College Physics

Phys 2010

Exam 1

Fall Semester 2008

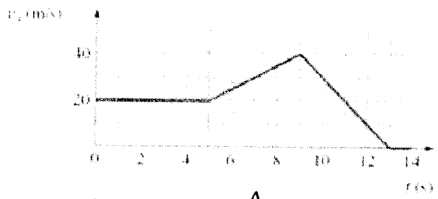
Notes

- You may use a calculator
- This test is closed book and closed notes.

NAME: Key

As you answer the following questions, you must show all your work for receiving full credit.

1. The graph shows v_x versus t for an object moving along straight line. What is the average speed from t = 0 to t = 11 s?



$V_{ave} = \frac{\Delta x}{\Delta t}$

Δx = distance = Area under the curve

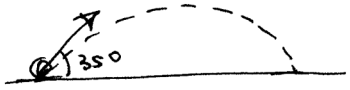
from t = 0 t = 5 : Area = $20 \times 5 = 100$ $\Rightarrow \Delta x_1 = 100$ m

from t = 5 t = 11 : Area = $\frac{20 \times 6}{2} + 20 \times 6 = 180 \Rightarrow \Delta x_2 = 180$ m

$\Rightarrow \Delta x = 100 + 180 = 280$ m

$V_{ave} = \frac{280}{11} = \boxed{24.5 \text{ m/s}}$

2. An object is launched from the origin with a velocity of 10.0 m/s at an angle of 35.0 degrees above the horizontal. What is the velocity (value and the angle) of the object 2.00 seconds later? Assume negligible air resistance.



$V_{ix} = 10 \cos 35^\circ = 8.2$ m/s

$V_{iy} = 10 \sin 35 = 5.7$ m/s

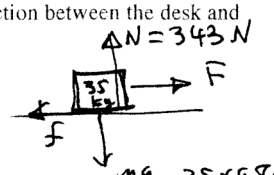
After 2 seconds, $V_{fx} = V_{ix} = 8.2$ m/s

$V_{fy} = V_{iy} + a_y \Delta t = 5.7 - 9.8 \times 2$

$V_{fy} = -13.9$ m/s

$\Rightarrow V_f = \sqrt{V_{fx}^2 + V_{fy}^2} = \sqrt{8.2^2 + (-13.9)^2} = \boxed{16.1 \text{ m/s}}$; $\theta = \tan^{-1}\frac{V_y}{V_x} = \boxed{-30.5^\circ}$

3. In sliding a 35-kg desk from one side of the classroom to the other, a professor finds that a horizontal force of 275 N is necessary to set the desk in motion, and a horizontal force of 195 N is necessary to keep it in motion with a constant velocity. Calculate the coefficients of static friction and kinetic friction between the desk and the floor.



→ for Static Case: $\sum F = 0 \Rightarrow F - f_s = 0$

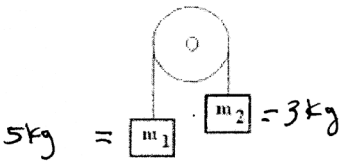
Thus $f_s = F = 275$

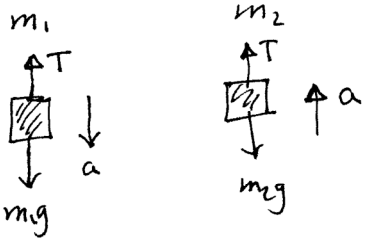
$f_s = \mu_s N \Rightarrow \mu_s = \frac{275}{343} = \boxed{0.8}$

→ for Kinetic Case: $\sum F = 0$ (constant velocity) $\Rightarrow F - f_k = 0$

$\Rightarrow 195 - \mu_k (343) = 0 \Rightarrow \boxed{\mu_k = 0.57}$

4. Two masses are suspended by cord that passes over a pulley with negligible mass. The cord also has negligible mass. One of the masses, m_1, has a mass of 5.0 kg and the other mass, m_2, has a mass of 3.0 kg. Draw free body diagrams for each mass and calculate the acceleration of m_1.





Using the free body diagrams:

m_1 : $m_1 g - T = m_1 a$ $\Rightarrow$ $5 \times 9.8 - T = 5a$ $\rightarrow$ $49 - T = 5a$

m_2 : $T - m_2 g = m_2 a$ $T - 3 \times 9.8 = 3a$ $T - 29.4 = 3a$

$\Rightarrow T = 3a + 29.4$ substitute this in eq. above it $\Rightarrow$

$49 - (3a + 29.4) = 5a \Rightarrow \boxed{a = 2.45 \text{ m/s}^2}$

5. Calculate the magnitude of the gravitational force that the earth exerts on the moon. Compare this to the gravitational force of the moon on the earth (i.e. more, less, the same). Explain your answer. Use the data on the equation sheet.

$$F = G\frac{m_E M_m}{r^2} = 6.67\times10^{-11}\ \frac{6\times10^{24}\times7.3\times10^{22}}{(384{,}000{,}000)^2}$$

$F \simeq 2\times10^{20}\ N$ = Earth on the moon.

→ The force of gravity of moon on the earth is the same. This is according to the Newton's 3rd law and also the law of gravity which depends on both masses.

6. A blue ball is dropped from the roof of a tall building with the horizontal launch of a red ball, which statement is true? Assume negligible air resistance.
   A. The red ball strikes the ground first with the higher speed.
   (B) Both balls hit the ground at the same time, but the red ball has the higher speed.
   C. The blue ball strikes the ground first, but with the lower speed.
   D. Both balls hit the ground at the same time with the same speed.

7. The net force on a moving object suddenly becomes zero. The object then
   A. stops abruptly
   B. stops during a short time interval
   C. changes direction
   (D.) continues at constant velocity
   E. slows down gradually

8. An object of mass m is hanging by a string from the roof of an elevator. The elevator is increasing its upward speed. What is the tension in the string?
   (A.) greater that mg (The object becomes heavier)
   B. less then mg
   C. equal to mg
   D. depends on the speed of the elevator