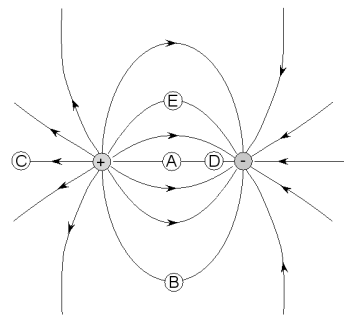


國立高雄大學 105 學年度第 2 學期
理學院普通物理學基礎能力會考試題
系級： 學號： 姓名：

1. A body oscillates with simple harmonic motion along the x axis. Its displacement varies with time according to the equation $x = 5.0 \cos(\pi t)$. The magnitude of the acceleration (in m/s^2) of the body at $t = 1.0$ s is approximately
 - (a) 3.5
 - (b) 49
 - (c) 14
 - (d) 43
2. If $y = 0.02 \sin(30x - 400t)$ (SI units), the frequency of the wave is
 - (a) 30 Hz
 - (b) $15/\pi$ Hz
 - (c) $200/\pi$ Hz
 - (d) 400 Hz
3. Two instruments produce a beat frequency of 5 Hz. If one has a frequency of 264 Hz, what could be the frequency of the other instrument?
 - (a) 269 Hz
 - (b) 254 Hz
 - (c) 264 Hz
 - (d) 5 Hz
4. A constant-volume gas thermometer has a pressure of 2.00 atm at 100°C . What would its pressure be at 0°C ?
 - (a) 0.732 atm
 - (b) 1.46 atm
 - (c) 1.24 atm
 - (d) 1.37 atm
5. Which statement below is **NOT** an assumption made in the molecular model of an ideal gas?
 - (a) The average separation between molecules is large compared with the dimensions of the molecules.
 - (b) The molecules undergo inelastic collisions with one another.
 - (c) The forces between molecules are short range.
 - (d) The molecules obey Newton's laws of motion.
6. Which statement below regarding the first law of thermodynamics is most correct?
 - (a) A system can do work externally only if its internal energy decreases.
 - (b) The internal energy of a system that interacts with its environment must change.

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- (c) No matter what other interactions take place, the internal energy must change if a system undergoes a heat transfer.
- (d) The internal energy of a system cannot change if the heat transferred to the system is equal to the work done by the system.
7. An ideal gas is allowed to undergo a free expansion. If its initial volume is V_1 and its final volume is V_2 , the change in entropy is
- (a) $nR \ln(V_2/V_1)$
 (b) $nRT \ln(V_2/V_1)$
 (c) $nk \ln(V_2/V_1)$
 (d) 0
8. Two particles are separated by a distance d . Particle A has a charge $+Q$ and particle B has a charge $+3Q$. At what distance from particle A along the line connecting particles A and B would you place a third charged particle such that no net electrostatic force acts on it?
- (a) $d/3$
 (b) $d/2$
 (c) $d/4$
 (d) $d/9$
9. A positively charged object is located to the left of a negatively charged object as shown. Electric field lines are shown connecting the two objects. The five points on the electric field lines are labeled A, B, C, D, and E. At which one of these points would a test charge experience the smallest force?
- (a) A
 (b) B
 (c) C
 (d) D
- 
10. When a particle with a charge Q is surrounded by a spherical Gaussian surface, the electric flux through the surface is Φ_S . Consider what would happen if the particle was surrounded by a cylindrical Gaussian surface or a Gaussian cube. How would the fluxes through the cylindrical Φ_{Cyl} and cubic Φ_{Cubic} surfaces compare to Φ_S ?
- (a) $\Phi_S = \Phi_{Cubic} > \Phi_{Cyl}$
 (b) $\Phi_S > \Phi_{Cubic} = \Phi_{Cyl}$
 (c) $\Phi_S = \Phi_{Cubic} = \Phi_{Cyl}$
 (d) $\Phi_S < \Phi_{Cubic} < \Phi_{Cyl}$

