

一、單選題 (共二十題、每題二分)

1. Bernoulli's equation is a conservation law for (A) momentum. (B) energy. (C) mass. (D) streamlines.
2. Which situation cannot be described with Bernoulli's equation? (A) the flow of water out of a tank having a small hole near its bottom (B) the steady flow of water in a fire hose (C) the flow of air around an airfoil (D) fluid flow through a pump equipped with a piston.
3. An electric dipole in a uniform electric field experiences (A) only a net external force. (B) only a torque. (C) both a net external force and a torque. (D) neither a net external force nor a torque.
4. Two isolated metallic spheres each have a net charge Q uniformly distributed over their surfaces. One sphere has a radius r and the other has a radius R , where $R > r$. Which charge distribution stores more electric energy? (A) the sphere of radius r . (B) the sphere of radius R . (C) need more information. (D) independent of the radius of the sphere.
5. In order to increase the energy stored in a parallel-plate capacitor when an electric potential is applied, we should (A) increase the area of the plates. (B) increase the separation between the plates. (C) insert a dielectric between the plates. (D) two of the above.
6. Which is(are) true? Kirchhoff's voltage rule (A) relates the sum of the emfs around a closed loop in a circuit to the potential changes across all resistors and circuit elements. (B) implies conservation of energy in electric circuits. (C) relates the currents entering and leaving any branch point in a circuit. (D) two of the above.
7. A Wheatstone bridge is a device used to measure (A) current. (B) potential. (C) resistance. (D) joule-heating losses.
8. Which is(are) true? (A) The magnetic field lines of a moving charge form closed loops. (B) The magnetic field obeys the principle of superposition. (C) The magnetic flux through a closed surface is proportional to the total number of magnetic poles enclosed within the surface. (D) two of the above.
9. Which is(are) true? The magnetic dipole moment of a current loop (A) is proportional to the area enclosed by the loop. (B) is proportional to the current in the loop. (C) is well defined only when the observer is far from the loop. (D) two of the above.
10. The Hall effect (A) provides empirical evidence that the charge carriers in metals are negative. (B) can be used to determine the density of free electrons in a metal. (C) both of the above (D) neither of the above
11. In a dc circuit (which means the frequency of the source of emf is zero), which circuit element presents the greatest "resistance" to charge flow? (A) capacitor (B) inductor (C) resistor (D) Answer depends on the relative values of C , L , and R .

(背面仍有題目,請繼續作答)

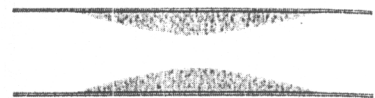
12. The current in an ac circuit is represented by a phasor. The value of the current at some time t is given by (A) the length of the phasor. (B) the value, in radians, of the angle between the phasor and the horizontal axis. (C) the projection of the phasor on the vertical axis. (D) the projection of the phasor on the horizontal axis.
13. The Maxwell modification of Ampère's law describing the creation of a magnetic field is the analog of (A) Gauss' law on electric fields and charges. (B) Gauss' law on magnetic fields and poles. (C) the Lorentz equation. (D) Faraday's law.
14. A grain of interplanetary dust is in the Sun's gravitational field. If we consider the grain to be isolated from all influences except the Sun, is it possible for the grain to move away from the Sun? (A) Yes, if the grain is sufficiently large and is a good absorber of light. (B) Yes, if the grain is sufficiently small and is a good absorber of light. (C) No, the Sun's gravitational field always attracts the grain to the Sun. (D) no effect.
15. Light is incident upon two polarizing filters arranged in tandem. The filters are crossed so that their polarization directions are perpendicular. The transmitted intensity through the second filter (A) is 100%. (B) depends on the frequency of the incident light. (C) depends on the intensity of the incident light. (D) is zero.
16. If the interference pattern produced by two light sources is to remain stationary in space, the sources must have (A) different frequencies and an arbitrary phase difference. (B) the same frequencies and an arbitrary phase difference. (C) different frequencies and a phase difference that is time-independent. (D) the same frequencies and a phase difference that is time-independent.
17. Which term does not arise in the discussion of interference patterns? (A) coherent sources (B) Fraunhofer approximation (C) magnifying power (D) principal maximum
18. Calculated classically, the spectral emittance of a blackbody diverges at short wavelengths. This result is known as (A) the Stefan-Boltzmann law. (B) the ultraviolet catastrophe. (C) the Compton effect. (D) Wien's law.
19. The Compton effect illustrates (A) the wave nature of light. (B) the ejection of an electron from an irradiated metal surface. (C) the particle nature of light. (D) the probabilistic nature of quantum waves.
20. The probability of finding a photon of light at a given point (A) increases as the wavelength of the light decreases. (B) is proportional to the intensity of the light. (C) is proportional to the magnitude of the electric field. (D) is independent of the electric field.

