

國立中央大學98學年度碩士班考試入學試題卷

所別：大氣物理研究所碩士班 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 object is thrown vertically in the air so that its position is given by $y=(20t-5t^2)$ meters. Determine its instantaneous velocity at 1.5 seconds and its instantaneous acceleration at 3.0 seconds. (in m/s and m/s^2)
(A) 18.9, -10 (B) 20, -5 (C) 7.5, -10 (D) 5, -10 (E) 5, -5
2. A block of mass 10 kg is on a table. The coefficient of kinetic friction is 0.1. A push force of 20 N is applied to the block at an angle 37 degrees below the horizontal. Determine the acceleration of the block. (in m/s^2)
(A) 2.0 (B) 1.6 (C) 0.62 (D) 0.5 (E) 0.06
3. A mass M is pulled to the top of a frictionless half cylinder of radius R. Determine the work done in moving the mass at a constant speed from the bottom to the top of the cylinder. (in m/s^2)
(A) $MgR/2$ (B) MgR (C) $3/2 MgR$ (D) $2MgR$ (E) 0
4. Two springs have the same force constant (200 N/m). Spring A obeys the force law $F=-kx^{3/2}$ while Spring B obeys Hooke's Law $F=-kx$. Determine the work done in stretching these two springs from $x=1$ meter to $x=4$ meters. (in Joules and Joules)
(A) 2480, 1500 (B) 1247, 900 (C) 2560, 1600 (D) 15500, 6200 (E) 16000, 6400
5. John and Mary are sitting in a 104 kg canoe in still water. John's mass is 80 kg and they are each 2.50 meters from the canoe's center and symmetric to it. They swish places and the canoe moves 0.50 meter relative to the shore. Determine Mary's mass. (in kg)
(A) 56.0 (B) 70.5 (C) 86.2 (D) 53.9 (E) 46.5
6. A 40 kg boy is on ice-skates on a frictionless ice pond. He throws a 0.5 kg snowball at a speed of 30 m/s relative to himself. At what speed does he recoil? (in m/s)
(A) 0.74 (B) 0.37 (C) 0.50 (D) 0.75 (E) 0.38
7. A pendulum consists of 5 kg mass at the end of a 40 cm long string. The maximum angular displacement is 60 degrees. Determine the maximum torque about the point of the support of the pendulum. (in ntm)
(A) 9.8 (B) 0 (C) 29 (D) 17 (E) 34
8. An angular ring consists of a cylinder of radius 8 cm with a 4 cm radius hole symmetric to its axis. If the mass of the ring is 5 kg, determine the rotational inertia about the axis parallel to the symmetry axis and 4 cm from it. (in $g m^2$)
(A) 20 (B) 24 (C) 16 (D) 32 (E) 28
9. A girl in South America rides a 12 meter diameter ferris wheel when the Sun is directly overhead. Her shadow on the ground executes S. H. M. If it takes 12 seconds for the ferris wheel to complete one revolution, what is the speed of her shadow when it is 3 meter away from the shadow of the axis of the ferris wheel? (in m/s)
(A) 3.14 (B) 2.72 (C) 6.08 (D) 1.57 (E) 0.92

