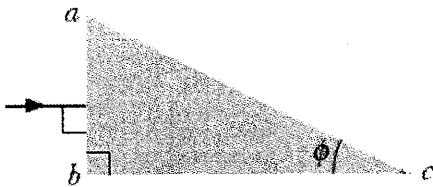


※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。
物理共 50 題選擇題，每題答對得 2 分，答錯倒扣 0.5 分；滿分 100 分，倒扣至 0 分為止。

1. A certain sound source is increased in sound level by 30.0 dB. By what multiple is its intensity increased? (a) 30 (b) 3 (c) 10^{30} (d) 0.3 (e) 10^3
2. A model airplane whose mass is 0.75kg is tethered by a wire so that it flies in a circle 30m in radius. The airplane engine provides a thrust of 0.80N perpendicular to the tethering wire. **Find the linear acceleration of the airplane tangent to its flight path.** (a) 1.06 m/s^2 (b) 2.12 m/s^2 (c) 3.18 m/s^2 (d) 5.30 m/s^2 .
3. A rigid rod of length 1m and negligible mass is pivoted at one end about a vertical axis so that it rotates freely in a horizontal plane. A 0.4-kg mass is attached to the free end. A horizontal force of 5N is applied perpendicularly to the rod at its midpoint. **Find the angular acceleration of the rod about the pivot.** (the force is always perpendicular to the rod) (a) 12.5 rad/s^2 (b) 6.25 rad/s^2 (c) 1.25 rad/s^2 (d) 0.625 rad/s^2 (e) 0.3125 rad/s^2 .
4. A layer of oil (specific gravity=0.80) is resting on top of a quantity of water (specific gravity =1.0). A uniform rectangular block floats at the interface between the oil and water such that one-third of the block's volume extends into the oil. Find the specific gravity of the block. (a) 0.800 (b) 0.833 (c) 0.900 (d) 0.933.
5. If one wave traveling along a stretching string be given by $y_m \sin(kx - \omega t)$ and another, shifted from the first by $y_m \sin(kx - \omega t + \phi)$, then what is the amplitude of the resultant wave due to the interference? (a) $2y_m \cos(\frac{1}{2}\phi)$ (b) $2y_m$ (c) $2y_m \sin(\frac{1}{2}\phi)$ (d) $2y_m \tan(\frac{1}{2}\phi)$
6. For a thin, uniform rod of mass M and length L , on an x axis with the origin at the rod's center. What is the rotational inertia of the rod about the perpendicular rotation axis through the center? (a) $\frac{1}{2}ML^2$ (b) $\frac{1}{3}ML^2$ (c) $\frac{1}{6}ML^2$ (d) $\frac{1}{12}ML^2$
7. A rocket whose initial mass M_i (kg) consumes fuel at the rate R (kg/s). The speed of the exhaust gases relative to the rocket engine is v_{rel} (m/s). What thrust does the rocket engine provide? (a) $M_i R$ (b) $M_i v_{rel}$ (c) $R v_{rel}$ (d) $M_i R v_{rel}$
8. Two wires made of the same material have the same lengths but different diameters. They are connected in parallel to a battery. The quantity that is NOT the same for the wires is: (a) the electron drift velocity (b) the current (c) the current density (d) the electric field
9. A certain x-ray tube requires a current of 7mA at a voltage of 80 kV. The rate of energy dissipation (in watts) is: (a) 560 (b) 5600 (c) 11.4 (d) 87.5

10. Two large parallel conducting plates are separated by a distance d , placed in a vacuum, and connected to a source of potential difference V . An oxygen ion, with charge $2e$, starts from rest on the surface of one plate and accelerates to the other. If e denotes the magnitude of the electron charge, the final kinetic energy of this ion is: (a) eV/d (b) eVd (c) Vd/e (d) $2eV$
11. A balloon is filled with cold air and placed in a warm room. It is NOT in thermal equilibrium with the air of the room until: (a) it rises to the ceiling (b) it sinks to the floor (c) it stops expanding (d) it starts to contract
12. In the below figure, a ray of light is perpendicular to the face ab of a glass prism ($n = 1.52$). Find the largest value for the angle ϕ so that the ray is totally reflected at face ac if the prism is immersed in air. (a) 46.9° (b) 47.9° (c) 48.9° (d) 49.9°

