Exam

Name_____

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

Solve the problem. (Use g = 9.8 m/s^2.)

1) A 21 kg box must be slid across the floor. If the coefficient of static friction between the box and floor is 0.37, what is the minimum force needed to start the box moving from rest? 1) _____
A) 53 N B) 106 N C) 76 N D) 205 N

Formula: F = coefficent of friction*m*g

2) A 6.0 kg box slides down an inclined plane that makes an angle of 39° with the horizontal. If the coefficient of kinetic friction is 0.19, at what rate does the box accelerate down the slope? 2) _____
A) 5.5 m/s^2 B) 4.7 m/s^2 C) 6.2 m/s^2 D) 5.2 m/s^2

F = mgsin(angle); f = mu*m*g cos(angle); a = (F–f)/m = g (sin(angle)–mu*cos(angle))

3) A skydiver reaches a "terminal velocity" of 120 km/h. If the skydiver has a mass of 89.0 kg, what is the magnitude of the upward force on the skydiver due to wind resistance? 3) _____
A) 9.08 N B) 8.17 N C) 872 N D) 959 N

Upward force = mg since there is no acceleration.

4) A driver in a 1000.0 kg car traveling at 37 m/s slams on the brakes and skids to a stop. If the coefficient of friction between the tires and the road is 0.80, how long will the skid marks be? 4) _____
A) 109 m B) 70 m C) 87 m D) 81 m

deceleration, a = mu*g; x = (v*v/2*a)

5) A rescue plane spots a survivor 123 m directly below and releases an emergency kit with a parachute. If the package descends at a constant vertical acceleration of 7.09 m/s^2 and the initial plane horizontal speed was 70.9 m/s, how far away from the survivor will it hit the waves? 5) _____
A) 2.46 km B) 436 m C) 418 m D) 296 m

calculate t and then x using y = 1/2*a*t*t; x = v*t

6) A robot submersible is released from a research vessel. Through computer controls the craft is to execute the following sequence: a) $\vec{a} = 3.18\,\hat{\mathbf{i}} - 3.60\,\hat{\mathbf{j}}$ m/s^2 for 24 s, b) maintain its velocity (no acceleration) for another 4.05 min, and c) come to a full stop. How far from the vessel will it be located? 6) _____
A) $1200\,\hat{\mathbf{i}} - 1400\,\hat{\mathbf{j}}$ m B) $2100\,\hat{\mathbf{i}} - 2400\hat{\mathbf{j}}$ m
C) $1200\,\hat{\mathbf{i}} + 1400\,\hat{\mathbf{j}}$ m D) $1100\,\hat{\mathbf{i}} - 1200\,\hat{\mathbf{j}}$ m

s = 1/2*a*t1*t1 + a*t1*t2; where a = acceleration vector, t1 = 24 s, t2 = 4.05 sec (not 4.05 min!)

7) A boy throws a rock with an initial velocity of 2.30 m/s at 30.0° above the horizontal. How long does it take for the rock to reach the maximum height of its trajectory? 7) _____
A) 0.117 s B) 0.207 s C) 0.324 s D) 0.230 s

t = v*sin(30deg)/g

8) A cat leaps to catch a bird. If the cat's jump was at 60.0° off the ground and its initial velocity was 7.22 m/s, what is the highest point of its trajectory? 8) _____
A) 2.00 m B) 1.30 m C) 28.88 m D) 4.00 m

t = v*sin(60deg)/g; y = v*t + 1/2*g*t*t

9) 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 8.4 rev/min, what is the velocity of the child in m/s? 9) _____

A) 15.8 m/s B) 7.9 m/s C) 5.5 m/s D) 1.3 m/s

v = omega*r = omega*d/2, where d = diameter = 2*r

10) A satellite is in orbit around a planet. The orbital radius is 29.0 km and the gravitational acceleration at that height is 3.7 m/s^2. What is the satellite's orbital speed? 10) _____

A) 10 m/s B) 330 m/s C) 33 m/s D) 100 m/s

v = square–root of (a*r)

11) A 22 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? 11) _____

A) 4.7 s B) 4.4 s C) 3.8 s D) 5.1 s

Find omega from this: m*omega^2*r = tension, and use omega here: T= 2*pi/omega

12) You are taking a turn at 39.0 m/s on a ramp of radius 29.0 m. What is your acceleration? 12) _____

