

國立中山大學 104 學年度轉學考招生考試試題

科目名稱：微積分【物理系二年級】

題號：723001

※本科目依簡章規定「不可以」使用計算機(問答申論題)

共 1 頁 第 1 頁

說明：(1) 本考試卷共有五大題目，每一大題均為 20 分；
(2) 作答必需寫在作答紙上(不可寫在試卷紙上)。

Question 1. (20 points) Evaluate the line integral

$$\int_C xy dx + \left(\frac{1}{2}x^3 + xy\right) dy$$

where C is the upper half of the ellipse $x^2 + 4y^2 = 1$ from $(-1, 0)$ to $(1, 0)$

Question 2. (20 points) Evaluate the integral

$$\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \frac{4e^{-(x-y)^2}}{1 + (x+y)^2} dx dy$$

Question 3. (20 points) Evaluate

$$\lim_{n \rightarrow \infty} \sum_{k=1}^n \frac{\sqrt{k^2 + n^2}}{4n^2}$$

Question 4. (20 points) Let $f(x, y) = 4(y - x^2)(y - x^3)$. Find all stationary points of $f(x, y)$ and classify them, if any.

Question 5. (20 points) Evaluate the surface integral

$$\iint_S (x^4 + y^4 + z^4) dS$$

where $S = \{(x, y, z) \mid x^2 + y^2 + z^2 = 4\}$

國立中山大學 104 學年度轉學考招生考試試題

科目名稱：普通物理【物理系二年級】

題號：723002

※本科目依簡章規定「不可以」使用計算機

共 3 頁第 1 頁

單選題，共 20 題，每題 5 分，總分 100 分，不作答 0 分，答錯倒扣 1 分。

1. If the magnitude of the sum of two vectors is less than the magnitude of either vector, then:
 (A) the scalar product of the vectors must be negative
 (B) the scalar product of the vectors must be positive
 (C) the vectors must be parallel and in opposite directions
 (D) the vectors must be parallel and in the same direction
 (E) none of the above

2. A particle starts from rest at time $t = 0$ and moves along the x axis. If the net force on it is proportional to t , its kinetic energy is proportional to:
 (A) t (B) t^2 (C) t^4 (D) $1/t^2$ (E) $1/t$

3. A ball of mass m , at one end of a string of length L , rotates in a vertical circle just fast enough to prevent the string from going slack at the top of the circle. Assuming mechanical energy is conserved, the speed of the ball at the bottom of the circle is



- (A) $\sqrt{2gL}$ (B) $\sqrt{3gL}$ (C) $\sqrt{4gL}$ (D) $\sqrt{5gL}$ (E) $\sqrt{7gL}$

4. At one instant of time a rocket is traveling in outer space at 2500 m/s and is exhausting fuel at a rate of 100 kg/s. If the speed of the fuel as it leaves the rocket is 1500 m/s, relative to the rocket, the thrust is:

- (A) 0 N (B) 1.0×10^5 N (C) 1.5×10^5 N (D) 2.9×10^5 N (E) 2.5×10^5 N

5. A cylinder is 0.10 m in radius and 0.20 m in length. Its rotational inertia, about the cylinder axis on which it is mounted, is $0.020 \text{ kg} \cdot \text{m}^2$. A string is wound around the cylinder and pulled with a force of 1.0 N. The angular acceleration of the cylinder is:

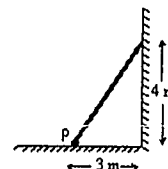
- (A) 2.5 rad/s^2 (B) 5.0 rad/s^2 (C) 10 rad/s^2 (D) 15 rad/s^2 (E) 20 rad/s^2

6. A uniform disk, a thin hoop, and a uniform sphere, all with the same mass and same outer radius, are each free to rotate about a fixed axis through its center. Assume the hoop is connected to the rotation axis by light spokes. With the objects starting from rest, identical forces are simultaneously applied to the rims, as shown. Rank the objects according to their angular momenta after a given time t , least to greatest.

- (A) all tie (B) disk, hoop, sphere (C) sphere, disk, hoop (D) hoop, sphere, disk (E) hoop, disk, sphere

7. An 80-N uniform plank leans against a frictionless wall as shown. The torque (about point P) applied to the plank by the wall is, in the unit of N·m,

- (A) 40 (B) 60 (C) 120 (D) 160 (E) 240.



