Pick the BEST answer. Questions 1-25 are each worth 4 points.

FORM A

PHYSICS 22000 – F16 Exam #1

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Formulæ

$\pi = 3.14159$ $G = 6.673 \times 10^{-11}\ \mathrm{m^3/(kg \cdot s^2)}$ $1\ \mathrm{N} = 1\ \mathrm{kg \cdot m/s^2}$

$g = 9.81\ \mathrm{m/s^2} = 32\ \mathrm{ft/s^2}$ $1\ \mathrm{lb} = 4.448\ \mathrm{N}$ $1\ \mathrm{mile} = 1.609\ \mathrm{km}$

$F_g = G\,\frac{m_1 m_2}{r^2}$ $F_{\mathrm{friction}} = \mu N$ $\vec{p} = m\,\vec{v}$ $\vec{J} = \vec{F}\Delta t = \Delta\vec{p}$

$x = x_0 + \frac{1}{2}(v_0 + v_f)t$ $v = v_0 + at$ $a_c = \frac{v^2}{r}$ $T^2 \propto r^3$

$x = x_0 + v_0 t + \frac{1}{2}at^2$ $v_f^2 = v_0^2 + 2a(x - x_0)$

$\vec{F} = m\vec{a}$ $K = \frac{1}{2}mv^2$ $U_g = mgy$ $U_s = \frac{1}{2}kx^2$

PHYSICS 220 Exam #1 FORM A

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1. An object travels around a circular path of radius $r = 1\ m$ every second. What is the speed of the object?

(a) 6.28 m/s (b) 1 m/s (c) 3.14 m/s (d) 0 (e) -6.28 m/s

2. It takes Prof. Jones 2 hours to drive 120 miles from West Lafayette to Chicago. If it takes an additional 4 hours for him to drive 160 miles from Chicago to Waupun WI, what is his average speed for the entire trip?

(a) 50 mi/h (b) 46.7 mi/h (c) 66.7 mi/h (d) 60 mi/h (e) 40 mi/h

3. Prof. Jones leaves West Lafayette at 8:00 am and drives north 175 km to South Bend, then 140 km to Kokomo and then drives 75 miles back to West Lafayette, where he arrives at 5:00 pm. At the end of the day, what is Prof. Jones' total displacement?

(a) 390 km (b) 130 km (c) 0 km (d) 12 m/s (e) not enough information

4. Prof. Finley throws a softball vertically upward with an initial velocity of 10 m/s. When it reaches the highest point in its trajectory, what is its acceleration?

(a) 0 m/s^2 (b) 9.8 m/s^2 (c) 10 m/s^2 (d) -10 m/s^2 (e) -9.8 m/s^2

5. Prof. Jones drives recklessly around the traffic circle on Northwestern Ave, which has a radius of $r = 50\ m.$, at a constant speed of 50 km/h. What is the magnitude of his car's acceleration?

(a) 4 m/s^2 (b) 3.86 m/s^2 (c) 25.1 m/s^2 (d) 27.8 m/s^2 (e) 0 m/s^2

6. A red marble is dropped straight down while a blue marble is shot horizontally out of a slingshot with an initial horizontal velocity of 10 m/s and from the same vertical height as the red marble. Which statement about the velocities of the two marbles, at the instant they each hit the ground, will be correct?

(a) $v_{red} > v_{blue}$ (b) $v_{red} < v_{blue}$ (c) $v_{red} = v_{blue}$ (d) $v_{red} \ll v_{blue}$ (e) not enough information

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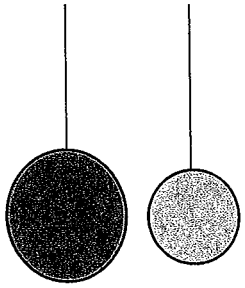
7. Two cars have coffee cups sitting on their dash boards. One car has a smooth dash board with a coefficient of friction $\mu_s = 0.05$ while the other car has a dirty, sticky dashboard which has a coefficient of friction $\mu_s' = 0.25$. Both cars are driving at the posted speed limit of 70 mi/h and they both drive around a banked curve on the interstate that has been designed assuming cars will be driving this speed limit. Which statement about the two coffee cups is true?

   (a) The one on the smooth surface is more likely to slip
   (b) The one on the sticky surface is more likely to slip
   (c) Neither coffee cup will slip
   (d) The coffee cup on the smooth surface would not slip if it was full of coffee
   (e) Not enough information to say anything about whether they would slip.

