Exam

Name________________________________

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

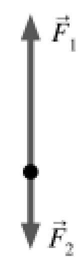
1) You want to swim straight across a river that is 76 m wide. You find that you can do this if you swim 28° upstream at a constant rate of 1.5 m/s relative to the water. At what rate does the river flow? The angle is measured from the river bank (directly upstream is $\Theta = 0°$ while directly across the river is $\Theta = 90°$). 1) ________

A) 0.7 m/s B) 1.8 m/s
C) 1.3 m/s D) 1.6 m/s

2) 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 5.4 rev/min, what is the velocity of the child in m/s? 2) ________

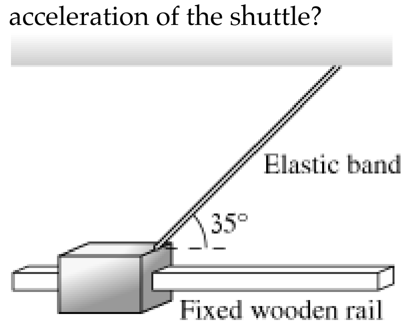
A) 3.6 m/s
B) 5.1 m/s
C) 10.2 m/s
D) 0.8 m/s

3) The figure shows two forces acting on an object, with magnitudes $F_1 = 78$ N and $F_2 = 26$ N. What third force will cause the object to be in equilibrium? 3) ________



A) 82 N pointing down
B) 52 N pointing down
C) 52 N pointing up
D) 82 N pointing up

4) A device has a 100 g wooden shuttle that is pulled along a square wooden rail by an elastic band. The shuttle is released when the elastic band has 9.0 N tension at a 35° angle. What is the magnitude of the initial acceleration of the shuttle? 4) ________



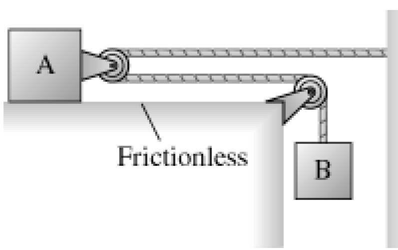
A) 74 m/s2 B) 90 m/s2
C) 84 m/s2 D) 52 m/s2

Solve the problem. (Use g = 9.8 m/s2.)

5) A driver in a 1000.0 kg car traveling at 20 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? 5) ________

A) 33 m
B) 21 m
C) 24 m
D) 26 m

6) A wooden block A of mass 4.0 kg slides on a frictionless table when pulled via a massless string and pulley array by a hanging box B of mass 5.0 kg, as shown in the figure. What is the acceleration of block A as it slides on the frictionless table? **Hint:** think carefully about the acceleration constraint. 6) ________



A) 3.5 m/s2
B) 4.1 m/s2
C) 3.1 m/s2
D) 2.7 m/s2

7) A 1.75 kg book is sitting on a stationary table. What is the magnitude and direction of the force exerted on the book by the table? 7) ________

A) 17.2 N, up
B) 18.6 N, up
C) 18.6 N, down
D) 17.2 N, down

8) You swing a ball in a circle in a vertical plane on string of length 15 cm. There is a *minimum* angular velocity ω_{min} you must maintain if you want the ball to complete the full circle. If you swing the ball at $\omega < \omega_{min}$, then the string goes slack before the ball reaches the top of the circle. What is ω_{min}? Give your answer in rpm. 8) ________

A) 1.2 rpm
B) 7.7 rpm
C) 480 rpm
D) 77 rpm

9) A tetherball is on a 2.1 m string which makes an angle of 44° with the vertical as it moves around the pole in a horizontal plane. If the mass of the ball is 1.3 kg, what is the ball's speed? 9) ________

A) 2.9 m/s
B) 3.4 m/s
C) 3.7 m/s
D) 4.2 m/s

10) A fisherman throws the anchor off her boat at an angle of 3.0°above the horizontal. If the anchor weighs 2.0 times as much as she does and the boat moves with speed 2.7 m/s during the launch, how fast did she throw the anchor? (Solve for her frame of reference. Assume the mass of the boat is negligible.) 10) ________

A) 4.1 m/s
B) 4.0 m/s
C) 1.3 m/s
D) 1.4 m/s

11) A 14 cm diameter champagne bottle rests on its side on top of a frictionless table. Suddenly, the cork pops and the bottle slides backward for a distance of 22.0 cm in 0.44 s. If the mass of the bottle is 500 times the mass of the cork, find the distance from the original position the cork will land on the table. 11) ______

A) 8.5 cm
B) 85 m
C) 3000 cm
D) 60 m

12) An object initially at rest explodes in two fragments of masses 4.3 kg and 1.6 kg that move in diametrically opposite directions. If the speed of the first fragment is 8.4 m/s, find the internal energy of the explosion. 12) ______

A) 210kJ B) 210J
C) 560J D) 560kJ

13) A potential is described by 13) ______

$$U(x) = 2.000\,x\,e^{-x^2/14.000}.$$

Find the point on the x-axis where the potential is a maximum.