A) 0.744 m/s^2 B) 52.4 m/s^2 C) 1.34 m/s^2 D) 21.6 m/s^2

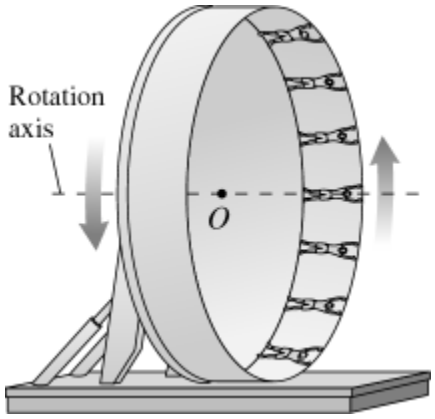
a = v^2/r

13) An aircraft performs a maneuver called an aileron roll. During this maneuver, the plane turns like a screw as it maintains a straight flight path, by using its ailerons to set the wings in circular motion. If it takes it 39 s to complete the circle and each wing length is 4.5 m, what is the acceleration of the wing tip? 13) _____

A) 0.54 m/s^2 B) 8.3 m/s^2 C) 1.9 m/s^2 D) 0.12 m/s^2

omega = 2*pi/T; a = omega^2*r

14) In an amusement park ride passengers stand inside an 8 m radius cylinder. Initially the cylinder rotates with its axis oriented along the vertical. After the cylinder has acquired sufficient speed, it tilts into a vertical plane, that is, the axis tilts into the horizontal, as shown in the figure. Suppose that, once the axis has tilted into the horizontal, the ring rotates once every 4.5 s. If a rider's mass is 44 kg, with how much force does the ring push on her at the top of the ride? 14) _____



A) 260 N B) 430 N C) 690 N D) 1100 N

F = m*omega^2*r, where omega = 2*pi/T

15) Two boxes are sitting side by side on a frictionless surface. The box on the left has a mass of 11 kg, and the box on the right has a mass of 17 kg. If a 28 N force pushes on the 11 kg box from the left, what is the force exerted on the 17 kg box by the 11 kg box? 15) _____

A) 17 N B) 21 N C) 11 N D) 14 N

This force gives acceleration to both: F = (m1+m2)a; F–F21 = m1*a; solve for F21

Solve the problem. (Use $g = 9.8$ m/s^2.)

16) A 10.0 kg block on a table is connected by a string to a 63 kg mass, which is hanging over the edge of the table. Assuming that frictional forces may be neglected, what is the magnitude of acceleration of the 10.0 kg block when the other block is released? 16) _____

A) 8.5 m/s^2 B) 8.1 m/s^2 C) 9.0 m/s^2 D) 7.5 m/s^2

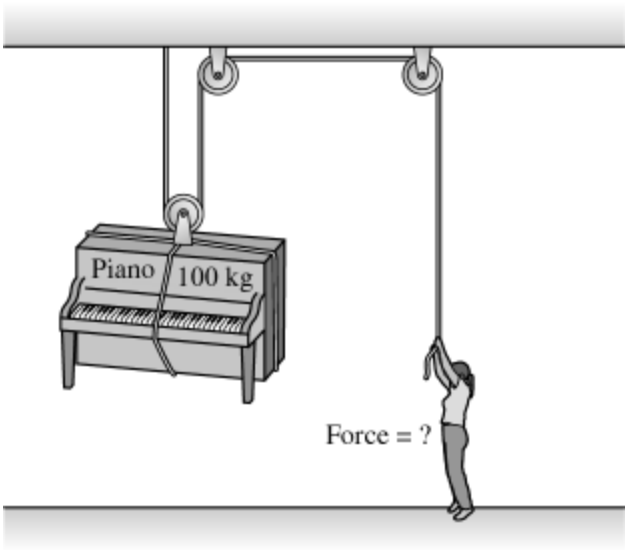
a = m2*g/(m1+m2) from the equations: T = m1*a; m2*g–T = m2*a

17) A 12 kg block on a table is connected by a string to a 26 kg mass, which is hanging over the edge of the table. If the 12 kg block is 2.0 m from the edge of the table, how much time will pass before the block falls off the table from when the other block is released? Assume that frictional forces may be neglected. 17) _____

A) 0.65 s B) 0.46 s C) 0.77 s D) 0.55 s

Find a using the same idea as in question #16, and use the equation of kinematics: x = 1/2*a*t^2

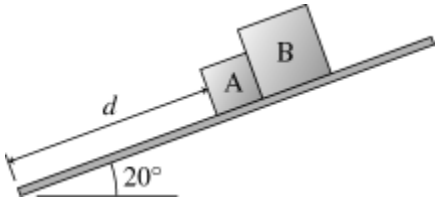
18) A piano mover raises a 100 kg piano at a constant rate using a frictionless pulley system, as shown below. With roughly what force is the mover pulling down on the rope? 18) _____



A) 1000 N
B) 2000 N
C) 500 N
D) 250 N
E) Depends on the velocity!

