臺灣綜合大學系統107學年度學士班轉學生聯合招生考試試題

科目名稱	電磁學	類組代碼	C01
		科目碼	C0101

※本項考試依簡章規定各考科均「不可以」使用計算機　　　本科試題共計 2 頁

共 10 題，全為單選題。每題 10 分，答錯每題倒扣 10/3 分。

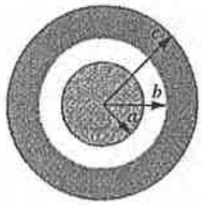
1. Find the angle between the body diagonals of a cube.
(A) $\theta=\cos^{-1}(\frac{1}{3})$ (B) $\theta=\cos^{-1}(\frac{1}{\sqrt{3}})$ (C) $\theta=\cos^{-1}(\frac{1}{2})$ (D) $\theta=\cos^{-1}(\frac{1}{\sqrt{2}})$

2. Find the divergence of the function $\mathbf{v}=s(2+\sin^2\phi)\hat{\mathbf{s}}+s\sin\phi\cos\phi\hat{\phi}+3z\hat{\mathbf{z}}$
(A)5 (B) 10 (C) 8 (D) 3

3. One of these is a possible electrostatic field. Which one?
(A) $\mathbf{E}=k[xy\hat{\mathbf{x}}+2yz\hat{\mathbf{y}}+3xz\hat{\mathbf{z}}]$ (B) $\mathbf{E}=k[y^2\hat{\mathbf{x}}+(2xy+z^2)\hat{\mathbf{y}}+2yz\hat{\mathbf{z}}]$
(C) $\mathbf{E}=k[y\hat{\mathbf{x}}+x^2\hat{\mathbf{z}}]$ (D) $\mathbf{E}=k[yz\hat{\mathbf{x}}+y^2\hat{\mathbf{y}}+z^2\hat{\mathbf{z}}]$

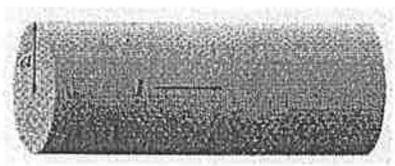
4. The potential at the surface of a sphere (radius R) is given by $V_0=k\cos 3\theta$ where k is a constant. Find the potential inside and outside the sphere, as well as the surface charge density $\sigma(\theta)$ on the sphere. (Assume there's no charge inside or outside the sphere.)
(A) $\frac{\varepsilon_0 k}{6R}\cos\theta[140\cos^2\theta-93]$ (B) $\frac{\varepsilon_0 k}{5R}\cos\theta[140\cos^2\theta]$
(C) $\frac{\varepsilon_0 k}{5R}\cos\theta[140\cos\theta-93]$ (D) $\frac{\varepsilon_0 k}{5R}\cos\theta[140\cos^2\theta-93]$

5. A certain coaxial cable consists of a copper wire, radius a, surrounded by a concentric copper tube of inner radius c. The space between is partially filled (from b out to c) with material of dielectric constant ε_r, as shown. Find the capacitance per unit length of this cable.



(A) $\frac{2\pi\varepsilon_0}{\ln(a/b)+(1/\varepsilon_r)\ln(c/b)}$ (B) $\frac{2\pi\varepsilon_0}{\ln(b/a)+(1/\varepsilon)\ln(c/b)}$
(C) $\frac{2\pi\varepsilon_0}{\ln(b/a)+(1/\varepsilon_r)\ln(c/b)}$ (D) $\frac{2\pi\varepsilon_0}{\ln(b/a)+(1/\varepsilon_r)\ln(b/c)}$

6. A steady current I flows down a long cylindrical wire of radius a. Find the magnetic field outside the wire if the current is uniformly distributed over the outside surface of the wire.



(A)0 (B) $\frac{\mu_0 Is^2}{2\pi a^3}\hat{\phi}$ (C) $\frac{\mu_0 Is^2}{2\pi a^2}\hat{\phi}$ (D) $\frac{\mu_0 I}{2\pi s}\hat{\phi}$

7. An infinitely long circular cylinder carries a uniform magnetization $\mathbf{M}$ parallel to its axis. Find the magnetic field (due to $\mathbf{M}$) inside the cylinder.
(A) $2\mu_0$M (B) μ_0M (C) 0 (D) μ_0M/4π

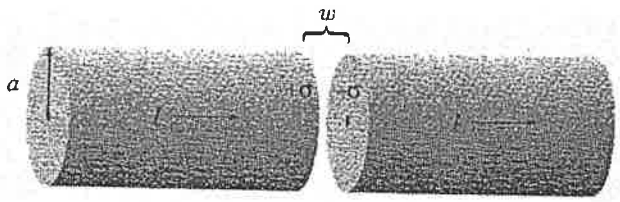
8. A square loop of wire, of side a, lies midway between two long wires, $3a$ apart, and in the same plane. (Actually, the long wires are sides of a large rectangular loop, but the short ends are so far away that they can be neglected.) A clockwise current I in the square loop is gradually increasing: $dI/dt=k$ (a constant). Find the emf induced in the big loop. Which way will the induced current flow?

背面有題，請繼續作答。

(A) $\frac{\mu_0 ka\ln 2}{\pi}$, *counterclockwise* (B) $\frac{\mu_0 ka\ln 2}{\pi}$, *clockwise*

(C) $\frac{\mu_0 ka\ln 2}{2\pi}$, *counterclockwise* (D) $\frac{\mu_0 ka\ln 2}{2\pi}$, *clockwise*

9. A fat wire, radius a, carries a constant current I, uniformly distributed over its cross section. A narrow gap in the wire, of width $\omega \ll a$, forms a parallel-plate capacitor, as shown in figure. Find the magnetic field in the gap, at a distance $s < a$ from the axis.



(A) $\frac{\mu_0 Is}{\pi a^2}\hat{\phi}$ (B) $\frac{\mu_0 Is^3}{2\pi a}\hat{\phi}$ (C) $\frac{\mu_0 Is}{2\pi a^2}\hat{\phi}$ (D) $\frac{\mu_0 Ia}{2\pi}\hat{\phi}$

10. Express the wave equation of the standing wave $f(z,t) = A\sin(kz)\cos(kvt)$ as the sum of a wave traveling to the left and a wave traveling to the right.

(A) $\frac{A}{2}\{\sin[k(z+vt)]+\sin[k(z-vt)]\}$ (B) $\frac{A}{2}\{\cos[k(z+vt)]+\sin[k(z-vt)]\}$

(C) $\frac{A}{2}\{\sinh[k(z+vt)]+\sinh[k(z-vt)]\}$ (D) $\frac{A}{2}\{\cosh[k(z+vt)]+\cosh[k(z-vt)]\}$