國立中興大學113學年度

學士後醫學系公費生招生考試

物理科試題

考試時間：100分鐘

考試開始鈴響前，不得翻閱試題，且不得書寫、畫記、作答!
本考試不得使用計算機

考生請注意：

一、考生應確實關閉行動電話(或取出電池)及手錶之鬧鈴設定；除准考證及考試必需用品外，所有物品(含行動電話、穿戴式裝置等)均應立即放置於臨時置物區，不得發出聲響或有影響試場秩序之情形。

二、請確認抽屜中、桌椅下、座位旁均無其他非必要用品。如有任何問題請立即舉手反映。

三、坐定後，雙手離開桌面，請核對並確認准考證、座位標籤、及答案卡上之准考證號碼是否完全相同。如有錯誤，應立即舉手請監試人員處理。

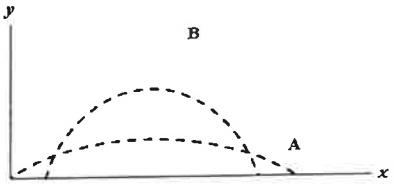
四、考生應試時不得飲食、飲水、抽菸、嚼食口香糖。

五、答案卡劃記以2B鉛筆為佳，劃記時要粗黑、清晰，劃滿作答格，不可出格，不得折損答案卡，修正作答以軟性橡皮擦擦拭乾淨，且不得使用修正液(帶)修正，未遵照正確作答方式而致機器無法正確辨識答案者，考生自行負責，不得以任何理由補救。答案寫在試題紙上者不予計分。

六、本試題必須與答案卡一併繳回，不得攜出試場。

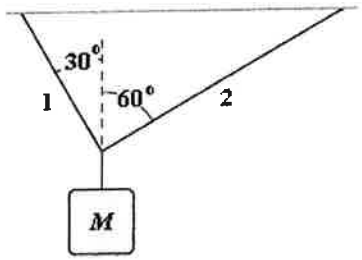
選擇題(單選題，共50題，一題2分，答錯不倒扣，請選擇最適切答案)

1. Cart A, of mass m, starts from rest and travels in a straight line with acceleration a. It traverses a distance x in time t. Cart B, of mass $4m$, starts from rest and travels in a straight line with acceleration $a/2$. At time t it has traversed the distance (A) $x/4$ (B) $x/2$ (C) x (D) $2x$ (E) $4x$
2. An automobile traveling along a straight road increases its speed from 30.0 m/s to 50.0 m/s in a distance of 180 m. If the acceleration is constant, how much time elapses while the auto moves this distance? (A) 6.00 s (B) 4.50 s (C) 3.60 s (D) 4.00 s (E) 9.00 s
3. A particle moves in the xy plane with a constant acceleration given by $\boldsymbol{a} = -4\hat{\boldsymbol{j}}$ m/s^2. At $t = 0$, its position and velocity are $10\hat{\boldsymbol{i}}$ m and $(-2\hat{\boldsymbol{i}} + 8\hat{\boldsymbol{j}})$ m/s, respectively. Here, $\hat{\boldsymbol{i}}$ and $\hat{\boldsymbol{j}}$ are unit vectors along x and y directions, respectively. What is the distance from the origin to the particle at $t = 2.0$ s? (A) 6.4 m (B) 10 m (C) 8.9 m (D) 2.0 m (E) 6.2 m
4. Two balls, projected at different times so they don't collide, have trajectories A and B, as shown below. Ignore the air resistance and friction. Which of the following is necessarily true?

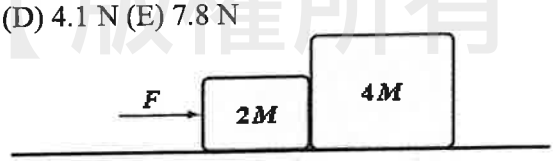


(A) The initial velocity of ball B is greater than that of ball A. (B) The initial velocity of ball A is greater than that of ball B. (C) Ball A is in the air for a longer time than ball B. (D) Ball B is in the air for a longer time than ball A. (E) Ball B has a greater acceleration than ball A.

5. If $M = 6.0$ kg, what is the tension in string 2? Note that the acceleration due to gravity $g = 9.8$ m/s^2. (A) 39 N (B) 35 N (C) 29 N (D) 44 N (E) 51 N

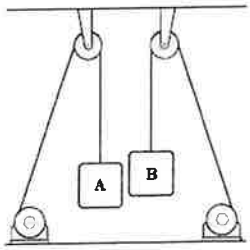


6. The horizontal surface on which the objects slide is frictionless. If M = 1.0 kg and the magnitude of the force of the small block on the large block is 5.2 N, determine F. (A) 6.0 N (B) 9.0N (C) 4.8 N (D) 4.1 N (E) 7.8 N

