編號： 42

國立成功大學 104 學年度碩士班招生考試試題

系所組別：物理學系

考試科目：普通物理學

考試日期：0212，節次：2

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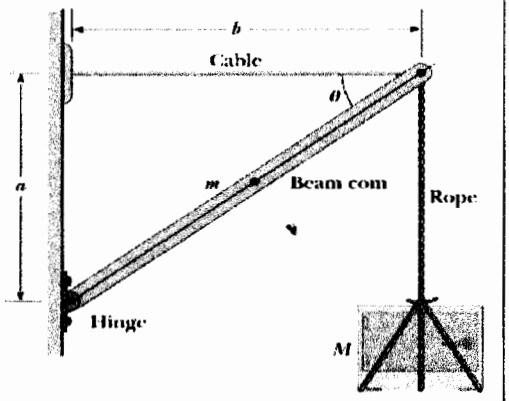
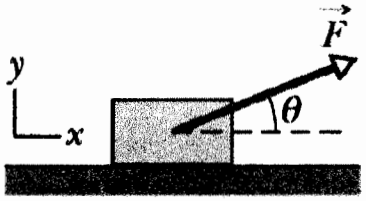
單選題: 100 分，每題 5 分，答錯倒扣 1 分，整題不答不給分亦不扣分

- Some information you might use:
  $\sin(15^0) \sim 0.259$; $\sin(45^0) \sim 0.707$; $\sin(60^0) \sim 0.866$;
  $\tan(15^0) \sim 0.268$; $\tan(30^0) \sim 0.575$; $\tan(60^0) \sim 1.732$

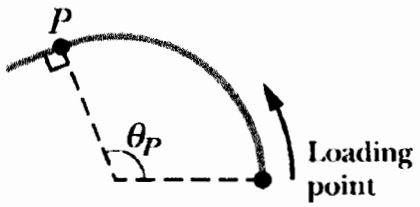
1. The Figure shows a safe (mass M = 400 kg) hanging by a rope (negligible mass) from a boom (a = 2.0 m and b = 32/11 m) That consists of a uniform hinged beam (m = 80 kg) and horizontal cable (negligible mass). What is the magnitude of the net force on the beam from the hinge (g is gravitational acceleration)?
   (A) 480g (B) 600g (C) 720g (D) 800g (E) 840g



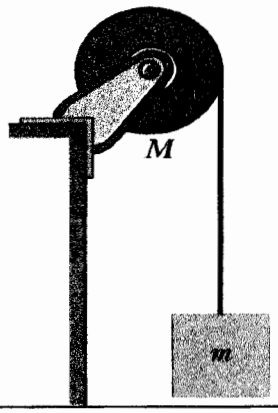
2. The figure shows that a block of mass m = 3.0 kg slides along the floor while a force $\vec{F}$ of magnitude 12.0 N is applied to it at an upward angle θ. The coefficient of kinetic friction between the block and floor is $\mu_k = 0.4$. We can vary θ from 0 to 90^0 (the block remains on the floor). What θ gives the maximum value of the block's acceleration magnitude a?
   (A) 12^0 (B) 22^0 (C) 32^0 (D) 45^0 (E) 60^0



3. The figure shows a horizontal track. Bob leaves the loading point from rest with initial tangential acceleration g. He later experiences a constant angular acceleration from the loading point to the point p. When he reaches the point p, the total acceleration acting on him is 4g. What is the angle θ_p (in rad.)?
   (A) $\sqrt{2}$ (B) $\sqrt{13}/2$ (C) $\sqrt{15}/2$ (D) $\sqrt{6}$ (E) $\sqrt{20}/3$



4. The figure shows a uniform disk, with mass M = 2.5 kg, radius R = 20cm, and moment of inertia $I = MR^2/2$, mounted on a fixed horizontal axle. A block with mass m = 1.0 kg hangs from a massless cord that is wrapped around the rim of the disk. The cord does not slip, and there is no friction at axle. What is the angular acceleration of the disk (g is gravitational acceleration)?
   (A) 20g/9 (B) 5g/2 (C) 10g/7 (D) 7g/3 (E) 10g/9



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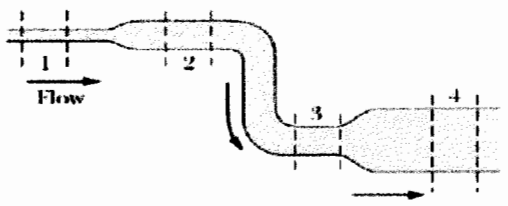
5. A uniform ball of mass M, radius R, and moment of inertia $(2/5)MR^2$, rolls smoothly (no sliding) from rest down a ramp at the angle $\theta = 30.0^0$. The coefficient of kinetic friction between the block and the ramp is $\mu_k = 1/(3\sqrt{3})$. The ball descends a vertical height h to reach the bottom of the ramp. What is its speed at the bottom?
(A) $\sqrt{3gh/5}$ (B) $\sqrt{2gh/3}$ (C) $\sqrt{10gh/21}$ (D) $\sqrt{10gh/7}$ (E) $\sqrt{5gh/3}$

6. A pirate ship 560 m from a fort defending a harbor entrance. A defense cannon, located at the sea level, fires ball at the initial speed $v_0 = 80.0$ m/s. At what angle θ_0 from the horizontal must a ball be fired to hit the ship? Use $g = 10.0$ m/s^2
(A) 25^0 (B) 45^0 (C) 40^0 or 50^0 (D)30^0 or 60^0 (E) None of the above.