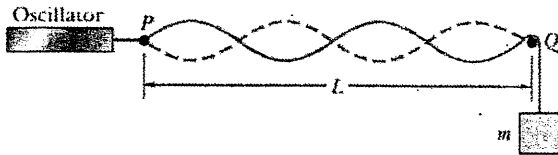


13. If a light reaches a polarizing sheet whose polarizing direction is parallel to a y axis. We shall rotate the sheet 40° clockwise about the light's line of travel. During this rotation, the fraction of the initial light intensity passed by the sheet (a) increase (b) decrease (c) remain the same (d) disappear if the light is initially unpolarized.
14. A $650\ \Omega$ and a $2200\ \Omega$ resistor are connected in series with a 12-V battery. What is the voltage across the $2200\ \Omega$ resistor? (a) 0.093 V (b) 0.93 V (c) 9.3 V (d) 93 V
15. An electron is projected vertically upward with a speed of 1.703×10^6 m/s into a uniform magnetic field of 0.480 T that is directed horizontally away from the observer. The magnetic force will cause centripetal motion, and the electron will move in a clockwise circular path if viewed in the direction of the magnetic field. The radius of the motion is ____ m (a) 2.02×10^{-1} (b) 2.02×10^{-3} (c) 2.02×10^{-5} (d) 2.02×10^{-7}
16. In an engine, an almost ideal gas is compressed γ -adiabatically to half its volume. In doing so, 2850 J of work is done on the gas. How much heat flows into or out of the gas?
(a) -28500 J (b) -2850 J (c) 0 J (d) 2850 J
17. The rotational energy gap of molecules is in the order of (a) 10^{-1} eV (b) 10^{-3} eV (c) 10^{-5} eV (d) 10^{-6} eV (e) 10^0 eV.
18. Calculate the rms speed (m/s) of helium atoms near the surface of the Sun at a temperature of about 6000 K. Helium has an atomic mass of 4.0. Boltzmann constant = 1.380649×10^{-23} JK $^{-1}$.
(a) 6×10^1 (b) 6×10^2 (c) 6×10^3 (d) 6×10^4

19. What formula best describes the emission spectrum of a blackbody? (a) Raleigh-Jeans formula (b) Wein's formula (c) Planck's formula (d) DeBroglie's formula (e) Einstein's formula.
20. When a UV light (wavelength = 300 nm and intensity = 1.00 W/m^2) is directed at a potassium surface, then the maximum kinetic energy of the photoelectrons is (a) 4.1 eV (b) 4.1 J (c) 3.5 eV (d) 3.5 J (e) None of the above.
21. Spacecraft A is moving at $0.9c$ with respect to the earth. If Spacecraft B is to pass A at a relative speed of $0.5c$ in the same direction, what speed must B have with respect to the earth? (c is the speed of light.) (a) Impossible (b) $0.4c$ (c) $0.97c$ (d) $1.8c$ (e) any speed higher than $0.5c$.
22. Heisenberg's Uncertainty Principle states that the ___ and ___ of an electron cannot be known simultaneously. (a) Position, momentum (b) Momentum, speed (c) Position, charge (d) Position, mass (e) Mass, speed
23. If you stay in the earth and John travels at a speed of $0.8c$ to the Neptune, then when your heart beats 10 times, how many times does John's heart beats? (c is the speed of light.) (a) 10 (b) 16 (c) 6 (d) 8 (e) 12.5.
24. In the medium of free space, the divergence of the electric flux density will be which of the following? (a) 1 (b) 0 (c) -1 (d) infinity.
25. In consideration of the Gauss law for electric field, the charge density of an electrostatic field is given by which of the following? (a) Curl of D (b) Curl of E (c) Divergence of D (d) Divergence of E .
26. The Maxwell second equation is based on which of the following law? (a) Lenz law (b) Faraday law (c) Ampere law (d) Coulomb law.
27. In a good conductor, the phase relation between the tangential components of the electric field and the magnetic field is as follows (a) the electric field and the magnetic field are in phase (b) the electric field and the magnetic field are out of phase (c) the electric field leads the magnetic field by 45° (d) the magnetic field leads the electric field by 90° .
28. In considering of the fundamental of electromagnetics, which of the following law/rule defines the electromagnetic forces? (a) Faraday's law (b) Ampere law (c) Fleming's right hand rule (d) Fleming's left hand rule.
29. The Earth has a magnetic field. Which of the following is the reason causing the magnetic field of the Earth? (a) The movement of liquid iron in the outer core of the Earth. (b) The magnetic force of iron ore embedded in the crust of the Earth. (c) The permanent magnet in the core of the Earth. (d) The gravitational field of the Earth.

