A.P. Physics – C

UNIT 2 TEST REVIEW

Forces, Newton's Laws, & Circular Motion
Chapters 5- 6

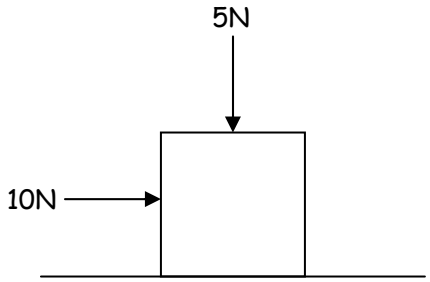
*** In studying for your test, make sure to study this review sheet along with your quizzes and homework assignments.**

Multiple Choice Review: **On this portion of the test, you will not be allowed to use your calculator or AP formula sheet. (You may, however, use your AP table of information.) Approximate $g=10m/s^2$ for simplicity of calculations. No partial credit will be given.**

1. A rope of negligible mass supports a block that weighs 30N. The breaking strength of the rope is 50N. The largest acceleration that can be given to the block by pulling up on it with the rope without breaking the rope is most nearly...

a. $6m/s^2$ **b.** $6.7m/s^2$ **c.** $10m/s^2$ **d.** $15m/s^2$ **e.** $16.7m/s^2$

2. A 2kg block slides with constant velocity along a horizontal tabletop. A horizontal applied force of 10N and a downward applied force of 5N act on the block, as shown. The coefficient of friction between the block and tabletop is most nearly...



a. 0.3 **b.** 0.4 **c.** 0.5 **d.** 0.75 **e.** 1

3. Three forces act on an object. If the object is in translational equilibrium, which of the following must be true?

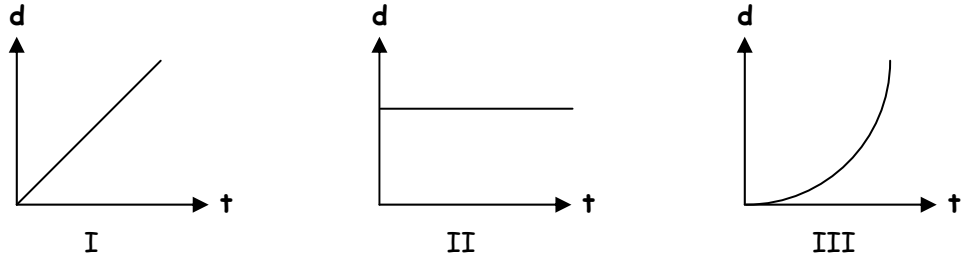
I. The vector sum of the three forces must equal zero.
II. The magnitudes of the three forces must all be equal.
III. All three forces must be parallel.

a. I only
b. II only
c. I and III only
d. II and III only
e. I, II, and III

4. The drag force acting on an object falling through the air does not depend at all on which one of the following?

a. mass of the object
b. density of the air
c. shape of the object
d. speed of the object
e. size of the object

5. Three objects can only move along a straight, level path. The graphs below show the position **d** of the objects plotted as a function of time **t**. The sum of the forces on the object is zero in which of the cases?



a. II only
b. III only
c. I and II only
d. I and III only
e. I, II, and III

6. Which one of the following is a statement of Newton's 3rd law of motion?

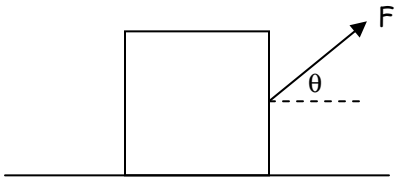
a. A moving object will continue moving if no net force acts on it.
b. The acceleration of an object is inversely proportional to its mass.
c. A net force is required to cause an object to accelerate.
d. Forces always happen in pairs of equal and opposite pairs.
e. An object at rest will continue at rest if no net force acts on it.

7. Two objects of weights W and 2W are connected by a lightweight cord that hangs over a frictionless pulley. The objects are hung freely from the pulley, and released from rest. How does the tension (F_T) in the cord compare to the weight of each object?

a. $W < F_T = 2W$
b. $W < F_T < 2W$
c. $W = F_T = 2W$
d. $W = F_T < 2W$
e. $W > F_T > 2W$

8. An object is pulled across a horizontal surface by a force F at an angle θ above the horizontal. If F is increased slightly, then the normal force _____. If θ is increased slightly, then the normal force _____.

a. increases, increases
b. increases, decreases
c. increases, remains constant
d. decreases, decreases
e. decreases, increases



9. An object of mass M is released to slide down a frictionless plane that is inclined at an angle θ. Which one of the following is the rate at which the object accelerates?

a. $Mg\cos\theta$
b. $Mg\sin\theta$
c. $g\sin\theta$
d. $g\cos\theta$
e. $g\tan\theta$

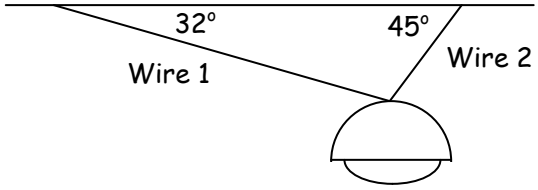
10. Which of the following objects is in equilibrium?

I. A free-fall object at its maximum height.
II. An object moving in a circular path at a constant speed.
III. An object at rest on a tabletop.

a. I only
b. II only
c. III only
d. I and III only
e. I, II, and III

Problem Review: On this portion of the test, you may use your calculator, AP formula sheet, and AP table of information. Partial credit will be given on these problems.

