Physics 221, April 26

Review

Test 3

Test 3 (the final exam) is a 1 hour and 20 minutes test.

Test 3 consists of 23 multiple-choice problems. You can omit 3 problems. The highest score you can get is 20/20. The constants and conversions and formulas you find on the first page of practice test 3 will also be on the first page of test 3.

To prepare for test 3, review modules 9-12, and make sure you understand and can solve the pre-lab and homework assignments 9-12, the problems we worked in class during the last 4 meetings and the problems in the 2 practice tests for test 3.

16 questions will address material covered in the last 4 modules.

7 questions will address material covered in modules 1-8. These questions will only probe your understanding of fundamental concepts and will not involve detailed calculations.

When reviewing the material from modules 1 – 8 concentrate on the concepts and the definitions of the words describing these concepts.

- Define average and instantaneous speed, velocity, and acceleration.
  Distinguish between vectors and scalars

- Use Newton's laws to analyze problems.
  1st law: define inertial frames 2nd law: $\mathbf{F} = m\mathbf{a}$ 3rd law: $\mathbf{F}_{12} = -\mathbf{F}_{21}$

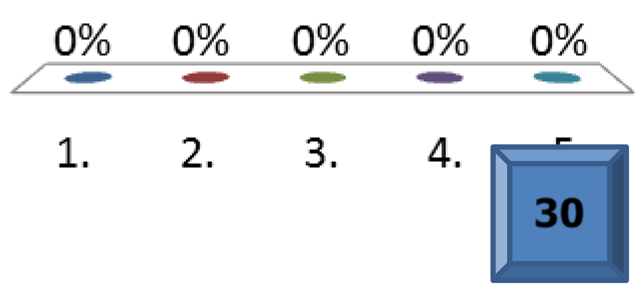
- Distinguish between mass and weight.
  $\mathbf{w} = m\mathbf{g}$

- Apply conservation laws.
  Energy, momentum, angular momentum

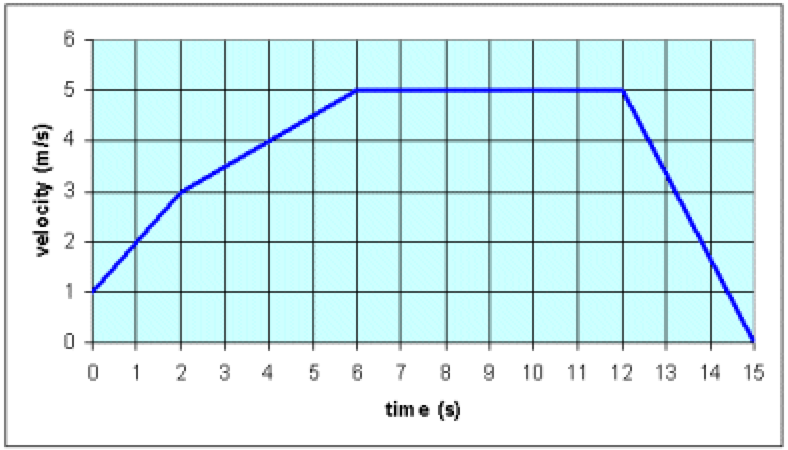
- Recall concepts of fluid dynamics.
  Pressure, Buoyancy, Archimedes' principle, Equation of continuity, Bernoulli's equation, Poiseuille's equation

Consider motion in one dimension along the x-axis. Which statement is TRUE?

1. An object that is slowing down always has a positive acceleration, regardless of the direction it travels.
2. An object that is slowing down always has a negative acceleration, regardless of the direction it travels.
3. An object that is slowing down while traveling in the negative x-direction always has a positive acceleration.
4. An object that is speeding up while traveling in the negative x-direction always has a positive acceleration.
5. An object that is speeding up always has a positive acceleration, regardless of the direction it travels.



The velocity versus time graph to the right represents the motion of an object moving in one dimension along the x-axis.
Between 0 and 15 s, the velocity of the object is never negative.



1. True
2. False

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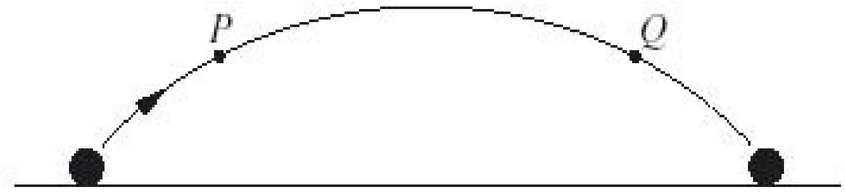
The diagram shows the trajectory of a golf ball. Which set of arrows shows the direction of the acceleration at points P and Q respectively?