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11. The sound level at a point P is 14 decibels (dB) below the sound level at a point 1.0 m from a point source. The distance from the source to point P is about:
- (a) 5 m.
 - (b) 14 m.
 - (c) 20 m.
 - (d) 14 cm.
12. Fahrenheit and Kelvin scales agree numerically at a reading of:
- (a) 574.
 - (b) 0.
 - (c) -40.
 - (d) 473.
13. A quantity of an ideal gas is compressed to half its initial volume. The process may be adiabatic, isothermal or isobaric. Rank those three processes in order of the work required of an external agent, least to greatest.
- (a) isobaric, isothermal, adiabatic
 - (b) isothermal, adiabatic, isobaric
 - (c) adiabatic, isobaric, isothermal
 - (d) adiabatic, isothermal, isobaric
14. One mole of an ideal gas expands reversibly and isothermally at temperature T until its volume is doubled. The change of entropy of this gas for this process is:
- (a) $R \ln 2$.
 - (b) Zero.
 - (c) $RT \ln 2$.
 - (d) $(\ln 2)/T$.
15. The displacement of a string carrying a traveling sinusoidal wave is given by $y(x,t) = y_m \sin(kx - \omega t - \phi)$. At time $t = 0$ the point at $x = 0$ has velocity v_0 and displacement y_0 . The phase constant ϕ is given by $\tan \phi =$:
- (a) $\omega y_0 / v_0$.
 - (b) $\omega v_0 / y_0$.
 - (c) $y_0 / \omega v_0$.
 - (d) $v_0 / \omega y_0$.
16. Suppose the maximum speed of a string carrying a sinusoidal wave is v_s . When the displacement of a point on the string is half its maximum, the speed of the point is:
- (a) $\sqrt{3}v_s/2$. (b) $3v_s/4$. (c) $v_s/2$. (d) $3v_s/4$.

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17. Charge Q is distributed uniformly throughout an insulating sphere of radius R . The magnitude of the electric field at a point $R/2$ from the center is:
- (a) $Q/8\pi\epsilon_0 R^2$.
 - (b) $3Q/4\pi\epsilon_0 R^2$.
 - (c) $Q/\pi\epsilon_0 R^2$.
 - (d) $Q/4\pi\epsilon_0 R^2$.
18. A particle with charge Q is on the y axis a distance a from the origin and a particle with charge q is on the x axis a distance d from the origin. The value of d for which the x component of the force on the second particle is the greatest is:
- (a) $a/\sqrt{2}$.
 - (b) $\sqrt{2}a$.
 - (c) a .
 - (d) 0.
19. A point particle with charge q is at the center of a Gaussian surface in the form of a cube. The electric flux through any one face of the cube is:
- (a) $q/6\epsilon_0$.
 - (b) $q/4\epsilon_0$.
 - (c) q/ϵ_0 .
 - (d) $q/4\pi\epsilon_0$.
20. Positive charge Q is placed on a conducting spherical shell with inner radius R_1 and outer radius R_2 . A point charge q is placed at the center of the cavity. The magnitude of the electric field at a point outside the shell, a distance r from the center, is:
- (a) $(q + Q)/4\pi\epsilon_0 r^2$.
 - (b) $q/4\pi\epsilon_0 r^2$.
 - (c) $(q + Q)/4\pi\epsilon_0 (R_1^2 - r^2)$.
 - (d) $Q/4\pi\epsilon_0 (R_1^2 - r^2)$.
21. An 100.0-MHz FM radio wave propagates at the speed of light $c = 3.0 \times 10^8$ m/s. What is its wavelength?
- (a) 3.0 m
 - (b) 3.3 m
 - (c) 3.5 m
 - (d) 5.0 m
22. A transverse wave with 3.1-cm amplitude and 78-cm wavelength propagates at 7.0 m/s on a stretched spring with mass per unit length 150 g/m. Find the spring tension.
- (a) 5.12 N (b) 6.04 N (c) 7.35 N (d) 8.71 N

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23. What is the intensity in W/m^2 of sound with intensity level of 60 dB.
- (a) $6.0 \times 10^{-3} \text{ W/m}^2$
 - (b) $2.5 \times 10^{-4} \text{ W/m}^2$
 - (c) $1.2 \times 10^{-5} \text{ W/m}^2$
 - (d) $1.0 \times 10^{-6} \text{ W/m}^2$
24. The outdoor temperature rises by 10°C . What's that rise in Fahrenheit?
- (a) 10°F
 - (b) 18°F
 - (c) 24°F
 - (d) 35°F
25. Find the average kinetic energy of a molecule in air at a temperature $T = 300 \text{ K}$. The Boltzmann's constant is $k = 1.38 \times 10^{-23} \text{ J/K}$.
- (a) $4.14 \times 10^{-21} \text{ J}$
 - (b) $6.21 \times 10^{-21} \text{ J}$
 - (c) $8.28 \times 10^{-21} \text{ J}$
 - (d) $9.36 \times 10^{-21} \text{ J}$
26. Find the relation between pressure and temperature in an adiabatic process.
- (a) $p^{1-r}T^r = \text{constant}$
 - (b) $p^{1-r}T^{r/2} = \text{constant}$
 - (c) $p^{1+r}T^r = \text{constant}$
 - (d) $p^{1+r}T^{r/2} = \text{constant}$
27. How much energy becomes unavailable for work in an isothermal process at 440 K, if the entropy increase is 25 J/K .
- (a) 3.5 KJ
 - (b) 6 KJ
 - (c) 11 KJ
 - (d) 17.6 KJ
28. Find the magnitude of the electric force on a $2.0\text{-}\mu\text{C}$ charge in a 100-N/C electric field.
- (a) $5.0 \times 10^{-1} \text{ N}$
 - (b) $2.5 \times 10^{-2} \text{ N}$
 - (c) $1.0 \times 10^{-3} \text{ N}$
 - (d) $2.0 \times 10^{-4} \text{ N}$
29. Find the magnitude of the electric field due to a charged ring of radius a and total charge Q on the ring axis at distance a from the ring's center.
- (a) $kQ/\sqrt{2}a^2$ (b) $kQ/\sqrt{8}a^2$ (c) $kQ/\sqrt{12}a^2$ (d) $kQ/\sqrt{26}a^2$

