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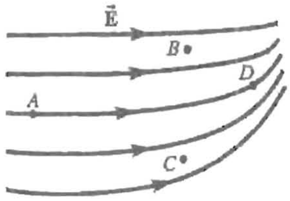
1. In figure, at which point is the potential lowest? (5%)

(a)B

(b)A

(c)All points are at the same potential

(d)D



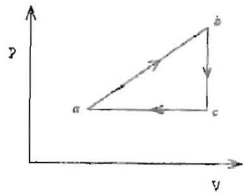
2. An ideal gas undergoes the process a→b→c→a shown in Figure. The heat gained in process a→b is 576 J, While in process b→c the system loses 67 J. In process a→b the system performs 320 J of work, while in process c→a work is done on the system in the amount of 238 J. How much heat is gained by the system in process c→a?(5%)

(a) 238 J

(b) -256 J

(c) -427 J

(d) -67 J



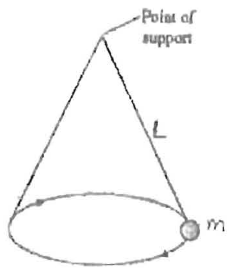
3. A conical pendulum is formed by attaching a ball of mass **m** to a string of length **L**, then allowing the mass to move in a horizontal circle. Suppose the string is known to break if the tension exceeds **Tc**. When the string breaks, how fast is it travelling? (5%)

(a) $\frac{T_c}{mL}$

(b) $\sqrt{\frac{T_c}{mL}}$

(c) $\sqrt{1-\frac{T_c^2}{(mg)^2}}\sqrt{\frac{T_cL}{m}}$

(d) $\sqrt{1-\frac{(mg)^2}{T_c^2}}\sqrt{\frac{T_cL}{m}}$



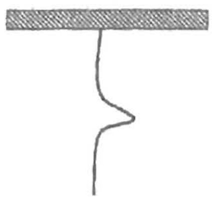
4. Suppose we have a massive rope attached to the ceiling. The bottom end of the rope is shaken and then released to produce a pulse that travels up the rope. What is the speed of the pulse when it is halfway up the rope? (5%)

(a)3.7 m/s

(b)4.7 m/s

(c)5.7 m/s

(d)6.7 m/s



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5. Neutrons are used in a Young's double slit experiment. The 1st bright fringe is found at **θ=1** degree above the central bright fringe, and the separation between the slits is 1×10^{-7} m. What is the speed of the neutrons?(**m_n = 1.675×10^{-22} kg**) (5%)

(a)227 m/s (b)2270 m/s (c)1.75×10^{-9} m/s (d)175 m/s

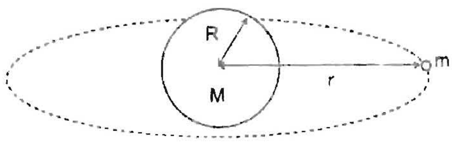
6. A small planet of mass m is in a circular orbit of radius r around a star of mass **M** and radius **R** in otherwise empty space (assume M >> m so the star is stationary). Now assume that the planet in subject to a viscous force of the form $\vec{\mathbf{F}} = -\mathbf{A}\mathbf{m}\mathbf{v}^2\hat{\mathbf{v}}$. Where **A** is a constant and $\hat{\mathbf{v}}$ is the direction of motion. Compute the change in radius of the planet in one orbital period due to the viscous force and the corresponding radial velocity based on the assumptions above, in terms of **G**, **M**, **r** and **A**. (5%)

(a)$-4A\sqrt{GMr}$

(b)$-2A\sqrt{GMr}$

(c)$-2A\sqrt{GM/r}$

(d)$-A\sqrt{GMr}$



7. For an ideal monatomic gas, (5%)

(a)*Cp* < *Cv*.

(b)*Cp* = *Cv*.

(c) *Cp* > *Cv*.

(d) More Information is needed to answer this question.

