PHY241 – General Physics I
Dr. Carlson, Fall 2013 Name_____
Prep

Exam 3 PREP

Chapters 6, 7, 8

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

1) Astronauts in orbiting satellites are weightless because they are so far from Earth that its gravitational pull is too weak to feel. 1) _____

2) Earth's gravity is caused by our planet's spin on its axis. 2) _____

3) Orbiting satellites accelerate toward Earth at 9.8 m/s^2. 3) _____

4) If the mass of Earth and all objects on it were suddenly doubled, the acceleration due to gravity at the surface would become 4 times what it is now. 4) _____

5) If a highway curve is properly banked and posted at 45 mph, it is a good idea to drive somewhat below this speed if your tires are bald or if the road is icy. 5) _____

6) While a Ferris wheel turns at uniform angular speed, a seat at the rim of the wheel has a nonzero radial acceleration toward the center of the wheel but a tangential acceleration of zero. 6) _____

7) If you swing a ball in a vertical circle using a thin string, at the bottom of the circle the tension in the string must be greater than the ball's weight. 7) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

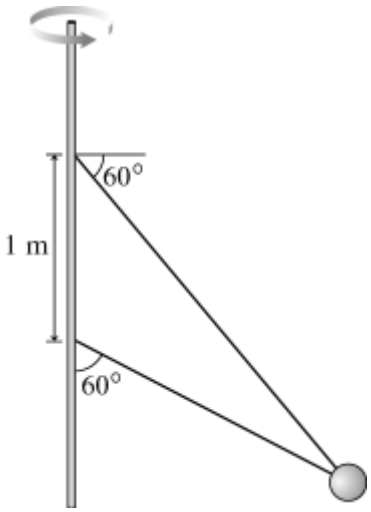
8) Calculate the angular speed, in rad/s, of a flywheel turning at 520.0 rpm. 8) _____
A) 40.83 rad/s B) 60.97 rad/s C) 54.44 rad/s D) 8.656 rad/s

9) An electrical motor spins at a constant 2857.0 rpm. If the armature radius is 2.685 cm, what is the acceleration of the edge of the rotor? 9) _____
A) 84.40 m/s^2 B) 844.4 m/s^2 C) 241,100 m/s^2 D) 2403 m/s^2

10) A 23 kg mass is connected to a nail on a frictionless table by a (massless) string of length 1.3 m. If the tension in the string is 51 N while the mass moves in a uniform circle on the table, how long does it take for the mass to make one complete revolution? 10) _____
A) 3.8 s B) 5.2 s C) 4.8 s D) 4.5 s

11) An aerobatic aircraft is to perform a spiral maneuver. If the engine provides a tangential acceleration of 5.41 m/s^2, what is the radial acceleration it will experience at the end of a circle 30.8 m in radius, if the speed at the beginning of the stunt was 55.0 m/s? 11) _____
A) 166 m/s^2 B) 257 m/s^2 C) 98 m/s^2 D) 132 m/s^2

12) The figure shows two wires tied to a 3.3 kg sphere that revolves in a horizontal circle at constant speed. At this particular speed the tension is the same in both wires. What is the tension? 12) _____



A) 24 N B) 44 N C) 22 N D) 32 N

13) At a given point above the surface of Earth, the gravitational acceleration is equal to 7.8 m/s^2. The altitude of this point, above the surface of Earth, in km, is closest to: 13) _____

A) 2000 B) 770 C) 1500 D) 2400 E) 970

14) An electrical motor spins at a constant 1926.0 rpm. If the armature radius is 6.867 cm, what is the acceleration of the edge of the rotor? 14) _____

A) 2793 m/s^2 B) 280,200 m/s^2 C) 150.1 m/s^2 D) 15.00 m/s^2

15) What is the gravitational force acting on a person due to another person standing 2 meters away? Assume each individual has 59 kg mass. 15) _____

A) 5.8×10^{-8} N
B) 8.5×10^{3} N
C) 2.0×10^{-9} N
D) 1.2×10^{-7} N
E) 9.8×10^{-10} N

16) The weight of spaceman Speff, solely due to the gravitational pull of planet X at its surface, is 389 N. If he moves to a distance of 1.86×10^{4} km above the planet's surface, his weight changes to 24.31 N. What is the mass of planet X, if Speff's mass is 75 kg? 16) _____

