國立臺灣海洋大學 101 學年度研究所碩士班暨碩士在職專班入學考試試題

考試科目：普通物理

系所名稱：光電科學研究所碩士班不分組　　* 可使用計算器

1.答案以橫式由左至右書寫。2.請依題號順序作答。

Single choice: 4 points each. (For each problem choose one proper answer from A. *to* E.)
Write down briefly the calculation steps.

1 Capacitors A and B are identical. Capacitor A is charged so it stores *4J* of energy and capacitor B is uncharged. The capacitors are then connected in parallel. The total stored energy in the capacitors is now:
A. *16J*　B. *8J*　C. *4J*　D. *2J*　E. *1J*

2 A particle with charge $5.0\text{-}\mu C$ is placed at the center of a cube. The total electric flux in $N \cdot m^2/C$ through all sides of the cube is:
A. *0*　B. 7.1×10^4　C. 9.4×10^4　D. 1.4×10^5　E. 5.6×10^5

3 An escalator is used to move *20* people (*60kg* each) per minuted from the first floor of a department store to the second floor, *5m* above. Neglecting friction, the power required is approximately:
A. *100W*　B. *200W*　C. *1000W*　D. *2000W*　E. *60000W*

4 A rectangular loop of wire has area *A*. It is placed perpendicular to a uniform magnetic field *B* and then spun around one of its sides at frequency *f*. The maximum induced emf is:
A. $2\pi BAf$　B. πBAf　C. BAf　D. $2BAf$　E. $4\pi BAf$

5 A thin-walled hollow tube rolls without sliding along the floor. The ratio of its translational kinetic energy to its rotational kinetic energy (about an axis through its center of mass) is:
A. *1*　B. *2*　C. *3*　D. *1/2*　E. *1/3*

6 The capacitance of a spherical capacitor with inner radius *a* and outer radius *b* is proportional to:
A. *a/b*　B. $b-a$　C. b^2-a^2　D. $ab/(b-a)$　E. $ab/(b^2-a^2)$

7 Two parallel wires, *4cm* apart, carry currents of *2A* and *4A* respectively, in opposite direction. The force per unit length in *N/m* of one wire on the other is:
A. 1×10^{-3}; repulsive　B. 1×10^{-3}; attractive　C. 4×10^{-5}; repulsive
D. 4×10^{-5}; attractive　E. none of these

8 The potential energy of a *0.2kg* particle moving along the *x* axis is given by $U(x)=(8.0\,J/m^2)\,x^2+(2.0\,J/m^2)\,x^4$. When the particle is at $x=1.0\,m$ it is traveling in the positive *x* direction with a speed of *5.0 m/s*. It next stops momentarily to turn around at *x*=
A. *1.1m*　B. *−1.1m*　C. *0*　D. *−2.3m*　E. *2.3m*

9 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. *(R/2) dB/dt*　B. *(R/4) dB/dt*　C. *R dB/dt*　D. *2R dB/dt*　E. zero

10 At one instant an electron (charge = $1.6\times 10^{-19}C$) is moving in the + plane, the components of its velocity being $v_x = 5\times 10^5 m/s$ and $v_y = 3\times 10^5 m/s$. A magnetic field of $0.8T$ is in the positive x direction. At that instant the magnitude of the magnetic force on the electron is:

A. 0 B. $2.6\times 10^{-14}N$ C. $3.8\times 10^{-14}N$ D. $6.4\times 10^{-14}N$ E. $1.0\times 10^{-14}N$

11 In a Young's double-slit experiment, the separation between slits is d and the screen is a distance D from the slits. D is much greater than d and λ is the wavelength of the light. The number of bright fringes per unit width on the screen is:

A. Dd/λ B. $D\lambda/d$ C. $D/d\lambda$ D. λ/Dd E. $d/D\lambda$

12 A $180cm$ basketball player wishes to see a full length image of herself in a plane mirror. The minimum length mirror required is:

A. $180cm$ B. $360cm$ C. $90cm$ D. $180cm$ E. depends on how far she stands from the mirror

13 The dimensions of $S = (1/\mu_0)E\times B$ are:

A. J/m^2 B. J/s C. W/s D. W/m^2 E. J/m^3

14 A $2.0kg$ mass and a $4.0kg$ mass are attached to two ends of a spring with a spring constant of $100N/m$. The masses are placed on a horizontal frictionless surface and the spring is compressed $10cm$. The spring was released with both masses at rest and then the masses oscillate. When the spring reaches its equilibrium length for the first time the $2.0kg$ mass has a speed of $0.36m/s$. The mechanical energy that has been lost to the instant is:

A. zero B. $0.31J$ C. $0.61J$ D. $0.81J$ E. $1.2J$

15 A uniform sphere of radius R rotates about a diameter with an angular velocity of magnitude ω and an angular momentum of magnitude L. Under the action of internal forces the sphere collapses to a uniform sphere of radius $R/2$. The magnitude of its new angular velocity and angular momentum are:

A. $4\omega,\ L$ B. $4\omega,\ L/4$ C. $2\omega,\ L/2$ D. $2\omega,\ L$ E. $1/2\omega,\ L$

16 A piano wire has length L and mass M. If its fundamental frequency is f, its tension is:

A. $2Lf/M$ B. $4ML f^2$ C. $2Mf^2/L$ D. $4L^3f^2/M$ E. $4LMf$

17 Two particles have charges Q and $-Q$ (equal magnitude and opposite sign). For a net force of zero to be exerted on a third charge it must be placed:

A. on the line joining Q and $-Q$, closer to $-Q$ B. midway between Q and $-Q$
C. on the line joining Q and $-Q$, closer to Q D. at the location of Q E. there is no place

18 At time $t = 0$ the charge on the $50\mu F$ capacitor in an LC circuit is $15\mu C$ and there is no current. If the inductance is $20mH$ the maximum current is:

A. $1.5\mu A$ B. $15\mu A$ C. $15mA$ D. $15nA$ E. $15A$

19 An *RLC* series circuit is driven by a sinusoidal emf with angular frequency ω_d. If ω_d is increased without changing the amplitude of the emf the current amplitude increases. If L is the inductance, C is the capacitance, and R is the resistance, which of the following is correct?

A. $\omega_d L > R$ B. $\omega_d L < R$ C. $\omega_d L = 1/\omega_d C$ D. $\omega_d L < 1/\omega_d C$ E. $\omega_d L > 1/\omega_d C$

20 A *40N* box rests on a rough horizontal floor. A *12N* horizontal force is then applied to it. If the coefficients of friction are $\mu_s = 0.5$ and $\mu_k = 0.4$, the magnitude of the friction force on the box is:

A. *8 N* B. *12 N* C. *16 N* D. *20 N* E. *40 N*

21 An object is constrained by a cord to move in a circular path of radius *0.5m* on a horizontal frictionless surface. The cord will break if its tension exceeds *16N*. The maximum kinetic energy the object can have is:

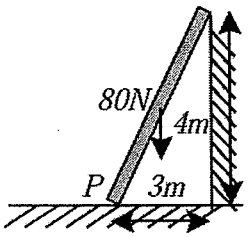
A. *8 J* B. *64J* C. *16 J* D. *32 J* E. *4J*

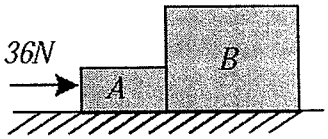
22 A source emits sound with a frequency of *1000Hz*. It and an observer are moving toward each other, each with a speed of *100m/s*. If the speed of sound is *340m/s*, the observer hears sound with a frequency of:

A. *294Hz* B. *545Hz* C. *1000Hz* D. *1830Hz* E. *3400Hz*

23 An *80-N* uniform rod leans against a frictionless wall as shown. The magnitude of the torque (about point P) applied to the rod by the wall is:

A. *40 N•m* B. *120 N•m* C. *60N•m* D. *160 N•m* E. *240 N•m*





24 Block A, with mass *4.0kg*, is in contact with another block B, with mass *20kg*. Both blocks sit on a horizontal frictionless surface. A *36N* constant force is applied to A as shown. The magnitude of the force of A on B is:

A. *30N* B. *10N* C. *6N* D. *20N* E. *16N*

25 A ball is threw upward with an angle θ from vertical, as shown in figure. The dash line shows its trajectory in the absence of gravity; points MNOP correspond to the position of its actual flight at one second (*1s*) intervals. If $g = 10\ m/s^2$, and there is no air drag, the lengths *x*, *y*, *z* are:

A. *1m, 2m, 5m* B. *5m, 10m, 15m* C. *10m, 40m, 90m* D. *10m, 20m, 30m* E. *5m, 20m, 45m*