國立高雄大學 109 學年度
第 1 學期理學院

普通物理學基礎能力
會考試題

考試日期：110.1.15(星期五)

考試時間：16：30-18：30

系所：_____ **姓名：**_____ **學號：**_____

規定事項：

1. 請攜帶學生證（或有照片之證件）準時應考，以便身分核對。
2. 應試時請依當日公告之座位表入座。
3. 遲到逾 20 分鐘者，不得入場；已入場應試者，60 分鐘內不得出場。
4. 答案卡應以 2B 鉛筆作答，攜帶軟性品質較佳之橡皮擦備用。
5. 禁止使用電子產品（如：手機）
6. 電子計算器:僅限簡易型電子計算機(限僅有數字鍵 0～9 及＋－×÷√%M 等功能)”
7. 考試期間請全程配戴口罩，未佩戴口罩不得進入考場。

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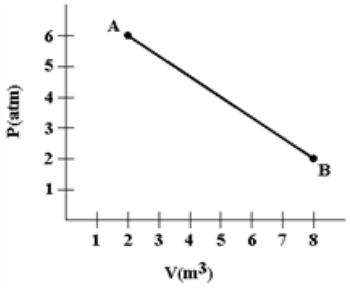
<第一部份-基礎題型 1-20 共 20 題，每題 2.5 分，共 50 分>

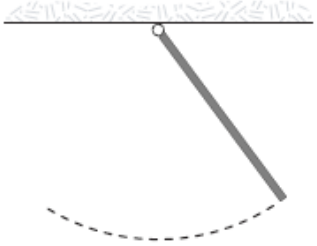
1. If the rms speed of helium atoms is $v_{rms,\,He}$ at temperature T, what is the rms speed of CO_2 at the same temperature?
   (A)$v_{rms,He}/44$
   (B)$v_{rms,He}/11$
   (C)$v_{rms,He}/\sqrt{44}$
   (D)$v_{rms,He}/\sqrt{11}$
   (E)$v_{rms,He}/\sqrt{22}$

2. A 5-kg piece of lead (specific heat 0.03 cal/g·℃) having a temperature of 80℃ is added to 500 g of water having a temperature of 20℃. What is the final equilibrium temperature (in ℃) of the system?
   (A)34
   (B)69
   (C)53
   (D)79
   (E)20

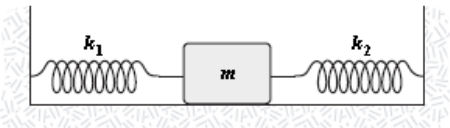
3. A gas expands from A to B as shown in the graph. Calculate the work (in joules) done by the gas. (1 atm = 1.01×10^5 N/m^2.)
   (A)12
   (B)24
   (C)1.21x10^6
   (D)2.42x10^6
   (E)3.64x10^6



4. A uniform rod (mass m = 1.0 kg and length L = 2.0 m) pivoted at one end oscillates in a vertical plane as shown below. The period of oscillation (in s) is approximately what?
   (A)4.0
   (B)1.6
   (C)3.2
   (D)2.3
   (E)2.0



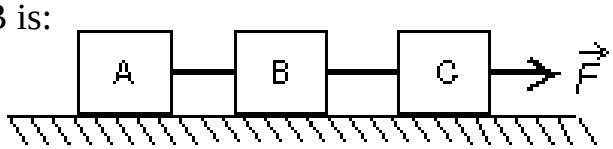
5. The mass in the figure slides on a frictionless surface. If m = 2 kg, k_1 = 800 N/m, and k_2 = 500 N/m, the frequency of oscillation (in Hz) is approximately what?
   (A)6 (B)2 (C)4 (D)8 (E)10



