

台灣聯合大學系統 93 學年度學士班轉學考試

類組別：B-5, B-6

科目：普通物理

(甲) 單選題 (總共 20 題, 每題 3%, 答案只有一個)

1. 一高 10 公分, 半徑 6 公分的塑膠圓錐體, 置於水中時有 1 公分的高度露出水面, 則塑膠圓錐體的比重為(A)0.9, (B)0.81, (C)0.73, (D)0.656, (E)以上皆非。
2. 橢圓形軌道的人造衛星與地球的距離在遠地點(apogee)與近地點(perigee)的比值為 2, 則在近地點的動能與遠地點的動能比值為(A)0.25, (B)0.5, (C)1, (D)2, (E)4。
3. 實心球($I = \frac{2}{5}MR^2$)在無摩擦力表面的滑行速率為 v 。當遇到有摩擦力的粗糙表面後, 開始有滾動產生。在球只剩下滾動運動時, 球心速率為多少 v ? (A) $\frac{3}{5}$, (B) $\frac{1}{2}$, (C) $\frac{5}{7}$, (D) $\frac{2}{3}$, (E) $\frac{7}{10}$ 。
4. 質量 m 的物體懸掛在彈簧下作垂直方向的簡諧運動(SHM), 測得的週期為 T 。如換成 $2m$ 的物體進行同樣的運動, 則週期為(A)2T, (B) $\sqrt{2}T$, (C)T, (D) $\frac{T}{\sqrt{2}}$, (E) $\frac{T}{2}$ 。
5. 喇叭輸出的功率增加 10 倍, 則聲音增加多少分貝(dB)? (A)100, (B)20, (C)10, (D)5, (E)2。
6. 實心球, 空心球及實心圓柱在以中心軸為轉軸的轉動慣量依次為 $\frac{2}{5}MR^2$, $\frac{2}{3}MR^2$ 及 $\frac{1}{2}MR^2$ 。轉動慣量相等的上述三個物體, 置於同一斜坡相同高度往下滾動時, 誰最先到達斜坡底部? (A)實心球, (B)空心球, (C)實心圓柱, (D)同時到達, (E)不能比較。
7. 一維系統中往 $+x$ 方向的力 $F_x(t) = 2 + 2t^3$ (N), 在 $t = 0$ 到 $t = 2$ 秒的時段作用在原先靜止於無摩擦力平面上質量一公斤的物體, 則物體在 $t = 4$ 秒的速度為(A)12, (B)6, (C)4, (D)3, (E)2。
8. 以一透鏡 (孔徑大小為 r , 焦距 f) 聚焦一平行光束, 考慮透鏡大小所造成的繞射效應, 下列何者所形成的焦點最小(A) $f=100$ cm, $r=2$ cm, (B) $f=1$ cm, $r=2$ cm, (C) $f=100$ cm, $r=10$ cm, (D) $f=100$ cm, $r=20$ cm, (E) $f=20$ cm, $r=20$ cm。
9. 一原子的激發態(excited state)具有生命期 2×10^{-8} sec, 回到基態(ground state)時發出一光子。依據測不準定律此光子的頻率的不確定範圍為(A) 5×10^{-2} Hz (B) 2×10^{-8} Hz (C) 5×10^7 Hz (D) 2×10^3 Hz (E) 10^2 Hz。

10. 靜止的電子(質量 m_e , 電荷 e)經一電壓為 $V = m_e c^2 / e$ 的電極加速後, 在相對論效應不可忽略的情況下, 該電

子的 de Broglie 波長為 (A) $\frac{h}{\sqrt{3}m_e C}$ (B) $\frac{h}{\sqrt{2}m_e C}$ (C) $\frac{h}{m_e C}$ (D) $\frac{\sqrt{2}h}{m_e C}$ (E) $\frac{\sqrt{3}h}{m_e C}$ 。

11. 一理想的雙原子分子(如 N_2 、 H_2)經過準穩定的絕熱膨脹(quasistatic adiabatic)後體積為原來的 32 倍, 則壓力為原來的 (A) $1/2^5$ (B) $1/2^3$ (C) $1/2^7$ (D) $1/3^5$ (E) $1/3^4$ 。