8. If Earth were to rotate only 100 times per year about its axis, then which of the following is correct:

- (A) airplanes flying west to east would make better time
 (B) we would fly off Earth's surface
 (C) our apparent weight would slightly increase
 (D) Earth's atmosphere would float into outer space
 (E) our apparent weight would slightly decrease

背面有題

國立中山大學 104 學年度轉學考招生考試試題

科目名稱：普通物理【物理系二年級】

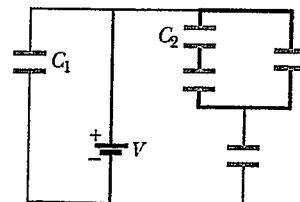
題號：723002

※本科目依簡章規定「不可以」使用計算機

共 3 頁第 2 頁

9. Standing waves are produced by the interference of two traveling sinusoidal waves, each of frequency 100 Hz. The distance from the 2nd node to the 5th node is 60 cm. The wavelength of each of the two original waves is, in cm, :
(A) 50 (B) 40 (C) 30 (D) 20 (E) 15.
10. A heat engine operates between a high temperature reservoir at T_H and a low temperature reservoir at T_L . Its efficiency is given by $1 - T_L/T_H$:
(A) only if the working substance is an ideal gas.
(B) only if the engine is reversible.
(C) only if the engine is quasi-static
(D) only if the engine operates on a Stirling cycle
(E) no matter what characteristics the engine has
11. 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) 0 (B) a (C) $\sqrt{2}a$ (D) $a/2$ (E) $a/\sqrt{2}$
12. Positive charge Q is distributed uniformly throughout an insulating sphere of radius R , centered at the origin. A particle with a positive charge Q is placed at $x = 2R$ on the x axis. The magnitude of the electric field at $x = R/2$ on the x axis is: (A) $Q/72\pi\epsilon_0 R^2$ (B) $Q/8\pi\epsilon_0 R^2$ (C) $7Q/18\pi\epsilon_0 R^2$ (D) $11Q/18\pi\epsilon_0 R^2$ (E) $Q/18\pi\epsilon_0 R^2$
13. An inductance L and a resistance R are connected in series to an ideal battery. A switch in the circuit is closed at time $t = 0$, at which time the current is zero. The rate of increase of the energy stored in the inductor is a maximum:
(A) just after the switch is closed
(B) at the time $t = L/R$ after the switch is closed
(C) at the time $t = 2L/R$ after the switch is closed
(D) at the time $t = (L/R)\ln 2$ after the switch is closed
(E) a long time after the switch is closed
14. Two conductors are made of the same material and have the same length. Conductor A is a solid wire of diameter 1 m. Conductor B is a hollow tube of inside diameter 1 m and outside diameter 2 m. The ratio of their resistance, R_A/R_B , is:
(A) 1 (B) $\sqrt{2}$ (C) 2 (D) 3 (E) 4
15. One of the two slits in a Young's experiment is painted over so that it transmits only one-half the intensity of the other slit. As a result:
(A) the fringe system disappears
(B) the bright fringes get brighter and the dark ones get darker
(C) the fringes just get dimmer
(D) the dark fringes just get brighter
(E) the dark fringes get brighter and the bright ones get darker

16. In the figure on the right, the battery has a potential difference of $V = 10.0$ V and the five capacitors each have a capacitance of 10.0 μF . What is the charge on capacitor 2?



- (A) $10 \mu\text{C}$ (B) $20 \mu\text{C}$ (C) $50 \mu\text{C}$ (D) $30 \mu\text{C}$ (E) $40 \mu\text{C}$

國立中山大學 104 學年度轉學考招生考試試題

科目名稱：普通物理【物理系二年級】

題號：723002

※本科目依簡章規定「不可以」使用計算機

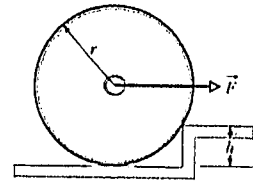
共 3 頁第 3 頁

17. A particle moves along the x' axis of frame S' with velocity $0.80c$. Frame S' moves with velocity $0.50c$ with respect to frame S . What is the velocity of the particle with respect to frame S ?

(A) $1.3c$ (B) $0.3c$ (C) $0.93c$ (D) $0.87c$ (E) $0.65c$

18. A coin is placed 20 cm in front of a two-lens system. Lens 1 (nearer the coin) has focal length $f_1=10$ cm, lens 2 has $f_2=12.5$ cm, and the lens separation is $d=30$ cm. For the image produced by lens 2, what is the overall lateral magnification? (A) 5.0 (B) -2.5 (C) -5.0 (D) 0.4 (E) 1.0

19. In the right figure, what magnitude of the force \vec{F} applied horizontally at the axle of the wheel is necessary to raise the wheel over an obstacle of height h ? The wheel's radius is r and its mass is m .



(A) $\frac{\sqrt{2rh-h^2}}{r+h}mg$ (B) $\frac{\sqrt{2rh-h^2}}{r-h}mg$ (C) $\frac{\sqrt{2rh+h^2}}{r-h}mg$ (D) $2\frac{\sqrt{2rh-h^2}}{r-h}mg$

(E) $\frac{\sqrt{2rh+h^2}}{r+h}mg$

20. In the right figure, the battery has emf $\mathcal{E}=12.0$ V, $R_1 = 2000 \Omega$, $R_2 = 3000 \Omega$, and $R_3 = 4000 \Omega$. What are the potential differences between V_A and V_B .

(A) 6.20 V (B) 5.25 V (C) 2.5 V (D) 4.35 V (E) 3.75 V

