 (4) 3, −4 (5) 0, 3

13. A truck is driving down the highway. While the traffic is light, the truck travels at 70 miles/hour for 45 minutes. In heavier traffic, the truck travels at 50 miles/hour for 30 minutes. What is the average velocity of the truck?

(1) 62 miles/hour (2) 60 miles/hour (3) 58 miles/hour (4) 56 miles/hour (5) None of these.

14. A train traveling along the x-axis is initially at the point x_i at $t = 0$. The train then travels 10 km to the East (*i.e.,* right) as shown in the figure. It then reverses direction and travels a distance dw to the West (*i.e.,* left) to the final point x_f. If the train's average speed for this trip was 15 km/h and its average velocity for the trip was −10 km/h, what was the distance dw (in km)?



(1) 50 (2) 30 (3) 20 (4) 10 (5) 40

15. A person is applying a horizontal force of F_{push} N to a push lawn mower. A frictional force opposes the motion of the mower. The net force on the mower is F_{net} N and the mower weighs m kg. When F_{push} is removed the mower travels a distance of d meters before coming to rest. What was the initial velocity of the mower when the force was removed? Answer in m/s.

(1) $\sqrt{\frac{2\,(\,F_{push} - F_{net}\,)\,d}{m}}$ (2) $\sqrt{\frac{2\,(\,F_{net} - F_{push}\,)\,d}{m}}$ (3) $\sqrt{\frac{2\,F_{net}\,d}{m}}$ (4) $\sqrt{\frac{-2\,(\,F_{push} - F_{net}\,)\,d}{m}}$ (5) $\sqrt{\frac{2\,m\,d}{F_{push} - F_{net}}}$

16. A book with mass m kg rests on the surface of a table. The coefficient of kinetic friction between the book and table is μ_k. The minimum force required to produce movement of the book across the surface of the table is applied F_m N. If the acceleration of the book is a m/s^2, what is the coefficient of static friction, μ_s?

(1) $\frac{a}{g} + \mu_k$ (2) $\frac{a}{g} - \mu_k$ (3) μ_k - $\frac{a}{g}$ (4) $\frac{a}{g}$ (5) $\frac{m\,a}{g} + \mu_k$