(A)

At P	At Q
↑	↓

(B)

At P	At Q
↓	↓

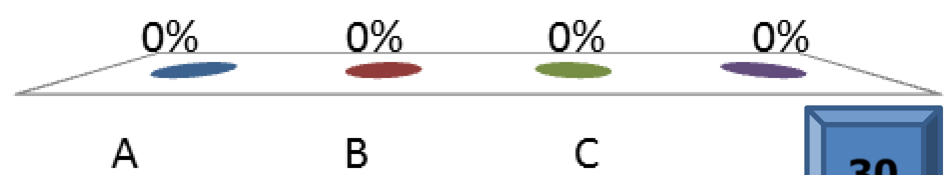
(C)

At P	At Q
↗	↘

(D)

At P	At Q
↙	↘

1. A
2. B
3. C
4. D



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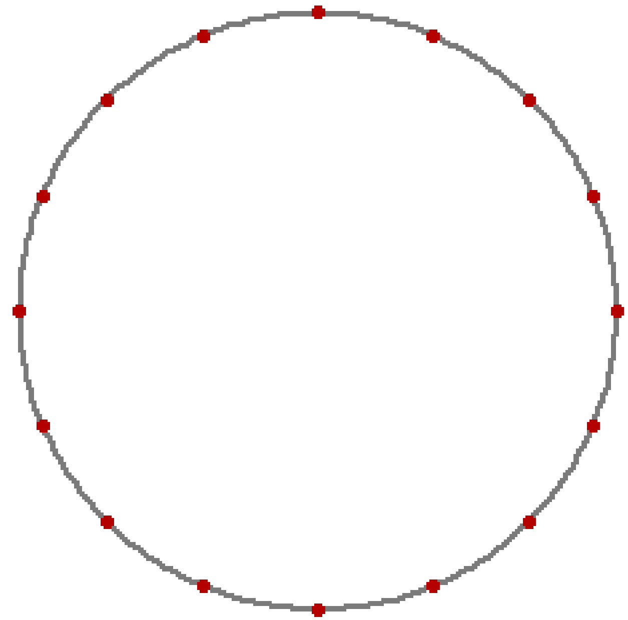
The positions of a dot is shown
at successive 1-second time intervals.



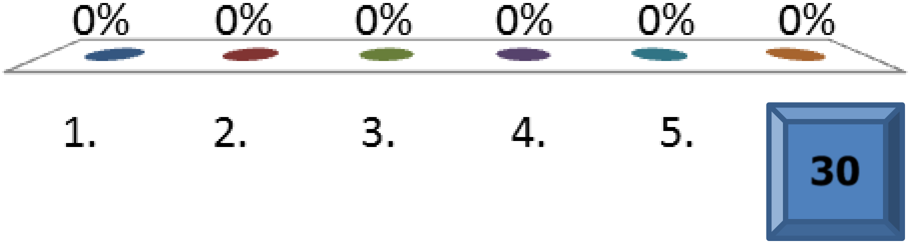
Which statements are true?

(A) The dot is moving with constant speed.

(B) The dot is moving with constant velocity.

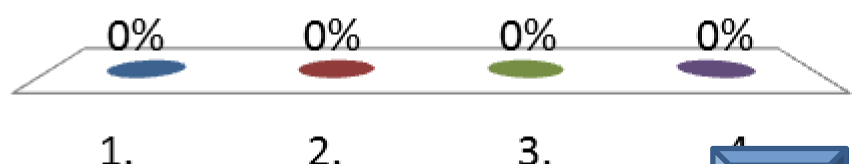
(C) The dot is accelerating.

1. A only
2. B only
3. C only
4. A and C
5. A and B
6. All statements are true.



Suppose an ice skater is moving on the surface of a frozen lake at constant velocity. What is true about the external (outside) forces acting on the skater?

1. There are none.
2. There could be some but they all cancel out.
3. Gravity can be ignored.
4. The all are perfectly horizontal.



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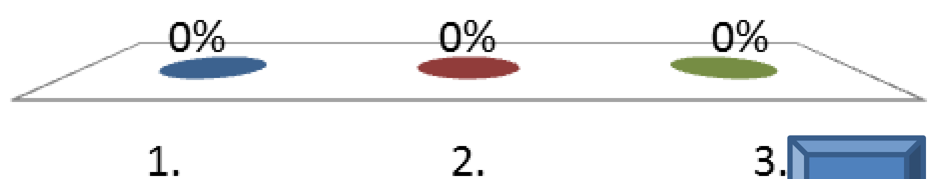
A rock is thrown vertically into the air.
At the very top of its trajectory the net force on it is

1. less than its weight.
2. more than its weight.
3. equal to its weight.