A) 2.96×10^{24} kg B) 2.96×10^{17} kg C) 2.96×10^{18} kg D) 1.59×10^{18} kg

17) From what height off the surface of Earth should an object be dropped to initially experience an acceleration of 0.5400 g? 17) _____

A) 2930 km B) 5426 km C) 1689 km D) 2298 km

18) A proton moving at 0.999 of the speed of light orbits a black hole 4972 km from the center of the attractor. What is the mass of the black hole? 18) _____

A) 6.71×10^{36} kg B) 6.71×10^{25} kg C) 6.71×10^{33} kg D) 6.71×10^{30} kg

19) A person ties a rock to a string and whirls it around in a vertical circle such that sometimes the rock is going straight upward and sometimes the rock is going straight down. She whirls the rock at the minimum speed (constant in time) such that the string is always taut (no sag). If she were to use a longer string, she would have to whirl the rock at a 19) _____

A) lower velocity. B) the same velocity. C) higher velocity.

20) A person ties a rock to a string and whirls it around in a vertical circle such that sometimes the rock is going straight upward and sometimes the rock is going straight down. She whirls the rock at the minimum speed (constant in time) such that the string is always taut (no sag). When is the tension the highest? 20) _____

A) It is highest when the rock is at the highest elevation.
B) The tension is constant as the rock moves around in a circle.
C) It is highest when the rock is at the lowest elevation.

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

21) There must be equal amounts of mass on either side of the center of mass. 21) _____

22) A cylinder and a sphere, both solid and uniform and having the same mass and diameter, roll without slipping down the same ramp starting from rest. Both of them will reach the ground at the same time. 22) _____

23) If a spinning object has a negative angular acceleration, it must be slowing down. 23) _____

24) If two objects have the same moment of inertia, they must have the same mass. 24) _____

25) If you deform an object, you do not change its mass but you may change its moment of inertia and the location of its center of mass. 25) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

26) A child is sitting on the outer edge of a merry–go–round that is 18 m in diameter. If the merry–go–round makes 4.9 rev/min, what is the velocity of the child in m/s? 26) _____

A) 4.6 m/s B) 0.7 m/s C) 3.2 m/s D) 9.2 m/s

27) Through what angle in degrees does a 33 rpm record turn in 0.32 s? 27) _____

A) 35° B) 74° C) 46° D) 63°

28) A wheel accelerates from rest to 59 rad/s at a rate of 74 rad/s^2. Through what angle (in radians) did the wheel turn while accelerating? 28) _____

A) 24 rad B) 30 rad C) 48 rad D) 19 rad

29) A 95 N force exerted at the end of a 0.50 m long torque wrench gives rise to a torque of 15 N • m. What is the angle (assumed to be less than 90°) between the wrench handle and the direction of the applied force? 29) _____

A) 25° B) 14° C) 22° D) 18°

30) A torque of 12 N • m is applied to a solid, uniform disk of radius 0.50 m. If the disk accelerates at 5.7 rad/s^2, what is the mass of the disk? 30) _____

A) 4.3 kg B) 17 kg C) 8.5 kg D) 13 kg

31) A particular motor can provide a maximum of 110.0 N • m of torque. Assuming that all of this torque is used to accelerate a solid, uniform flywheel of mass 10.0 kg and radius 3.00 m, how long will it take for the flywheel to accelerate from rest to 6.04 rad/s? 31) _____

A) 3.24 s B) 2.99 s C) 2.10 s D) 2.47 s

32) A force in the +y direction applied at the point x = 2.3 m, y = 1.4 m gives rise to a torque of 71 N• m about the origin. Find the magnitude of the force. 32) _____

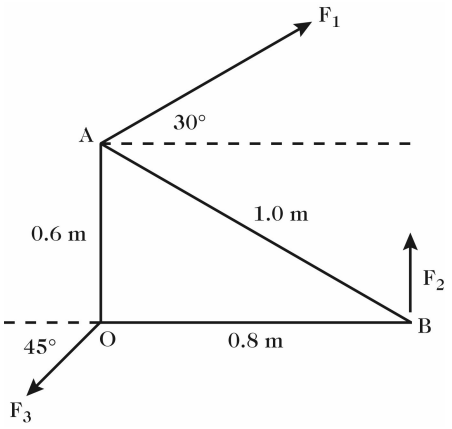
A) 31 N B) 51 N C) 87 N D) 71 N

33) A machinist turns the power on to a grinding wheel, at rest, at time t = 0 s. The wheel accelerates uniformly for 10 s and reaches the operating angular velocity of 29 rad/s. The wheel is run at that angular velocity for 27 s and then power is shut off. The wheel slows down uniformly at 2.7 rad/s^2 until the wheel stops. In this situation, the average angular velocity in the time interval from t = 0 s to t = 25 s is closest to: 33) _____

