

國立中央大學98學年度碩士班考試入學試題卷

所別：太空科學研究所碩士班 一般生 科目：普通物理 共 3 頁 第 1 頁

\*請在試卷答案卷(卡)內作答

總分爲一百分，共計二十五單選題，每題四分。每答錯一題倒扣一分，最多扣至零分爲止。

1. An open elevator is going up at a constant speed of 4.9 m/s. When it is 20 meters above the ground a ball is thrown up at the 24.5 m/s relative to the elevator. Determine the maximum height above the ground that the ball will go and the time required for it to return to the elevator. (in meters and second)  
(A) 64, 6 (B) 51, 5 (C) 51, 2 (D) 48, 3 (E) 64, 5
2. A block of mass  $M$  starts at a velocity of 10 m/s in the horizontal direction and then slides up an incline at 30 degrees with respect to the horizontal. (Assume frictionless surface and  $g=10 \text{ m/s}^2$ ) Determine how far up the incline the block will go and how long it takes to return to the bottom of the incline. (in meters and second)  
(A) 5, 2 (B) 10, 4 (C) 5, 1 (D) 20, 4 (E) 10, 2
3. A particle of mass  $m$  is moving at  $0.5 c$  ( $1.5 \times 10^8 \text{ m/s}$ ). Calculate the kinetic energy of the particle. (in  $mc^2$ )  
(A) 0.155 (B) 0.125 (C) 1.41 (D) 0.41 (E) 1.155
4. An object experiences a potential of  $U=4(x-5)^2$ . If the total energy of the system is 16 Joules, determine the turning points, the stable equilibrium, and force at  $x = 6$  meters. (in meters, meters, meters, and newtons)  
(A) 1, 9, 5, -8 (B) 11, 21, 10, -48 (C) 3, 7, 5, -8 (D) 1, 9, 8, 4 (E) 3, 7, 5, 4
5. A 1500 kg car moving at 25 m/s collides with a 1000 kg car traveling in the same direction at 18 m/s. Their bumpers lock so that they move forward together. How much energy was lost in the collision? (in kilojoules)  
(A) 99.1 (B) 84.4 (C) 61.6 (D) 14.7 (E) 5.9
6. In an experiment at Los Alamos, New Mexico 200 nu-pions strike a 2 millimeter thick aluminum-27 target and knock out protons producing magnesium-26. If there are  $4 \times 10^6$  pions incident per second and there are 144 magnesium nuclei produced per second, what is the cross section for this reaction? (in millibarns) (density= $2.7 \text{ gms/cm}^3$ , at wt.=27 gms/mole)  
(A) 6.7 (B) 6.0 (C) 8.9 (D) 2.3 (E) 3.0
7. A spinning wheel has its axis fixed in space. It initially has an angular velocity of 30 rad/s north. 12 seconds later its angular velocity is 48 rad/s south. Determine the magnitude of the angular acceleration (assumed constant) and the angular displacement during the 12 second intervals. (in  $\text{rad/s}^2$ , radians)  
(A) 6.5, 108 (B) 1.5, 486 (C) 4.7, -20 (D) 6.5, 828 (E) 1.5, 450
8. A wood bar of mass 2.4 kg is 40 cm long and is mounted on a horizontal axis through its center. The bar is stationary when a 12 gram bullet moving at 600 m/s perpendicular to the bar, hits it 10 cm from one end and remains imbedded in it. Determine the angular velocity of the bar after collision. (in rad/s)  
(A) 15 (B) 22.4 (C) 7.5 (D) 31 (E) 58
9. A 20.0 gram mass experiences S.H.M. of amplitude 10 cm and a period of 2.0 sec. If the motion starts at  $t=0$  with the mass 6.0 cm from its equilibrium position, determine the kinetic energy of the mass at  $t=3$  sec. (in ergs)  
(A) 6320 (B) 3550 (C) 9870 (D) 4200 (E) 0

參考用

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所別：太空科學研究所碩士班 一般生 科目：普通物理 共 3 頁 第 2 頁

