PHYS 220 Exam 2 Spring 2016

PHYSICS 220 FORM A

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PHYSICS 220

$\pi = 3.14159$ $\quad G = 6.673\times10^{-11}\ \mathrm{m}^3/\left(\mathrm{kg}\bullet\mathrm{s}^2\right)$ $\quad 1\mathrm{N} = 1\mathrm{kg}\left(\mathrm{m}/\mathrm{s}^2\right)$

$g = 9.81 m/s^2 = 32\ ft/s^2$ $\quad 1\ \mathrm{lb} = 4.448\ \mathrm{N}$ $\quad 1\ \mathrm{mile} = 1.609\ \mathrm{km}$

$k = 1.38\times10^{-23}\ J/K$; $\quad R = N_A k$ $\quad N_A = 6.022\times10^{23}\ /\ mole$

$\rho_{water} = 1{,}000\ ^{kg}/_{m^3}$ $\quad 1Pa = 1\dfrac{N}{m^2}$; $\quad 1atm = 1.013\times10^5 Pa = 14.7\dfrac{lb}{in^2}$ $\quad \rho_{water} = 1{,}000\ ^{kg}/_{m^3}$

$F_{Grav} = G\dfrac{m_1 m_2}{r^2}$ $\quad F_{friction} = \mu N$ $\quad \vec{p} = m\vec{v}$ $\quad \vec{J} = \vec{I} = \vec{F}\,\Delta t = \Delta\vec{p}$

$x = x_o + \dfrac{1}{2}(v_o + v_f)t$ $\quad v_f = v_o + at$ $\quad a_c = \dfrac{v^2}{r}$ $\quad F = -kX$

$x = x_o + v_o t + \dfrac{1}{2}at^2$ $\quad v_f^2 = v_o^2 + 2a(x - x_o)$ $\quad A_{circle} = \pi R^2$

$\vec{p} = m\vec{v}$ $\quad (PE)_{grav} = U_g = mgy = mgh$ $\quad (PE)_{elastic} = U_s = \dfrac{1}{2}kx^2$

$\omega = \omega_o + \alpha t$ $\quad \theta = \theta_o + \omega_o t + \dfrac{1}{2}\alpha t^2$ $\quad \omega_f^2 = \omega_o^2 + 2\alpha(\theta - \theta_o)$

$KE_{ave} = \dfrac{3}{2}kT = \dfrac{1}{2}mv^2$ $\quad P = \rho g y_{depth}$ $\quad F_B = V\,\rho_{fluid} g$ $\quad X_{cg} = \dfrac{\sum_i w_i x_i}{\sum_i w_i}$

$W = Fd = \tau\theta$, $\quad P = \dfrac{W}{t} = Fv = \tau\omega$, $\quad L = I\omega = mvr$,

$KE = \dfrac{1}{2}mv^2 = \dfrac{1}{2}I\omega^2$ $\quad W = Fd\cos\theta$ $\quad \theta = \dfrac{s}{r} = \dfrac{vt}{r}$ $\quad \omega = \dfrac{\theta}{t}$

$\tau = FL\sin\theta$ $\quad a_T = \alpha r$ $\quad \alpha = \dfrac{\Delta\omega}{\Delta t}$

$I_{Sphere} = \dfrac{2}{5}mR^2$; $I_{Hoop,pipe} = mR^2$; $I_{Disk,cylinder} = \dfrac{1}{2}mR^2$ $\quad V_{sphere} = \dfrac{4}{3}\pi R^3$

$P + \rho g h + \frac{1}{2}\rho v^2 = \text{constant}$, $\quad v_1 A_1 = v_2 A_2$ $\quad Q = \dfrac{\mathrm{Vol}}{\Delta t} = vA$

$T_F = \dfrac{9}{5}T_C + 32^\circ$; $T_C = T_K - 273^\circ$ $\quad PV = NkT = nN_A kT = nRT$

PHYSICS 220 TEST II

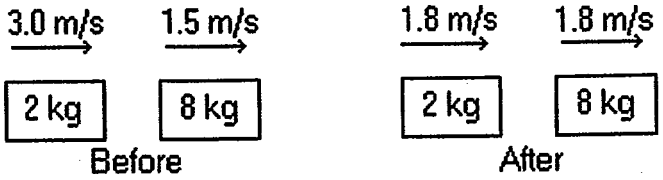
FORM A

QUESTIONS 1 - 25 EACH WORTH 4 POINTS

1) Person X pushes twice as hard against a stationary brick wall as person Y. Which is correct?
A) Both do positive work, but person X does four times the work of person Y.
B) Both do positive work, but person X does twice the work of person Y.
C) Both do the same amount of positive work. D) Both do zero work.
E) Both do positive work, but person X does one-half the work of person Y.