12. n mole 的理想氣體在定體積下, 溫度由 T_1 上升到 T_2 , 熵(entropy)的改變量為

(A) $nR \exp(T_2 - T_1)$ (B) $\frac{3nR}{2} \ln \frac{T_2}{T_1}$ (C) $\frac{3nR}{2} (T_2 - T_1)$ (D) $\frac{nR}{3} \frac{T_2}{T_1}$ (E) $\frac{nR}{3} \sqrt{T_2 - T_1}$ 。

13. 一 x-ray 與一電子作用, 經過康卜吞散射(Copmpton scattering)後, 散射光與原入射光夾角為 θ , 在何種狀況下, 散射光的波長最短?(A) $\theta = 135^\circ$ (B) $\theta = 90^\circ$ (C) $\theta = 0^\circ$ (D) $\theta = 180^\circ$ (E) $\theta = -90^\circ$ 。

14. In right figure, charge is placed on the piece of copper. How will the charge be distributed on the object?

- (A) Uniformly over the surface.
- (B) Uniformly throughout the volume.
- (C) With greatest density near point C on the surface.
- (D) With greatest density near point E on the flat surface.
- (E) With greatest density near point D in the interior.



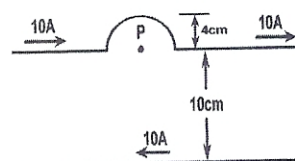
15. A proton is projected toward a fixed nucleus of charge $+Ze$ with velocity v . Initially the two particles are very far apart. When the proton is a distance R from the nucleus its velocity has decreased to $1/2 v$. How far from the nucleus will the proton be when its velocity has dropped to $1/4 v$?

(A) $1/16 R$ (B) $1/4 R$ (C) $1/2 R$ (D) $4/5 R$ (E) None of these.

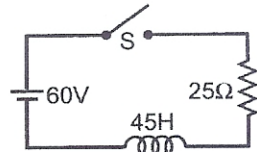
16. Which of the following is an accurate statement?

- (A) An ammeter disturbs a circuit, whereas a voltmeter does not.
- (B) The resistance between the terminals of an ammeter should be as large as possible.
- (C) When one attaches a resistor to a galvanometer to construct a voltmeter, the current through the galvanometer is typically much less than that through the resistor.
- (D) An ammeter is constructed by placing a resistor in series with a galvanometer.
- (E) A "shunt" resistor is the name given the resistor placed in parallel with a galvanometer.

17. In right figure, the upper wire has two straight lines and a semicircular arc of radius 4.0 cm. The lower wire is parallel to the upper wire and separated by 10 cm. The upper wire carries a current of 10 A and the lower wire carries the return current. The magnitude of the magnetic field at the center of the semicircular arc P, in μT , is closest to: (A) 80 (B) 60 (C) 100 (D) 140 (E) 180.



18. A R-L circuit has a 60 V battery, a 45 H inductor, a 25 Ω resistor, and a switch S in series, as shown in right figure. Initially, S is open and there is no magnetic flux in the inductor. At $t = 0$ s, S is closed. When the current is 1.5 A, the rate of change of the current is closest to (A/s) (A) 0.67 (B) 0.58 (C) 0.50 (D) 0.75 (E) 0.83.



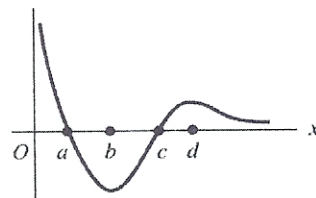
19. A 30.0 GHz electromagnetic wave propagates in carbon tetrachloride with a speed of 3.0×10^8 m/s. The wavelength of the wave in carbon tetrachloride is closest to: (A) 10 mm, (B) 10 cm, (C) 10 m, (D) 10 km, (E) 10 nm.
20. The main reason the Michelson-Morley experiment is considered important is that
- (A) it showed that light could exhibit interference effects.
 - (B) it demonstrated that light was an electromagnetic wave.
 - (C) it gave strong experimental support to the special theory of relativity.
 - (D) it demonstrated the existence of the ether.
 - (E) it provided an accurate measurement of the speed of light.