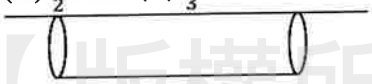


7. The total force needed to drag a box at constant speed across a surface with coefficient of kinetic friction μ is least when the force is applied at an angle θ such that (A) $\sin\theta = \mu$ (B) $\cos\theta = \mu$ (C) $\tan\theta = \mu$ (D) $\cot\theta = \mu$ (E) $\sec\theta = \mu$

8. A race car traveling at 100 m/s enters an unbanked turn of 400 m radius. The coefficient of (static) friction between the tires and the track is 1.1. The track has both an inner and an outer wall. Which statement is correct? (A) The race car will crash into the outer wall. (B) The race car will crash into the inner wall. (C) The car will stay in the center of the track. (D) The car will stay in the center of the track if the driver speeds up. (E) The car would stay in the center of the track if the radius were reduced to 200 m.
9. A certain pendulum consists of a 1.5-kg mass swinging at the end of a string (length = 2.0 m). At the lowest point in the swing the tension in the string is equal to 20 N. To what maximum height above this lowest point will the mass rise during its oscillation? Note that the acceleration due to gravity $g = 9.8$ m/s^2. (A) 77 cm (B) 50 cm (C) 63 cm (D) 36 cm (E) 95 cm
10. Two equal masses are raised at constant velocity by ropes that run over pulleys, as shown below. Mass B is raised twice as fast as mass A. The magnitudes of the forces exerted by the ropes on masses A and B are, respectively, F_A and F_B, while the power supplied for each is P_A and P_B. Which statement is correct? (A) $F_B = F_A$; $P_B = P_A$. (B) $F_B = F_A$; $P_B = 2\,P_A$. (C) $F_B = 2\,F_A$; $P_B = P_A$. (D) $F_B = 2\,F_A$; $P_B = 2\,P_A$. (E) $P_A = F_A$; $P_B = F_B$.

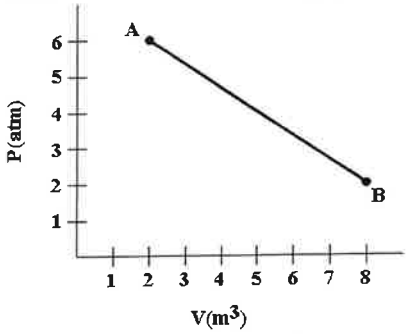


11. A ball of mass m_B is released from rest and acquires velocity of magnitude v_B before hitting the ground. The ratio of the kinetic energy the Earth acquires to the kinetic energy the ball acquires is (A) 0 (B) $(m_B/m_E)^2$ (C) m_B/m_E (D) 1 (E) m_E/m_B
12. A wheel rotating about a fixed axis with a constant angular acceleration of 2.0 rad/s^2 turns through 2.4 revolutions during a 2.0-s time interval. What is the angular velocity at the end of this time interval? (A) 9.5 rad/s (B) 8.5 rad/s (C) 8.0 rad/s (D) 10.2 rad/s (E) 12.3 rad/s
13. A uniform cylinder of radius R, mass M, and length L rotates freely about a horizontal axis parallel and tangent to the cylinder, as shown below. The moment of inertia of the cylinder about this axis is (A) $\frac{1}{2}MR^2$ (B) $\frac{2}{3}MR^2$ (C) MR^2 (D) $\frac{3}{2}MR^2$ (E) $\frac{7}{5}MR^2$



14. A body of mass 5.0 kg is suspended by a spring which stretches 10 cm when the mass is attached. It is then displaced downward an additional 5.0 cm and released. Note that the acceleration due to gravity $g = 9.8$ m/s^2. Its position as a function of time is approximately (A) $-0.10\sin 9.9t$ m (B) $-0.10\cos 4.9t$ m (C) $-0.05\cos 4.9t$ m (D) $-0.05\sin 4.9t$ m (E) $-0.05\cos 9.9t$ m.
15. The motion of a particle connected to a spring is described by $x = 10\sin \pi t$. At what time (in s) is the potential energy equal to the kinetic energy? (A) 0 (B) 0.25 (C) 0.5 (D) 0.86 (E) 1.0
16. Bats can detect small objects such as insects that are of a size on the order of a wavelength. If bats emit a chirp at a frequency of 60 kHz and the speed of soundwaves in air is 330 m/s, what is the smallest size insect they can detect? (A) 1.5 mm (B) 3.5 mm (C) 5.5 mm (D) 7.5 mm (E) 9.8 mm
17. If $y = 0.2\sin(30x - 400t)$ (SI units), the velocity of the wave is (A) 3/40 (m/s) (B) $40\pi/3$ (m/s) (C) $60\pi/400$ (m/s) (D) $400/60\pi$ (m/s) (E) 40/3 (m/s)

