國立中興大學 112 學年度學士後醫學系招生考試試題

科目：物理　　系所：學士後醫學系甲、乙組

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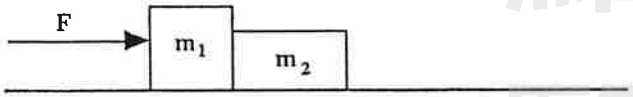
一、選擇題，共 50 題，每題 2 分，共 100 分。

1. Dagwood and Blondie are driving two identical cars. Blondie is passing Dagwood at twice his speed. They apply their brakes with equal constant force and stop on the level road. Dagwood travels a distance D in a time T while braking. How long does Blondie take to stop?
(A)T (B)1.4T (C)2T (D)2.8T (E)4T.

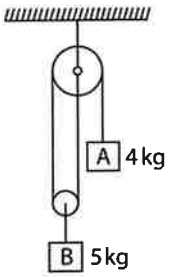
2. On a distant planet where the gravitational constant g = 6.0 m/s^2, Sherlock Holmes dropped his pipe from the roof of a building. Dr. Watson, in a room below, noticed the pipe flash past a window, taking 0.30 seconds to cover the 1.5 m vertical dimension of the window. Exactly 1.4 seconds after passing the bottom of the window on the way down, it passed it again on the way up, having made a perfectly elastic collision with the level ground below. Calculate the height of the building.
(A) 7.1 m (B) 11.6 m (C) 9.4 m (D) 4.8 m (E) 8.5 m.

3. Two blocks are in contact on a frictionless table. A horizontal force is applied to one block as shown. If m_1 = 2.0 kg, m_2 = 1.0 kg, and F = 3.0 N, find the force of contact between the two blocks.



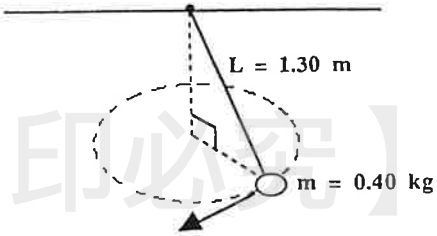
(A) 1 N (B) 2 N (C) 3 N (D) 6 N (E) 9 N.

4. The accelerations of the blocks A and B respectively as seen in the situation shown in the figure are (pulleys and strings are massless and pulleys are frictionless, acceleration due to gravity is g)?

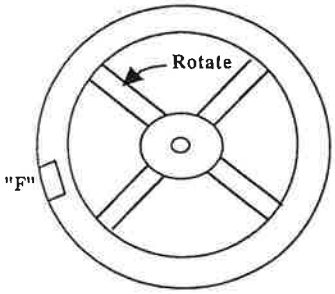


(A) 2g/3 downward, g/3 upward (B) 2g/7 downward, g/7 upward
(C) 2g/5 downward, g/5 upward (D) 10g/13 downward, 5g/13 upward
(E) A and B are at rest.

5. For the conical pendulum shown, the 0.40 kg mass has a periodic time of 1.90 s. What is the tension in the string? (Answer in N.)
(A) 3.92 (B) 4.37 (C) 5.69 (D) 6.48 (E) 7.85.



6. An astronaut, spaced out as usual, sits in her room at position "F" on the outer rim of a wheel-shaped station as shown. Gravitational forces are negligible. The station rotates about its axis 100 times each hour as shown. She weighed 900 N on earth. Her mass has not changed, but when she stands on a spring scale at "F" it correctly reads 1000 N. Calculate the radius of the station. Answers in meters.
(A) 400 (B) 360 (C) 330 (D) 280 (E) 260.



7. A piece of thin uniform wire of mass *m* and length 3*b* is bent into an equilateral triangle. Find the moment of inertia of the wire triangle about an axis perpendicular to the plane of the triangle and passing through one of its vertices.
(A)$2mb^2/3$ (B) $7mb^2/4$ (C) $1mb^2/3$ (D) $1mb^2/4$ (E) $1mb^2/2$.

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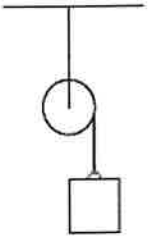
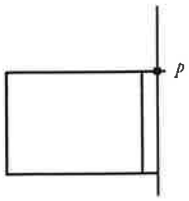
8. A uniform solid sphere of mass M and radius R rotates with an angular speed ω about an axis through its center. A uniform solid cylinder of mass M, radius R, and length $2R$ rotates through an axis running through the central axis of the cylinder. What must be the angular speed of the cylinder so it will have the same rotational kinetic energy as the sphere?
(A)$2\omega/5$ (B) $\sqrt{2/5}\omega$ (C) $4\omega/5$ (D) $2\omega/\sqrt{5}$ (E) $\omega/\sqrt{5}$.