A) $x = -2.646$
B) $x = -4.000$
C) $x = 2.646$
D) $x = 4.000$

14) Calculate the average power output necessary for a 55.8 kg person to run up a 12.0 m long hillside, which is inclined at 25.0° above the horizontal, in 3.00 s. Express your answer in horsepower. 14) ______

A) 1.86 hp B) 2.93 hp
C) 0.74 hp D) 1.24 hp

15) A tennis ball bounces on the floor three times. If each time it loses 22.0% of its energy due to heating, how high does it rise after the third bounce, provided we released it 2.3 m from the floor? 15) ______

A) 11 cm B) 110 mm
C) 140 cm D) 110 cm

16) Calculate the average power needed to spin a uniform, solid disk of mass 2.2 kg and radius 0.70 m from rest to 5.0 rad/s in 2.3 s. 16) ______

A) 3.5 W B) 2.9 W
C) 2.3 W D) 4.1 W

17) A force of 22.04 N is applied tangentially to a wheel of radius 0.340 m and gives rise to an angular acceleration of 1.20 rad/s^2. Calculate the rotational inertia of the wheel. 17) ______

A) 4.68 kg $\cdot$ m^2
B) 6.24 kg $\cdot$ m^2
C) 7.80 kg $\cdot$ m^2
D) 9.36 kg $\cdot$ m^2

18) 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? 18) ______

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

19) At what distance from the Earth should an astronaut be placed so that he will feel no net force when the Earth and the moon and he are aligned? 19) ______

A) 3.44×10^8 m

B) 4.29×10^8 m

C) 0.47×10^8 m

D) 0.38×10^8 m

20) A standard atmosphere has a pressure versus altitude relation approximated by 20) ______

$$p = P_0 e^{-\alpha h},$$

with $\alpha = 0.116\ \text{km}^{-1}$. An aircraft flies at 30,000 ft but maintains a cabin pressure of that at 8000 ft. What force is exerted by air pressure on a square meter of cabin wall area?

A) 7.6×10^4 N

B) 4.1×10^4 N

C) 124 N

D) 3.5×10^4 N

21) Calculate the pressure exerted on the ground by a 57 kg person standing on one foot. Assume that the bottom of the person's foot is 13 cm wide and 28 cm long. 21) ______

A) 3.4×10^4 Pa

B) 1.6×10^3 Pa

C) 3.8×10^4 Pa

D) 1.5×10^4 Pa

22) A hot air balloon has a volume of $2000\ \text{m}^3$ when fully inflated, and the air inside the balloon is always at atmospheric pressure because of the large opening used to fill the balloon and heat the air inside it. What's the mass of hot air inside the balloon if its temperature is 120°C? (Assume a molecular weight of 28.8 g/mole for air.) 22) ______

A) 203 kg

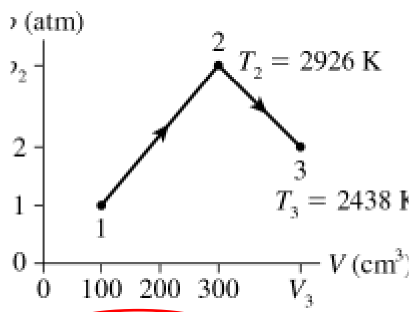
B) 1790 kg

C) 5850 kg

D) 62.0 kg

E) none of the above

23) The figure shows 0.0066 mol of gas that undergoes the process 1 → 2 → 3. What is the pressure p_2? 23) ______



A) 5.3 atm

B) 1.6×10^6 atm

C) 5.3×10^5 atm

D) 16 atm

24) An ideal gas with $\gamma = 1.3$ occupies 7.0 L at 3.0 K and 200 kPa pressure. It is compressed adiabatically to 1/7 of its original volume, then cooled at constant volume to 300 K, and finally allowed to expand isothermally to 7.0 L. How much work is done on the gas?

24) ______

A) 980 J
B) 6400 J
C) –6400 J
D) –270,000 J

25) The temperature is increased from 20°C to 180°C. By what factor does the rms speed of a molecule change?

25) ______

A) 2.4
B) 1.5
C) 1.2
D) 3.0

26) Neon is held in a tank at a temperature of 25°C. The pressure inside a tank is 450 atm. How many atomic diameters does a neon atom move between collisions on average?

26) ______

A) 41
B) 36
C) 38
D) 43

27) A heat pump with a coefficient of performance of 4.9 absorbs heat from the atmosphere at a rate of 30 kW. At what rate is it doing work?

27) ______

A) 117 kW
B) 6 kW
C) 36 kW
D) 147 kW