18. An organ pipe open at both ends is 1.5 m long. A second organ pipe that is closed at one end and open at the other is 0.75 m long. The speed of sound in the room is 330 m/s. Which of the following sets of frequencies consists of frequencies which can be produced by both pipes? (A) 110 Hz, 220 Hz, 330 Hz. (B) 220 Hz, 440 Hz, 660 Hz. (C) 110 Hz, 330 Hz, 550 Hz. (D) 330 Hz, 660 Hz, 990 Hz.. (E) 330 Hz, 440 Hz, 550 Hz.
19. Two harmonic waves traveling in opposite directions interfere to produce a standing wave described by $y = 2\sin 4x\cos(3t)$ where x is in m and t is in s. What is the speed (in m/s) of the interfering waves? (A) 0.75 (B) 0.25 (C) 1.33 (D) 12 (E) 3.0
20. A hydraulic lift raises a 2000-kg automobile when a 500-N force is applied to the smaller piston. If the smaller piston has an area of 10 cm^2, what is the cross-sectional area of the larger piston? Note that the acceleration due to gravity $g = 9.8$ m/s^2. (A) 40 cm^2 (B) 80 cm^2 (C) 196 cm^2 (D) 392 cm^2 (E) 160 cm^2
21. People can snorkel down to a depth of roughly one meter. This means that the additional pressure on the air in their lungs is roughly (A) 9800 N (B) 9800 Pa (C) 9800 atm (D) 19600 N (E) 19600 N/m^2
22. Consider a thin horizontal layer of the atmosphere, of thickness *dy*, of area *A*, with pressure *P* at the bottom. This layer contains n_V molecules per unit volume with an average mass *m* per molecule, and is under the influence of gravity with gravitational acceleration *g*. What is the magnitude, *dP*, of the pressure difference between the top and bottom of the layer? (A) *mgdy*. (B) mgn_Vdy. (C) *mgAdy*. (D) mgn_VAdy. (E) mgn_VAPdy.
23. A gas expands from A to B as shown in the graph. Calculate the work (in joules) done by the gas. (1 atm = 1.01×10^5 N/m^2.) (A) 12 (B) 24 (C) 1.21×10^6 (D) 2.42×10^6 (E) 3.64×10^6



24. A heat pump has a coefficient of performance of 4. If the heat pump absorbs 20 cal of heat from the cold outdoors in each cycle, the heat expelled (in cal) to the warm indoors is about (A) 14 (B) 27 (C) 40 (D) 48 (E) 77
25. Consider *n* moles of an ideal gas being compressed isothermally at absolute temperature *T* from an initial volume V_1 to a final volume V_2. The *R* and k_B are, respectively, universal gas constant and Boltzmann constant. What is the change in entropy? (A) $nR\ln(V_2/V_1)$ (B) $nRT\ln(V_2/V_1)$ (C) $nk_B\ln(V_2/V_1)$ (D) $nk_BT\ln(V_2/V_1)$ (E) $nk_B(V_2 - V_1)$
26. A charge per unit length given by $\lambda(x) = bx$, where $b = 12$ nC/m^2, is distributed along the *x* axis from $x = +9.0$ cm to $x = +16$ cm. If the electric potential at infinity is taken to be zero, what is the electric potential at the point P on the *y* axis at $y = 12$ cm?
(A)5.4 V (B)7.2 V (C)9.0 V (D)12.2 V (E)16.0 V
27. Light of wavelength 580 nm is incident on a slit having a width of 0.300 mm. The viewing screen is 2.00 m from the slit. Find the width of the central bright fringe.
(A) 3.2mm (B) 5.0mm (C) 7.7mm (D) 9.2mm (E) 11.3mm

28. For a long ideal solenoid having a circular cross-section, the magnetic field strength within the solenoid is given by the equation B(t) = 5.0t[T], where t is time in seconds. If the induced electric field outside the solenoid is 1.1 V/m at a distance of 2.0 m from the axis of the solenoid, find the radius of the solenoid.
(A) 30.2m (B) 15.4m (C) 6.4m (D) 2.4m (E) 0.9m

29. You are designing a generator to have a maximum emf of 8.0 V. If the generator coil has 200 turns and a cross-sectional area of 0.030 m^2, what should be the frequency of the generator in a uniform magnetic field of 0.030 T?
(A) 7.1 Hz (B) 8.4 Hz (C) 9.7 Hz (D) 10.6 Hz (E) 12.6 Hz

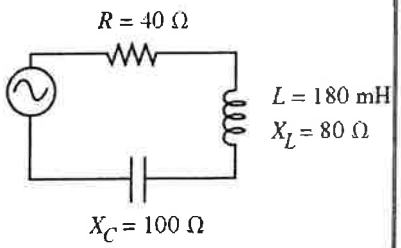
30. A neutron has a mass of 1.67×10^{-27} kg. Its de Broglie wavelength is 1.4×10^{-10} m. What is its kinetic energy (h=6.626×10^{-34} m^2kg/s) ?
(A) 40 eV (B) 4 eV (C) 0.4 eV (D) 0.04 eV (E) 0.004 eV