9. A record is dropped vertically onto a freely rotating (undriven) turntable. Frictional forces act to bring the record and turntable to a common angular speed. If the rotational inertia of the record is 0.54 times that of the turntable, what percentage of the initial kinetic energy is lost?
(A) 10% (B) 35% (C) 18% (D) 46% (E) 60%.

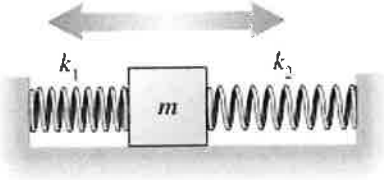
10. In the figure, a mass of 31.77 kg is attached to a light string that is wrapped around a cylindrical spool of radius 10.0 cm and moment of inertia 4.00 kg · m^2. The spool is suspended from the ceiling, and the mass is then released from rest a distance 5.70 m above the floor. How long does it take to reach the floor?
(A) 10.83 s (B) 3.98 s (C) 1.14 s (D) 5.59 s (E) 7.89 s.



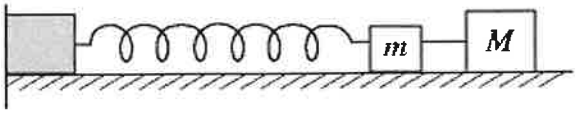
11. A uniform sign is supported against a wall at point P as shown in the figure. If the sign is a square 0.4 m on a side and its mass is 4.0 kg, what is the magnitude of the horizontal force that the wall at P experiences?
(A) 5.8 N (B) 10.0 N (C) 20 N (D) 98 N (E) 75 N.



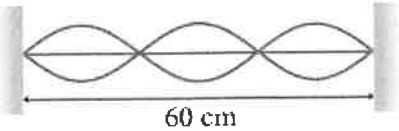
12. A 2.0 kg block on a frictionless table is connected to two ideal massless springs with spring constants k_1 and k_2 whose opposite ends are fixed to walls, as shown in the figure. What is the angular frequency of the oscillation if k_1=7.6 N/m and k_2=5.0 N/m?
(A) 2.5 rad/s (B) 3.5 rad/s (C) 0.40 rad/s (D) 0.56 rad/s (E) 5.5 rad/s.



13. In the figure, two masses, M = 16 kg and m = 12.8 kg, are connected to a very light rigid bar and are attached to an ideal massless spring of spring constant 100 N/m. The system is set into oscillation with an amplitude of 78 cm. At the instant when the acceleration is at its maximum, the 16-kg mass separates from the 12.8-kg mass, which then remains attached to the spring and continues to oscillate. What will be the amplitude of oscillation of the 12.8-kg mass?
(A) 35 cm (B) 62 cm (C) 78 cm (D) 98 cm (E) 110 cm.



14. A standing wave is oscillating at 690 Hz on a string, as shown in the figure. What is the speed of traveling waves on this string?
(A) 140 m/s (B) 210 m/s (C) 280 m/s (D) 340 m/s (E) 410 m/s.



15. A violin with string length 32 cm and string density 1.5 g/cm resonates with the first overtone from a 2.0 m long organ pipe with one end closed and the other end open. What is the tension in the string?
(A) 56 N (B) 110 N (C) 450 N (D) 1000 N (E) 1500 N.

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16. Consider a very small hole in the bottom of a tank 20.0 cm in diameter filled with water to a height of 50.0 cm. Find the speed at which the water exits the tank through the hole.
(A) 1.8 m/s (B) 3.13 m/s (C) 5.10 m/s (D) 9.4 m/s (E) 14.9 m/s.

17. A 7.8-kg solid sphere, made of metal whose density is 2500 kg/ m^3, is suspended by a cord. When the sphere is immersed in water (of density 1000 kg/m^3), what is the tension in the cord?
(A) 16 N (B) 30 N (C) 46 N (D) 61 N (E) 72 N.

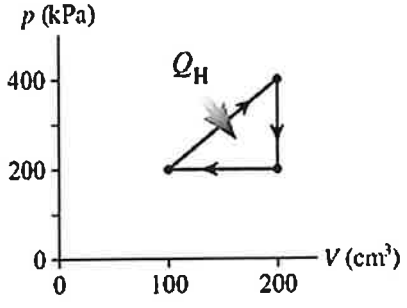
18. A heat conducting rod, 0.90m long, is made of an aluminum section that is 0.10 m long, and a copper section that is 0.8 m long. Both sections have cross-sectional areas of 0.0004 m^2. The aluminum end is maintained at a temperature of 40 °C and the copper end is at 150 °C. The thermal conductivity of aluminum is 205 W/m·K and of copper is 385 W/m·K. Steady state has been reached, and no heat is lost through the well-insulated sides of the rod. The temperature of the aluminum-copper junction in the rod is closest to
(A) 61°C. (B) 48°C. (C) 56°C. (D) 34°C. (E) 70°C.