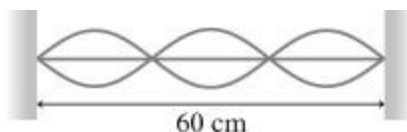
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30. A negative charge $-q$ lies midway between two positive charges $+Q$. What must Q be such that the electric force on all three charges is zero?

- (a) $Q=2q$
- (b) $Q=3q$
- (c) $Q=4q$
- (d) $Q=5q$

31. A standing wave is oscillating at 690 Hz on a string, as shown in the figure. What is the wave speed?

- (a) 140 m/s
- (b) 410 m/s
- (c) 210 m/s
- (d) 280 m/s



32. The velocity of a longitudinal sound wave in an ideal gas is given by $v = \sqrt{\gamma P / \rho}$, where γ is the ratio of the specific heat at constant pressure to that at constant volume, P is the pressure, and ρ is the mass density. Assuming an ideal gas with $\gamma = 1.4$ and $\rho = 1.4 \text{ g/l}$ at standard temperature and pressure, find the wavelength for a 2700 Hz sound wave.

- (a) 0.00 m
- (b) 8.33 m
- (c) 0.12 m
- (d) 0.02 m

33. A wire, 1.0 m long, with a mass of 90 g, is under tension. A transverse wave is propagated on the wire, for which the frequency is 890 Hz, the wavelength is 0.10 m, and the amplitude is 6.5 mm. The tension in the line, in SI units, is closest to:

- (a) 1000
- (b) 710
- (c) 1100
- (d) 820

34. What is the average kinetic energy of an ideal gas at 842 K? (The value of Boltzmann's constant is $1.38 \times 10^{-23} \text{ J/K}$.)

- (a) $5.81 \times 10^{-21} \text{ J}$
- (b) $3.93 \times 10^{-19} \text{ J}$
- (c) $1.18 \times 10^{-17} \text{ J}$
- (d) $1.74 \times 10^{-20} \text{ J}$

35. 114.0 g of water is heated using 67.0 W of power, with perfect efficiency. How long will it take to raise the temperature of the water from 15°C to 25°C?

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- (a) 4.1 s
- (b) 17 s
- (c) 71 s
- (d) 320,000 s

36. A heat engine operates between $T_c = 294 \text{ K}$ and $T_h = 450 \text{ K}$. What is the maximum possible efficiency?

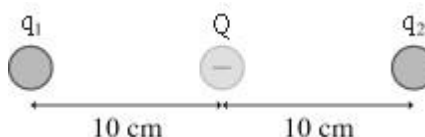
- (a) 1.53
- (b) 0.35
- (c) 0.65
- (d) 0.53

37. Two electrons are passing 26.0 mm apart. What is the electric repulsive force that they exert on each other? (The value of k is $9.0 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$.)

- (a) 1.3 N
- (b) $3.4 \times 10^{-27} \text{ N}$
- (c) $1.3 \times 10^{10} \text{ N}$
- (d) $3.4 \times 10^{-25} \text{ N}$

38. In the figure below the charge in the middle is $Q = -3.1 \text{ nC}$. For what charge q_1 will charge q_2 be in static equilibrium?

- (a) 25 nC
- (b) 6.2 nC
- (c) 3.1 nC
- (d) 12 nC



39. A proton is located at $x = 1.0 \text{ nm}$, $y = 0.0 \text{ nm}$ and an electron is located at $x = 0.0 \text{ nm}$, $y = 4.0 \text{ nm}$. Find the attractive Coulombic force between them. (The value of k is $9.0 \times 10^9 \text{ N}\cdot\text{m}^2/\text{C}^2$.)

- (a) $1.4 \times 10^{-11} \text{ N}$
- (b) $5.3 \times 10^{-18} \text{ N}$
- (c) $5.9 \times 10^{-15} \text{ N}$
- (d) $5.3 \times 10^8 \text{ N}$

40. The figure shows two 5.0 g spheres suspended from 1.0-m-long threads. The spheres repel each other after being charged to $+91 \text{ nC}$. What is the angle θ ?

- (a) 16 degrees
- (b) 8.2 degrees
- (c) 4.1 degrees
- (d) 12 degrees