31. What is the quantum number n of a particle of mass m confined to a one-dimensional box of length L when its momentum is $4h/L$?
(A) 1 (B) 2 (C) 4 (D) 8 (E) 16

32. A conducting circular loop is placed in a uniform magnetic field of 0.04 T with its plane perpendicular to the magnetic field. The radius of the loop starts shrinking at 2 mm/s. The induced emf in the loop when the radius is 2 cm is
(A) 0.8π μV (B) 1.2π μV (C) 1.6π μV (D) 2.4π μV (E) 3.2π μV

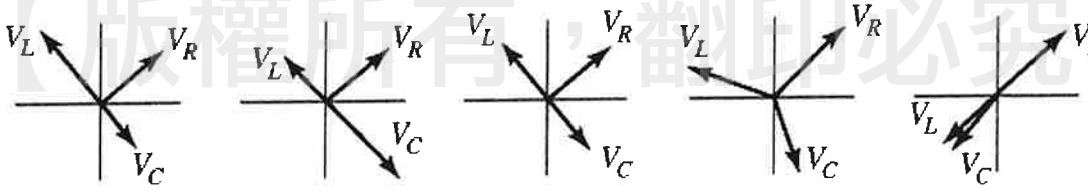
33. An alternating current is supplied to an electronic component with a warning that the voltage across it should never exceed 12V. What is the highest rms voltage that can be supplied to this component while staying below the voltage limit in the warning?
(A) $6\sqrt{2}$V (B) $12\sqrt{2}$V (C) 12V (D) 6 V (E) 24V

34. An ac circuit is shown in the figure. The rms current in the circuit is measured to be 1.8 A. What is the capacitance of the capacitor?
(A)11 μF (B) 17 μF (C) 23 μF (D) 29 μF (E) 35 μF



35. Two flat 4.0cm×4.0cm electrodes carrying equal but opposite charges are spaced 2.0 mm apart with their midpoints opposite each other. Between the electrodes but not near their edges, the electric field strength is 10^6 N/C. What is the magnitude of the charge on each electrode? ($\varepsilon_0 = 8.85\times10^{-12}$ F/m)
(A) 4 nC (B) 10 nC (C) 14 nC (D) 20 nC (E) 24 nC

36. Which one of the phasor diagrams shown below best represents a series *LRC* circuit driven at resonance?

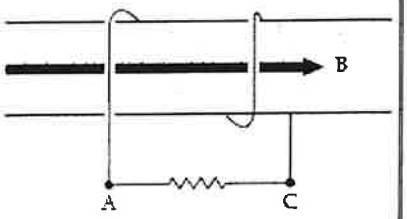


(A) 1 (B) 2 (C) 3 (D) 4 (E) 5

37. A solid nonconducting sphere of radius R carries a uniform charge density throughout its volume. At a radial distance $r_1 = R/4$ from the center, the electric field has a magnitude E_0. What is the magnitude of the electric field at a radial distance $r_2 = 2R$? (A) $E_0/8$ (B) $E_0/4$ (C) $E_0/2$ (D) E_0 (E) $2E_0$

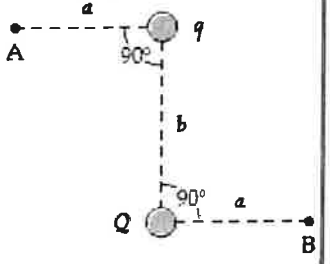
38. Which of the following expressions is a static electric field
(A) $\vec{E} = (2xy, -2yz, -y^2)$ (B) $\vec{E} = (2z, -2yz, -x^2)$ (C) $\vec{E} = (2x, -2yz, -y^2)$
(D) $\vec{E} = (yz, yz, yz)$ (E) $\vec{E} = (2xy - 3, 2x^2, 0)$

39. The coil shown in the figure has 2 turns, a cross-sectional area of 0.20 m^2, and a field (parallel to the axis of the coil) with a magnitude given by $B = (4.0 + 3.0t^2)$ T, where t is in s. What is the potential difference, $V_A - V_C$, at $t = 3.0$ s
(A) +7.2V (B) -7.2V (C) +4.8V (D) -4.8V (E) -12.0V



40. A fish appears to be 2.00 m below the surface of a pond when viewed almost directly above by a fisherman. What is the actual depth of the fish? ($n_{water} = 1.33$)
(A) 1.33 m (B) 0.38 m (C) 4.12 m (D) 3.02 m (E) 2.66 m

41. As shown in the figure, point charges q and Q are positioned as shown. If $q = +2.0$ nC, $Q = -2.0$ nC, $a = 3.0$ m, and $b = 4.0$ m, what is the electric potential difference, $V_A - V_B$?
(A) 2.4V (B) 4.8V (C) 6.0V (D) 7.2V (E) 8.4V