19. Some properties of glass are listed here:
Density: 2300 kg/m^3
Specific heat: 840 J/kg·C°
Coefficient of linear thermal expansion: 8.5×10^{-6} $(C°)^{-1}$
Thermal conductivity: 0.80 W/(m·C°)
A glass window pane is 2.7 m high, 2.4 m wide, and 2.0 mm thick. The temperature at the inner surface of the glass is 22°C and at the outer surface 4.0°C. How much heat is lost each hour through the window under steady state conditions?
(A) 1.7×10^5 J (B) 1.7×10^6 J (C) 4.7×10^7 J (D) 1.7×10^8 J (E) 4.7×10^9 J.

20. If we double the root-mean-square speed (thermal speed) of the molecules of a gas, then
(A) its temperature must increase by a factor of 4.
(B) its temperature must increase by a factor of 2.
(C) its temperature must increase by a factor of $\sqrt{2}$.
(D) its pressure must increase by a factor of 2.
(E) its pressure must increase by a factor of 4.

21. An ideal gas in a balloon is kept in thermal equilibrium with its constant-temperature surroundings. How much work is done by the gas if the outside pressure is slowly reduced, allowing the balloon to expand to 6.0 times its original size? The balloon initially has a pressure of 645.0 Pa and a volume of 0.1 m^3. The ideal gas constant is $R = 8.314$ J/mol · K.
(A) 60 J (B) 115 J (C) 160 J (D) 200 J (E) 250 J.

22. The graph in the figure shows a cycle for a heat engine for which $Q_H = 35$ J.
What is the thermal efficiency of this engine?
(A) 14 % (B) 21 % (C) 29 % (D) 35 % (E) 49 %.



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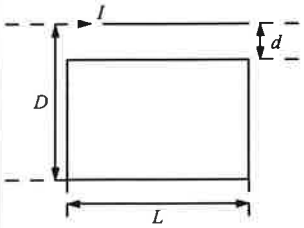
23. The second law of thermodynamics leads us to conclude that
(A) the total energy of the universe is constant.
(B) the total energy in the universe is decreasing with time.
(C) it is theoretically impossible to convert work into heat with 100% efficiency.
(D) the total energy in the universe is increasing with time.
(E) disorder in the universe is increasing with the passage of time.

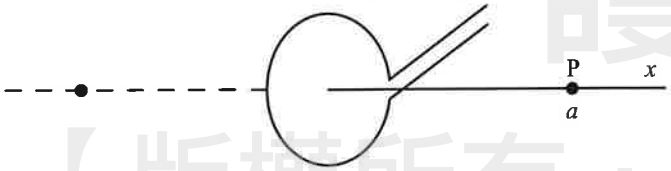
24. A crane lifts a 425 kg steel beam vertically a distance of 117m. How much work does the crane do on the beam if the beam accelerates upward at 1.8 m/s2? Neglect frictional forces.
(A) 1.8×10^5 J (B) 3.4×10^5 J (C) 4.0×10^5 J (D) 4.9×10^5 J (E) 5.8×10^5 J.

25. A certain spherical asteroid has a mass of 3.5×10^{16} kg and a radius of 8.8 km. What is the minimum speed needed to escape from the surface of this asteroid? ($G = 6.67 \times 10^{-11}\text{N} \cdot \text{m}^2/\text{kg}^2$)
(A) 223 m/s (B) 126 m/s (C) 52 m/s (D) 34 m/s (E) 23 m/s.

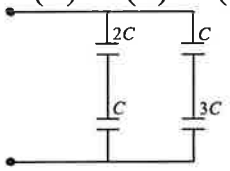
26. A loop of wire (resistance = 2.0 mΩ) is positioned as shown with respect to a long wire that carries a current. If $d = 1.0$ cm, $D = 6.0$ cm, and $L = 1.5$ m, what current in mA is induced in the loop at an instant when the current in the wire is increasing at a rate of 100 A/s?
(A) 34 (B) 30 (C) 27 (D) 38 (E) 0.50.



27. Current enters a circular loop as shown below. At point P, where $x = a$, the magnetic field has the value $B_x\hat{\mathbf{i}}$. The value of the magnetic field at $x = -a$ is:
(A) 0 (B) $-B_x\hat{\mathbf{i}}$ (C) $B_x\hat{\mathbf{i}}$ (D) $-B_y\hat{\mathbf{i}}$ (E) $B_y\hat{\mathbf{i}}$.



