臺灣綜合大學系統 113 學年度學士班轉學生聯合招生考試試題

科目名稱	普通物理 C	類組代碼	共同考科
		科目碼	E0016

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Some useful constants

Gas constant $R = 8.314$ J/mol·K

Mass of Sun $= 2.0 \times 10^{30}$ kg

Radius of Earth $= 6.4 \times 10^{6}$ m

Electron mass $m_e = 9.1 \times 10^{-31}$ kg

Electric constant (permittivity) $\epsilon_0 = 8.85 \times 10^{-12}$ C^2 /N·m^2

Magnetic constant (permeability) $\mu_0 = 4\pi \times 10^{-7}$ T·m/A

Plank's constant $h = 6.63 \times 10^{-34}$ J·s

Boltzmann constant $k_b = 1.380 \times 10^{-23}$ J·K^{-1}

Gravitational constant $G = 6.68 \times 10^{-11}$ N·m^2 /kg^2

Mass of Earth $= 6.0 \times 10^{24}$ kg

Radius of Sun $= 7.0 \times 10^{8}$ m

Electron charge $e = 1.6 \times 10^{-19}$ C

1 eV $= 1.6 \times 10^{-19}$ J

選擇題（單選，總分 100 分）

共 20 題，每題 5 分。

1. The number of significant figures of (0.00150 m×3.2 cm) is: (A) 2 (B) 3 (C) 4 (D) 5 (E) 6.

2. A 32-N force, parallel to the incline, is required to push a certain crate at constant velocity up a frictionless incline that is 30° above the horizontal. The mass of the crate is: (A) 3.3 kg (B) 3.8 kg (C) 5.7 kg (D) 6.5 kg (E) 16 kg.

3. When a certain rubber band is stretched a distance x, it exerts a restoring force $F = ax + bx^2$, where a and b are constants. The work done in stretching this rubber band from $x = 0$ to $x = L$ is: (A) $aL^2/2 + bL^3/3$ (B) $aL+bL^2/2$ (C) $a + 2bL$ (D) $aL + 2bL^2$ (E) $aL^2 + bLx^3$.

4. The potential energy of a 2.0-kg particle moving along the x axis is given by

$$U(x) = (5.0\text{J/m}^4)x^4\ J$$

When the particle is at $x = 1.0$ m it is traveling in the positive x direction with a speed of 5.0 m/s. It next stops momentarily to turn around at about $x =$ (A) *0* (B) *1.56 m* (C) *-1.56 m* (D) *3.02 m* (E) *-3.02 m.*

5. A sled loaded with sand, slides along a horizontal frictionless track. As the sled moves, sand trickles out at a constant mass-reduced rate through a hole in the back. The speed of the sled will: (A) decrease at a constant rate (B) increase at a constant rate (C) remain the same (D) decrease at a variable rate (E) increase at a variable rate.

6. When the speed of a rear-drive car is increasing on a horizontal road the direction of the frictional force on the tires is: (A) forward for all tires (B) backward for all tires (C) forward for the front tires and backward for the rear tires (D) backward for the front tires and forward for the rear tires (E) zero.

7. Two uniform cylinders have different masses and different rotational inertias. They simultaneously start from rest at the top of an inclined plane and roll without sliding down the plane. The cylinder that gets to the

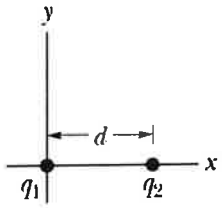
bottom first is: (A) the one with the larger mass (B) the one with the smaller mass (C) the one with the larger rotational inertia (D) the one with the smaller rotational inertia (E) neither (they arrive together).

8. A meter stick is pivoted at a point a distance a from its center and swings as a physical pendulum. Of the following values for a, which results in the shortest period of oscillation? (A) a = 0.5 m (B) a = 0.3 m (C) a = 0.2 m (D) a = 0.1 m (E) a = 0 m.

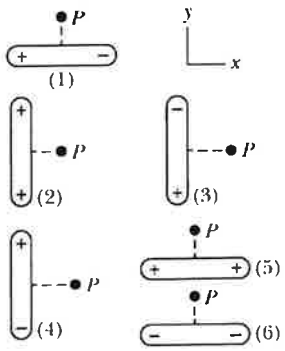
9. A quantity of an ideal gas is compressed to half its initial volume. The process may be adiabatic, isothermal or isobaric. Rank those three processes in order of the work required of an external agent, least to greatest. (A) adiabatic, isothermal, isobaric (B) adiabatic, isobaric, isothermal (C) isothermal, adiabatic, isobaric (D) isobaric, adiabatic, isothermal (E) isobaric, isothermal, adiabatic.

10. For all reversible processes involving a system and its environment: (A) the entropy of the system does not change. (B) the entropy of the system increases. (C) the total entropy of the system and its environment does not change. (D) the total entropy of the system and its environment increases. (E) none of the above (the provided information is not enough).

11. The figure shows two charged particles (q_1 = +6e, q_2 = -2e) that are fixed in place and separated by distance d = 1.50 m. At what x coordinate (m) can a third charged particle be placed such that the net force on the third particle is zero? (A) 0.35 (B) -3.96 (C) 3.55 (D) -0.54 (E) 7.10.



12. The figure shows six charged rods. Some have the same sign charge throughout and are uniformly charged. The rest have one sign on one half and the opposite sign on the other half, with each half uniformly charged. For each rod, a point P on a perpendicular bisector is indicated. In which situation is the net electric field at P in the positive direction of the y axis? (A) 2 and 5, (B) 2 and 6, (C) 4 and 5, (D) 1 and 4, (E) 3 and 5.



