I. Fill the answer or correct item in answer sheet (80%, i.e. 4% for each)

※本大題請於答案卷內之「非選擇題作答區」標明空格編號依序作答。

(1) A certain force gives an object of mass m_1 an acceleration of 12.0 m/s^2 and an object of mass m_2 an acceleration of 4.0 m/s^2. What acceleration would the force give to an object of mass $m_1 + m_2$?
(1) m/s^2

(2) A raindrop with radius R = 1.5 mm falls from a cloud that is at height h = 1200 m above the ground. The drag coefficient C for the drop is 0.60. Assume that the drop is spherical throughout the fall. The density of water is 1000 kg/m^3, and the density of air is 1.2 kg/m^3. What is the terminal speed of the drop? (2) m/s.

(3) A 12.0 N force with fixed orientation does work on a particle as the particle moves through displacement $\vec{d} = (4.00\hat{i} + 3.00\hat{j})$ m. What is the angle between the force and the displacement if the change in the particle's kinetic energy is 30 J? (3) °.

(4) A ballot box with mass m = 6.0 kg slides with speed v = 4.0 m/s across a frictionless floor in the positive direction of an x axis. The box explodes into two pieces. One piece, with mass m_1 = 2.0 kg, moves in the positive direction of the x axis at v_1 = 8.0 m/s. What is the velocity of the second piece, with mass m_2? (4) m/s.

(5) A uniform ball, of mass M = 6.00 kg and radius R, rolls smoothly from rest down a ramp at angle θ = 30.0°. (a) The ball descends a vertical height h = 1.20 m to reach the bottom of the ramp. What is its speed at the bottom? (5) m/s (b) What is the magnitude of the frictional force on the ball as it rolls down the ramp? (6) N. (The rotational inertia of the ball $I_{ball} = \frac{2}{5}MR^2$)

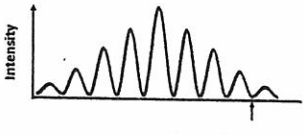
(6) At what altitude above Earth's surface would the gravitional acceleration be 4.9 m/s^2? (7) (g = 9.8 m/s^2)

(7) How much heat must be absorbed by ice of mass m = 720 g at -10°C to take it to liquid state at 15°C? (8) kJ.

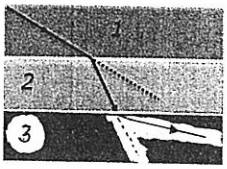
(8) A rocket moves at the speed of 243 m/s directly toward a stationary pole (through stationary air) while emitting sound waves at frequency f = 1000 Hz. What frequency f' is measured by a detector that is attached to the pole? (9) Hz.

(9) A 1800-kg car stopped at a traffic light is struck from the rear by a 900-kg car and the two become entangled (糾纏在一起). If the smaller car was moving at 20.0 m/s before the collision, what is the speed of the entangled cars after the collision? (10) m/s.

(10) In a double-slit experiment, what *path difference* have the waves from each slit traveled to give a minimum at the indicated position? (11) (hint: how many wavelength)



(11) Parallel light rays cross interfaces from medium 1 into medium 2 and then into medium 3. What is the correct relation of the index of refraction of these media? (1) $n_1 > n_2 > n_3$ (2) $n_3 > n_2 > n_1$ (3) $n_2 > n_3 > n_1$ (4) $n_1 > n_3 > n_2$ (5) none of the above? (12)



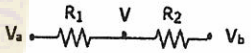
見背面

(12) A conducting spherical shell of inner radius a = 0.2m and out radius b = 0.25m has a total charge of 5.0 μC on its surface. A point charge of -6.0 μC is placed at the center of the shell. determine correct item for the electric field E in the regions (1) $a < r$, $E = 1.0\,\mu C/\left(4\pi\varepsilon_0 r^2\right)$ (2) $a < r < b$, $E = 0$ (3) $r > b$ $E = 6.0\,\mu C/\left(4\pi\varepsilon_0 r^2\right)$ (13)

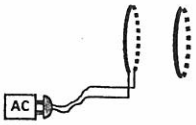
(13) Condition same as above, determine the charge q_a and q_b on the inner and out surface of the conducting spherical shell. (1) $q_a = -1.0\,\mu C$ (2) $q_b = +6.0\,\mu C$ (3) $q_a = +6.0\,\mu C$ (4) $q_b = -6.0\,\mu C$ (14)

(14) Which following statement regarding the electric field or potential is correct? (15) (1) The electric field at a short distance above a single plane, with uniform surface charge density σ, has the magnitude $E = \sigma/\varepsilon_0$, where ε_0 is permeability in air. (2)The electric field at any point between two parallel infinite conducting plates, each with uniform surface charge density σ, has the magnitude $E = \sigma/2\varepsilon_0$ (3) The electric field at any point outside two parallel infinite conducting plates, each with uniform surface charge density σ, has the magnitude $E = 0$ (4) The electric potential at any point at any point between two parallel infinite conducting plates, each with uniform surface charge density σ, has constant value.

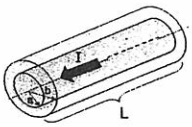
(15)A voltage divider is shown as the figure. The voltage V in the center is (in terms of V_a, V_b, R_1, R_2) (16) If we consider this divider consisting of a resistor R and capacitor C, that is, replacing R_1 by C and let $R = R_2$. If ω is the frequency of the input voltage, and j is the imaginary unit, let $V_b = 0$, this divider will then have voltage ratio V/V_a = (17)



(16)A loop connected with an AC current, to produce a time varying magnetic field to another loop, called induction loop. The induction loop can be made of plastic or copper. In which of the loops (same area) is the induced voltage greater? (1) the plastic loop (2) the copper loop (3) voltage is same in both case (4) can not be determined (18)



(17)A long coaxial cable, with the inner cylinder, radius a and the outer cylinder, radius b, carries current I, as shown in figure. The self-inductance in a section of length L of the cable is (19) (take μ_0 as permeability in air)



(18)The Fermat's principle can be used to derive which of following laws (20) (1) linear path of light in vacuum (2) law of reflection (3) law of diffraction (4) Snell's law of refraction (5) law of black body radiation.

II. Answer the following question with detailed description (20%)

1. (a) Please give (at least) three examples of experimental evidences for the foundation of quantum mechanics. (b)What is the uncertainty principle and its physics significance.
2. (a) Suppose 1 mol of an ideal gas undergoes a free expansion to four times its initial volume. Calculate the entropy change of this gas. (b) One mole of oxygen (assume it to be an ideal gas) expands at a constant temperature T of 300 K from an initial volume V_i of 12 L to a final volume V_f of 19 L. How much work is done by the gas during the expansion?

試題隨卷繳回