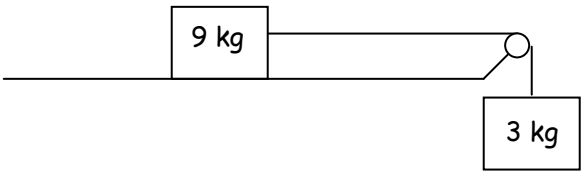
11. The light fixture in the figure is at rest. If the tension in wire 2 is 130N, find the tension in wire 1 and the weight of the light fixture.



12. The coefficient of static friction between a 3kg crate and the 35° incline it sits upon is 0.200. This friction is not enough to keep the box from sliding down the incline. What is the minimum 'squeezing' force that must be applied to the box, perpendicular to the incline, to keep the crate from sliding?

13. An airplane accelerates uniformly from rest. A physicist passenger holds up a thin string of negligible mass to which she has tied her ring and notices that the string makes an angle with the vertical. If the plane reaches a takeoff speed of 65m/s after accelerating for a total of 30s, determine the angle θ that the string makes with the vertical during the acceleration of the plane before it leaves the ground.

14. The two blocks in the picture are being held in place, and are then released from rest. Use force ideas and kinematics to find the following, assuming the table and pulleys are frictionless: the tension in the cord connecting the blocks, the acceleration of the 3kg block as it descends, and the speed of the 3kg block as it strikes the floor, 1.2m below where it started.



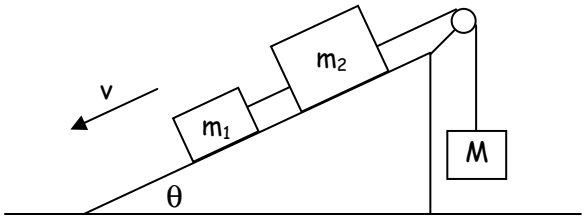
15. A 2000kg car rounds a circular turn of radius 30m. If the road is flat and the coefficient of static friction between the tires and road is 0.67, what is the fastest velocity the car can have as it rounds the corner without skidding?

16. A roller-coaster car has a mass of 600kg when fully loaded with passengers. The vehicle is approaching the top of a hill that is shaped like part of a circle of radius 20m.

a. What is the maximum speed the car can have when it is at the top of the hill, in order for gravity to keep the car on the track?

b. What is the normal force on the car if its speed is half of the maximum calculated in part A?

17.



Blocks 1 and 2 of masses m_1 and m_2, respectively, are connected by a light string. These blocks are further connected to a block of mass M by another light string that passes over a pulley of negligible mass and friction. Blocks 1 and 2 move with a constant velocity v down the inclined plane, which makes an angle θ with the horizontal. The kinetic frictional force on block 1 is f and that on block 2 is 2f. Express your answers to each of the following in terms of m_1, m_2, g, θ, f.

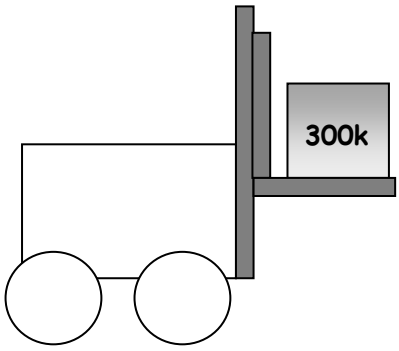
a. Determine the coefficient of kinetic friction between the inclined plane and block 1.

b. Determine the value of the suspended mass M that allows blocks 1 and 2 to move with constant velocity down the plane.

c. The string between blocks 1 and 2 is now cut. Determine the acceleration of block 1 while it is on the inclined plane.

18. A 25cm-diameter spherical ball of mass 0.8kg is falling in the presence of air resistance. If the ball's drag coefficient is 0.9 and the air's density is 1.19kg/m^3, calculate the terminal speed of the ball. ($F_{drag} = \frac{1}{2}C\rho Av^2$)

19. Actual A.P. Physics C Free-Response Question (1996):



A 300kg box rests on a horizontal platform attached to a forklift, as shown. Starting from rest at time t=0, the box is lowered with a downward acceleration of 1.5m/s^2.

a. Determine the upward force exerted by the horizontal platform on the box as it is lowered.

At time t=0, the forklift also begins to move forward with an acceleration of 2m/s^2 while lowering the box as described above. The box does not slip or tip over.

b. Determine the frictional force on the box.

c. Given that the box does not slip, determine the minimum possible coefficient of static friction between the box and platform.

d. Determine an equation for the path of the box that expresses y as a function of x (and <u>not</u> of t), assuming that, at time t=0, the box has a horizontal position x=0 and a vertical position y=2m above the ground, with zero velocity.

20. Actual A.P. Physics C Free-Response Question (2000):

A rubber ball of mass m is dropped from a cliff. As the ball falls, it is subjected to air drag. The drag force on the ball has magnitude bv^2, where b is a constant drag coefficient and v is the instantaneous speed of the ball. The drag coefficient is directly proportional to the cross-sectional area of the ball and the air's density, and does not depend on the mass of the ball. As the ball falls, its speed approaches a constant value called the terminal speed.

a. On the figure to the right, draw and label all forces acting on the ball at some instant before it reaches terminal speed.

b. State whether the magnitude of the acceleration of the ball of mass m increases, decreases, or remains the same as the ball approaches terminal speed. Explain.

c. Write, but do NOT solve a differential equation for the instantaneous speed v of the ball in terms of time t, the given quantities, and fundamental constants.

d. Determine the terminal speed v_t in terms of the given quantities and fundamental constants.