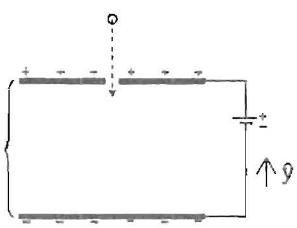
8. Imagine that a beam of electrons is being fired into the parallel plate capacitor as shown. The power source has the ability to be adjusted so that the potential difference that it provides is just enough so that the electrons do not reach the negative plate. If this happens when the power source is set to 10.3V then how fast are the electrons traveling when they enter the capacitor? (5%)

(a)-1.9×10^6 m/s

(b)-1.7×10^6 m/s

(c)-1.5×10^6 m/s

(d)-1.3×10^6 m/s



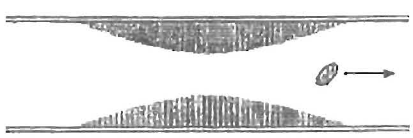
9. A blood platelet drifts along with the flow of blood through an artery that is partially blocked by deposits. As the platelet moves from the narrow region to the wider region, it feels：(5%)

(a)a decrease in pressure

(b)decrease to half of original pressure

(c)no change in pressure

(d)an increase in pressure



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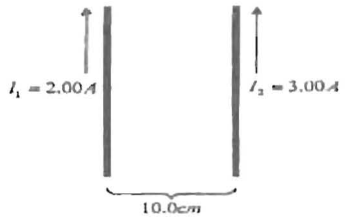
10. Two parallel wires are carrying currents as shown in the diagram. The electrons that make up the current I_2 move at a very slow average speed, in this case approximately **6.9X10^{-5} m/s.** What is the magnitude of the magnetic force, that is exerted on one of the moving electrons in the wire on the right.($\mu_0 = 4\pi x10^{-7}$ T·m/A) (5%)

(a)3.8x10^{-29} N

(b)4.42X10^{-29} N

(c)5.2x10^{-29} N

(d)5.5x10^{-29} N



11. The material to be used for an antireflective coating has index of refraction of **1.25**. How thick should the coating be to give the best result for **λ=500** nm and an angle of incidence of **30^0** with the normal? (5%)

(a)120 nm (b)150 nm (c)180 nm (d) 200 nm

12. If an object constrained to move along the x-axis has a constant positive acceleration, then which ONE of the following is **TRUE**? (5%)

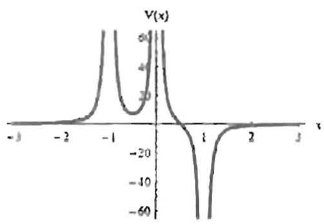
(a) Its velocity must be positive at all times.

(b) Its velocity must be changing at all times.

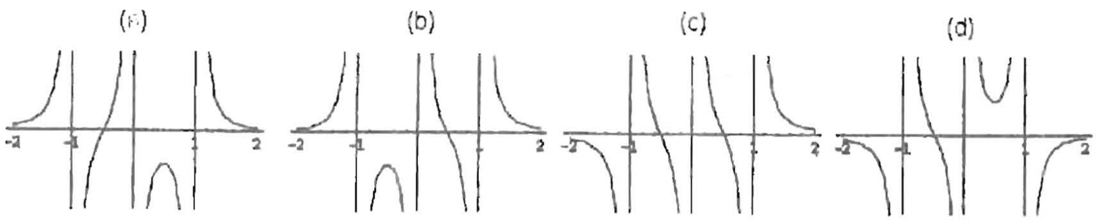
(c) Its speed must be increasing at all times.

(d) The net force acting on the object must be zero.

13. Refer to the graph below, depicting the potential on the x-axis as a function of x



What is the x component of the electric field for points on the x-axis given by the potential depicted above? (5%)



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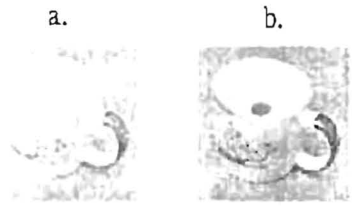
14. Galaxy A moves along the line that connects it to the Earth. How fast the galaxy must be moving if an absorption line found at **550 nm** for a stationary galaxy is shifted to **500 nm** for the earth's observer? Consider this motion as "relativistic".(c is velocity of light) (5%)
(a)0.095c (b)0.01c (c)0.093c (d)0.097c

15. In figure, a coin is right up against the far edge of the mug. In picture (a), the coin is just hidden from view and when the mug is filled with water (**n=1.33**) as in picture (b), we can almost see the whole coin. If the mug is **5 cm** in diameter and **8 cm** tall, what is the diameter of the coin? (5%)

(a)1.34 cm
(b)1.52 cm
(c)1.75 cm
(d)2 cm



16. A bowling ball (solid, uniform-density sphere of mass **M** and radius **R**) rolls without slipping toward a hill of maximum height **H** and varying slope. If the bowling ball starts with linear speed $\mathbf{v_0}$ at the bottom of the hill, what is its linear speed as it rounds the crest of the hill? (5%)