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10. The Moon is 60 Earth radii from the the Earth's center and has a period of 27.3 days. A GPS satellite with a period of 12 hours. How many earth radii is the satellite from the center of the Earth?  
(A) 1.1 (B) 35 (C) 6.6 (D) 3.3 (E) 4.2
11. Observer A, sound source S, and observer B are 33, 66, and 99 meters, respectively from a reflecting wall and on a straight line. The source can move either direction at speed V. Which of the following is not correct?  
(A) A hears no beats when S moves towards the wall  
(B) B hears the same beat frequency when S moves either direction  
(C) A hears the same beat frequency when S moves towards the wall as B does when S moves away  
(D) A hears no beats when S moves away from the wall  
(E) If B moves in either direction, the resulting asymmetry in beats tells him which way S is moving.
12. Two equally charged beads, each having a mass of 12 grams, have a small hole drilled through their diameter. They are placed onto a virtual thread. The first bead is stopped by a knot in the thread and the second is suspended 4 cm above it by the coulomb force. What is the charge on each bead? (in  $10^{-8}$  coul)  
(A) 4.51 (B) 20.9 (C) 3.81 (D) 14.5 (E) 0.46
13. An electric dipole consists of two opposite charges of magnitude  $2 \times 10^{-6}$  C separated by 3 cm. The dipole is placed in an electric field of  $4 \times 10^5$  N/C. Determine the torque on the dipole when it is at 60 degrees to the field and the work required of an external agent to line it up with the field.  
(A) 4.20, 2.4 (B) 1.2, 2.1 (C) 2.0, -1.0 (D) 2.08, -1.2 (E) 2.40, 4.2
14. A 20 cm radius non-conducting sphere has a volume charge density  $5.0r \times 10^{-6}$  c/m<sup>3</sup>, in which r is the distance from the center of the sphere. Determine the electric field at 10 cm from the center.  
(A) 1.41 (B) 5.64 (C) 18.8 (D) 56.4 (E) 565
15. A dipole and a point charge produce an axial potential given by  $V = kq(1+2a/r)/r$ . Determine the axial electric field due to this charge configuration.  
(A)  $kq(1+2a/r)/r^2$  (B)  $kq(4a/r^3)$  (C)  $kq/r^3$  (D)  $kq(1+4a/r)/r^2$  (E)  $kq/r^2$
16. A 5 microfarad capacitor, having a dielectric whose constant is 4, is connected to a 60 volt power supply and left connected. Determine the free charge on the plates and the surface charge on the dielectric. (in microcoulombs and microcoulombs)  
(A) 75, 56 (B) 12, 9 (C) 300, 56 (D) 300, 225 (E) 1200, 900
17. Determine the electric field required to give the electrons in a copper wire a drift speed of 0.30 mm/s. Assume that those are  $8.4 \times 10^{22}$  electrons/cm<sup>3</sup> and that the resistivity is  $1.7 \times 10^{-8}$  ohm m. (in millivolts/meter)  
(A) 76.2 (B) 14.6 (C) 68.5 (D) 26.8 (E) 23.7
18. Two 12 volt barratries, of internal resistance 1 and 2 ohms respectively, are connected in parallel across a 10 ohm external resistor. Determine the current through each battery. (in amps and amps)  
(A) 1.09, 1.00 (B) 0.75, 0.375 (C) 1.09, 0 (D) 0.833, 0.417 (E) 1.85, 1.85

參考用

注意：背面有試題

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19. A beam of 200 keV identical particles pass through mutually perpendicular electric and magnetic fields of  $10^4$  V/m and 2.285 mT unaffected. When the magnetic field is turned off the particles experience a force of  $1.6 \times 10^{-15}$  Nts. What are the particles?  
(A) proton (B) deuteron (C) triton (D) alpha particle (E) bee pollen
20. A solenoid of radius 4 cm and 5000 turns/meter carries a current of 15 amps. At its center is a 6 turn loop of radius 2 cm with a current of 2 amps. If the axis of the loop and the axis of the solenoid are 30 degree apart, what torque acts on the loop (in  $10^{-4}$  Nt-m)  
(A) 14.2 (B) 7.1 (C) 1.2 (D) 1.4 (E) 0.28
21. The radius of the electron's orbit in a betatron is 64 cm. The magnetic field oscillates sinusoidally at 60 Hz. In the accelerating portion of the cycle an electron makes 800 revolutions and reaches 160 keV energy. At what rate is the magnetic field changing? (in tesla/s) HINT: use average emf- the average of the sine over a quarter cycle is 0.637.  
(A) 155 (B) 122 (C) 244 (D) 200 (E) 283
22. Which of the following is not correct?  
(A) Atomic dipoles of a paramagnetic sample tend to line up with the magnetic field.  
(B) Diamagnetic substances are repelled when placed near the pole of a strong magnet.  
(C) Ferromagnetism is evidently a property not only of the individual atom or ion but also of the interaction of each atom or ion with its neighbors in the crystal lattice of the solid.  
(D) The magnetization of a ferromagnetic material does not change with external conditions.  
(E) Magnetization of a paramagnetic specimen is directly proportional to the effective magnetic field in which the specimen is placed.
23. The radio in an airplane is able to detect a signal as weak as  $5 \times 10^{-8}$  watt/m<sup>2</sup>. Assume that the transmitter radiates 1000 watts all in a hemisphere above the ground. Determine the maximum radius from the transmitter that the station can still be received. (in miles, 1 mile = 1609 meters)  
(A) 35 (B) 40 (C) 45 (D) 50 (E) 55
24. A precision coating technique puts a 228 nanometer film on a glass lens. When the lens is viewed by reflection in white light it appears greenish-yellow (wavelength 570 nm). What is the index of refraction of the film?  
(A) 0.625 (B) 2.50 (C) 1.45 (D) 1.875 (E) 1.25
25. A light of wavelength 310 nm is incident on a piece of sodium metal. The stopping potential is measured to be 1.8 V. What is the work function for sodium (in eV)  
(A) 2.2 (B) 1.8 (C) 4.0 (D) 4.6 (E) 5.8

參考用