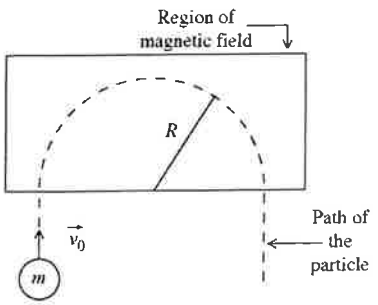
42. In a transformer, how many turns are necessary in a 110V primary if the 24V secondary has 100 turns?
(A) 458 (B) 240 (C) 110 (D) 22 (E) 4

43. Charge of uniform density (20 nC/m^2) is distributed over a cylindrical surface (radius = 1.0 cm), and a second coaxial surface (radius = 3.0 cm) carries a uniform charge density of -12 nC/m^2. Determine the magnitude of the electric field at a point 4.0 cm from the symmetry axis of the two surfaces ($\varepsilon_0 = 8.85\times10^{-12}$ F/m)
(A) 0.23 kN/C (B) 1.1 kN/C (C) 1.7 kN/C (D) 0.45 kN/C (E) 0.1 kN/C

44. Light of wavelength 400 nm falls on a metal surface having a work function 1.70 eV. What is the maximum kinetic energy of the photoelectrons emitted from the metal? ($c = 3.00\times10^8$ m/s, h=6.626×10^{-34} m^2kg/s, 1eV =1.60×10^{-19} J)
(A) 4.5 eV (B) 3.1 eV (C) 1.4 eV (D) 2.2 eV (E) 1.0 eV

45. Consider: radio waves (r), visible light (v), infra-red (i), x-rays (x), ultraviolet (u). In order of increasing frequency, they are:
(A) r, v, i, x, u (B) r, i, v, u, x (C) i, r, v, u, x (D) i, v, r, u, x (E) r, i, v, x, u

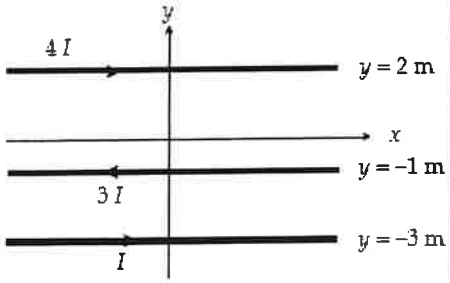
46. As shown in the figure, a small particle of charge q= -7.0×10^{-6} C and mass m=3.1×10^{-12} kg has velocity v=9.4×10^3 m/s as it enters a region of uniform magnetic field. The particle is observed to travel in the semicircular path shown, with radius $R = 5.0$ cm. Calculate the magnitude of the magnetic field in the region.
(A) 0.26T (B) 0.20T (C) 0.14T (D) 0.08T (E) 0.02T



47. A hydrogen atom in the 4f state has a total angular momentum (in terms of $\hbar$) of magnitude
(A) $\sqrt{3}$ (B) $2\sqrt{3}$ (C) $\sqrt{2}$ (D) $2\sqrt{2}$ (E) $\sqrt{3}/2$

48. What is the energy of an incident photon that is just enough to excite a hydrogen atom from its ground state to its $n = 4$ state?
(A) 0.85 eV (B) 2.40 eV (C) 3.40 eV (D) 10.20 eV
(E) 12.75 eV

49. Three long wires parallel to the x axis carry currents as shown. If $I = 20$ A, what is the magnitude of the magnetic field at the origin?



(A) 10μT (B) 19μT (C) 28μT (D) 37μT (E) 52μT

50. A mall bulb is rated at 7.50 W when operated at 125 V. The tungsten filament has a temperature coefficient of resistivity $\alpha = 4.50 \times 10^{-3}$ /°C. When the filament is hot and glowing, its temperature is seven times room temperature (20 °C). What is the resistance of the filament (in ohms) at room temperature?
(A) 240 (B)1350 (C) 2080 (D) 4530 (E) 5630

科目：物理

題號	答案	題號	答案	題號	答案	題號	答案	題號	答案	題號	答案	題號	答案
1.	B	16.	C	31.	D	46.	D	61.		76.		91.	
2.	B	17.	E	32.	E	47.	B	62.		77.		92.	
3.	B	18.	C	33.	A	48.	E	63.		78.		93.	
4.	D	19.	A	34.	C	49.	B	64.		79.		94.	
5.	C	20.	D	35.	C	50.	B	65.		80.		95.	
6.	E	21.	B	36.	C	51.		66.		81.		96.	
7.	C	22.	B	37.	D	52.		67.		82.		97.	
8.	A	23.	D	38.	C	53.		68.		83.		98.	
9.	D	24.	B	39.	B	54.		69.		84.		99.	
10.	B	25.	A	40.	E	55.		70.		85.		100.	
11.	C	26.	A	41.	B	56.		71.		86.			
12.	A	27.	C	42.	A	57.		72.		87.			
13.	D	28.	E	43.	D	58.		73.		88.			
14.	E	29.	A	44.	C	59.		74.		89.			
15.	B	30.	C	45.	B	60.		75.		90.			