參考用

注

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10. An object weight 100.0 Nts at the poles. How much does it weight in an airplane flying west along the equator at 456 m/s? Assume that the earth is a perfect sphere and that the plane is close to the Earth (in Nts)
(A) 85.6 (B) 98.6 (C) 99.6 (D) 100.0 (E) 101.4
11. Two 60 Hz continuous transverse waves travel in opposite directions on a string at 8.4 m/s. Each has an amplitude of 8 mm. Determine the maximum displacement at 16.1 cm from one of the fixed ends of the string (in mm)
(A) 2.01 (B) 12.9 (C) 15.9 (D) 6.47 (E) 16.0
12. Trooper B is chasing speeder A along a straight stretch of road. The speed of the speeder is 160 km/hr. The sound of siren issued by the trooper B has frequency of 600 Hz and the frequency of the echo from the speeder A received by B is 584 Hz. Assume the speed of sound is 1200 km/hr. What is the speed of trooper B? (in km/hr)
(A) 176 (B) 160 (C) 144 (D) 192 (E) 128
13. A thin glass rod of length $2a$ has a charge Q evenly distributed over its right half and a charge $-Q$ over its left half. Determine the electric field a distance a to the right of positive end. (in kQ/a^2)
(A) 0 (B) $1/3$ (C) $1/2$ (D) $1/4$ (E) $64/225$
14. Which of the following is not correct?
(A) A excess charge placed inside of a conductor moves to the newest inner or otter surface as predicated by Gauss's law
(B) Gauss's law predicts the exponent in Coulomb's law to be 2.002
(C) Coulomb used a theoretical approach to get Coulomb's law
(D) Plimpton and Lawton detected a small but measurable movement of charge on their electrometer
(E) The exponent in Coulomb's law has been experimentally measured to be 2 with a very low uncertainty.
15. Three identical 6×10^{-6} coul charges are at the corners of a right triangle whose sides are 3 cm and 4 cm. Determine the potential energy of the system. (in joules)
(A) 18.9 (B) 6.92 (C) 25.4 (D) 4.97 (E) 28.8
16. A 10 microfarad capacitor has its plates separated by 4 mm and is left connected to a 30 volt battery. 0.018 J work is required to insert a dielectric slab of thickness 4 mm between the plates. Find the dielectric constant of the slab.
(A) 1 (B) 2 (C) 3 (D) 4 (E) 5
17. A current of 20.0 milliamps consists of a positive ion beam of 8×10^7 doubly charged ions/cubic centimeter. If the ion beam is confined to a tube of 4 centimeter in diameter, determine the current density and drift velocity. (in 10^{-3} amps/cm² and 10^5 m/s)
(A) 1.59, 6.22 (B) 0.80, 3.11 (C) 3.2, 2.49 (D) 1.59, 12.4 (E) 0.80, 6.22
18. A car with a 12.0 volt battery has its lights on bright but the engine is not running. All lights combined dissipate 100 watts and draw 8.39 amps. Determine the internal resistance of the battery. (in ohms)
(A) 0.0096 (B) 0 (C) 0.0082 (D) 0.080 (E) 0.68

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19. A square, 200-turn loop of wire, is 15 cm by 15 cm. It carries a current of 8.0 A and is in a uniform magnetic field of 4.0T. Determine the value of magnetic dipole momentum (in Am^2) and the maximum value of the torque on the loop (in Nt-m)
(A) 0.18, 0.72 (B) 36, 144 (C) 1.2, 4.8 (D) 240, 960 (E) 4.5, 18
20. Two concentric cylindrical shells of radii 3 cm and 1 cm carry equal current of 15 amps in opposite directions. Use Ampere's Law to determine the magnetic field at 2 cm (in millitesla).
(A) 0.05 (B) 0.15 (C) 0.10 (D) 0.25 (E) 0.30
21. A circular coil of radius 15 cm with 12 turns moves at 30 m/s in a magnetic field which is perpendicular to the plane of the loop. If the magnetic field increases at 180 gauss/m, determine the induced emf in the coil. (in volts)
(A) 0.25 (B) 0.46 (C) 0.038 (D) 0.12 (E) 16.9
22. A two small identical bar magnets (0.5 cm x 0.5 cm x 4 cm) are arranged with one them fixed. The other is located 1 meter away along the axis of the first and is suspended so that the torque on it can easily be measured. The maximum torque is measured to be 8×10^{-5} Ntm. Determine the magnetic dipole moment of the two magnets (in ampxm^2).
(A) 20 (B) 40 (C) 12 (D) 25 (E) 63
23. A beam of light with an energy flux of 8.4 w/cm^2 shines for one minute on a perfectly reflecting plane mirror of 10 cm^2 area. What force acts on the mirror (in 10^{-6} N) ?
(A) 33.6 (B) 16.8 (C) 8.4 (D) 0.56 (E) 0.28
24. An object is placed in front of a spherical mirror having a focal length of magnitude 15 cm. If the magnification is +0.4 and the image is virtual, determine the type of mirror, the object distance and the image distance (in cm).
(A) concave, 37.5, -15 (B) convex, 22.5, -9 (C) convex, 37.5, -15
(D) convex, 57.5, -21 (E) concave, 22.5, -9
25. What are the energy, momentum and wavelength of the photon that is emitted from a hydrogen atom as it undergoes a transition from the state $n=5$ to $n=2$? (in eV, 10^{-27} kgm/s , nm)
(A) 4.08, 2.18, 304 (B) 3.40, 1.81, 365 (C) 2.86, 1.53, 434
(D) 0.54, 0.29, 1226 (E) 13.6, 7.25, 91.3

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