28. Determine the equivalent capacitance in pF for the network shown when $C = 12$ pF.
(A) 34 (B) 17 (C) 51 (D) 68 (E) 21.



29. By what factor is the drift velocity in a conductor changed if the voltage is doubled?
(A) 1 (B) 2 (C) 3 (D) 1/2 (E) 1/4.

30. The distance from an antinode to a node nearest to that antinode is
(A) $\frac{\lambda}{4}$ (B) $\frac{\lambda}{2}$ (C) λ (D) 2λ (E) 3λ.

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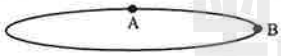
31. A flute player holding a tone with a frequency of 520 Hz approaches a wall at 2 m/s on a day when the speed of sound in air is 340 m/s. The frequency in Hz he hears coming back to him from the wall is (A) 260 (B) 517 (C) 520 (D) 523 (E) 526.

32. The *xy* plane is "painted" with a uniform surface charge density equal to $40\ \mathrm{nC/m^2}$. Consider a spherical surface with a 4.0 cm radius that has a point in the *xy* plane as its center. What is the electric flux in $\mathrm{Nm^2/C}$ for that part of the spherical surface for which $z>0$?
($\varepsilon_o = 8.85\times10^{-12}\ \mathrm{C^2/Nm^2}$)
(A) 14 (B) 11 (C) 17 (D) 20 (E) 23.

33. A charged conductor has the oval shape shown below. When we compare the potential at points A and B, we find that: (A) $V_A > V_B$ (B) $V_A = V_B$ (C) $V_A < V_B$ (D) $V_A \le V_B$ (E) we must first determine the charge distribution on the surface before we can calculate the potential difference between two points on the surface.



34. Three charges, the outer two $+q$, and the inner one $-q$, are placed in a line, as shown below. The potential energy of these charges is

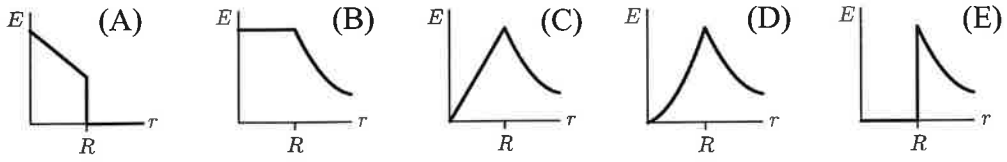
(A) $-\frac{5}{2}\frac{k_e q^2}{r}$ (B) $-\frac{3}{2}\frac{k_e q^2}{r}$ (C) $-\frac{k_e q^2}{r}$ (D) $+\frac{3}{2}\frac{k_e q^2}{r}$ (E) $+\frac{5}{2}\frac{k_e q^2}{r}$.

35. Two long parallel wires carry unequal currents in the same direction. The ratio of the currents is 3 to 1. The magnitude of the magnetic field at a point in the plane of the wires and 10 cm from each wire is 4.0 μT. What is the larger of the two currents in A? (A) 5.3 (B) 3.8 (C) 4.5 (D) 3.0 (E) 0.5.

36. A 30 turn square coil (length of side = 12 cm) with a total resistance of 2.5 Ω is placed in a uniform magnetic field directed perpendicularly to the plane of the coil. The magnitude of the field varies with time according to $B = Ae^{8t}$, where $A = 50$ mT and t is measured in seconds. What is the magnitude in V of the induced *emf* in the coil at $t = 0$?
(A) 0.31 (B) 0.27 (C) 0.17 (D) 0.20 (E) 22 x 10^{-3}.

37. Charge Q is spread uniformly along the circumference of a circle of radius R. A point particle with charge q is placed at the center of this circle. The total force exerted on the particle can be calculated by Coulomb's law:
(A) just use R for the distance (B) just use 2R for the distance (C) just use 2πR for the distance (D) the result of the calculation is zero (E) none of the above.

38. A solid insulating sphere of radius R contains positive charge that is distributed with a volume charge density that does not depend on angle but does increase with distance from the sphere center. Which of the graphs below might give the magnitude E of the electric field as a function of the distance r from the center of the sphere?



　背面有題，請繼續作答。

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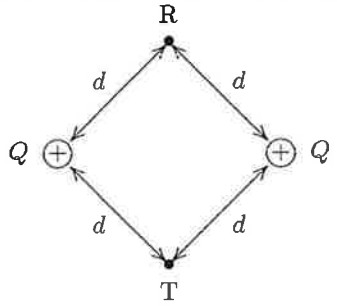
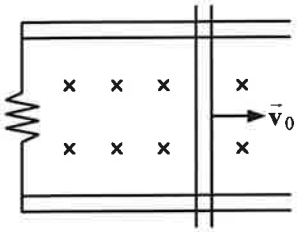
39. If the electric field is in the positive x direction and has a magnitude given by $E = Cx^2$, where C is a constant, then the electric potential is given by V =
(A) 2Cx (B) -2Cx (C) $Cx^3/3$ (D)- $Cx^3/3$ (E) $-Cx^3$.