國立中興大學113學年度學士後醫學系招生考試

試題參考答案疑義釋疑公告

科目	題號	疑義答覆	釋疑結果
物理	30	本題為正確答案誤植，答案更正為(D)	答案更正為(D)

物 理

程量子(陳宗德)老師提供

1. Cart A, of mass m, starts from rest and travels in a straight line with acceleration a. It traverses a distance x in time t. Cart B, of mass $4m$, starts from rest and travels in a straight line with acceleration $a/2$. At time t it has traversed the distance (A) $x/4$ (B) $x/2$ (C) x (D) $2x$ (E) $4x$

1. 解：(B)

$$x = x_A = 0 + \frac{1}{2}at^2$$

$$x_B = 0 + \frac{1}{2}(\frac{a}{2})t^2 = \frac{1}{2}(\frac{1}{2}at^2) = \frac{1}{2}x_A = \frac{1}{2}x$$

2. An automobile traveling along a straight road increases its speed from 30.0 m/s to 50.0 m/s in a distance of 180 m. If the acceleration is constant, how much time elapses while the auto moves this distance? (A) 6.00 s (B) 4.50 s (C) 3.60 s (D) 4.00 s (E) 9.00 s

2. 解：(B)

$$v^2 = v_0^2 + 2ax \Rightarrow 50^2 = 30^2 + 2\cdot a\cdot 180 \Rightarrow a = 4.44$$

$$v = v_0 + at \Rightarrow 50 = 30 + (4.44)\cdot t \Rightarrow t = 4.5[s]$$

3. A particle moves in the xy plane with a constant acceleration given by $\boldsymbol{a} = -4\hat{j}$ m/s^2. At $t = 0$, its position and velocity are $10\hat{i}$ m and $(-2\hat{i} + 8\hat{j})$ m/s, respectively. Here, $\hat{i}$ and $\hat{j}$ are unit vectors along x and y directions, respectively. What is the distance from the origin to the particle at $t = 2.0$ s? (A) 6.4 (B) 10 m (C) 8.9 m (D) 2.0 m (E) 6.2 m

3. 解：(B)

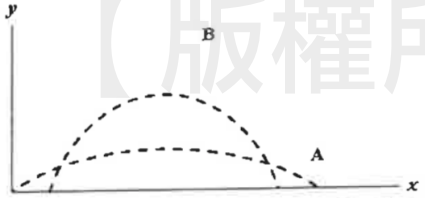
$$\vec{x}_0 = 10\hat{i},\ \vec{v}_i = -2\hat{i} + 8\hat{j},\ \vec{a} = -4\hat{j}$$

$$x = x_0 + v_{ix}t + \frac{1}{2}a_x t^2 = 10 + (-2)\times 2 + \frac{1}{2}(0)(2)^2 = +6$$

$$y = y_0 + v_{iy}t + \frac{1}{2}a_y t^2 = 0 + 8\times 2 + \frac{1}{2}(-4)(2)^2 = +8$$

$$R = \sqrt{x^2 + y^2} = \sqrt{6^2 + 8^2} = 10[m]$$

4. Two balls, projected at different times so they don't collide, have trajectories A and B, as shown below. Ignore the air resistance and friction. Which of the following is necessarily true?



(A) he initial velocity of ball B is greater than that of ball A. (B) The initial velocity of ball A is greater than that of ball B. (C) Ball A is in the air for a longer time than ball B. (D) Ball B is in the air for a longer time than ball A. (E) Ball B has a greater acceleration than ball A.

4. 解：(D)

由 $T = \frac{2v_0\sin\theta}{g}$ 及 $H = \frac{v_0^2\sin^2\theta}{2g}$ 得 $H = \frac{gT^2}{8}$，知高度越高，飛行時間越長

12. A wheel rotating about a fixed axis with a constant angular acceleration of 2.0 rad/s^2 turns through 2.4 revolutions during a 2.0-s time interval. What is the angular velocity at the end of this time interval? (A) 9.5 rad/s (B) 8.5 rad/s (C) 8.0 rad/s (D) 10.2 rad/s (E) 12.3 rad/s

12. 解：(A)

$$\theta = \omega_0 t + \frac{1}{2}\alpha t^2 \Rightarrow 15 = \omega_0(2) + \frac{1}{2}(2)(2)^2 \Rightarrow \omega_0 = 5.5$$
$$\omega = \omega_0 + \alpha t = 5.5 + 2 \times 2 = 9.5[rad/s]$$

13. A uniform cylinder of radius R, mass M, and length L rotates freely about a horizontal axis parallel and tangent to the cylinder, as shown below. The moment of inertia of the cylinder about this axis is (A) $\frac{1}{2}$MR^2 (B) $\frac{2}{3}$MR^2 (C) MR^2 (D) $\frac{3}{2}$MR^2 (E) $\frac{7}{5}$MR^2