6. If the wave function $y = 0.02 \sin(30x - 400t)$ (SI units), the velocity of the wave is what?
   (A)3/40 m/s
   (B)40/3 m/s
   (C)60π/400 m/s
   (D)400/60π m/s
   (E)400 m/s
7. A car approaches a stationary police car at 36 m/s. The frequency of the siren (relative to the police car) is 500 Hz. What is the frequency (in Hz) heard by an observer in the moving car as he approaches the police car? (Assume the velocity of sound in air is 343 m/s.)
   (A)220
   (B)448
   (C)526
   (D)552
   (E)383
8. A projectile is fired in such a way that its horizontal range is equal to three times its maximum height. What is the angle θ of projection?
   (A) $\theta = \tan^{-1}(1/3)$ (B) $\theta = \tan^{-1}(2/3)$ (C) $\theta = \tan^{-1}(4/3)$ (D) $\theta = \tan^{-1}(3/4)$ (E) $\theta = \tan^{-1}(3/2)$
9. The same force F is applied horizontally to bodies 1, 2, 3, and 4, of masses m, $2m$, $3m$, and $4m$, initially at rest and on a frictionless surface, until each body has traveled distance d. The correct listing of the magnitudes of the velocities of the bodies, v_1, v_2, v_3, and v_4 is
   (A) $v_4 = \sqrt{\frac{4}{3}}v_3 = \sqrt{\frac{3}{2}}v_2 = 2v_1$ (B) $v_1 = 2v_2 = 3v_3 = 4v_4$ (C) $v_4 = v_2 > v_3 = v_1$
   (D) $v_1 = \sqrt{2}v_2 = \sqrt{3}v_3 = 2v_4$ (E) $v_4 = \frac{3}{4}v_3 = \frac{2}{3}v_2 = \frac{1}{2}v_1$
10. In uniform circular motion,
   (A)the acceleration is always constant in magnitude and direction
   (B)the velocity is always constant in magnitude and direction
   (C)the net force is always constant in magnitude and direction
   (D)the velocity is always changing direction but the acceleration is always in the same direction
   (E)both the acceleration and the velocity are continually changing direction

11. Three blocks (A, B, C), each having the same mass *M*, are connected by strings as shown. Block C is pulled to the right by a force $\vec{F}$ that causes the entire system to accelerate. Neglecting friction, the net force acting on block B is:

(A)0 (B)$\vec{F}/3$ (C)$\vec{F}/2$ (D)$\overrightarrow{2F}/3$ (E)$\vec{F}$



12. A particle is subject to the potential $U = 2x^2y + 6y$. What is the value of the *y* component of the force on the particle at the point (*x*, *y*) = (2.0, 3.0)?

(A)-28
(B)-24
(C)-14
(D)28
(E)42

13. A particle moving along the *x* axis is acted upon by a single force $F = F_0e^{-kx}$, where F_0 and *k* are constants. The particle is released from rest at *x* = 0. It will attain a maximum kinetic energy of:

(A)F_0/k
(B)F_0/e^k
(C)kF_0
(D)$1/2(kF_0)^2$
(E)ke^kF_0

14. As an object moves from point A to point B only two forces act on it: one force is non-conservative and does -30J of work, the other is conservative and does +50J of work. Between A and B,

(A)kinetic energy of object increases, mechanical energy decreases
(B)kinetic energy of object decreases, mechanical energy decreases
(C)kinetic energy of object decreases, mechanical energy increases
(D)kinetic energy of object increases, mechanical energy increases
(E)kinetic energy of object remains constant, mechanical energy increases

15. A 0.80 kg ball moving horizontally at 5.0 m/s strikes a vertical wall and rebounds with speed 2.0 m/s. What is the magnitude of the change in its linear momentum?

(A)2.4 kg.m/s (B)3.0 kg.m/s (C)4.8 kg.m/s (D)5.6 kg.m/s (E)6.9 kg.m/s

16. A 5.20 g bullet moving at 700 m/s strikes a 650 g wooden block at rest on a frictionless surface. The bullet emerges, traveling in the same direction with its speed reduced to 450 m/s. What is the resulting speed of the block?
(A)2.00 m/s (B)3.60 m/s (C)5.50 m/s (D)7.40 m/s (E)9.20 m/s

17. The angular position of a point on a rotating wheel is given by $\theta = 5.0 + 3.0t^2 + 2.0t^3$, where θ is in radians and *t* is in seconds. What is its angular acceleration at $t = 2.0$ s?
(A)12 rad/s^2
(B)25 rad/s^2
(C)30 rad/s^2
(D)46 rad/s^2
(E)58 rad/s^2

18. A plum is located at coordinates (2.0 m, 5.0 m, 0). In unit-vector notation, what is the torque about the origin on the plum if that torque is due to a force whose only component is $F_y = 6.0$ N?
(A)$(6\ \text{N}\cdot\text{m})\hat{\text{k}}$
(B)$(12\ \text{N}\cdot\text{m})\hat{\text{k}}$
(C)$(18\ \text{N}\cdot\text{m})\hat{\text{k}}$
(D)$(30\ \text{N}\cdot\text{m})\hat{\text{k}}$
(E)$(42\ \text{N}\cdot\text{m})\hat{\text{k}}$

