

本試題是否可以使用計算機: 可使用, 不可使用 (請命題老師勾選)

I. 選擇題: (每題 6 分)

1. A 2.5-kg stone is released from rest and falls toward Earth. After 4.0s, the magnitude of its momentum (in $\text{kg} \cdot \text{m/s}$) is:
A. 98
B. 78
C. 39
D. 24
E. zero
2. An ice skater with rotational inertia I_0 is spinning with angular speed ω_0 . She pulls her arms in, decreasing her rotational inertia to $I_0/3$. Her angular speed becomes:
A. $\omega_0/3$
B. $\omega_0/\sqrt{3}$
C. ω_0
D. $\sqrt{3} \omega_0$
E. $3\omega_0$
3. An object of mass m , oscillating on the end of a spring with spring constant k , has amplitude A . Its maximum speed is:
A. $A\sqrt{k/m}$
B. A^2k/m
C. $A\sqrt{m/k}$
D. Am/k
E. A^2m/k
4. A stationary source emits a sound wave of frequency f . If it were possible for a man to travel toward the source at the speed of sound, he would observe the emitted sound to have a frequency of:
A. zero
B. $f/2$
C. $2f/3$
D. $2f$
E. infinity
5. An ideal gas, consisting of n moles, undergoes an irreversible process in which the temperature has the same value at the beginning and end. If the volume changes from V_i to V_f , the change in entropy of the gas is given by:
A. $nR(V_f - V_i)$
B. $nR \ln(V_f - V_i)$
C. $nR \ln(V_i / V_f)$
D. $nR \ln(V_f / V_i)$
E. none of the above (entropy can't be calculated for an irreversible process)
6. Charge Q is distributed uniformly throughout an insulation sphere of radius R . The magnitude of the electric field at a point $R/2$ from the center is:
A. $Q/4\pi\epsilon_0 R^2$
B. $Q/\pi\epsilon_0 R^2$
C. $3Q/4\pi\epsilon_0 R^2$
D. $Q/8\pi\epsilon_0 R^2$
E. none of these

(背面仍有題目, 請繼續作答)

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7. Consider the four Maxwell equations:

1. $\oint \vec{E} \cdot d\vec{A} = q / \epsilon_0$

2. $\oint \vec{B} \cdot d\vec{A} = 0$

3. $\oint \vec{E} \cdot d\vec{s} = -d\Phi_B / dt$

4. $\oint \vec{B} \cdot d\vec{s} = \mu_0 i + \mu_0 \epsilon_0 d\Phi_E / dt$

Which of these must be modified if magnetic poles are discovered?

- A. Only 1 D. Only 3 and 4
B. Only 2 E. Only 2, 3, and 4
C. Only 2 and 3

8. Monochromatic light, at normal incidence, strikes a thin film in air. If λ denotes the wavelength in the film, what is the thinnest film in which the reflected light will be a maximum?

- A. Much less than λ D. $3\lambda/4$
B. $\lambda/4$ E. λ
C. $\lambda/2$

9. Quasar Q1 is moving away from us at a speed of $0.8c$. Quasar Q2 is moving away from us in the opposite direction at a speed of $0.5c$. The speed of Q1 as measured by an observer on Q2 is:

- A. $0.21c$ D. $1.3c$
B. $0.5c$ E. $2.17c$
C. $0.93c$

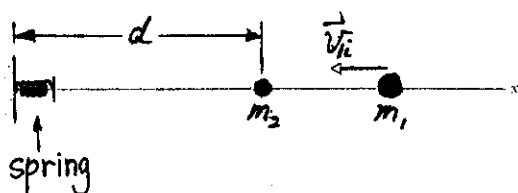
10. Of the following which is the best evidence for the wave nature of matter?

- A. The photoelectric effect
B. The Compton effect
C. The spectral radiancy of cavity radiation
D. The relationship between momentum and energy for an electron
E. The reflection of electrons by crystals

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II. 解答題：

- (15分) 1) In figure, a target glider, whose mass m_2 is 350 g, is at rest on an air track, a distance $d = 53$ cm from the left end of the track. A projectile glider, whose mass m_1 is 590 g, approaches the target glider with velocity $\vec{v}_{1i} = -75$ cm/s and collides elastically with it. Then the target glider rebounds elastically from a spring at the left end of the track and meets the projectile glider for a second time. (Assume the spring has a negligible length when compressed by the glider.) How far from the left end of the track does this second collision occur?



- (10分) 2) When 20.9 J was added as heat to a particular ideal gas, the volume of the gas changed from 50.0 cm^3 to 100 cm^3 while the pressure remained constant at 1.00 atm. (a) By how much did the internal energy of the gas change? If the quantity of gas present is 2.00×10^{-3} mol, find the molar specific heat of the gas at (b) constant pressure and (c) constant volume.

- (15分) 3) The circuit of figure shows a capacitor, two ideal batteries, two resistors, and a switch S. Initially S has been open for a long time. If it is then closed for a long time, by how much does the charge on the capacitor change? Assume

$$C = 10 \mu\text{F}, \mathcal{E}_1 = 1.0 \text{ V}, \mathcal{E}_2 = 3.0 \text{ V}, R_1 = 0.20 \Omega, \text{ and } R_2 = 0.40 \Omega.$$

