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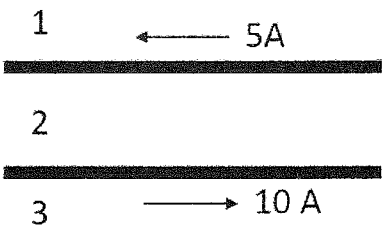
單選題，答案請填於答案卡。一題五分，答錯不倒扣，整題不作答不給分也不扣分。

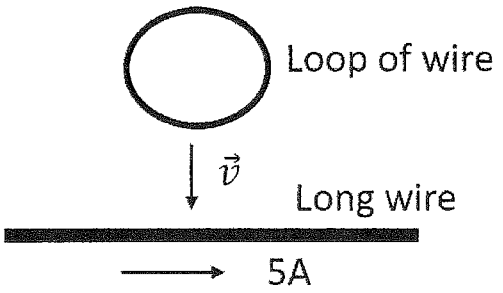
1. When two objects of different masses collide, the impulses they exert on each other are: **(A)** equal for all collisions. **(B)** equal but opposite only when the bodies have equal but opposite accelerations. **(C)** equal but opposite only for elastic collisions. **(D)** equal but opposite only for inelastic collisions. **(E)** equal but opposite for all collisions.
2. A force acting on an object moving along the x axis is given by $F_x = (16x - 3.0x^2)$ N, where x is in m. How much work is done by this force as the object moves from x = –1 m to x = +2 m? **(A)** +40 J, **(B)** +12 J, **(C)** +15 J, **(D)** +42 J, **(E)** –28 J.
3. A 0.125 kg harmonic oscillator has a total oscillation energy of 2.0 J. If the oscillation amplitude is 20.0 cm, what is the oscillation frequency? **(A)** 1.4 Hz, **(B)** 4.5 Hz, **(C)** 3.1 Hz, **(D)** 2.3 Hz, **(E)** 6.4Hz.
4. Water is flowing at 4.0 m/s in a circular pipe. If the diameter of the pipe decreases to 1/3 its former value, what is the velocity of the water downstream? **(A)** 1.0 m/s, **(B)** 2.0 m/s, **(C)** 8.0 m/s, **(D)** 16 m/s, **(E)** 36.0 m/s.
5. In which process will the internal energy of the system change? **(A)** An adiabatic compression of an ideal gas. **(B)** An isothermal expansion of an ideal gas. **(C)** An isobaric compression of an ideal gas. **(D)** A free expansion of an ideal gas. **(E)** Statements (a) and (c) are found to be correct.
6. An ideal heat engine can have an efficiency of 100% if the temperature of the low temperature reservoir is **(A)** 0°F. **(B)** 0°C. **(C)** 10 K. **(D)** 0 K. **(E)** the same as the temperature of the heat source.
7. The reason that we can calculate the change in entropy of a system is that, **(A)** entropy always increases. **(B)** entropy always decreases. **(C)** systems always follow irreversible paths. **(D)** it depends only on the properties of the initial and final equilibrium states. **(E)** systems always follow reversible paths.
8. If n moles of an ideal gas are expanded isothermally from an initial volume V_1 to a final volume V_2, the change in entropy is **(A)** $nRT \ln (V_2/V_1)$, **(B)** $nR \ln (V_2/V_1)$, **(C)** $nk_B \ln (V_2/V_1)$, **(D)** $n C_p \int dT/T$, **(E)** $n C_p/T$.
9. A body oscillates with simple harmonic motion along the x axis. Its displacement varies with time according to the equation $x = 5.0 \sin(\pi t + \pi/3)$. The velocity (in m/s) of the body at $t = 2.0$ s is **(A)** +8.0, **(B)** -8.0, **(C)** -5.0, **(D)** -14.0, **(E)** +14.0.
10. Calculate the average power needed to spin a uniform, solid disk of mass 2.2 kg and radius 0.70 m from rest to 10.0 rad/s in 2.3 s.
    (A) 9.2 W, **(B)** 11.6 W, **(C)** 14.0 W, **(D)** 12.0 W, **(E)** 16.4 W.

注意:背面有試題

11. Two long, parallel wires, separate by 10 cm. One carries a current of 5.0 A and another carries a current of 10.0 A in the opposite direction. Which of the following statements is true? **(A)** In region 1, the magnetic field is into the page and is never zero. **(B)** In region 2, the field is into the page and is never zero. **(C)** In region 3, the magnetic field is into the page and is never zero. **(D)** In region 3, the magnetic field is out of the page and can be zero. **(E)** There are no points where the field is zero.



12. A loop of wire locates at the upper side of a long wire carrying currents of 5A. When the loop falls down toward the wire at the speed of v, what is the direction of force exerted on the loop by the long wire at this moment? **(A)** upward, **(B)** downward, **(C)** left, **(D)** right, **(E)** impossible to determine.