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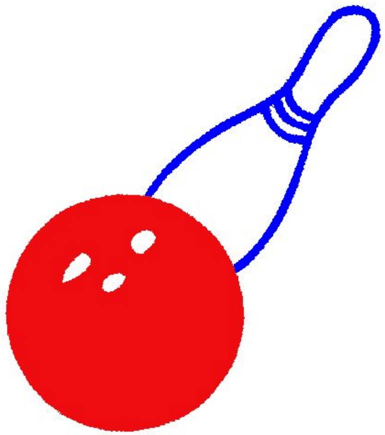
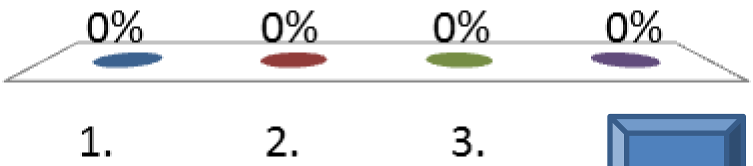
A bowling ball rolls down an alley and hits a bowling pin. Which statement below is true about the magnitudes of the forces exerted during the impact?

1. The bowling pin exerts a larger force on the ball than the ball on the pin.
2. The bowling ball exerts a larger force on the pin than the pin on the ball.
3. The magnitudes of the forces that they exert on each are equal.
4. Any of the above answers could be true. It depends on how fast the bowling ball is moving.





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When sliding a heavy box across the floor, it is often times helpful to lift up on it slightly because

A. you are lessening the friction force by reducing the normal force the floor exerts on the box.
B. you are reducing the weight of the box.
C. you are working against friction by lifting up.
D. you are working against gravity, even if the box does not move upwards.

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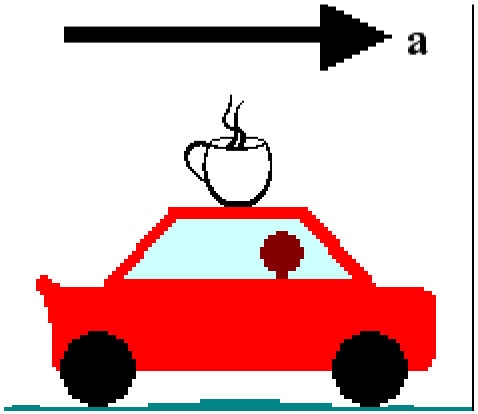
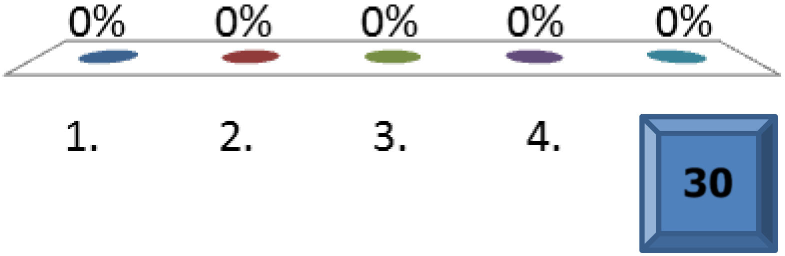
Assume the car is accelerating towards the right and its speed is increasing. A cup of coffee left on the roof is accelerating with the car at the same rate. What is the direction of the frictional force on the cup?

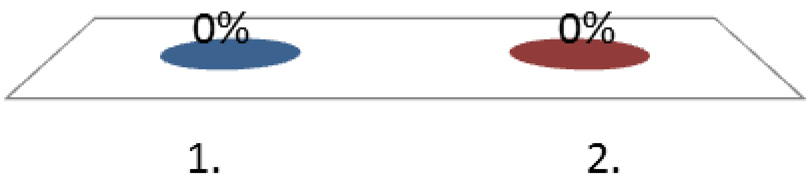


1. Towards the right
2. Towards the left
3. Up
4. Down
5. Down and towards the left



Can work be done on an object without moving it?