(乙) 複選題 (總共 10 題, 每題 4%, 不倒扣, 答案有一至五個)

21. 有關兩端固定的弦產生的駐波(standing wave), 何者正確? (A)節點(node)與反節點(antinode)的數目一樣, (B)波長 = 弦長除以(節點數目-1), (C)相鄰節點的距離為波長一半, (D)波形不隨時間改變, (E)頻率量子化的原因來自弦端被固定。

22. 在密度均勻的星球表面上, 重力場強度為 g 。如星球的(A)密度加倍, 則 g 變成 $4g$, (B)半徑減半, 則 g 變成 $0.5g$, (C)質量不變, 半徑減半, 則 g 變成 $4g$, (D)密度不變, 體積加倍, 則 g 變成 $2g$, (E)密度加倍, 半徑減半, 則 g 不變。

23. 一個彈珠在 x 軸上的位能函數如右圖所示, 則(A)在 a 點彈珠受力 = 0, (B)在 c 點彈珠受力 = 0, (C)穩定平衡點是 b 點, (D)不穩定平衡點是 d 點, (E)在 $x \geq c$ 的區域, 彈珠受到 $+x$ 方向的作用力。



24. 無窮深位能井($0 < x < L : U = 0$, 且 $x < 0, x > L : U = \text{inf.}$)中有一質量為 m 的粒子, 下列何者為其可能的波函數

(A) $A \sin \frac{2\pi x}{L}$ (B) $A \sin \frac{\pi x}{2L}$ (C) $A \sin \frac{102\pi x}{L}$ (D) $A \sin \frac{3\pi x}{L}$ (E) $A \sin \frac{5\pi x}{2L}$ 。

25. 已知氫原子的基態(ground state)能階為 -13.6eV , 下列何者為氫原子其他可能的能階
- (A) -6.8eV (B) -3.4eV (C) -1.51eV (D) -0.85eV (E) -0.75eV 。

26. 有關熵(entropy)的敘述下列何者正確? (A)熱力學第一定律中的熵，是由能量守恆的觀念得來 (B)在不可逆的過程中熵的變化量 $\Delta S \leq 0$ (C)在可逆的過程中熵的變化量 $\Delta S = 0$ (D)熵是有關一個系統中無次序(disorder)程度的物理量 (E)在不可逆的過程中熵的變化量 $\Delta S \geq 0$ 。
27. 一薄膜折射率為 1.4，可強化波長為 685nm 與 411nm 的反射。下列何者正確?
(A) 薄膜厚度為 367nm (B) 薄膜厚度為 342.5nm (C) 在波長為 535nm 區域無反射 (D) 在波長為 514nm 區域無反射 (E) 在日光燈下，反射光看起來是紫紅色。
28. Two conductors are joined by a long copper wire. Thus
(A) each conductor must be at the same potential. (B) the electric field at the surface of each conductor is the same.
(C) free charge can be present on either conductor. (D) the potential on the wire is equal to that on each conductor.
(E) each carries the same free charge.
29. An air-filled parallel-plate capacitor is connected to a battery and allowed to charge up. Now a slab of dielectric material is placed between the plates while the capacitor is still connected to the battery. After that, one would find
(A) the charge on the capacitor had not changed. (B) the energy stored in the capacitor had increased.
(C) the voltage across the capacitor had not changed. (D) the charge on the capacitor had increased. (E) None of these is true.
30. Which of the following are accurate statements?
(A) The magnetic force on a wire carrying current is greatest when the wire is perpendicular to the magnetic field.
(B) A magnetic field line is tangent to the direction of the magnetic force on a moving charge.
(C) When a loop carrying current is put into a magnetic field, the loop plane tends to line up with the field.
(D) Magnetic field lines have north and south poles as their sources.
(E) The magnetic force on a moving charge does not change its energy.