2) A 35-N bucket of water is lifted vertically 3.0 m and then returned to its original position. How much work did the gravitational force exerted by Earth on the object do on the bucket during this process?
A) 180 J B) 90 J C) 45 J D) 0 J E) 900 J

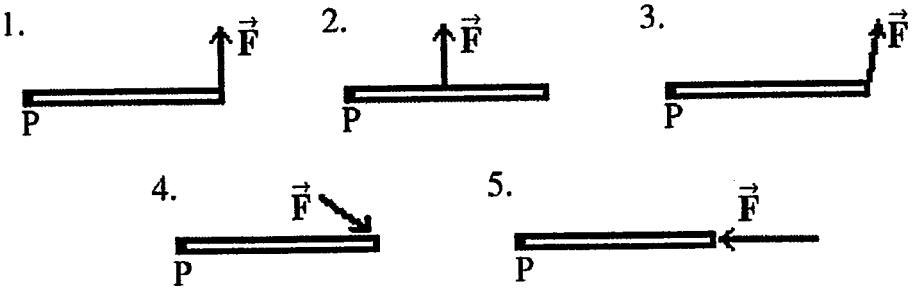
3) In the figure, determine the character of the collision. The masses of the blocks, and the velocities before and after, are shown. The collision is:



A) perfectly elastic. B) partially inelastic. C) completely inelastic.
D) characterized by an increase in kinetic energy. E) not possible because momentum is not conserved.

4) A force is exerted on a system doing work W in a time T. What will be the power of the process that involves a force that does six times as much work in half as much time?
A) 12P B) 6P C) P D) (1/6) P E) (1/12) P

5) As shown in the figure, a given force is applied to a rod in several different ways. In which case is the torque about the pivot P due to this force the greatest?



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

6) Which of the following is correct concerning the center of mass?
A) always at the geometric center of the object B) always the same as the center of gravity
C) does not have to be located within the boundaries of the object
D) never the same as the center of gravity E) none of the above are correct

7) Suppose a solid uniform sphere of mass M and radius R rolls without slipping down an inclined plane starting from rest. The angular velocity of the sphere at the bottom of the incline depends on
A) the mass of the sphere. B) the radius of the sphere. C) both the mass and the radius of the sphere.
D) neither the mass nor the radius of the sphere. E) center of gravity of sphere

8) A person sits, with arms extended, on a freely spinning lab stool that has no friction in its axle. When this person pulls her arms next to her body,
A) her moment of inertia decreases and her angular speed increases.
B) her moment of inertia decreases and her angular speed decreases.
C) her moment of inertia increases and her angular speed increases.
D) her moment of inertia increases and her angular speed decreases.
E) her moment of inertia increases and her angular speed remains the same.

9) Consider a solid uniform sphere of radius R and mass M rolling without slipping. Which form of its kinetic energy is larger, translational or rotational?
A) Translational kinetic energy is larger. B) Rotational kinetic energy is larger.
C) Both are equal. D) You need to know the speed of the sphere to tell.
E) You need to know the angular acceleration.

10) Two children, Ahmed and Jacques, ride on a merry-go-round. Ahmed is at a greater distance from the axis of rotation than Jacques.
A) Jacques has a greater angular speed than Ahmed.
B) Jacques and Ahmed have the same angular speed.
C) Jacques has a smaller angular speed than Ahmed.
D) Ahmed and Jacques have zero angular speed.
E) Jacques and Ahmed have the same tangential speed.