40. Points R and T are each a distance d from each of two particles with equal positive charges as shown. If $k_e = 1/4\pi\epsilon_0$, the work required to move a particle with charge q from R to T is:
(A) 0 (B) k_eQq/d^2 (C) k_eQq/d (D) $k_eQq/(\sqrt{2}d)$ (E) $k_eQq/(2d)$.

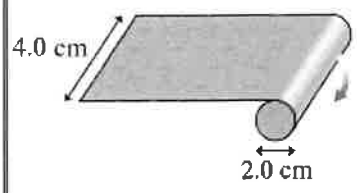


41. A metal bar sliding on parallel rails a length ℓ apart from one another is given initial velocity v_0 to the right. The rails are connected by a resistor of resistance R at their left. If a constant magnetic field B is directed into the page, what is the magnitude of the force on the rod?
(A) $B\ell v$ (B)$B^2\ell^2 v$ (C) $\frac{B\ell v}{R}$ (D) $\frac{B^2\ell^2 v}{R}$ (E) $\frac{B^2\ell^2 v}{mR}$.



42. An alpha particle is a nucleus of helium. It has twice the charge and four times the mass of the proton. When they were very far away from each other, but headed toward directly each other, a proton and an alpha particle each had an initial speed of $0.0030c$, where c is the speed of light. What is their distance of closest approach? ($c = 3.00 \times 10^8$ m/s, $k_e = 1/4\pi\varepsilon_0 = 8.99 \times 10^9$ N · m^2/C^2, $e = 1.60 \times 10^{-19}$ C, $m_{proton} = 1.67 \times 10^{-27}$ kg)
(A) 2.1×10^{-13} m (B) 3.3×10^{-13} m (C) 2.6×10^{-13} m (D) 2.9×10^{-13} m (E) 4.2×10^{-13} m.

43. The figure shows a 2.0-cm diameter roller that turns at 90 rpm. A 4.0-cm wide plastic film is being wrapped onto the roller, and this plastic carries an excess electric charge having a uniform surface charge density of 5.0 nC/cm^2. What is the current of the moving film?
(A) 190 nA (B) 23 μA (C) 30 nA (D) 11 μA (E) 16 nA.



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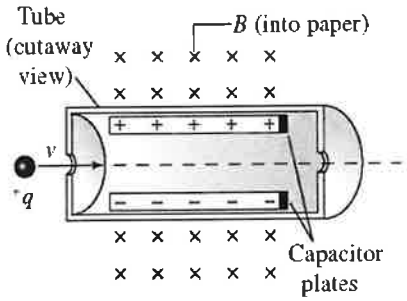
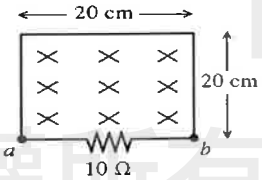
44. The heater element of a particular 120-V toaster is a 8.9-m length of nichrome wire, whose diameter is 0.86 mm. The resistivity of nichrome at the operating temperature of the toaster is $1.3 \times 10^{-6}\ \Omega \cdot m$. If the toaster is operated at a voltage of 120 V, how much power does it draw?
(A) 720 W (B) 700 W (C) 750 W (D) 770 W (E) 800 W.

45. The figure shows a velocity selector that can be used to measure the speed of a charged particle. A beam of particles is directed along the axis of the instrument. A parallel plate capacitor sets up an electric field E, which is oriented perpendicular to a uniform magnetic field B. If the plates are separated by 2.0 mm and the value of the magnetic field is 0.60 T, what voltage between the plates will allow particles of speed 5.0×10^5 m/s to pass straight through without deflection?
(A) 94 V (B) 1900 V (C) 3800 V (D) 190 V (E) 600 V.



46. As shown in the figure, a wire and a 10-Ω resistor are used to form a circuit in the shape of a square, 20 cm by 20 cm. A uniform but nonsteady magnetic field is directed into the plane of the circuit. The magnitude of the magnetic field is decreased from 1.50 T to 0.50 T in a time interval of 63 ms. The average induced current and its direction through the resistor, in this time interval, are closest to
(A) 63 mA, from b to a (B) 38 mA, from b to a (C) 63 mA, from a to b (D) 38 mA, from a to b (E) 95 mA, from a to b.