30. At a finite temperature $T > 0$ K, the probability of occupancy for the electrons with the Fermi energy E_F is equal to: (a) 1 (b) 1/2 (c) 1/3 (d) 1/4
31. If the volume density of free electrons in a metal is n_e , the Fermi energy of the electrons is proportional to: (a) n_e (b) n_e^2 (c) $n_e^{3/2}$ (d) $n_e^{2/3}$
32. If the electron of an atom is described to be in the 5f state, what is its orbital quantum number? (a) 5 (b) 1 (c) 2 (d) 3
33. Which of the following functions cannot become a wave function for the particle moving in the range $0 \leq x \leq \infty$? (a) $1/(x+1)^2$ (b) $2/(x+1)^3$ (c) e^x (d) e^{-x}
34. In the photoelectric effect, the kinetic energies of electrons liberated by light are dependent on: (a) the intensity of light (b) the time of illumination (c) the frequency of light (d) none of above
35. In a Blackbody radiation at temperature T (K), the total area under the spectral distribution curve of the emitted energy density is proportional to: (a) T (b) T^2 (c) T^3 (d) T^4
36. A particle has the rest mass of m_0 and is moving at the speed of V . If V is much smaller than the speed of light (i.e. $V \ll c$), the total energy of the particle is approximately equal to: (a) $m_0V^2/2$ (b) m_0V^2 (c) $m_0c^2/2$ (d) m_0c^2
37. An x-ray beam of a certain wavelength is incident on an NaCl crystal, at 30.0° to a certain family of reflecting planes of spacing 39.8 pm. If the reflection from those planes is of the first order, what is the wavelength of the x rays? (a) 39.8 pm (b) 39.8 nm (c) 79.6 nm (d) 79.6 pm (e) 19.9 pm
38. Two yellow flowers are separated by 30 cm along a line perpendicular to your line of sight to the flowers. How far are you from the flowers when they are at the limit of resolution according to the Rayleigh criterion? Assume the light from the flowers has a single wavelength of 550 nm and that your pupil has a diameter of 5.5 mm. (a) 2459 m (b) 4918 m (c) 3000 m (d) 6000 m (e) 3660 m
39. What is the fastest transverse wave that can be sent along a steel wire? For safety reasons, the maximum tensile stress to which steel wires should be subjected is 7.80×10^9 N/m². The density of steel is 7800 kg/m³. (a) 1000 m/s (b) 100 m/s (c) 10000 cm/s (d) 50 m/s (e) 50 cm/s
40. What is the speed of a transverse wave in a rope of length 2.00 m and mass 400.0 g under a tension of 500 N? (a) 5 m/s (b) 50 m/s (c) 1.58 m/s (d) 129 m/s (e) 62.5 m/s
41. Referring to the below Fig., a string, tied to a sinusoidal oscillator at P and running over a support at Q, is stretched by a block of mass m . Separation $L = 1.20$ m, linear density $\mu = 1.6$ g/m, and the oscillator $f = 120$ Hz. The amplitude of the motion at P is small enough for that point to be considered a node. A node also exists at Q. What mass m allows the oscillator to set up the fourth harmonic on the string?

(a) $m=0.658$ kg (b) $m=0.764$ kg (c) $m=0.822$ kg (d) $m=0.846$ kg (e) $m=0.985$ kg



42. The pupil of a person's eye has a diameter of 5.00 mm. According to Rayleigh's criterion, what distance apart must two small objects be if their images are just barely resolved when they are 500 mm from the eye? Assume they are illuminated with light of wavelength 500 nm. (a) $61 \mu\text{m}$ (b) $36.5 \mu\text{m}$ (c) $15.25 \mu\text{m}$ (d) $40.5 \mu\text{m}$ (e) $20.5 \mu\text{m}$
43. In the consideration of electromagnetics, which of the following is not a vector function? (a) Curl (b) Gradient (c) Divergence (d) No non-vector functions.
44. The reason for non existence of magnetic monopoles is which of the following? (a) Due to the permeability (b) Due to magnetization (c) The magnetic field cannot be split (d) Due to magnetostriction.
45. In order to find internal structure of nucleus, electrons should be accelerated by voltages up to \sim (a) 10^5 V (b) 10^7 V (c) 10^9 V (d) 10^{11} V (e) 10^{13} V
46. A proton is released in a uniform electric field, and it experiences an electric force of 2.183×10^{-14} N toward the south. What are the magnitude and direction of the electric field? ($q=1.602 \times 10^{-19}$ C) (a) 1.36×10^2 N/C south (b) 1.36×10^3 N/C south (c) 1.36×10^4 N/C south (d) 1.36×10^5 N/C south
47. A 1.5-V dry cell can be tested by connecting it to a low-resistance ammeter. It should be able to supply at least 25 A. What is the internal resistance of the cell in this case, assuming it is much greater than that of the ammeter? (a) 0.006Ω (b) 0.060Ω (c) 0.600Ω (d) 6.000Ω
48. An EM wave has frequency 8.56×10^{14} Hz. What is its wavelength? Light speed is 3×10^8 m/s. (a) 311 nm (b) 633 nm (c) 978 nm (d) 1029 nm
49. When a beam made up of waves of both blue and red light is refracted through a surface, such as from air into quartz or vice versa, which light bends more? (a) red light (b) blue light (c) the same (d) unjustified
50. Sunlight just outside Earth's atmosphere has an intensity of 1.40 kW/m^2 . Calculate the maximum electric field E_m . (a) 1.03 kV/m (b) 1.04 kV/m (c) 1.05 kV/m (d) 1.06 kV/m