國立高雄大學 102 學年度轉學招生考試試題(轉二年級)

科目：微積分
考試時間：80 分鐘

系所：
電機工程學系(無組別)

是否使用計算機：是

本科原始成績：100 分

- 共十題，每題十分。
- 請依題號順序作答，否則酌以扣分。

1. Find the area of the largest rectangle that can be inscribed in a semicircle of radius *r*.

2. Find

   (a) $\int (\sin x)^5 (\cos x)^2 dx$

   (b) $\int (\tan x)^6 (\sec x)^4 dx$

3. A solid E lies within the cylinder $x^2 + y^2 = 1$, below the plane $z = 4$, and above the paraboloid $z = 1 - x^2 - y^2$. The density at any point is proportional to its distance from the axis of the cylinder. Find the mass of E.

4. Find *y* that satisfies

   $$\frac{dy}{dt} = ky(M - y)$$

   where *k* is a constant and *y* cannot exceed a maximal size *M*.

5. Find the Maclaurin series of the function $f(x) = e^x$ and its radius of convergence.

6. If $f(x, y, z) = x\sin(yz)$, (a) find the gradient of *f* and (b) find the directional derivative of *f* at (1,3,0) in the direction of $\vec{v} = \vec{i} + 2\vec{j} - \vec{k}$.

7. Find the work done by the force field

   $\vec{F}(x, y, z) = 2x\,\vec{i} + 3y\,\vec{j} + z\,\vec{k}$

   in moving a particle along the circular helix

   $C:\ \vec{r}(t) = \cos t\,\vec{i} + \sin t\,\vec{j} + t\,\vec{k}$

   from point $\vec{r}(0) = \vec{i}$ to point $\vec{r}(\pi) = -\vec{i} + \pi\vec{k}$.

背面尚有試題

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8. A thin lamina has the shape of a triangle with vertices at (0,0), (2,0), and (2,4). The density function associated with the lamina has equation $\rho(x, y) = 4x + 2y + 2$. Find the mass and center of mass of the lamina.

9. Evaluate the double integral

$$\iint_Q r \sin\theta \, dA$$

where Q is the region inside the upper half of the cardioid $r = 1 + \cos\theta$.

10. Find the tangent plane to the surface with parametric equations $x = u^2$, $y = v^2$, $z = u + 2v$ at the point (1,1,3).

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科目：物理
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系所：
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本科原始成績：100 分

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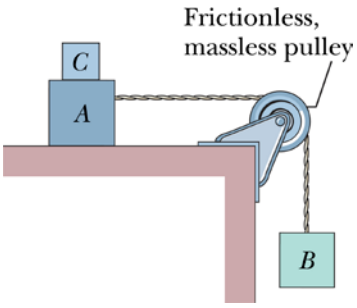
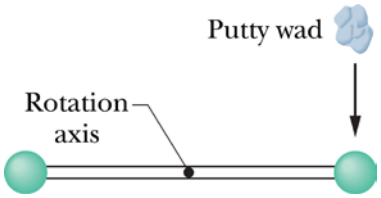
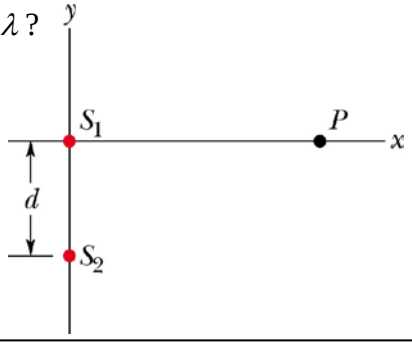
1. (15%) Blocks *A* and *B* have weights of 44 N and 22 N, respectively as shown. (a) Determine the minimum weight of block *C* to keep *A* from sliding if μ_s between *A* and the table is 0.20. (b) Block *C* suddenly is lifted off *A*. What is the acceleration of block *A* if μ_k between *A* and the table is 0.15?



2. (15%) Two 2.00 kg balls are attached to the ends of a thin rod of length 50.0 cm and negligible mass. The rod is free to rotate in a vertical plane without friction about a horizontal axis through its center. With the rod initially horizontal as shown, a 50.0 g wad of wet putty drops onto one of the balls, hitting it with a speed of 3.00 m/s and then sticking to it. (a) What is the angular speed of the system just after the putty wad hits? (b) What is the ratio of the kinetic energy of the system after the collision to that of the putty wad just before? (c) Through what angle θ will the system rotate before it momentarily stops? Hint: Answer the question (c) with the value of $\cos\theta$.