47. A man is nearsighted and cannot see things clearly beyond 110 cm from his eyes. What is the focal length of the contact lenses that will enable him to see very distant objects clearly?
(A) 50 cm (B) -50 cm (C) -110 cm (D) 110 cm (E) -30 cm.

48. Light of wavelength 500 nm illuminates a round 0.50-mm diameter hole. A screen is placed 6.3 m behind the slit. What is the diameter of the central bright area on the screen?
(A) 15 mm (B) 270 μm (C) 7.7 mm (D) 3800 μm (E) 5 mm.

49. Given that the wavelengths of visible light range from 400 nm to 700 nm, what is the highest frequency of visible light? ($c = 3.0 \times 10^8$ m/s)
(A) 3.1×10^8 Hz (B) 7.5×10^{14} Hz (C) 2.3×10^{20} Hz (D) 4.3×10^{14} Hz (E) 5.0×10^8 Hz.

50. What resistance should be added in series with a 3.0-H inductor to complete an LR circuit with a time constant of 4.0 ms?
(A) 20 Ω (B) 0.75 k Ω (C) 12 Ω (D) 0.75 Ω (E) 2.5 Ω.

科目：物理

題號	答案	題號	答案	題號	答案	題號	答案	題號	答案	題號	答案	題號	答案
1.	C	16.	B	31.	E	46.	A	61.		76.		91.	
2.	E	17.	C	32.	B	47.	C	62.		77.		92.	
3.	A	18.	A	33.	B	48.	A	63.		78.		93.	
4.	B	19.	D	34.	B	49.	A	64.		79.		94.	
5.	C	20.	A	35.	D	50.	B	65.		80.		95.	
6.	B	21.	B	36.	C	51.		66.		81.		96.	
7.	E	22.	C	37.	D	52.		67.		82.		97.	
8.	D	23.	E	38.	D	53.		68.		83.		98.	
9.	B	24.	E	39.	D	54.		69.		84.		99.	
10.	B	25.	E	40.	A	55.		70.		85.		100.	
11.	C	26.	C	41.	D	56.		71.		86.			
12.	A	27.	C	42.	A	57.		72.		87.			
13.	C	28.	B	43.	A	58.		73.		88.			
14.	C	29.	B	44.	A	59.		74.		89.			
15.	D	30.	A	45.	E	60.		75.		90.			

國立中興大學 112 學年度學士後醫學系招生考試

試題參考答案疑義釋疑公告

科目	題號	疑義答覆	釋疑結果
物理	1	考題為單選題，且一般而言，汽車的質量(~1000-1500 公斤)跟兩個人的質量差(<30 公斤)相差很多，若把此誤差考慮進去，答案還是(C)。	維持原答案(C)
	6	$F=m*R*\varpi^2$ $m=900[N]/10[m/s^2]=90kg$ $F=1000[N]$ $R=F/(m*\varpi^2)=1000/(90*(2\pi*100/3600)^2)\approx360$ 答案為(B)。	維持原答案(B)
	10	答案會因取重力加速度的不同有所不同，但答案(B)誤差在範圍之內，且其他答案已設計與(B)有很大的差距，故維持正確原答案(B)。	維持原答案(B)
	15	本題未提供聲速 344m/s，本題送分。	本題送分
	38	The key sentence is "the volume charge density does **increase** with distance from the sphere center". From Gauss's law: $4\pi r^2 \cdot E(r) = \frac{1}{\epsilon}\int_0^r 4\pi r'^2 dr' \rho(r')$ Therefore, outside the sphere, the E field falls like the square of the distance from the center. By Gauss' law, if the charge distribution were constant, then the E field would rise linearly from the center ($Q_{enc} \propto r^3$ and $E = kQ_{enc}/r^2$). However, here the volume charge density increases with distance from the center, therefore the enclosed charge rises more slowly from the center, which is described only by (D).	維持原答案(D)
	39	Electric potential difference is defined as the potential difference between **two points.** However, problem 39 is not the case, it asked for a general form of electric potential, and no any two points were mentioned.	維持原答案(D)
	49	本題為正確答案誤植，答案更正為(B)。	答案更正為(B)

物　理　　程量子(陳宗德)老師提供

1. Dagwood and Blondie are driving two identical cars. Blondie is passing Dagwood at twice his speed. They apply their brakes with equal constant force and stop on the level road. Dagwood travels a distance D in a time T while braking. How long does Blondie take to stop?
(A)T　　(B)1.4T　　(C)2T　　(D)2.8T　　(E)4T.

