

考題皆為單選題，請在答案卡上作答。

共 25 題，每題 4 分，答錯不倒扣。

1. A small coin is placed at the rim of a turntable of radius R which rotates at angular velocity ω . What is the minimum coefficient of friction (μ_{\min}) for the coin to stay on?
 (A) $R\omega/2g$; (B) $R\omega^2/2g$; (C) $R\omega^2/g$; (D) $R^2\omega/g$; (E) None.

2. A pendulum of length L has its motion interrupted by a peg vertically beneath the support at a distance y below support, see Fig. 1. The bob is released when the string is horizontal. What is the minimum value of y for the bob to swing in a complete circle?
 (A) $L/2$; (B) $2L/3$; (C) $3L/4$; (D) $3L/5$; (E) None.

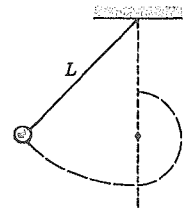


Fig. 1

3. A rocket is fired vertically with half the “escape speed”. (Ignore the earth’s rotation) What is its maximum altitude in terms of the earth R_E ? (A) R_E ; (B) $R_E/2$; (C) $R_E/3$; (D) $R_E/4$; (E) None.
4. How can a skydiver achieve a smaller “terminal speed”? (A) Reducing the effective cross-section; (B) Losing weight; (C) Diving in a diluted atmosphere; (D) All; (E) None.
5. What is not correct for a “conservative force”? (A) It can always be associated with a potential energy; (B) Its work done between two locations depends on the path taken; (C) It cannot be a function of velocity; (D) The total work done by it is 0 upon returning to the starting point; (E) None.
6. Which is correct for a downhill race among a loop, a cylinder, and a solid sphere (all with the same mass M and radius R) by rolling (with no slip)? (A) The loop is the loser; (B) The solid sphere is in the 2nd place; (C) The cylinder is the winner; (D) All; (E) None.
7. A block of density ρ_B has a horizontal cross-sectional area A and a vertical height h . It floats in a fluid of density ρ_f . The block is pushed down and released. Which quantity has nothing to do with the frequency of “simple harmonic motion” it will execute? (A) ρ_B ; (B) ρ_f ; (C) A ; (D) All; (E) None.

8. Two sound waves differ in their intensity levels by 20 dB. What is the ratio of their displacement amplitudes? (A) 2; (B) 10; (C) 100; (D) 400; (E) None.
9. A cylindrical tank of height H is open at the top and has a diameter of D . It is filled with water up to a height of h . Which quantity is linearly proportional to the time it takes to empty the tank through a hole of radius R in its bottom? (A) H ; (B) D ; (C) h ; (D) R ; (E) None.
10. A traveling wave on a string of linear density μ can be described by the wave function $y(x, t) = A \sin(Bx + Ct + D)$ where A, B, C, D are all positive constants. Which statement is not correct? (A) wavelength (λ) = $2\pi/C$; (B) velocity of the wave (v) = C/B ; (C) tension (F) = $\mu C^2/B^2$; (D) All; (E) None.

11. A monatomic gas undergoes the set of thermodynamic processes shown in Fig. 2. There are n mol of gas. Which statement is correct? (A) $T_B = T_C$; (B) The total work done on the gas during one cycle is $(P_A - P_B)(V_C - V_B)$; (C) The heat is transferred when the gas goes from B to C is $(3/2)P_B(V_C - V_B)$; (D) All; (E) None.