13. 解：(D)

$$I = I_C + Md^2 = \frac{1}{2}MR^2 + MR^2 = \frac{3}{2}MR^2$$

14. A body of mass 5.0 kg is suspended by a spring which stretches 10 cm when the mass is attached. It is then displaced downward an additional 5.0 cm and released. Note that the acceleration due to gravity g = 9.8 m/s^2. Its position as a function of time is approximately

(A) -0.10 sin 9.9t m (B) -0.10 cos 4.9t m (C) -0.05 cos 4.9t m

(D) -0.05 sin 4.9t m (E) -0.05 cos 9.9t m.

14. 解：(E)

$$\omega = \sqrt{\frac{g}{l}} = \sqrt{\frac{9.8}{0.1}} = 9.9,\ y_m = \frac{mg}{k} = A$$

題意說明物體額外伸長5.0 cm，靜止釋放，故此為平衡點位置，則振幅為5.0cm，則有

$$y = -0.05\sin 9.9t[m] \text{ 或 } y = -0.05\cos 9.9t[m]$$

15. The motion of a particle connected to a spring is described by x = 10 sin πt. At what time (in s) is the potential energy equal to the kinetic energy? (A) 0 (B) 0.25 (C) 0.5 (D) 0.86 (E) 1.0

15. 解：(B)

$$U_s = K$$
$$\frac{1}{2}kx^2 = \frac{1}{2}mv^2$$
$$\Rightarrow \frac{1}{2}k[10\sin(\pi t)]^2 = \frac{1}{2}m[10\pi\cos(\pi t)]^2$$
$$\Rightarrow \frac{k}{m}\sin^2(\pi t) = \pi^2\cos^2(\pi t)$$
$$\Rightarrow \sqrt{\frac{k}{m}} = \pi\frac{\cos(\pi t)}{\sin(\pi t)} \qquad (\omega \equiv \sqrt{\frac{k}{m}} = \pi)$$
$$\Rightarrow \tan(\pi t) = 1$$
$$\Rightarrow t = 0.25[s]$$

21. People can snorkel down to a depth of roughly one meter. This means that the additional pressure on the air in their lungs is roughly
(A) 9800 (B) 9800 Pa (C) 9800 atm (D) 19600 N (E) 19600 N/m^2

21. 解：(B)

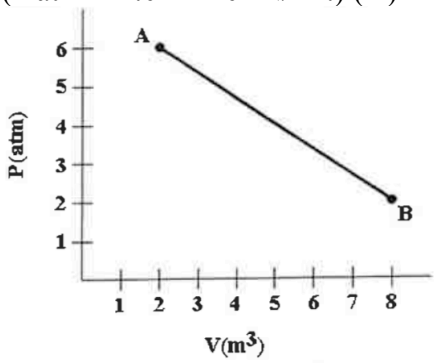
$$P = P_0 + \rho gh = 1\times10^5 + (1000\times9.8\times1)$$
$$\Rightarrow P - P_0 = \rho gh = 9800[Pa]$$

22. Consider a thin horizontal layer of the atmosphere, of thickness *dy*, of area *A*, with pressure *P* at the bottom. This layer contains n_V molecules per unit volume with an average mass *m* per molecule, and is under the influence of gravity with gravitational acceleration *g*. What is the magnitude, *dP*, of the pressure difference between the top and bottom of the layer? (A) $mgdy$. (B) mgn_Vdy. (C) $mgAdy$. (D) mgn_VAdy. (E) mgn_VAPdy.

22. 解：(B)

$$dP = \rho gdy = \frac{m}{V}gdy = \frac{Nm_0}{V}gdy = n_V m_0 gdy$$

23. gas expands from A to B as shown in the graph. Calculate the work (in joules) done by the gas. (1 atm = 1.01 × 10^5 N/m^2.) (A) 12 (B) 24 (C) 1.21 × 10^6 (D) 2.42 × 10^6 (E) 3.64 × 10^6



23. 解：(D)

$$W = \frac{(6+2)\times1.01\times10^5\times6}{2} = 2.42\times10^6[J]$$

24. heat pump has a coefficient of performance of 4. If the heat pump absorbs 20 cal of heat from the cold outdoors in each cycle, the heat expelled (in cal) to the warm indoors is about (A) 14 (B) 27 (C) 40) 48 (E) 77

24. 解：(B)

$$COP = \frac{Q_h}{Q_h - Q_c}$$
$$4 = \frac{Q_h}{Q_h - 20} \Rightarrow Q_h = 26.6[cal]$$