A) 11 rad/s B) 8.7 rad/s C) 17 rad/s D) 15 rad/s E) 13 rad/s

34) A force of 17 N is applied to the end of a 0.63 m long torque wrench at an angle 45° from a line joining the pivot point to the handle. What is the magnitude of the torque generated about the pivot point? 34) _____

A) 9.7 N•m B) 10.7 N•m C) 12.0 N•m D) 7.6 N•m



35) A light triangular plate OAB is in a horizontal plane. Three forces, F_1 = 2 N, F_2 = 4 N, and F_3 = 7 N, act on the plate, which is pivoted about a vertical axis through point O. In the figure, consider the counterclockwise sense as positive. The sum of the torques about the vertical axis through point O, acting on the plate due to forces F_1, F_2, and F_3, is closest to: 35) _____

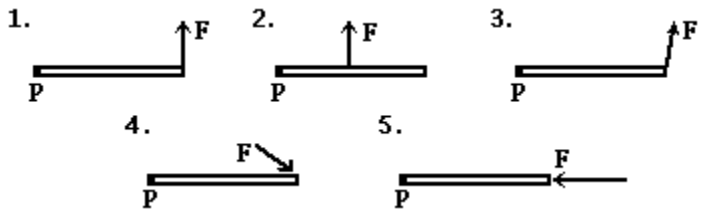
A) –2.6 N • m B) zero C) 2.6 N • m D) –2.2 N • m E) 2.2 N • m

36) A disk and a sphere are released simultaneously at the top of an inclined plane. They roll down without slipping. Which will reach the bottom first? 36) _____

A) the disk
B) the one of smallest diameter
C) the sphere
D) the one of greatest mass
E) They will reach the bottom at the same time.

37) A tall tree and a short tree (both having the same width and mass density) are cut at the base at the same time, and begin tipping over. Which tree hits the ground first? 37) _____

A) the tall tree
B) the small tree
C) They hit at the same time.



38) In the figure, a given force F is applied to a rod in several different ways. In which case is the torque due to F about the pivot P greatest? 38) _____

A) 1 B) 2 C) 3 D) 4 E) 5

TRUE/FALSE. Write 'T' if the statement is true and 'F' if the statement is false.

39) If two forces of equal magnitude act on an object that is hinged at a pivot, the force acting farther from the pivot must produce the greater torque about the pivot. 39) _____

40) A car is being towed at constant velocity on a horizontal road using a horizontal chain. The tension in the chain must be equal to the weight of the car in order to maintain constant velocity. 40) _____

41) A box of mass m is pulled with a constant acceleration a along a horizontal frictionless floor by a wire that makes an angle of 15 degrees above the horizontal. The tension in this wire is greater than ma. 41) _____

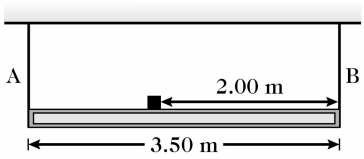
42) A stone rolls down a sloping hillside. The normal force that the surface of the hill exerts on the stone is equal to the stone's weight. 42) _____

43) Two unequal weights are connected by a massless string which passes over a frictionless pulley. If the pulley has no appreciable mass, the tension in the string is the same on both sides of the pulley; but if the pulley has mass, the tension will not be the same on both sides of the pulley. 43) _____

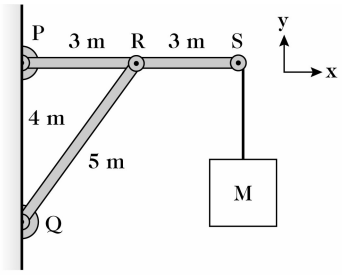
44) If the forces on an object balance, it does not necessarily follow that the torques balance. 44) _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

45) A uniform 1200 N beam that is 3.50 m long is suspended horizontally by two vertical wires at its ends. A small but dense 550 N weight is placed on the beam 2.00 m from one end, as shown in the figure. The tensions, A and B, in the two wires are: 45) _____