2*T = mg and T = mg/2

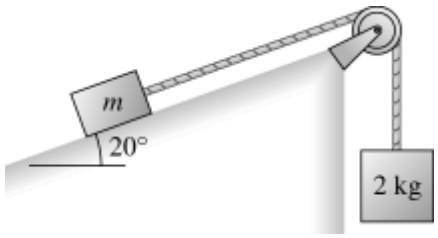
19) The figure shows two packages that start sliding down a 20° ramp from rest a distance $d = 3.1$ m along the ramp from the bottom. Package A has a mass of 5.0 kg and a coefficient of friction 0.20. Package B has a mass of 10 kg and a coefficient of friction 0.15. How long does it take package A to reach the bottom? 19) _____



A) 2.0 s B) 2.2 s C) 2.4 s D) 1.8 s

Forces on A: Fa – fa + Fba = m1*a; Forces on B: Fb–fb–Fab = m2*a; Fba = –Fab (Newton's 3rd law)
Fa = force down the plane for A = mg sin(theta), fa = frictional force = mu*m1*gcos(theta); d=1/2*a*t^2

20) The figure shows a block of mass m resting on a 20° slope. The block has coefficients of friction $\mu_S = 0.46$ and $\mu_K = 0.36$ with the surface. It is connected via a massless string over a massless, frictionless pulley to a hanging block of mass 2.0 kg. What is the minimum mass m that will stick and not slip? 20) _____



A) 4.6 kg B) 4.0 kg C) 1.5 kg D) 2.6 kg

mg*sin(20deg) +mu*mg*cos(20deg) = 2kg*g

21) A container explodes and breaks into three fragments that fly off 120° apart from each other, with mass ratios 1:4:2. if the first piece flies off with a speed of 6.2 m/s, what is the speed of the other two fragments? (All fragments are in the plane.) 21) _____

A) 1.6 and 0.9 m/s B) 0.9 and 3.1 m/s C) 1.6 and 3.1 m/s D) 1.0 and 3.1 m/s

Hint: use the principle of conservation of momentum along x– and y–directions.

22) A 0.140 kg baseball is thrown with a velocity of 42.3 m/s. It is struck with an average force of 5000.0 N, which results in a velocity of 37.0 m/s in the opposite direction. How long were the bat and ball in contact? 22) _____

A) 5.33×10^{-3} s B) 3.82×10^{-2} s C) 1.59×10^{-2} s D) 2.22×10^{-3} s

F*t = momentum change; t = momentum change/F

23) A golf ball of mass 0.050 kg has a velocity of 102 m/s immediately after being struck. If the club and ball were in contact for 0.64 ms, what is the average force exerted on the ball? 23) _____

A) 7.0 kN B) 8.0 kN C) 9.0 kN D) 6.2 kN

use the same formula as in 22

24) A 0.15 kg pool ball moving in the $+x$ direction collides with another pool ball. The collision lasts 50 ms, and the average impulsive force on the first ball is $-12\,\hat{\mathbf{i}} + 9.2\,\hat{\mathbf{j}}$ N. If the initial velocity of the first pool ball is 9.2 m/s, what is the magnitude of its velocity after the collision? 24) _____

A) 7.2 m/s B) 7.9 m/s C) 6.0 m/s D) 5.2 m/s

vf = (Ft + m*vi)/m, where vi = initial velocity vector = 50 i^

25) A 1200 kg cannon fires a 100.0 kg cannonball at 37 m/s. What is the recoil velocity of the cannon? Assume that frictional forces are negligible and the cannon is fired horizontally. 25) _____

A) 3.4 m/s B) 37 m/s C) 3.7 m/s D) 3.1 m/s

mv – MV = 0 ; V = mv/M

26) A box is moving on a tilted conveyor belt. Express its change in potential energy, as it goes from point A to point B, a distance Δh higher. 26) _____

A) $-mg(\Delta h)$ B) $mg(r_A - r_B)$ C) $mg(\Delta h)$ D) $mg(r_B - r_A)$

Hint: potential energy is increasing

27) A horizontal spring–mass system oscillates on a frictionless table. If the ratio of the mass to the spring constant is 0.077 kg•m/N, and the maximum speed of the mass was measured to be 11.49 m/s, find the maximum extension of the spring. 27) _____

A) 0.88 m B) 3.2 m C) 88 cm D) 3.2 cm

1/2*mv^2 = 1/2*k*x^2; solve for x

Answer Key
Testname: SAMPLEQUESTIONS2

1) C
2) B
3) C
4) C
5) C
6) A
7) A
8) A
9) B
10) B
11) A
12) B
13) D
14) A
15) A
16) A
17) C
18) C
19) D
20) D
21) C
22) D
23) B
24) C
25) D
26) C
27) B