13. The figure shows a Gaussian rectangular structure with sides parallel to the axes and in the electric field

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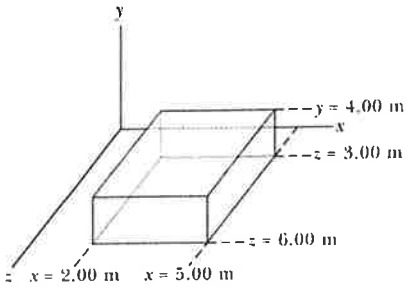
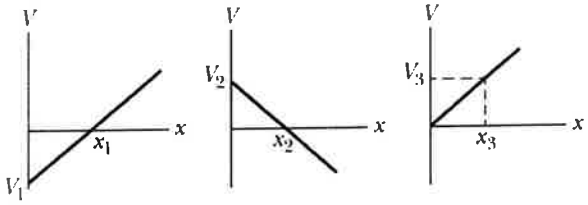
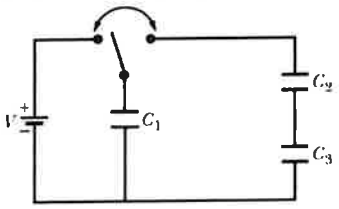
$\vec{E} = (3.00x + 2.00)\hat{i} + 4.00\hat{j} + 14.0\hat{k}$ N/C. What is the charge (C) enclosed by the structure? (A) 7.91×10^{-11}, (B) 9.56×10^{-10}, (C) 2.66×10^{-9}, (D) 0, (E) 3.72×10^{-8}.



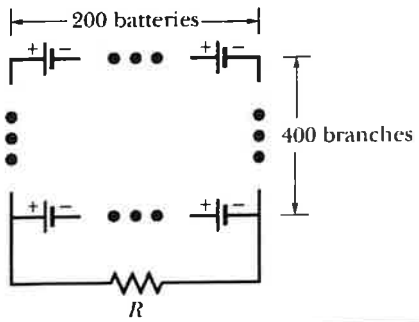
14. The figure shows three graphs of how a potential varies along an x axis. V_1 = -200 V, x_1 = 0.20 m; V_2 = 400 V, x_2 = 0.40 m; V_3 = 300 V, x_3 = 0.30 m. Rank the situations according to the magnitude of the electric field along the axis. (A) 1=2=3, (B) 2>3>1, (C) 3>1>2, (D) 3>1=2, (E) 1>2>3.



15. The figure shows a battery (30.0 V) and three (uncharged capacitors): C_1=12.0 μF, C_2= 4.00 μF, C_3=6.00 μF. The switch is first thrown to the left to charge C_1. Then the switch is thrown to the right to transfer charge to C_2 and C_3. When equilibrium is reached, what is the energy (J) stored in C_1?
(A) 3.75×10^{-3}, (B) 2.52×10^{-6}, (C) 5.89×10^{-5}, (D) 9.60×10^{-2}, (E) 1.04×10^{-4}.



16. The figure shows an array of identical real batteries, each with emf 0.050 V and internal resistance 0.20 ohm. There are 400 branches, each with 200 batteries. What is the current (A) through the external resistor, which has resistance R = 0.40 Ω? (A) 2.5, (B) 5.6, (C) 20, (D) 12, (E) 58.



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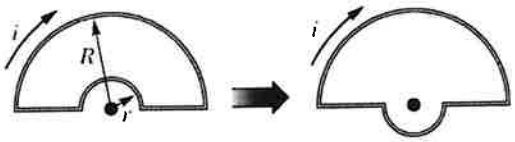
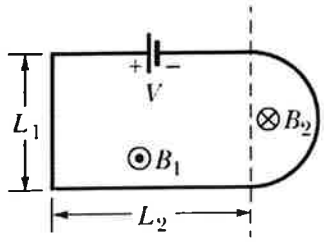
17. The first figure shows a closed loop with current i. The loop consists of a half-circle of radius r and a half circle of radius $R = 2r$. The second figure shows the same half-circles but the small one has been flipped over. The net magnetic field at the common center of the circular sections is B_1 for the first figure and B_2 for the second figure. What is the magnitude of the ratio B_2 / B_1 ? (A) 0.75, (B) 3.0, (C) 0.10, (D) 1.5, (E) 5.0.



18. The figure shows two regions of uniform magnetic field. On the left of the dashed line, $B_1 = 4.00t^2$ in teslas and seconds, and on the right, $B_2 = 60.0$ T. The dimensions are $L_1 = 2.00$ m and $L_2 = 3.00$ m. The circuit includes an ideal 60 V battery, and the total resistance is 15.0 Ω. What is the current (A) in the circuit at time $t = 3.00$ s? (A) 9.83, (B) 1.91, (C) 5.60, (D) 16.8, (E) 2.50.



19. A certain elementary particle has a mass that is 207 times that of an electron. That type of particle has a proper lifetime of 2.20×10^{-6} s. What is the particle's kinetic energy (MeV) if we measure its lifetime as 8.17×10^{-6} s? The electron's rest energy is 0.511 MeV. (A) 2.87×10^{2}, (B) 1.24×10^{3}, (C) 6.33×10^{4}, (D) 9.87×10^{2}, (E) 1.54×10^{4}.

20. The figure is a plot of stopping voltage V_{stop} versus light frequency f in a photoelectric experiment with a certain metal. What happens to the plotted line if we switch to a metal with a smaller work function? (A) plot's slope increases, but horizontal intercept remains the same, (B) plot's slope decreases, but horizontal intercept remains the same, (C) plot shifts rightward and slope increases, (D) plot shifts leftward, with no change in slope, (E) there is no change in the plot.