二、複選題 (共十題、每題三分)

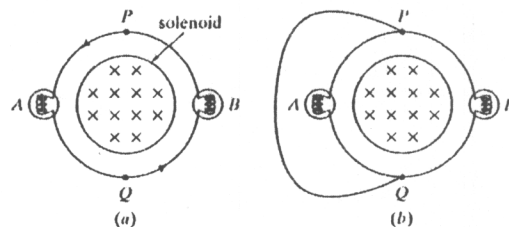
21. An empty steel-can and a filled aluminum-can both have the same mass. If your friend roll both of them down from the same graded slope, what are true? (A) The steel-can reaches the ground with higher speed. (B) The filled aluminum-can reaches the ground with higher speed. (C) The total energy is the same. (D) The kinetic energy is the same.

22. The Moon does not fall to Earth not because (A) the net force on it is zero. (B) It is in Earth's gravitational field. (C) Its pulled by the Earth is balanced by the pulls of the Sun and other planets. (D) all of the above.
23. Cathode rays are beams of electrons. Which are incorrect reasons for the electrons not deflecting downward by gravity; (A) the electrons go so fast there's no time to fall. (B) the effect of gravity on electrons is negligible. (C) a cathode ray tube has no air resistance. (D) the electrons are quantum particles and not classical particles.
24. As the capacitor shown below is charged with a constant current I , between the plates and on the plates there are is a (A) changing electric field. (B) changing magnetic field. (C). changing charge density (D) constant electric field.
25. A planar electromagnetic wave is propagating through space. Its electric field vector is given by $\vec{E} = E_0 \sin(kz - \omega t) \hat{i}$. (A) Its magnetic field vector is $\vec{B} = B_0 \sin(kz - \omega t) \hat{j}$. (B) Its magnetic field vector is $\vec{B} = B_0 \sin(kz - \omega t) \hat{k}$. (C) Its magnetic field vector is $\vec{B} = B_0 \sin(kz + \omega t) \hat{j}$. (D) The Poynting vector is pointing along the $+\hat{k}$ direction.

(For problem 26 and 27) Blood flows through a coronary artery that is partially blocked by deposits along the artery wall, as shown in this figure.



26. (A) The flux is the same throughout the artery. (B) The flux is largest at the narrow part. (C) The flow speed is smallest at the narrow (D) The flow speed is largest at the narrow.
27. A blood platelet drifts along this artery. (A) When it moves from the narrow region to the wider region, its speed decreases. (B) When it moves from the narrow region to the wider region, its speed increases. (C) When it moves from the narrow region to the wider region, it experiences an increase in pressure. (D) When it moves from the narrow region to the wider region, it experiences a decrease in pressure.
28. In figure 28(a), a solenoid produces a magnetic field whose strength increases into the plane of the page. An induced emf is established in a conducting loop surrounding the solenoid, and this emf lights bulbs A and B . In figure 28(b), points P and Q are shorted. After the short is inserted, what of the following statements are not correct; (A) both bulbs go out. (B) bulb A goes out; bulb B gets brighter. (C) bulb B goes out; bulb A gets brighter. (D) bulb A goes out; bulb B gets dimmer.



29. Of the following statements, what are the proper statement of the second law of thermodynamics (A) there is no perfect heat engines (B) there is no perfect refrigerators (C) The entropy of the universe tends to increase after a physical process. (D) For a given temperature interval, no heat engines is more efficient than a Carnot Engine.
30. An ideal gas undergoes a adiabatic free expansion into a vacuum and double its volume in this process. (A) The heat exchange with the environment is zero. (B) There is no entropy change for this system, (C) The temperature of the system is unchanged, (D) It is not a quasi-static process and the entropy change can not be computed.

三、簡答題 (共六題、每題五分)

31. In order to run an ordinary household appliance from the cigarette lighter of a car, you can buy a device that converts the car battery's 12-V dc to 110-V ac. One part of the circuit in such a device makes the voltage alternating; another uses a transformer to increase the voltage. Does it make a difference in which order these two operations are carried out?
32. A laser that is used to weld detached retinas emits light with a wavelength of 652 nm in pulses that are 20.0 ms in duration. The average power in each pulse is 0.600 W. (a) How much energy in each pulse in joules? In electron volts? (b) What is the energy of one photon in joules? In electron volts? (c) How many photons are in each pulse?
33. For a particle in a box, the probability function is zero at the walls. Does this mean that the particle never strikes the walls? Please explain.
34. The computer's CPU is made of semiconducting materials. In the early era of Pentium chips, during operation the chips were often over-heated and then stopped function properly. What are really happen to these early Pentium chips?
35. The most common type of radium, ^{225}Ra , has a half-life of about 1600 years. If the universe was formed over 10^9 years ago, why is there any radium left now?
36. The focal length of a f2.8 camera is 85.0 mm. (a) What is the aperture diameter of the lens? (b) If the correct exposure of a certain scene is 1/120 s at f/2.8, what is the correct exposure at f/5.6?

Useful constants:

$$h = 6.626 \times 10^{-34} \text{ J} \cdot \text{s}; \quad c = 3.0 \times 10^8 \text{ m/s}; \quad 1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$$