37. A solid nonconducting sphere of radius R carries a uniform charge density throughout its volume. At a radial distance $r_1 = R/4$ from the center, the electric field has a magnitude E_0. What is the magnitude of the electric field at a radial distance $r_2 = 2R$?
(A) $E_0/8$ (B) $E_0/4$ (C) $E_0/2$ (D) E_0 (E) $2E_0$

37. 解：(D)

r<R, $E = \frac{\rho}{3\varepsilon_0} r = \frac{\rho}{3\varepsilon_0}(\frac{R}{4}) = E_0$

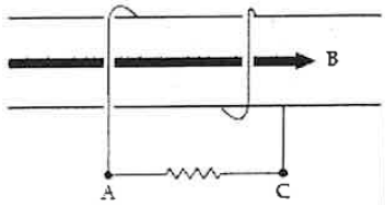
r> $E = \frac{\rho R^3}{3\varepsilon_0 r^2} = \frac{\rho R^3}{3\varepsilon_0 (2R)^2} = \frac{\rho}{3\varepsilon_0}(\frac{R}{4}) = E_0$

38. hich of the following expressions is a static electric field
(A) $\vec{E} = (2xy, -2yz, -y^2)$ (B) $\vec{E} = (2z, -2yz, -x^2)$ (C) $\vec{E} = (2x, -2yz, -y^2)$
(D) $\vec{E} = (yz, yz, yz)$ (E) $\vec{E} = (2xy - 3, 2x^2, 0)$

38. 解：(C)

$$\vec{\nabla} \times \vec{E} = 0$$
$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ 2x & -2yz & -y^2 \end{vmatrix} = 0$$

39. he coil shown in the figure has 2 turns, a cross-sectional area of 0.20 m^2, and a field (parallel to the axis of the coil) with a magnitude given by $B = (4.0 + 3.0t^2)$ T, where t is in s. What is the potential difference, $V_A - V_C$, at $t = 3.0$ s



(A) +7.2 (B) -7.2V (C) +4.8V (D) -4.8V (E) -12.0V

39. 解：(B)

$$\varepsilon = -N\frac{d\phi_B}{dt} = -N\frac{d}{dt}(BA) = -2\frac{d}{dt}\left[(4+3t^2)(0.2)\right]\Big|_{t=3} = -7.2[V]$$

其中 V_A 為低電位，V_C 為高電位

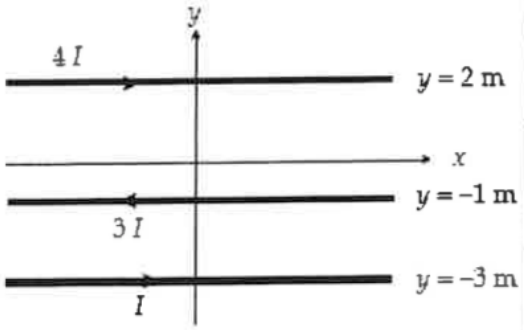
40. fish appears to be 2.00 m below the surface of a pond when viewed almost directly above by a fisherman. What is the actual depth of the fish? ($n_{water} = 1.33$)
(A) 1.33 (B) 0.38 m (C) 4.12 m (D) 3.02 m (E) 2.66 m

40. 解：(E)

視深＝實深/折射率

$2 \times 1.33 = 2.66[m]$

49. hree long wires parallel to the x axis carry currents as shown. If $I = 20$ A, what is the magnitude of the magnetic field at the origin?



(A) 10 T (B) 19μT (C) 28μT (D) 37μT (E) 52μT

49. 解：(B)

$$B_{y=-3} = \frac{\mu_0 \cdot 20}{2\pi \cdot 3} = 2 \times 10^{-7} \times \frac{20}{3}$$

$$B_{y=-1} = \frac{\mu_0 \cdot (3 \times 20)}{2\pi \cdot 1} = 2 \times 10^{-7} \times 60$$

$$B_{y=2} = \frac{\mu_0 \cdot (4 \times 20)}{2\pi \cdot 2} = 2 \times 10^{-7} \times 40$$

考慮向量重疊原理

$$B = B_{y=2} + B_{y=-1} - B_{y=-3} = 1.86 \times 10^{-5} = 18.6[\mu T]$$

50. A mall bulb is rated at 7.50 W when operated at 125 V. The tungsten filament has a temperature coefficient of resistivity $\alpha = 4.50 \times 10^{-3}$ /°C. When the filament is hot and glowing, its temperature is seven times room temperature (20 °C). What is the resistance of the filament (in ohms) at room temperature?

(A) 240 (B)1350 (C) 2080 ( ) 4530 (E) 5630

50. 解：(B)

$$P = \frac{V^2}{R} \Rightarrow 7.5 = \frac{(125)^2}{R} \Rightarrow R = 2083$$

$$R = R_{ref}\left[1 + \alpha(T - T_{ref})\right]$$

$$2083 = R_{ref}\left[1 + (4.5 \times 10^{-3})(140 - 20)\right] \Rightarrow R_{ref} = 1352[\Omega]$$