1. Yes
2. No



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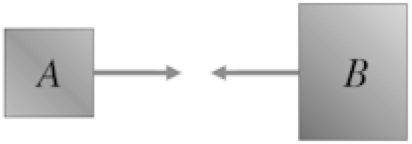
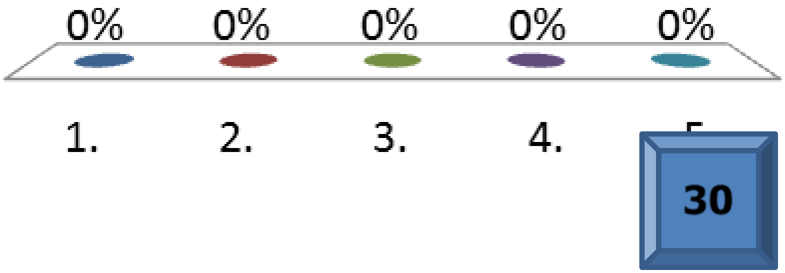
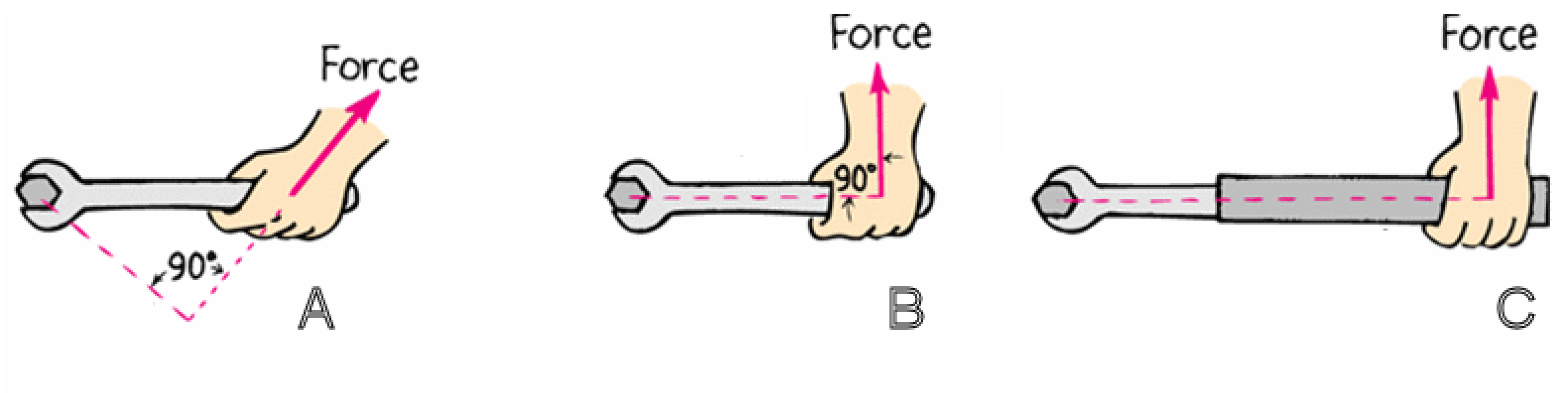
Two objects with different masses collide and stick to each other. Compared to before the collision, the system of two objects after the collision has



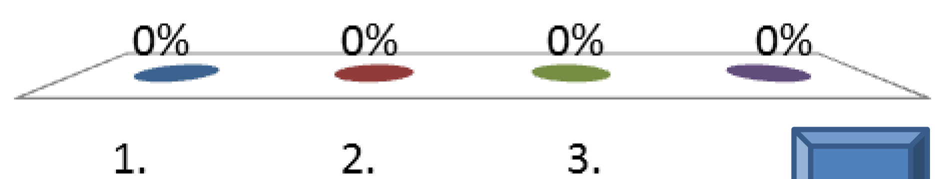
1. the same total momentum and the same total kinetic energy.
2. the same total momentum but less total kinetic energy.
3. less total momentum but the same total kinetic energy.
4. less total momentum and less total kinetic energy.
5. not enough information given to decide.



You need to loosen a very tight bolt. You have one wrench and you exert maximum force. Which configuration shown below gives you maximum chance of success?