7. Water flow smoothly through the pipe shown in the figure, descending in the process. Rank the four numbered sections of pipe according to the water pressure p within them.
(A) 1=2>3=4 (B) 1>3>2>4 (C) 4>3>2>1
(D) 1>2>3>4 (E) 4=3>2=1



8. At t = 0, the displacement x(0) of the block in a linear oscillator (spring-block system) is -8.0 cm. The block's velocity v(0) then is 0.3 m/s, and its acceleration a(t) is +2.0 m/s^2. What is the amplitude x_m?
(A) 8.0 cm (B) 6.0 cm (C) 10.0 cm (D) 4.0 cm (E) 12.0 cm

9. Bats navigate and search out prey by emitting, and then detecting reflections of, ultraviolet waves, which are sound waves with frequencies greater than can be heard by a human. Suppose a bat emits ultrasound at frequency $f_{be} = 85$ kHz while flying with velocity $\vec{v}_b = (40.0 \text{ m/s})\hat{\imath}$ as it chases a moth that flies with velocity $\vec{v}_m = (20.0 \text{ m/s})\hat{\imath}$. What frequency f_{bd} does a bat detect in the returning echo from the moth (the speed of sound is 340 m/s)?
(A) 76 kHz (B) 96 kHz (C) 91 KHZ (D) 108 KHz (E) 100 KHz

10. Positive charge Q is distributed uniformly throughout an insulating sphere of radius R, centered at the origin. A particle with 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) $Q/9\pi\varepsilon_0R^2$ (B) $Q/8\pi\varepsilon_0R^2$ (C). $Q/72\pi\varepsilon_0R^2$ (D). $17Q/72\pi\varepsilon_0R^2$ (E) none of these

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11. A cyclotron operates with a fixed magnetic field and a fixed frequency. If R denotes the radius of the final point, the final particle energy is proportional to
(A) 1/R (B) R (C)R^2 (D) R^3 (E)$1/R^2$

12. A cylindrical region of radius R contains a uniform magnetic field parallel to its axis. The field is zero outside the cylinder. If the magnitude of the field is changing at the rate dB/dt, the electric field induced at a point 2R from the cylinder axis is:
(A) 0 (B) 2R dB/dt (C) R dB/dt (D) (R/2) dB/dt (E) (R/4) dB/dt

13. A flat coil of wire, having 5 turns, has an inductance L. The inductance of a similar coil (with the same length and cross sectional area) having 20 turns is:
(A) 4L (B) L/4 (C) 16L (D) L/16 (E) L

14. A spherical conducting shell has charge Q. A particle with charge q is placed at the center of the cavity. The charge on the inner surface of the shell and the charge on the outer surface of the shell, respectively, are:
(A) 0, Q (B) q, Q − q (C) Q, 0 (D) −q, Q + q (E) −q−Q, Q

15. A loop of wire carrying a current of 2.0 A is in the shape of a right triangle with two equal sides, each 15 cm long. A 0.7 T uniform magnetic field is in the plane of the triangle and is perpendicular to the hypotenuse. The resultant magnetic force on the two equal sides has a magnitude of:
(A) 0 N (B) 0.21 N (C) 0.30 N (D) 0.41 N (E) 0.51 N

16. The temperature of n moles of an ideal monatomic gas is increased by ΔT at constant pressure. The energy Q absorbed as heat, change ΔE_{int} in internal energy, and work W done by the environment are given by:
(A) $Q = (5/2)nR\Delta T$, $\Delta E_{int} = 0$, $W = -nR\Delta T$
(B) $Q = (3/2)nR\Delta T$, $E_{int} = (5/2)nR\Delta T$, $W = nR\Delta T$
(C) $Q = (5/2)nR\Delta T$, $E_{int} = (3/2)nR\Delta T$, $W = nR\Delta T$
(D) $Q = (3/2)nR\Delta T$, $E_{int} = (5/2)nR\Delta T$, $W = -nR\Delta T$
(E) $Q = (5/2)nR\Delta T$, $E_{int} = (3/2)nR\Delta T$, $W = -nR\Delta T$

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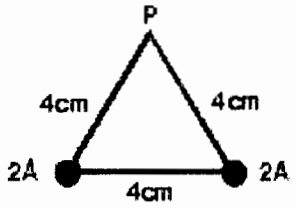
17. A 1-μF capacitor is connected to an emf that is increasing uniformly with time at a rate of 100 V/s. The displacement current between the plates is:
(A) 0 A (B) $1.0 \cdot 10^{-8}$ A (C) $1.0 \cdot 10^{-6}$ A (D) $1.0 \cdot 10^{-4}$ A (E) 100 A

18. A capacitor in an LC oscillator (a circuit only consists of inductor and capacitor with no resistance and no power supply; its oscillation is similar to S.H.M) has a maximum potential difference of 15 V and a maximum energy of 360 μJ. At a certain instant the energy in the capacitor is 40 μJ. At that instant what is the potential difference across the capacitor?
(A) 0 V (B) 5 V (C) 10 V (D) 15 V (E) 20 V

19. Two long straight wires pierce the plane of the paper at vertices of an equilateral triangle as shown below. They each carry 2.0 A, out of the paper. The magnetic field at the third vertex (P) has magnitude ($\mu_0 = 4\pi \cdot 10^{-7}$ N/m^2):
(A) $5.0 \cdot 10^{-6}$ T
(B) $8.7 \cdot 10^{-6}$ T
(C) $1.0 \cdot 10^{-5}$ T
(D) $1.7 \cdot 10^{-5}$ T
(E) $2.0 \cdot 10^{-5}$ T



20. A liquid of refractive index n = 4/3 replaces the air between a fixed wedge formed from two glass plates (n = 1.5) as shown. As a result, the spacing between adjacent dark bands in the interference pattern:
(A) increases by a factor of 4/3
(B) increases by a factor of 2
(C) remains the same
(D) decreases to 3/4 of its original value
(E) decreases to 1/3 of its original value