8. A lead ball with a mass of 50 kg has a radius of 10 cm while an iron ball with a mass of 8 kg has a radius of 6.2 cm. These two balls are hung from thin wires and separated by a horizontal distance of 1 cm between their surfaces as shown:



Calculate the ratio of the horizontal gravitational force that the lead ball exerts on the iron ball to the vertical gravitational force that the earth exerts on the iron ball.

(a) 1.15×10^{-8} (b) 1.98×10^{-9} (c) 3.40×10^{-6} (d) 1.13×10^{-7} (e) 8.70×10^{7}

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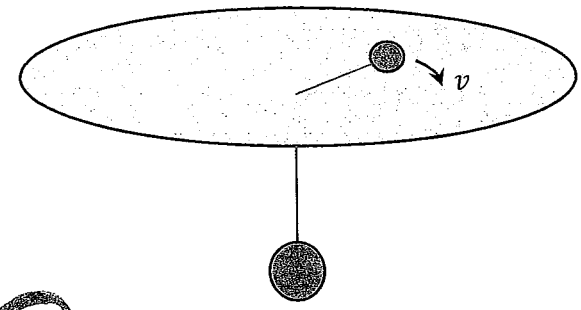
9. An object with a mass of 0.100 kg moves with a speed of $v = 8\ m/s$ and is tied to a string that passes through a hole in the center of a frictionless table. If the other end of the string is tied to a mass of 1 kg, what is the radius of the circle that the sliding object will make if it moves with uniform circular motion?

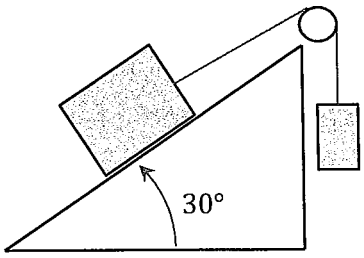


(a) 1.00 m (b) 0.653 m (c) 0.500 m (d) 0.125 m (e) 0.0625 m

10. A box with a mass of 20 kg slides with constant velocity down a ramp that is inclined at an angle of $\theta = 30°$ with respect to the horizontal. The net force acting on the box is:

(a) 170 N (b) 392 N (c) 95.2 N (d) 0 N
(e) It depends on the coefficient of friction

11. A box of mass 10 kg slides on a frictionless plane, inclined at an angle of 30° with respect to the horizontal, but is attached via a string to a 2 kg mass that hangs vertically as shown:



What will be the resulting acceleration of the small mass?

(a) 2.45 m/s^2 down (b) 14.7 m/s^2 up (c) 9.8 m/s^2 down
(d) 2.45 m/s^2 up (e) 5.75 m/s^2 up

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12. Which of the following is a vector quantity?

(a) energy (b) mass (c) path length (d) speed (e) acceleration

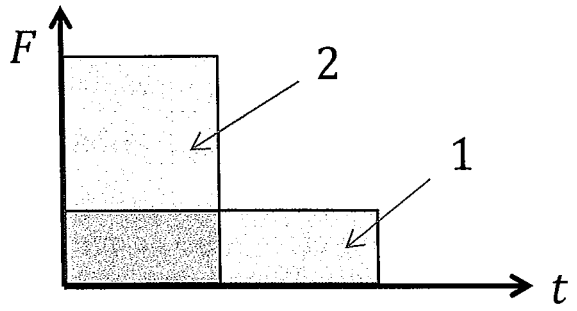
13. On the moon, the acceleration of gravity is approximately 1/6 what it is on Earth. If a force of 6 N is applied in the horizontal direction to a mass on Earth and an acceleration of 3 m/s^2 is observed, what would the corresponding acceleration be on the moon when subjected to the same horizontal force?

(a) 3 m/s^2 (b) 0.5 m/s^2 (c) 18 m/s^2 (d) 6 m/s^2 (e) 12 m/s^2

14. A car, which was initially travelling with a constant velocity, suddenly swerves to avoid an accident, spilling a cup of coffee that was sitting on the center of the dash board into the passenger's lap. Which statement describes the motion of the car as it swerves to avoid the accident?

(a) The car accelerated and swerved to the right
(b) The car accelerated and swerved to the left
(c) The car decelerated and swerved to the left
(d) The car decelerated and swerved to the right
(e) The car accelerated, swerving right and then left

15. The following graphs show the forces, as functions of time, that are exerted on two objects of equal mass which were initially at rest.