1. A
2. B
3. C
4. It does not matter.



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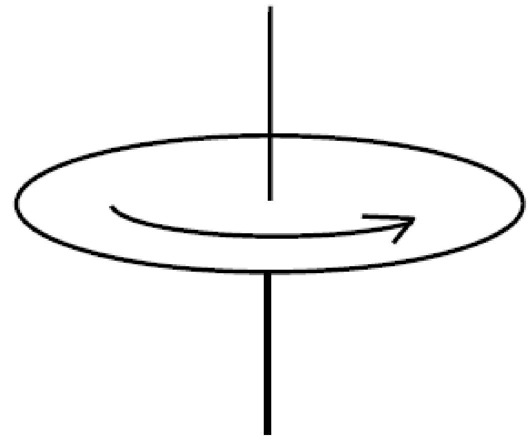
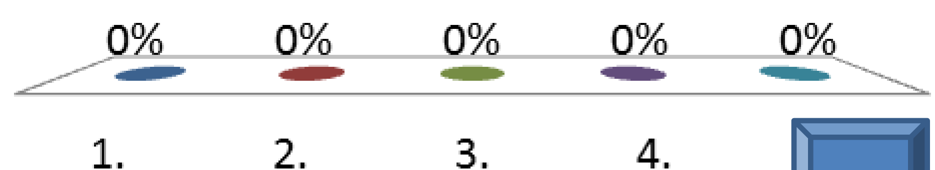
A disk is spinning with angular velocity **ω** as shown. It begins to speed up. While it is speeding up, what are the
(i) directions of its angular velocity **ω**
(ii) and its angular acceleration **α**?



A) → B) ← C) ↑ D) ↓

1. A, C
2. A, B
3. C, C
4. C, D
5. Some other directions.



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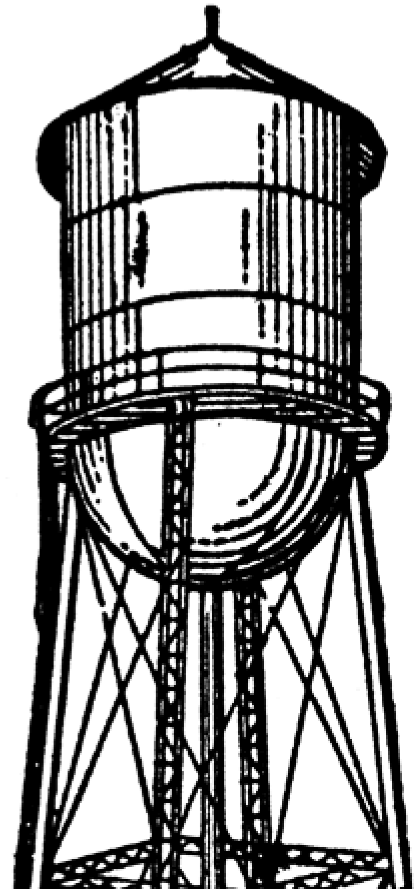
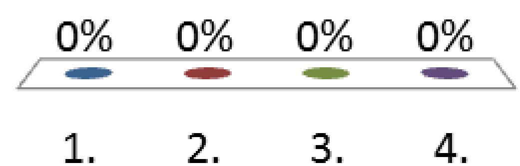
Near the surface of the earth, the fluid at the bottom of a container is

1. under less pressure than the fluid on the top.
2. under more, less, or the same pressure as the fluid on the top, depending on the circumstances.
3. under more pressure than the fluid on the top.
4. under the same pressure as the fluid on the top.





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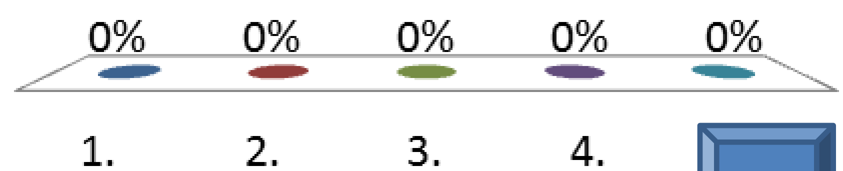
Suppose you work in the E.R. and a choking patient comes in with their trachea half obstructed. (The diameter is half of what it was before the obstruction.) You manage to correct the problem and send them on their way safely, explaining that such obstructions are particularly dangerous because

1. a half – blocked airway passes only 1/4 the regular amount of air.
2. a half – blocked airway passes only 1/16 the regular amount of air.
3. a half – blocked airway passes only 1/2 the regular amount of air.
4. a half – blocked airway passes only 1/32 the regular amount of air.
5. a half – blocked airway passes only 1/8 the regular amount of air.

Hint:
$Q = \pi \Delta P r^4/(8\eta L)$
$Q \propto r^4$



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Oscillations and Waves:

Harmonic motion:

$F = -kx$

$x(t) = A\cos(\omega t + \phi)$, $v(t) = -\omega A\sin(\omega t + \phi)$, $a(t) = -\omega^2 A\cos(\omega t + \phi) = -\omega^2 x$.

