Second sample exam

Please circle the correct answer and fill in the circle on the Opscan answer sheet. (7 points each)

1. A sealed can is cooled from 273 K to 77 K. What happens to the pressure in the can if the process is isochoric (also called isovolumetric)?

a) it doubles b) it increases by some factor other than 2 c) it is halved

d) it decreases by some factor other than 2 e) it is unchanged

2. How much heat in kilocalories is needed to convert 1 kg of ice at 0 degrees C into 1 kg of steam at 100 degrees C? ($L_{ice} = 80$ cal/gr, $L_{steam} = 540$ cal/gr)

a) 640 b) 180 c) 720 d) 360 e) 620

3. Five moles of an ideal gas expands isothermally at 100 degrees C to five times its initial volume. How much heat (in Joules) flows into the system?

a) 2.5×10^4 b) 1.1×10^4 c) 6.7×10^3 d) 2.9×10^3 e) 7.0×10^2

4. A refrigerator is set in the middle of an insulated room on a hot day. The door of the refrigerator is left open in an effort to cool down the room. What actually happens to the room temperature?

a) Nothing b) It decreases c) It increases d) Impossible to say

e) It first increases and then it decreases later.

5. A device that partially converts thermal energy into useful work is called

a) a perpetual motion machine b) a violation of thermodynamics c) a heat engine

d) a refrigerator e) a heat pump

6. A Carnot engine has a 0.35 efficiency factor and an exhaust temperature of 270 K. What is the high temperature operating point of this engine, in Kelvin?

a) 420 b) 390 c) 430 d) 380 e) 440

Second sample exam

7. A which point on this velocity-time graph is the acceleration 0?

a) A b) B c) C d) D) E

8. At t = 1.8 s a particle moving with constant velocity is at $x = 5.2$ m. At $t = 3.2$ s the particle is at $x = 8.1$ m. What is its speed in m/s?

a) 1.4 b) 1.5 c) 2.1 d) 3.2 e) 4.2

9. A 2 kg car collides elastically with an 8 kg cart. Which cart experiences the greater average force during the collision?

a) the 2 kg car b) the 8 kg cart c) the average force is 0 d) it is impossible to say
e) the forces are equal in magnitude and opposite in direction

10. Stars originate as large bodies of slowly rotating gas which collapses because of gravitational attraction. The angular velocity of the star is greater than that of the rotating gas. Why?

a) no one knows for sure b) conservation of linear momentum c) conservation of energy
d) conservation of angular momentum e) the Bohr model

(*Note: Physics 116a students in 2008 do not have to know relativity in the first semester.*)

11. Two observers are traveling towards each other at a speed of $.49c$ each. Observer A sends a pulse of light towards observer B. Observer B will measure the light speed as

a) $0.49c$ b) $0.98c$ c) c d) 0 e) $1.98c$

12. A planet has the same mass as the Earth but its radius is one-third that of the Earth. The acceleration due to gravity at this planet's surface will be

a) $g/9$ b) $g/3$ c) g d) $3g$ e) $9g$

Second sample exam

13. A fish which weighs 10.0 N is placed in an elevator accelerating upward at 2.6 m/s^2. What would its apparent weight be in this moving elevator (answer in N)?

a) 7.35 b) 10.7 c) 11.7 d) 12.7 e) 13.7

14. A 15 kg block is resting on a rough horizontal surface. A minimum of 25 N must be exerted to get the block moving. What is the coefficient of static friction between the block and the surface?

a) 0.12 b) 0.15 c) 0.17 d) 0.19 e) 0.21

15. Tarzan is located 12 m above the Earth's surface. He swings down on a vine but brushes by some branches on the way down such that is speed at the lowest point is 5 m/s less than it would normally be. How far up (in meters) will he swing on the other side?

a) 7.32 b) 5.45 c) 5.93 d) 4.84 e) 4.57

16. Vector $\vec{A}$ is $-2\,\hat{\mathbf{j}}$ and vector $\vec{B}$ is $-3\,\hat{\mathbf{i}}$ What is the direction of $\vec{B} \times \vec{A}$?