1. 解：(C)

$$v = v_0 + at$$

Dagwood $0 = v_D + (-\frac{F}{m})T_D \Rightarrow T_D = \frac{mv_D}{F}$

Blondie $0 = 2v_D + (-\frac{F}{m})T_B \Rightarrow T_B = \frac{2mv_D}{F}$

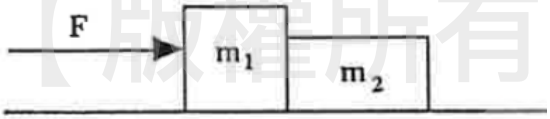
故 $T_B = 2T_D = 2T$

2. On a distant planet where the gravitational constant g = 6.0 m/s^2, Sherlock Holmes dropped his pipe from the roof of a building. Dr. Watson, in a room below, noticed the pipe flash past a window, taking 0.30 seconds to cover the 1.5 m vertical dimension of the window. Exactly 1.4 seconds after passing the bottom of the window on the way down, it passed it again on the way up, having made a perfectly elastic collision with the level ground below. Calculate the height of the building.
(A) 7.1 m　　(B) 11.6 m　　(C) 9.4 m　　(D) 4.8 m　　(E) 8.5 m.

2. 解：(E)

$$y = v_0 t + \frac{1}{2}gt^2 = 0 + \frac{1}{2} \times 6 \times (0.3 + 1.4)^2 = 8.67[m]$$

3. Two blocks are in contact on a frictionless table. A horizontal force is applied to one block as shown. If m_1 = 2.0 kg, m_2 = 1.0 kg, and F = 3.0 N, find the force of contact between the two blocks.



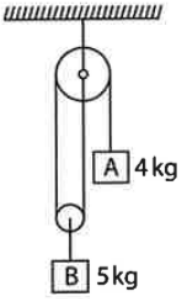
(A) 1 N　　(B) 2 N　　(C) 3 N　　(D) 6 N　　(E) 9 N.

3. 解：(A)

$$F = (m_1 + m_2)a \Rightarrow 3 = (1+2)a \Rightarrow a = 1[m/s^2]$$

$$F_{21} = m_2 a = (1) \times 1 = 1[N]$$

4. The accelerations of the blocks A and B respectively as seen in the situation shown in the figure are (pulleys and strings are massless and pulleys are frictionless, acceleration due to gravity is g)?



(A) 2g/3 downward, g/3 upward (B) 2g/7 downward, g/7 upward
(C) 2g/5 downward, g/5 upward (D) 10g/13 downward, 5g/13 upward
(E) A and B are at rest.

4. 解：(B)

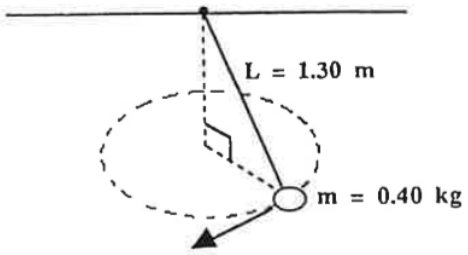
由 $\vec{F} = m\vec{a}$

A: $T - 4g = -4a_A = -4(2a_B)$ $(-\frac{a_A}{2} = a_B)$

B: $2T - 5g = +5a_B$

得 $a_B = +\frac{1}{7}g$ (m_B向上), $a_A = -\frac{2}{7}g$ (m_A向下)

5. For the conical pendulum shown, the 0.40 kg mass has a periodic time of 1.90 s. What is the tension in the string? (Answer in N.)



(A) 3.92 (B) 4.37 (C) 5.69 (D) 6.48 (E) 7.85

5. 解：(C)

由 $\vec{F} = m\vec{a}$

$T'\sin\theta = m\frac{v^2}{L\sin\theta}$ ------(1)

$T'\cos\theta - mg = 0$--------(2)

由(1)(2)式解得

$\Rightarrow \tan\theta = \frac{v^2}{gL\sin\theta} \Rightarrow v = \sqrt{gL\sin\theta\tan\theta}$

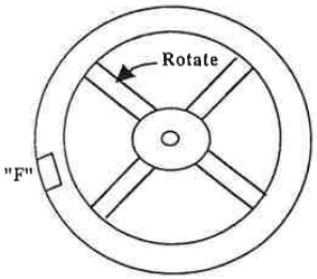
$v = \sqrt{gL\sin\theta\tan\theta} = (L\sin\theta)\omega = (L\sin\theta)(\frac{2\pi}{T})$

$\Rightarrow gL\sin\theta(\frac{\sin\theta}{\cos\theta}) = (L\sin\theta)^2(\frac{2\pi}{T})^2$

$\Rightarrow \cos\theta = 0.7$

原式 $T'\cos\theta - mg = 0 \Rightarrow T'\cos\theta = mg \Rightarrow T' \times 0.7 = 0.4 \times 9.8 \Rightarrow T' = 5.69[N]$

6. An astronaut, spaced out as usual, sits in her room at position "F" on the outer rim of a wheel-shaped station as shown. Gravitational forces are negligible. The station rotates about its axis 100 times each hour as shown. She weighed 900 N on earth. Her mass has not changed, but when she stands on a spring scale at "F" it correctly reads 1000 N. Calculate the radius of the station. Answers in meters.