$\omega = \text{sqrt}(k/m) = 2\pi f = 2\pi/T$.

Pendulum: $T = 2\pi(L/g)^{1/2}$

Traveling waves: $y(x,t) = A \sin(kx - \omega t \pm \phi)$

Waves on a string: $v = (F/\mu)^{1/2}$

Sound level: $\beta = 10 \log_{10}(I/I_0)$

Beat frequency: $|f_1 - f_2|$

Standing sound waves:

tube of length L with two open ends: $L = n\lambda/2$, $n = 1, 2, 3, ...$

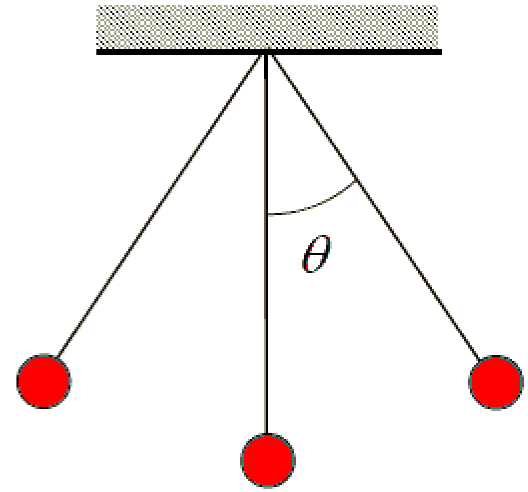
tube of length L with one open end and one closed: $L = n\lambda/4$, n = odd integer

Doppler effect:

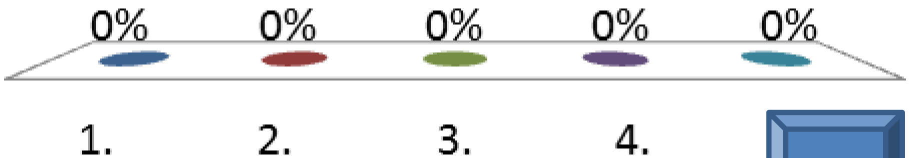
$f = f_0(v - v_{obs})/(v - v_s)$ (velocity components in the direction of v are positive)

A simple pendulum consists of a point mass m suspended by a massless, unstretchable string of length L.

If the mass is doubled while the length of the string remains the same, the period of the pendulum



1. becomes 4 times greater.
2. becomes twice as great.
3. becomes greater by a factor of square root of 2.
4. remains unchanged.
5. decreases.



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Temperature and Heat

Ideal gas: $PV = (2/3)N(m\langle v^2\rangle/2) = (2/3)U$, $PV = Nk_BT = nRT$

$k_B = 1.381*10^{-23}$ J/K, $R = 8.31$ J/(mol K)

Linear expansion: $\Delta L = \alpha L\Delta T$

Thermal conductivity: $\Delta Q/\Delta t = -kA\ \Delta T/\Delta x$

Stefan-Boltzmann Law: Radiated power = emissivity * σ * T^4 * Area

Wien Law: $\lambda_{max}(nm) = 3*10^6/T(K)$

Specific heat: $c = \Delta Q/(m\ \Delta T)$

Latent heat: $\Delta Q = mL$

Thermodynamics:

First law: $\Delta U = \Delta Q - \Delta W$

Second law: $Q_{high}/T_{high} = Q_{low}/T_{low}$

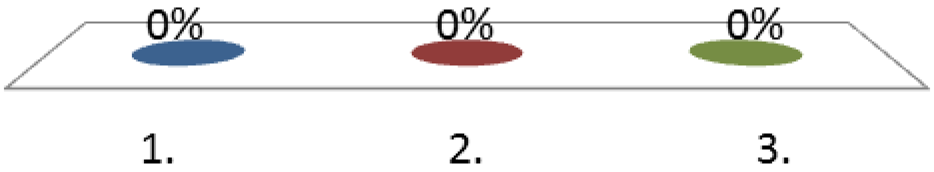
Entropy: $S = k_B \ln\Omega$, $\Delta S = \Delta Q/T$

Conversion:

Cal = 1 kcal = 4186 J

You are trying to bring a pot of water to a boil, to boil some eggs. To use the least amount of gas (energy), do the following.

1. Turn the flame on high.
2. Turn the flame on low.
3. Turn the flame on a medium setting.



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The water is now boiling. To boil the eggs using the least amount of gas do the following.

1. Turn the flame on high, so that the water is boiling vigorously.
2. Turn the flame on low, so that the water is barely boiling.
3. Turn the flame on a medium setting.