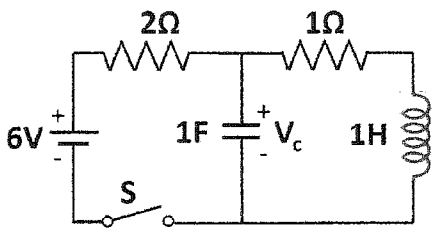


13. A Wi-Fi signal uses 5GHz frequency band for electromagnetic sinusoidal wave transmission. When the amplitude of electrical field of the EM wave is 6 V/m, what is the wave function of magnetic field B(x,t)? ($u_0 = 4\pi \times 10^{-7}\ \ N/A^2, \varepsilon_0 = 8.85 \times 10^{-12}\ \ F/m$).

(A) $5 \times 10^7 \cos(16.67x - 3.14 \times 10^{10}t)$. **(B)** $5 \times 10^7 \cos(104.72x - 3.14 \times 10^{10}t)$.
(C) $2 \times 10^{-8} \cos(16.67x - 3.14 \times 10^{10}t)$. **(D)** $2 \times 10^{-8} \cos(104.72x - 3.14 \times 10^{10}t)$.
(E) $0.17 \cos(16.67x - 3.14 \times 10^{10}t)$.

14. A plane electromagnetic (EM) sinusoidal wave propagates in the x direction. Suppose the wavelength is 500.0 nm and the electrical field has an amplitude of 300.0 V/m. What is the intensity (average of poyting vector) of this EM wave ($u_0 = 4\pi \times 10^{-7}\ \ N/A^2, \varepsilon_0 = 8.85 \times 10^{-12}\ \ F/m$) **(A)** 477.5 J/s.m^2, **(B)** 337.6 J/s.m^2, **(C)** 238.7 J/s.m^2, **(D)** 168.8 J/s.m^2, **(E)** 119.4 J/s.m^2.

15. The switch of this circuit is closed at t=0, what is the voltage across capacitor (Vc) after a long time (>> time constant) when the capacitor and inductor are in the steady state? **(A)** 1V, **(B)** 2V, **(C)** 3V, **(D)** 4V, **(E)** 6V.



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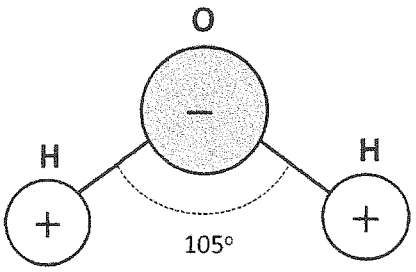
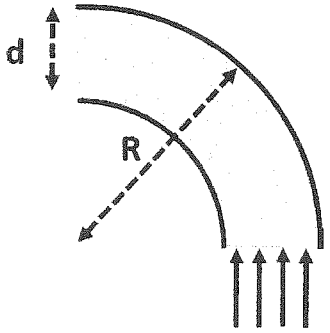
16. A particle with charge $1C$ is at the origin (x = 0.0 m). A particle with charge -4C is at x = 2.0 m on the x axis. What finite value(s) of x is the electric potential zero?
(A) -2 and -2/3, **(B)** -2 and 2/3, **(C)** -2/3 and 2/3, **(D)** -2/3 and 2/5, **(E)** 2/3 and 2/5.

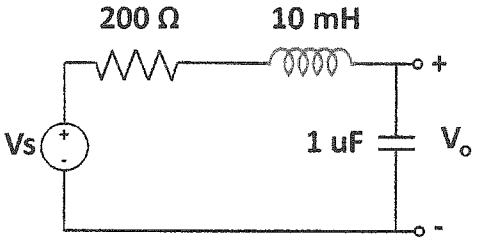
17. The electric dipole moment of O-H bond is 5×10^{-30} C.m. What is the magnitude of electric dipole moment for water molecule? ($\sin(52.5°) = 0.79$, $\cos(52.5°) = 0.61$)
(A) 3.05×10^{-30} C.m. **(B)** 3.95×10^{-30} C.m.
(C) 6.10×10^{-30} C.m. **(D)** 7.90×10^{-30} C.m.
(E) 9.65×10^{-30} C.m.



18. An optical fiber has an index of refraction, n=1.5, and diameter, d = 10.0 um. It is surrounded by vacuum (n=1.0). When light is sent into the fiber along its axis, find the minimum outside radius, R, permitted for a bend in the fiber if no light is to escape?
(A) 16.7 um, **(B)** 20.0 um, **(C)** 25.0 um, **(D)** 30.0 um, **(E)** 50.0 um.



19. For a RLC circuit with L = 10 mH, C = 1.0 μF, and R = 200.0 Ω, when $v_s(t) = 2\sin(10000t)$, what is the amplitude of output voltage $v_o(t)$?
(A) 2.0 V, **(B)** 1.0 V, **(C)** 0.707 V, **(D)** 0.5 V, **(E)** <1.0 mV.



20. A student performed Young's double-slit experiment in air using red light. When he immersed the apparatus in water repeated the experiment, what happens to the interference pattern on the screen? **(A)** No change happens in the interference pattern. **(B)** The bright and dark fringes stay in the same locations, but the contrast is reduced. **(C)** It disappears. **(D)** The bright fringes are farther apart. **(E)** The bright fringes are closer together.