a) $\hat{\mathbf{j}}$ b) $\hat{\mathbf{i}}$ c) $\hat{\mathbf{k}}$ d) $-\hat{\mathbf{k}}$ e) $-\hat{\mathbf{i}}$

17. A 16 N suitcase and a 64 N suitcase fall off a loading cart. What is their ratio of accelerations due to gravity?

a) 1:1 b) 1:4 c) 1:8 d) 1:16 e) 1:32

18. A 5.0 kg mass moves in a circle of radius 0.70 m. If the maxium centripetal force which can be endured by the sample is 120 N, what is the maximum speed the object can have? (in m/s)

a) 14.2 b) 14.8 c) 15.2 d) 16.8 e) 4.1

Second sample exam

Part II. Answer all five questions (15 points each.)

1. A train is moving along a straight, horizontal track at a constant speed of 20 m/s. From a flatcar on the train a small cannon fires a projectile at an elevation angle of 60 degrees above the horizontal. The exit speed of the projectile, relative to the cannon, is 15 m/s. (Use Classical Mechanics, not Special Relativity, in this problem.)

a) What is the **velocity** of the projectile relative to the tracks? (5 points)

b) How much time will it take the projectile to reach its highest point in its trajectory (5 points)?

c) How far away, in the horizontal direction, will the projectile land with respect to the horizontal position at which it was fired (ignore any height difference between the cannon and the tracks; 5 points)?

Second sample exam

2. A 0.5 kg mass hangs from a light string which is wound around the rim of a wheel with an 0.18 m radius. The wheel rotates on a frictionless horizontal axle through its center. The 0.5 kg mass is released from rest and is observed to fall a distance of 4.0 m in 2.0 seconds.

a) From what is stated directly in the problem, compute the constant linear acceleration a of the mass (2 points).

b) In terms of the weight of the mass m and the tension T in the string write Newton's Second Law for the constant linear acceleration a of the mass (4 points).

c) In terms of the tension T in the string, the radius R of the wheel, and the unknown moment of inertia I of the wheel, write Newton's Second Law for the constant angular acceleration α of the wheel (4 points).

d) What is the relationship between the linear acceleration a of the mass and the angular acceleration α of the wheel, assuming that there is no slipping of the string (2 points)?

e) Using all the previous answers, compute I the value the moment of inertia of the wheel (3 points).

Second sample exam

3. Two moles of an ideal gas are put through a closed cycle represented by points A, B, and C in a two dimensional P vs. V diagram. From A to B there is an isothermal expansion from a volume of 2.0 m^3 to a volume 12.0 m^3. From B to C there is a contraction at constant pressure from 12.0 m^3 back to 2.0 m^3. And from point C back to the original starting point A there is an increase in pressure back to the original pressure which was 3×10^5 Pa.

a) What is the absolute temperature at points A and B (4 points)?

b) What is the pressure at points B and C (4 points)

c) How much work was done by the gas in going from point A to point B (4 points)?

d) What was the net total work in this cycle (3 points)?

Second sample exam

4. A projectile of mass m is moving with a constant speed v_0 in the $+x$ direction. Suddenly it ejects a particle with a mass $0.1m$ leaving it with $0.9m$ remaining. A student observes that the ejected mass is traveling in the $+y$ direction with a speed of $3v_0$.

a) What is the x velocity component of the $0.9m$ mass after the ejection occurs (5 points)?

b) What is the y velocity component of the $0.9m$ mass after the ejection occurs (5 points)?

c) Does this process conserve transalational kinetic energy, and if not by how much is the kinetic energy changed (5 points)?

Second sample exam

5. In a TV set an electron $m_e = 9.1 \times 10^{31}$ kg is accelerated from rest to a speed of 4.0×10^7 m/s in a time of 0.5 nanoseconds.

a) How much work was done on the electron to give it this speed (use Classical Mechanics; 4 points)?

b) What was the average power expended during the acceleration process (4 points)?

c) What was the (Newtonian mechanics) linear momentum of the electron after the acceleration process (4 points)?

d) What was the (Newtonian mechanics) force exerted on the electron? (3 points)