(a)$[V_0^2 - gH]^{-\frac{1}{2}}$ (b) $[V_0^2 - (gH)^2]^{-\frac{1}{2}}$ (c)$[V_0^2 - (\frac{10}{7})gH]^{-\frac{1}{2}}$ (d) $[V_0^2 - (\frac{10}{7})gH]$

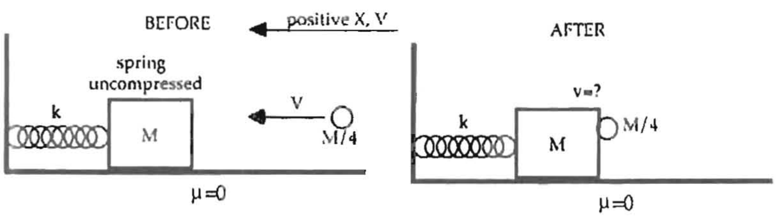
17. A metal block of mass **M** is attached to a spring of negligible mass and spring constant **k** as shown, and is free to slide on a frictionless, horizontal surface. A clay ball of mass **M/4** is fired at the block with velocity **V**, and sticks to it as shown. The block is initially at rest and the spring is initially uncompressed. Chose an equation for the position of the block as a function of time after the collision, assuming that at **t = 0**, the instant of the impact, it is at **x = 0** which is the unstretched point of the spring. (5%)

(a)$X = \frac{V}{5}\sqrt{\frac{5M}{4k}}\sin(\sqrt{\frac{4k}{5M}}t)$

(b) $X = V\sqrt{\frac{5M}{4k}}\sin(\sqrt{\frac{4k}{5M}}t)$

(c) $X = \sqrt{\frac{5M}{4k}}\sin(\sqrt{\frac{3k}{5M}}t)$

(d) $X = \frac{V}{3}\sqrt{\frac{5M}{4k}}\sin(\sqrt{\frac{4k}{5M}}t)$



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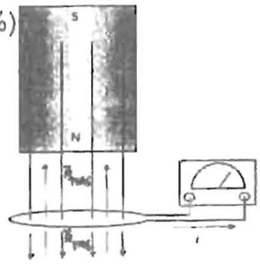
18. A circular coil of wire. The coil has **50** windings and a radius of **5 cm**. It has a resistance of **0.50Ω**. An electromagnet. Basically it acts like a bar magnet except that it can be turned on and off. It creates a magnetic field with a maximum average strength of **3.00 T**. It takes **0.50 s** for the electromagnet to come up to maximum strength from zero, and **0.50 s** to shut down from maximum strength. Determine the value of the induced current. (5%)



(a)3.5 A
(b)4.2 A
(c)4.7 A
(d)5.1 A

19. An **LC** circuit oscillates with an angular frequency of **1.2×10^6 rad/s**. When a second capacitor is inserted in series with the original one, the angular frequency becomes **1.6×10^6 rad/s**. If the capacitors are replaced by a resistor of **0.02Ω**, the current drops to **1/2** of its initialvalue in **3.5 ms**. What are the values of the two capacitors and of the inductance **L**? (5%)

(a)L=0.2 mH; C_1= 3.9 μF; C_2= 5.0 μF (b) L=0.1 mH; C_1= 3.5 μF; C_2= 5.0 μF
(c) L=0.1 mH; C_1= 3.9 μF; C_2= 5.3 μF (d) L=0.1 mH; C_1= 3.9 μF; C_2= 5.0 μF

20.A rocket of total mass $\mathbf{M_0}$, half of which is fuel, starts at rest on a long horizontal table. The coefficient of friction between the rocket and table surfaces is μ. At time **t = 0**, the rocket is ignited, ejecting fuel out at a constant rate γ = **|dM/dt|** with velocity $\mathbf{v_{ex}}$ relative to the rocket. Constant gravitational acceleration g acts downward. Assuming that the rocket satisfies this requirement, what is the maximum speed $\mathbf{V_{MAX}}$ achieved by the rocket? (5%)

(a)$v_{ex}\ln2-\mu g\frac{M_0}{2\gamma}$

(b) $v_{ex}\ln2-\mu g\frac{M_0}{\gamma}$

(c) $v_{ex}\ln2-\mu g\frac{3M_0}{2\gamma}$

(d) $v_{ex}\ln2-\mu g\frac{2M_0}{\gamma}$