11) A Styrofoam sphere of radius R has a density ρ. You now carefully compress the sphere so its radius is R/2. What is the density of the compressed sphere?
A) 2ρ B) 4ρ C) $\rho\sqrt{8}$ D) $\rho\sqrt{2}$ E) 8ρ

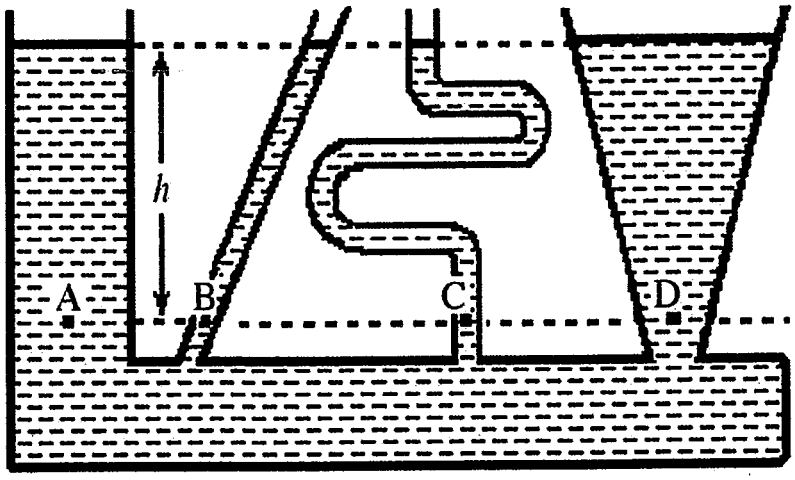
12) A sample of an ideal gas is heated and its Kelvin temperature doubles. If the root-mean-square speed of its molecules was originally v, what is the new root-mean-square speed?
A) 4v B) 2v C) $v\sqrt{2}$ D) $v/\sqrt{2}$ E) v/4

13) A fixed container holds oxygen and helium gases at the same temperature. Which of the following statements is correct?
A) The oxygen molecules have the greater average kinetic energy.
B) The helium molecules have the greater average kinetic energy.
C) The oxygen molecules have the greater speed.
D) The helium and oxygen molecules have the same speed.
E) The helium molecules have the same average kinetic as the oxygen molecules.

14) An ideal gas is held in a container of volume V at pressure P. The rms speed of a gas molecule under these conditions is v. If now the volume and pressure are changed to 2V and 2P, the rms speed of a molecule will be
A) v/2 B) v C) 2v D) 4v E) v/4

15) Oxygen molecules are 16 times more massive than hydrogen molecules. At a given temperature, the average molecular kinetic energy of oxygen molecules, compared to that of hydrogen molecules,
A) is greater. B) is less. C) is the same. D) is 16 times greater
E) cannot be determined without knowing the pressure and volume.

16) As shown in the figure, fluid fills a container having several sections. At which of the indicated points is the pressure greatest?



A) A B) B C) C D) D E) The pressure is the same at each of the points.

17) If atmospheric pressure increases by an amount ΔP, which of the following statements about the pressure in a lake is true?
A) The absolute (total) pressure does not change.
B) The absolute (total) pressure increases, but by an amount less than ΔP.
C) The absolute (total) pressure increases by ΔP. D) The gauge pressure decreases by ΔP.
E) The pressure only depends on the distance below the surface of the lake.

18) The water company increased the water pressure in the water flowing to an apartment. The water enters the apartment through an entrance valve at the front of the apartment. Where will the increase in the static water pressure be greatest when no water is flowing in the system?
A) at a faucet close to the entrance valve B) at a faucet far from the entrance valve
C) It will be the same at all faucets. D) There will be no increase in the pressure at the faucets.
E) Need to know the pipe diameters.

19) A 10-kg square piece of aluminum sits at the bottom of a lake, right next to a 10-kg square piece of lead, which is much denser than aluminum. Which one has the greater buoyant force exerted on it by the water?
A) the aluminum B) the lead C) The same buoyant force is exerted on both.
D) It cannot be determined without knowing their volumes.
E) Neither is floating so there is no buoyant force.

20) Water flows through a pipe. The diameter of the pipe at point B is larger than at point A. Where is the water pressure greatest?
A) at point A B) at point B C) It is the same at both A and B.
D) depends on the speed of the flow E) where the water is most compressed

21) A roof is blown off a house during a tornado. Why does this happen?
A) The air pressure inside the house is higher than outside.
B) The air pressure inside the house is lower than outside.
C) The wind is so strong that it blows the roof off.
D) It is due to the difference in densities between inside and outside.
E) Due to the turbulent air flow in the tornado.