A) A = 8960 N, B = 8190 N
B) A = 8190 N, B = 8960 N
C) A = 836 N, B = 914 N
D) A = 875 N, B = 875 N
E) A = 914 N, B = 836 N

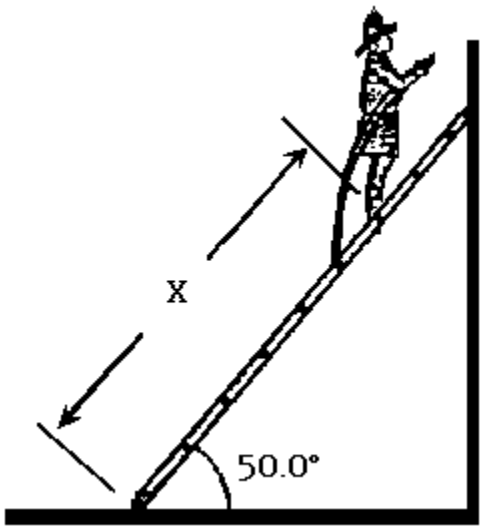


46) A uniform 200 kg beam, 6 m long, is freely pivoted at P. The beam is supported in a horizontal position by a light strut, 5 m long, which is freely pivoted at Q and is loosely pinned to the beam at R. A load of mass is suspended from the end of the beam at S. A maximum compression of 25,000 N in the strut is permitted, due to safety. In the figure, the maximum mass M of the load is closest to: 46) _____

A) 665 kg B) 920 kg C) 1175 kg D) 1120 kg E) 1375 kg

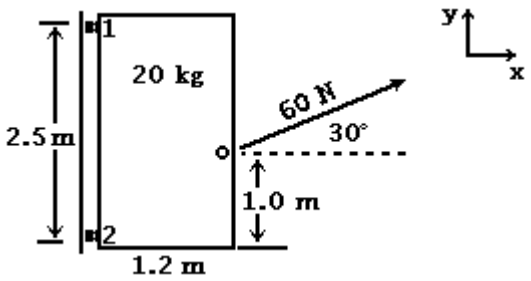
47) A uniform 600 kg beam, 6 m long, is freely pivoted at P. The beam is supported in a horizontal position by a light strut, 5 m long, which is freely pivoted at Q and is loosely pinned to the beam at R. A load of mass is suspended from the end of the beam at S. A maximum compression of 18,000 N in the strut is permitted, due to safety. In the figure, under maximum load, the x–component of the force exerted on the beam by the pivot at P is closest to: 47) _____

A) 10,800 N B) 16,200 N C) 12,600 N D) 14,400 N E) 18,000 N



48) In the figure, a ladder of weight 200 N and length 10 meters leans against a smooth wall (no friction on wall). A firefighter of weight 600 N climbs a distance x up the ladder. The coefficient of friction between the ladder and the floor is 0.5. What is the maximum value of x if the ladder is not to slip? 48) _____

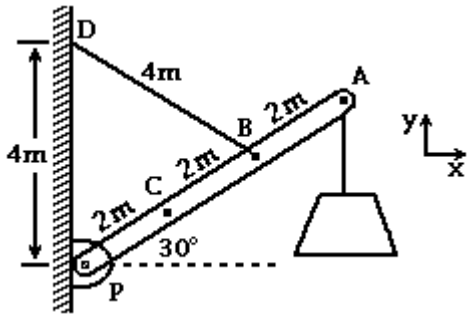
A) 5.00 m B) 8.44 m C) 3.93 m D) 6.04 m E) 6.28 m



A 20 kg uniform door has a width of 1.2 m and a height of 2.5 m. The door is mounted on a post by a pair of hinges, marked 1 and 2, at the top and bottom of the door. An external force of 60 N, at an angle of 30° above the horizontal, is applied to the doorknob, as shown. The doorknob is 1.0 m above the bottom of the door.