19. Two Earth satellites, A and B, each of mass *m*, are to be launched into circular orbits about Earth's center. Satellite A is to orbit at an altitude of 6370 km. Satellite B is to orbit at an altitude of 19850 km. The radius of Earth R_E is 6370 km. What is the ratio of the potential energy of satellite B to that of satellite A, in orbit?
(A)0.058
(B)0.124
(C)0.297
(D)0.321
(E)0.486

20. A uniform solid sphere of radius *R* produces a gravitational acceleration of a_{g} on its surface. At what distance from the sphere's center is the point outside the sphere where the gravitational acceleration is $a_{\text{g}}/3$?
(A)$\sqrt{2}R$ (B)$\sqrt{3}R$ (C)$\sqrt{4}R$ (D)$\sqrt{5}R$ (E)$\sqrt{6}R$

<第二部份-進階題型 21-30 共 10 題，每題 5 分，共 50 分>

21. One mole of helium gas expands adiabatically from 2 atm pressure to 1 atm pressure. If the original temperature of the gas is 20℃, what is the final temperature of the gas? (γ = 1.67)
(A)111K
(B)222K
(C)333K
(D)125 K
(E) 145 K

22. If 25 kg of ice at 0℃ is combined with 4 kg of steam at 100℃, what will be the final equilibrium temperature (in ℃) of the system?
(A)40
(B)20
(C)60
(D)100
(E) 8

23. In the figure below, a disk (radius R = 1.0 m, mass = 2.0 kg) is suspended from a pivot a distance d = 0.25 m above its center of mass. For a circular disk, $I_{cm} = \frac{1}{2}mR^2$. The angular frequency (in rad/s) for small oscillations is approximately what?
(A)2.1
(B)4.2
(C)1.5
(D)1.0
(E) 3.8

24. A ball is thrown horizontally from the top of a 20-m high hill. It strikes the ground at an angle of 45°. With what speed was it thrown? Use g = 10 m/s^2.
(A)14 m/s
(B)20 m/s
(C)28 m/s
(D)32 m/s.
(E) 40 m/s

25. The total force needed to drag a box at constant speed across a surface with coefficient of kinetic friction μ_k is least when the force is applied at an angle θ such that

(A) $\tan\theta = \mu_k$

(B) $\cot\theta = \mu_k$

(C) $\sin\theta = \mu_k$

(D) $\cos\theta = \mu_k$

(E) $\sec\theta = \mu_k$

26. A ball of mass *m*, at one end of a string of length *L*, rotates in a vertical circle just fast enough to prevent the string from going slack at the top of the circle. Assuming mechanical energy is conserved, the speed of the ball at the bottom of the circle is:

(A) $\sqrt{2gL}$

(B) $\sqrt{3gL}$

(C) $\sqrt{4gL}$

(D) $\sqrt{5gL}$

(E) $\sqrt{6gL}$

27. Block 1, with mass m_1 and speed 14.70 m/s, slides along an *x* axis on a frictionless floor and then undergoes a one-dimensional elastic collision with stationary block 2, with mass $m_2 = 0.50m_1$. The two blocks then slide into a region where the coefficient of kinetic friction is 0.50; there they stop. How far into that region do block 1 slide?

(A) 2.45 m

(B) 3.64 m

(C) 4.58 m

(D) 5.73 m

(E) 6.12 m

28. A thin rod of length 0.75 m and mass 0.42 kg is suspended freely from one end. It is pulled to one side and then allowed to swing like a pendulum, passing through its lowest position with angular speed 4.0 rad/s. Neglecting friction and air resistance, find the rod's kinetic energy at its lowest position.

(A) 0.15 J

(B) 0.26 J

(C) 0.48 J

(D) 0.51 J

(E) 0.63 J

29. The rotational inertia of a collapsing spinning star drops to $\frac{1}{4}$ its initial value. What is the ratio of the new rotational kinetic energy to the initial rotational kinetic energy?
(A)2
(B)4
(C)8
(D)12
(E)16

30. What is the escape speed on a spherical asteroid whose radius is 700 km and whose gravitational acceleration at the surface is 4.5 m/s^2?
(A)1.1×10^3 m/s
(B)1.6×10^3 m/s
(C)2.5×10^3 m/s
(D)2.9×10^3 m/s
(E)3.2×10^3 m/s