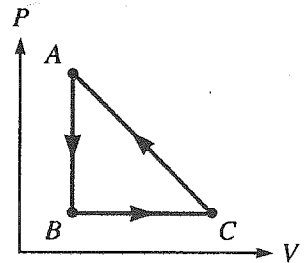


Fig. 2

12. A non-conducting sphere of radius R has a total charge Q spread uniformly throughout its volume. What is the potential energy U of the sphere? (k = Coulomb-law constant) (A) kQ^2/R ; (B) $kQ^2/2R$; (C) $3kQ^2/2R$; (D) $3kQ^2/4R$; (E) $3kQ^2/5R$.
13. When a ductile metal wire is stretched to N times its original length (without changing its density and resistivity), the resistance R will change by a factor of (A) $1/N^2$; (B) $1/N$; (C) N ; (D) N^2 ; (E) None.
14. Which phenomenon can be analyzed by the mathematical tool of "phasor"? (A) ac circuits; (B) Interference of multiple slits; (C) Diffraction of a single slit; (D) All; (E) None.
15. A capacitor of capacitance C_1 is charged to a potential difference V . The terminals of the charged capacitor are then connected to those of an uncharged C_2 capacitor. Which statement is correct for this procedure? (A) The original charge of the system is $C_1 V$; (B) The final potential difference across each capacitor is $C_1 V / (C_1 + C_2)$; (C) The total electrical energy of the system decreases when the two capacitors are connected; (D) All; (E) None.

16. The potential difference across the terminals of a battery is V_1 when there is a current of I_1 in the battery from the negative to the positive terminal. When the current is I_2 in the reverse direction, the potential difference becomes V_2 . (Note that V_1 , V_2 , I_1 and I_2 are all defined as positive values) Which statement is not correct for this system? (A) $V_1 = V_2$; (B) The internal resistance of the battery is $(V_2 - V_1)/(I_1 + I_2)$; (C) The emf of the battery is $(I_1 V_2 + I_2 V_1)/(I_1 + I_2)$; (D) All; (E) None.
17. A dc motor with its rotor and field coils connected in series has an internal resistance of R . When the motor is running at full load on a supply of V , the emf in the rotor is ϵ . Which statement is not correct for this system? (A) The current drawn by the motor from the supply is $(V - \epsilon)/R$; (B) The power delivered to the motor is $V(V - \epsilon)/R$; (C) The mechanical power developed by the motor is $(V - \epsilon)\epsilon/R$; (D) All; (E) None.
18. A slender metal rod of length L rotates with an angular speed of ω about an axis through one end and perpendicular to the rod. The plane of rotation of the rod is perpendicular to a uniform magnetic field with a magnitude of B . Which statement is not correct for this system? (A) The induced emf in the rod is $\omega B L^2$; (B) The potential difference between its ends is $\omega B L^2/2$; (C) The induced emf in the rod is equal to the potential difference between its ends; (D) All; (E) None.
19. Which is not an appropriate pair of analogy between mechanical and electrical quantities of the oscillating systems? (A) $v \leftrightarrow I$; (B) $k \leftrightarrow C$; (C) $m \leftrightarrow L$; (D) $F \leftrightarrow V$; (E) None. ($k =$ spring constant)
20. An electromagnetic wave has an electric field given by $\mathbf{E}(y, t) = E_0 \mathbf{k} \cos(ky - \omega t)$. Which statement is not correct? (A) The wave is traveling in (+ y) direction; (B) It is polarized along x-direction; (C) $\mathbf{B}(y, t) = (E_0/c) \mathbf{i} \cos(ky - \omega t)$; (D) All; (E) None.
21. Which is necessary for two sources of waves to be "coherent"? (A) They are "in phase"; (B) They have the same amplitude; (C) They have the same frequency; (D) All; (E) None.
22. The image of a real object produced by a convex mirror is (A) virtual; (B) erect; (C) reduced; (D) All; (E) None.
23. Which quantity of the electron in a hydrogen atom is a constant multiplied by an integer in Bohr's model? (A) Linear momentum; (B) Angular momentum; (C) Binding energy; (D) All; (E) None.

24. An electron is accelerated by a voltage from rest until the wavelength of its matter wave is λ . What is the accelerating voltage V ? (A) $h^2/(2me\lambda^2)$; (B) $h^2/(me\lambda^2)$; (C) $h^2/(2me\lambda)$; (D) $h/(2me\lambda^2)$; (E) None. (h = Planck's constant)
25. Which behavior in the "photoelectric effect" can also be explained by the wave theory of light? (A) There is a "threshold frequency" for the incident light; (B) The "stopping potential" is not dependent on the intensity of light; (C) The "photocurrent" is proportional to the intensity of light; (D) All. (E) None.