

※ 注意：選擇題請於答案卷之「選擇題作答區」依序作答。

選擇題每題 4 分，請依答案卷首頁所印題號序作答。計算問答題每題 10 分，過程內容要詳述，不然無法得分。一些常數值： $g=10\text{ m/s}^2$, $k=9\times 10^9\text{ Nm}^2/\text{C}^2$,
 $e=1.6\times 10^{-19}\text{ C}$

- The Planck constant has the same SI unit as: (A) energy (B) momentum (C) power (D) angular momentum (E) torque
- The ratio of the centripetal acceleration to the gravitational acceleration of a person standing on the earth surface around equator is about: (A) 0.003% (B) 0.03% (C) 0.3% (D) 3% (E) 30%
- A particle with mass 1 kg is acted by a force $F(x) = 3x^2 + x + 1/2$ along the x axis, where x is in meter and F in Newton. If the particle's speed is 0 at $x=0$, what is its speed at $x=1$? (A) 0 (B) 2 m/s (C) 4 m/s (D) 6 m/s (E) 8 m/s
- Which of the following is rolling down faster on a slanted surface assuming they have the same mass and outer radius? (A) solid sphere (B) hollow sphere (C) disk (D) tire (E) ring
- Water is streaming downward from a faucet opening with an area of $5.0\times 10^{-4}\text{ m}^2$. The cross sectional area of the stream 0.2 m below shrinks to $3.0\times 10^{-4}\text{ m}^2$. What is the water speed in m/s at the faucet end? (A) 1.5 m/s (B) 3.0 m/s (C) 4.5 m/s (D) 6.0 m/s (E) 7.5 m/s
- A sinusoidal wave, $0.01\sin(0.2x-10t+\pi/2)$, is propagating on a string, where all terms are written in SI units. If the tension of this string is 10 N, what is the linear density of this string? (A) 0.0004 kg/m (B) 0.004 kg/m (C) 0.04 kg/m (D) 0.4 kg/m (E) 4. kg/m
- For an ideal gas, the difference between the molar specific heat at constant pressure and constant volume, i.e. $C_p - C_v$, equals to: (A) $-R$ (B) $-1/2 R$ (C) $1/2 R$ (D) R (E) $3/2 R$
 R is the universal gas constant.
- A pump utilizing the geothermal energy is set up to operate between the ground and the underground heat source. Assuming the average ground temperature is 15 C° and the source end has a temperature 450 C° , approximately what is the best possible efficiency of this pump? (A) 20% (B) 30% (C) 40% (D) 50% (E) 60%
- Estimate the pressure needed to make two deuterons fused into a helium nucleus assuming the Coulomb force to confine deuterons is uniformly distributed on the surface of a 2 fm radius sphere. (A) $5\times 10^{10}\text{ N/m}^2$ (B) $5\times 10^{15}\text{ N/m}^2$ (C) $5\times 10^{20}\text{ N/m}^2$ (D) $5\times 10^{25}\text{ N/m}^2$ (E) $5\times 10^{30}\text{ N/m}^2$
- In an oscillating series RLC circuit with $R=50\ \Omega$, $L=20\text{ mH}$ and $C=2.0\ \mu\text{F}$, the maximum charge is stored on the capacitor at $t=0$. Find the time required for the charge on the capacitor falling to 37% of its initial value. (A) $1.\times 10^{-4}\text{ s}$ (B) $2.\times 10^{-4}\text{ s}$ (C) $4.\times 10^{-4}\text{ s}$ (D) $6.\times 10^{-4}\text{ s}$ (E) $8.\times 10^{-4}\text{ s}$
- A ball is held 50 cm in front of a plane mirror. The distance between the ball and its image is: (A) 100 cm (B) 200 cm (C) 25 cm (D) 10 cm (E) 500 cm
- The phase difference between the two waves which give rise to a dark spot in a Young's double-slit experiment is (where $m = \text{integer}$): (A) $2\pi m + \pi/2$ (B) $2\pi m + \pi/4$ (C) $2\pi m + \pi/8$ (D) zero (E) $2\pi m + \pi$
- The rainbow seen after a rain shower is caused by: (A) polarization (B) absorption (C) refraction (D) interference (E) diffraction

14. An astronaut travels to a hypothetical star located 30 light years from Earth in a spaceship at $0.6c$. According to a clock located on the spaceship, how long does the trip take? (A) 10 years (B) 20 years (C) 30 years (D) 40 years (E) 50 years
15. The frequency of light beam A is twice that of light beam B. The ratio E_A/E_B of photon energies is: (A) $1/2$ (B) $1/4$ (C) $1/3$ (D) 2 (E) 8
16. If the kinetic energy of a non-relativistic free electron doubles, the frequency of its wave function changes by the factor: (A) $1/2$ (B) 4 (C) $3/2$ (D) 3 (E) 2
17. The energy of a particle in a one-dimensional trap with zero potential energy in the interior and infinite potential energy at the walls is proportional to (n = quantum number): (A) n (B) $2n$ (C) $1/n$ (D) $4n$ (E) n^2
18. Possible values of the principal quantum number n for an electron in an atom are: (A) 0 and 1 (B) 2,4,6,... (C) 0,1,2,... (D) 1,3,5,... (E) 1,2,3,...
19. Two protons are about 10^{-10} m apart. Their relative motion is chiefly determined by: (A) nuclear forces (B) electrical forces (C) gravitational forces (D) torque from electrical dipole moments (E) magnetic forces
20. Nuclear fusion in the Sun is increasing its supply of: (A) neutrons (B) helium (C) positrons (D) hydrogen (E) nucleons

※ 注意：請於答案卷內之「非選擇題作答區」標明題號依序作答。

21. A current I is running uniformly toward the positive z direction on a long thin plate lying on the x - z plane with wider width w . Find out the magnetic field at a place very close to the center part of the plate (3 points). If this plate is bent to form a cylinder centering at the z axis with radius $r = w/2\pi$, what will be the magnetic field inside and outside this cylinder (3 points)? What is the pressure acting on this cylinder due to the magnetic force induced by the parallel current (4 points)?
22. What are the two basic postulates through which Einstein based his Special Theory of Relativity on (10 points)?

試題隨卷繳回