(A) 400 (B) 360 (C) 330 (D) 280 (E) 260.

6. 解：(B)

$F = mR\omega^2 \Rightarrow 1000 = \frac{900}{9.8} \times R \times (\frac{100 \times 2\pi}{3600})^2 \Rightarrow R = 359[m]$

7. A piece of thin uniform wire of mass *m* and length 3*b* is bent into an equilateral triangle. Find the moment of inertia of the wire triangle about an axis perpendicular to the plane of the triangle and passing through one of its vertices.
(A) $2mb^2/3$ (B) $7mb^2/4$ (C) $1mb^2/3$ (D) $1mb^2/4$ (E) $1mb^2/2$.
7. 解：(E)

$$I_A = 2\times\frac{1}{3}(\frac{1}{3}m)b^2 = \frac{2}{9}mb^2$$
$$I_B = \frac{1}{12}(\frac{1}{3}m)b^2 + (\frac{1}{3}m)(\frac{\sqrt{3}}{2}b)^2 = \frac{5}{18}mb^2$$
$$I = I_A + I_B = \frac{2}{9}mb^2 + \frac{5}{18}mb^2 = 0.5mb^2$$

8. A uniform solid sphere of mass *M* and radius *R* rotates with an angular speed ω about an axis through its center. A uniform solid cylinder of mass *M,* radius *R,* and length 2*R* rotates through an axis running through the central axis of the cylinder. What must be the angular speed of the cylinder so it will have the same rotational kinetic energy as the sphere?
(A) $2\omega/5$ (B) $\sqrt{2/5}\omega$ (C) $4\omega/5$ (D) $2\omega/\sqrt{5}$ (E) $\omega/\sqrt{5}$.
8. 解：(D)

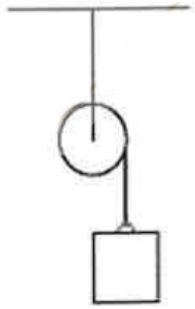
$$K_s = K_c$$
$$\frac{1}{2}(\frac{2}{5}MR^2)\omega^2 = \frac{1}{2}(\frac{1}{2}MR^2)\omega'^2 \Rightarrow \omega' = \frac{2}{\sqrt{5}}\omega$$

9. A record is dropped vertically onto a freely rotating (undriven) turntable. Frictional forces act to bring the record and turntable to a common angular speed. If the rotational inertia of the record is 0.54 times that of the turntable, what percentage of the initial kinetic energy is lost?
(A) 10% (B) 35% (C) 18% (D) 46% (E) 60%.
9. 解：(B)

由角動量守恆 $I_i\omega_i = I_f\omega_f$

$$I_t\omega_0 = (I_r + I_t)\omega_f = (0.54I_t + I_t)\omega_f \Rightarrow \omega_f = \frac{1}{1.54}\omega_0$$
$$E_i = K_i = \frac{1}{2}I_t\omega_0^2$$
$$E_f = K_f = \frac{1}{2}(1.54I_t)\omega_f^2 = \frac{1}{2}(1.54I_t)(\frac{1}{1.54}\omega_0)^2 = \frac{1}{2}\times\frac{1}{1.54}I_t\omega_0^2 = \frac{1}{1.54}K_i$$
$$\frac{K_i - K_f}{K_i} = \frac{K_i - \frac{1}{1.54}K_i}{K_i} \approx 0.35 = 35\%$$

10. In the figure, a mass of 31.77 kg is attached to a light string that is wrapped around a cylindrical spool of radius 10.0 cm and moment of inertia 4.00 kg·m^2. The spool is suspended from the ceiling, and the mass is then released from rest a distance 5.70 m above the floor. How long does it take to reach the floor?



(A) 10.83 s (B) 3.98 s (C) 1.14 s (D) 5.59 s (E) 7.89 s.

10. 解：(B)

$$RT = I\frac{a}{R}\text{----------(1)}$$

$$T - mg = -ma\text{-----(2)}$$

由(1)(2)式解得

$$R(mg - ma) = I\frac{a}{R} \Rightarrow a = \frac{mgR^2}{I + mR^2} = \frac{31.77 \times 9.8 \times 0.1^2}{4 + 31.77 \times 0.1^2} = 0.72$$

$$y = v_0 t + \frac{1}{2}at^2 \Rightarrow 5.7 = 0 + \frac{1}{2} \times 0.72 \times t^2 \Rightarrow t = 3.98[s]$$