22) Choose a device that reduces the pressure caused by a force.
A) Snowshoes B) Scissors C) Knife D) Nail E) Syringe

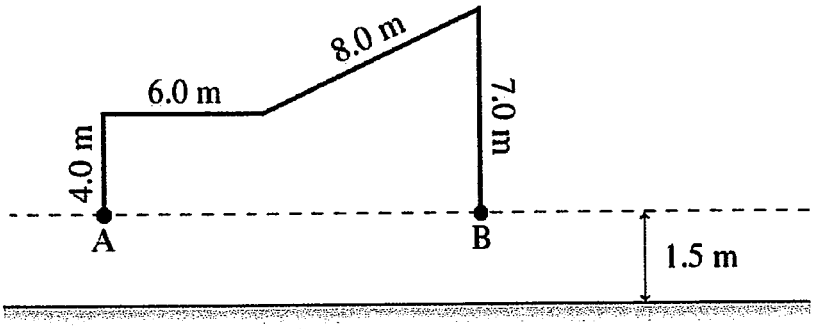
23) You push a child on a swing. Why doesn't the child continue in a vertical loop over the top of the swing?
A) The torque of the force that the Earth exerts on the child pulls him back.
B) The swing does not have enough kinetic energy when at the bottom.
C) The swing does not have enough angular momentum,
D) All of the above are correct. E) None of the above are correct.

24) A hiker descends from the South Rim of the Grand Canyon to the Colorado River. During this hike, the work done by gravity on the hiker is:
A) Positive and independent of the path taken B) Positive and depends on the path taken
C) Negative and depends on the path taken D) Negative and independent of the path taken
E) Zero. No work was done by gravity.

25) An object at rest begins to rotate with a constant angular acceleration. If this object rotates through an angle θ in time t, through what angle did it rotate in the time (1/2) t ?
A) (1/4) θ B) (1/2) θ C) θ D) 2 θ E) 4 θ

QUESTIONS 26 - 31 EACH WORTH 7 POINTS

26) A person carries a 25.0-N rock through the path shown in the figure, starting at point A and ending at point B. The total time from A to B is 1.50 min. How much work did the gravitational force exerted on the rock by Earth do on the rock between A and B?



A) 625 J B) 20.0 J C) 275 J D) 75 J E) 0 J

27) A 60.0-kg man stands at one end of a 20.0-kg uniform 10.0-m long board. How far from the man is the center of mass of the man-board system?
A) 1.25 m B) 2.50 m C) 5.00 m D) 7.50 m E) 9.00 m

28) How long does it take for a rotating object to speed up from 15.0 rad/s to 33.3 rad/s if it has a uniform angular acceleration of 3.45 rad/s^2?

A) 4.35 s B) 5.30 s C) 9.57 s D) 10.6 s E) 63.1 s

29) A certain automobile tire has a volume of 0.0185 m^3. If the absolute (or total) pressure in the tire is 500 kPa and the temperature is 298 K, how many molecules are there inside the tire?

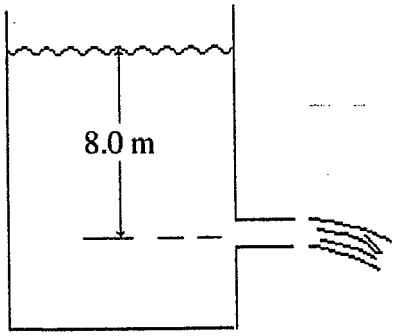
A) 2.25×10^{23} molecules B) 2.25×10^{24} molecules C) 3.25×10^{23} molecules

D) 3.25×10^{24} molecules E) 3.25×10^{25} molecules

30) A 12,000-N car is raised using a hydraulic lift, which consists of a U-tube with arms of unequal areas, filled with oil and capped at both ends with tight-fitting pistons. The wider arm of the U-tube has a radius of 18.0 cm and the narrower arm has a radius of 5.00 cm. The car rests on the piston on the wider arm of the U-tube. The pistons are initially at the same level. What is the initial force that oil must exert on the smaller piston in order to start lifting the car? For purposes of this problem, neglect the mass of the pistons.

A) 727 N B) 926 N C) 2.90 kN D) 3.33 kN E) 1.20 kN

31) Water flows out of a large reservoir through an open pipe, as shown in the figure. What is the speed of the water as it comes out of the pipe?



A) 8.9 m/s B) 9.9 m/s C) 13 m/s D) 14 m/s E) 16 m/s

QUESTION 32 WORTH 8 POINTS

32) In a section of horizontal pipe with a diameter of 3.0 cm, the pressure is 100 kPa and water is flowing with a speed of 1.5 m/s. The pipe narrows to 2.0 cm. What is the pressure in the narrower region?

A) 95 kPa B) 48 kPa C) 44 kPa D) 230 kPa E) 67 kPa