3. (20%) The figure shows two point sources S_1 and S_2 that emit sound of wavelength $\lambda = 2.00\,\text{m}$. The emissions are isotropic and in phase, and the separation between the sources is $d = 16.0\,\text{m}$. At any point *P* on the *x* axis, the wave from S_1 and the wave from S_2 interfere. When *P* is very far away ($x \approx \infty$), what are (a) the phase difference between the arriving waves from S_1 and S_2 and (b) the type of interference they produce? Now move point *P* along the *x* axis toward S_1. (c) Does the phase difference between the waves increase or decrease? At what distance *x* do the waves have a phase difference of (d) 0.50λ and (e) 1.00λ?



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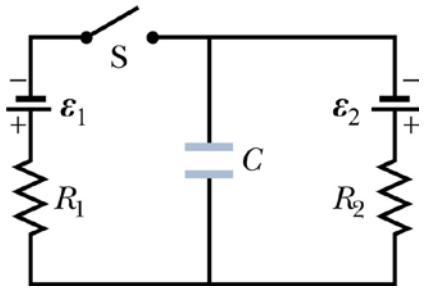
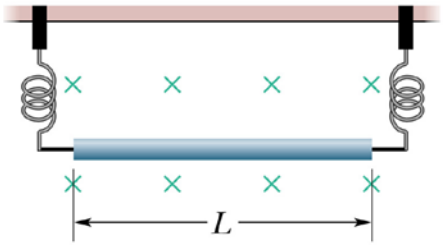
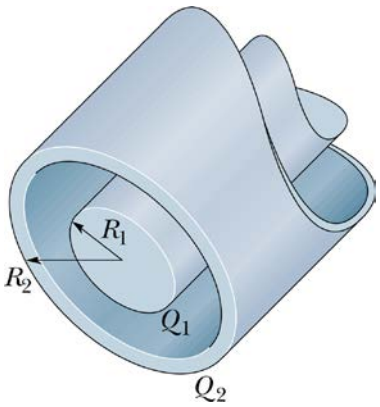
4. (10%) The circuit shows a capacitor, two ideal batteries, two resistors, and a switch S. Initially S has been open for a long time. If it is then closed for a long time, what is the change in the charge on the capacitor? Assume $C = 10\ \mu\text{F}$, $\varepsilon_1 = 1.0\ \text{V}$, $\varepsilon_2 = 3.0\ \text{V}$, $R_1 = 0.20\ \Omega$, and $R_2 = 0.40\ \Omega$.



5. (10%) A 13.0 g wire of length $L = 62.0\ \text{cm}$ is suspended by a pair of flexible leads in a uniform magnetic field of magnitude 0.440 T as shown. What are the (a) magnitude and (b) direction (left or right) of the current required to remove the tension in the supporting leads?



6. (20%) The figure is a section of a conducting rod of radius $R_1 = 1.30\ \text{mm}$ and length $L = 11.00\ \text{m}$ inside a thin-walled coaxial conducting cylindrical shell of radius $R_2 = 10.0R_1$ and the (same) length L. The net charge on the rod is $Q_1 = +3.40 \times 10^{-12}\ \text{C}$; that on the shell is $Q_2 = -2.00Q_1$. (a) What are the magnitude and direction (radially inward or outward) of the electric field **E** at radial distance $r = 2.00R_2$? (b) What are the magnitude and direction (radially inward or outward) of **E** at $r = 5.00R_1$? (c) What are the charges on the interior and exterior surfaces of the shell?



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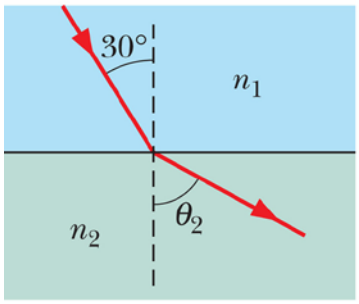
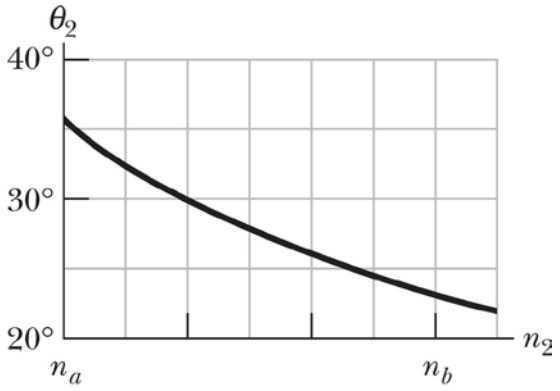
7. (10%) A beam of light in material 1 is incident on a boundary at an angle of 30° as shown. The extent to which the light is bent due to refraction depends, in part, on the index of refraction n_2 of material 2. The figure gives the angle of refraction θ_2 versus n_2 for a range of possible n_2 values, from $n_a = 1.30$ to $n_b = 1.90$. What is the speed of light in material 1?



(a)



(b)