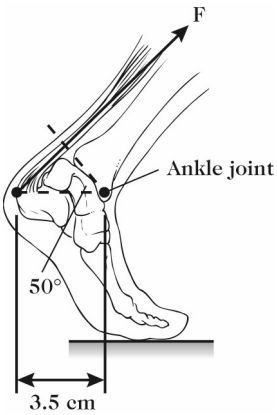
49) In the figure, the x–component of the force, exerted on the door at the top by hinge 1, is closest to: 49) _____

A) +80 N B) –80 N C) zero D) +55 N E) –55 N



50) A 100 kg nonuniform boom, 6.0 m long, is loosely pinned at the pivot at P. A 600 kg block is suspended from the end of the boom at A. The boom forms a 30° angle with the horizontal, and is supported by a cable, 4.0 m long, between points D and B. Point B is 4.0 m from P, and point D is 4.0 m above P. The center of mass of the boom is at point C, which is 2.0 m from P. In the figure, the tension in the cable is closest to: 50) _____

A) 6900 N B) 9300 N C) 7500 N D) 8400 N E) 8100 N



51) In the figure, the Achilles tendon exerts a force F = 720 N. What is the torque it exerts about the ankle joint? 51) _____

A) 16.2 N • m B) 25.9 N • m C) 36.0 N • m D) 21.2 N • m E) 12.2 N • m

52) An object attached to a spring is pulled across a frictionless surface. If the spring constant is 45 N/m and the spring is stretched by 0.88 m when the object is accelerating at 1.4 m/s^2, what is the mass of the object? 52) _____

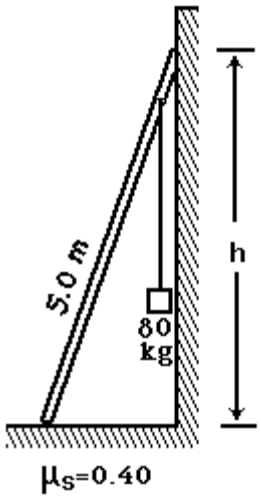
A) 28 kg B) 36 kg C) 31 kg D) 24 kg

53) A force of 30 N stretches a spring 0.73 m from equilibrium. What is the value of the spring constant? 53) _____

A) 34 N/m B) 22 N/m C) 41 N/m D) 46 N/m

54) A spring stretches by 21.0 cm when a 135 N object is attached. What is the weight of a fish that would stretch the spring by 44.9 cm? 54) _____

A) 176 N B) 405 N C) 289 N D) 63 N



55) A 40 kg uniform ladder, 5.0 m long, is placed against a smooth wall at a height of h = 4.0 m. The base of the ladder rests on a rough horizontal surface whose coefficient of static friction is 0.40. An 80 kg block is suspended from the top rung of the ladder, just at the wall. In the figure, the force exerted on the wall by the ladder is closest to: 55) _____

A) 740 N B) 1300 N C) 900 N D) 980 N E) 1100 N

56) A small branch is wedged under a rock and rests on a smaller object. The smaller object is 2.0 m from the large rock and the branch is 10.0 m long. If the mass of the branch is 20.0 kg, what force must be exerted on the smaller rock? 56) _____

A) 49 N B) 490 N C) 200 N D) 50 N

57) Suppose that a heavy person and a light person are balanced on a teeter–totter made of a plank of wood. Each person now moves in toward the fulcrum a distance of 25 cm. What effect will this have on the balance of the teeter–totter? 57) _____

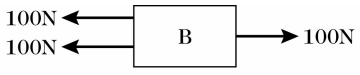
A) The light person's end will go down.
B) The teeter–totter will remain in balance.
C) The heavy person's end will go down.
D) One cannot tell whether either end will rise or fall without knowing the relative mass of the plank.
E) Only if the plank has significant mass will the light person's end go down.

58) Which of the following is an accurate statement? 58) _____

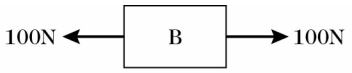
A) The ratio stress/strain is called the elastic modulus.
B) Tensile stress is measured in Newtons.
C) Tensile strain is measured in meters.
D) "Strain" has a meaning very close to "force."
E) "Stress" has a meaning very close to "stretch."

59) Two blocks, A and B, are being pulled to the right along a horizontal surface by a horizontal 100 N pull, as shown in the figure. Both of them are moving together at a constant velocity of 2.0 m/s to the right, and both weigh the same. Which of the figures below shows a correct free-body diagram of the horizontal forces acting on lower block, B? 59) _____

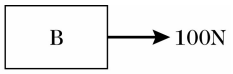
A)



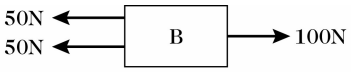
B)



C)



D)



E) None of these diagrams is correct.