The final velocities of the two objects are

(a) $v_1 > v_2$ (b) $v_1 = v_2$ (c) $v_1 < v_2$ (d) $v_1 = -v_2$ (e) not enough information

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16. A satellite is orbiting a planet at distance r from its center with tangential velocity v. Another satellite is orbiting with twice this velocity. What is the distance r' from the center of the planet of the other satellite's orbit?

(a) $r' = 2r$ (b) $r' = 4r$ (c) $r' = r/2$ (d) $r' = r/4$ (e) $r' = r^{2/3}$

17. In projectile motion, the vertical component of the objects acceleration

(a) Decreases on the way up and increases on the way down
(b) Is constant throughout the flight of the projectile
(c) Is zero at the top of the trajectory
(d) Is zero throughout the whole trajectory
(e) Depends on the mass of the projectile.

18. A spring has spring constant $k = 200\ N/m$ and is initially compressed a distance of 20 cm. When released, it launches a 50 gram mass vertically in the air. At the instant the mass leaves contact with the spring, its velocity is

(a) 12.6 m/s (b) 14.1 m/s (c) 8 m/s (d) 20 m/s (e) 0.632 m/s

19. What is the maximum height that the mass described in question #18 reaches?

(a) 12.6 m (b) 8.15 m (c) 4 m (d) 13.2 m
(e) It depends on how long the spring takes to decompress

20. Jeff and Jim are on ice skates and hold opposite ends of a rope. If Jeff has a mass of 75 kg and Jim has a mass of 100 kg, and they each pull on the rope with an average force of 100 N for 2 seconds, what will their relative velocity be when they collide?

(a) 6.67 m/s (b) 4.67 m/s (c) 2.40 m/s (d) 3.33 m/s (e) 1.67 m/s

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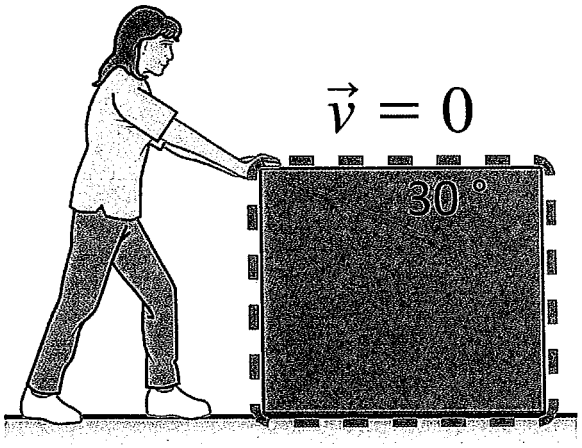
21. Super-Dave Osborne is to be shot out of a canon that is aimed at 60° above the horizontal. What muzzle velocity is needed if he is to land in a net that is located 50 m away at the same height as the muzzle of the canon?

(a) 18.6 m/s (b) 21.3 m/s (c) 23.8 m/s (d) 173 m/s (e) 566 m/s

22. The coefficient of kinetic friction

(a) Is always greater than the coefficient of static friction
(b) Is always less than the coefficient of static friction
(c) Can be greater or less than or equal to the coefficient of static friction
(d) Is never equal to the coefficient of static friction
(e) Is the same as the coefficient of static friction

23. A person pushes on a box in the downward direction and to the right as shown:



If the weight of the box is 2000 N and the maximum force that the person can apply before the box slips, when directed at 30° below the horizontal, is 1000 N, what is the coefficient of static friction between the box and the floor?

(a) 0.05 (b) 0.15 (c) 0.25 (d) 0.35 (e) 0.45

Pick the BEST answer. Questions 1-25 are each worth 4 points.

24. A spring with spring constant $k = 100\ N/m$ is compressed a distance of 10 cm and when released, shoots a marble with mass 10 g down a ramp. If the initial height of the marble was 1 meter, what is the final velocity of the marble at the bottom of the ramp?

(a) 8 m/s (b) 9 m/s (c) 10 m/s (d) 11 m/s (e) 12 m/s

25. If an external force acts in the same direction of the motion of an object,

(a) The energy of the object increases
(b) The energy of the object decreases
(c) Only the kinetic energy of the object increases
(d) Only the potential energy of the object increases
(e) The force does no work.