

# 國立高雄大學 108 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：109.1.9(星期四)

考試時間：17：00-19：00

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  $+$   $-$   $\times$   $\div$   $\sqrt{\%}$  M 等功能）”

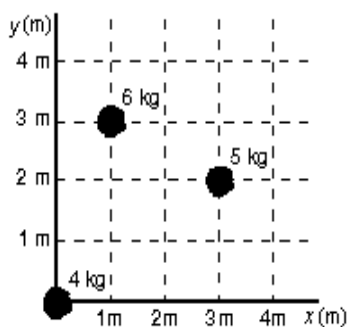


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<第一部份-基礎題型 1-20 共 20 題，每題 2.5 分，共 50 分>

1. The  $x$  and  $y$  coordinates in meters of the center of mass of the three-particle system shown below are:

- (A) 0 m, 0 m
- (B) 1.3 m, 1.7 m
- (C) 1.4 m, 1.9 m
- (D) 1.9 m, 2.5 m
- (E) 1.4 m, 2.5 m



2. One revolution per minute is about:

- (A) 0.0524 rad/s
- (B) 0.105 rad/s
- (C) 0.95 rad/s
- (D) 1.57 rad/s
- (E) 6.28 rad/s

3. When a thin uniform stick of mass  $M$  and length  $L$  is pivoted about its midpoint, its rotational inertia is  $ML^2/12$ . When pivoted about a parallel axis through one end, its rotational inertia is:

- (A)  $ML^2/12$
- (B)  $ML^2/6$
- (C)  $ML^2/3$
- (D)  $7ML^2/12$
- (E)  $13ML^2/12$

4. A 2.0-kg block travels around a 0.50-m radius circle with an angular velocity of 12 rad/s. The magnitude of its angular momentum about the center of the circle is:

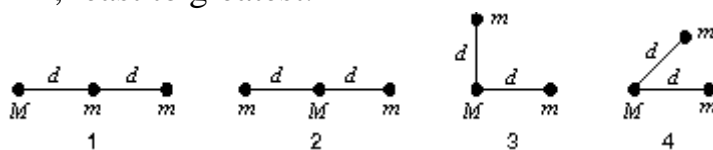
- (A) 6.0 kg·m<sup>2</sup>/s
- (B) 12 kg·m<sup>2</sup>/s
- (C) 48 kg·m<sup>2</sup>/s
- (D) 72 kg·m<sup>2</sup>/s
- (E) 576 kg·m<sup>2</sup>/s

5. A hoop ( $I = MR^2$ ) of mass 2.0 kg and radius 0.50 m is rolling at a center-of-mass speed of 15 m/s. An external force does 750 J of work on the hoop. What is the new speed of the center

of mass of the hoop?

- (A) 19 m/s
- (B) 22 m/s
- (C) 24 m/s
- (D) 27 m/s
- (E) 68 m/s

6. Three particles, two with mass  $m$  and one mass  $M$ , might be arranged in any of the four configurations known below. Rank the configurations according to the magnitude of the gravitational force on  $M$ , least to greatest.



- (A) 1, 2, 3, 4
- (B) 2, 1, 3, 4
- (C) 2, 1, 4, 3
- (D) 2, 3, 4, 2
- (E) 2, 3, 2, 4

7. Consider a free expansion of an idea gas, in which no work is done, and no heat is transferred. What are the changes in the internal energy and temperature?

- (A)  $\Delta U=0 \text{ J}, \Delta T=0^\circ\text{K}$
- (B)  $\Delta U=1 \text{ J}, \Delta T=0^\circ\text{K}$
- (C)  $\Delta U=0 \text{ J}, \Delta T=100^\circ\text{K}$
- (D)  $\Delta U=1 \text{ J}, \Delta T=100^\circ\text{K}$
- (E) None of the above.

8. A wave has an angular frequency of 110 rad/s and a wavelength of 1.80 m. What is the speed of the wave?

- (A) 31.5 m/s
- (B) 38.4 m/s
- (C) 37.6 m/s
- (D) 29.3 m/s
- (E) 31.2 m/s

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9. Two sinusoidal waves of the same frequency travel in the same direction along a string. If  $y_{m1}=3.0\text{ cm}$  ,  $y_{m2}=4.0\text{ cm}$  ,  $\phi_1 = 0$  , and  $\phi_2 = \pi/2$  rad, what is the amplitude of the resultant wave?
- (A) 2.0 cm  
(B) 3.0 cm  
(C) 4.0 cm  
(D) 5.0 cm  
(E) 6.0 cm
10. A particle with a mass of  $1.00 \times 10^{-20}\text{ kg}$  is oscillating with simple harmonic motion with a period of  $1.00 \times 10^{-5}\text{ s}$  and a maximum speed of  $1.00 \times 10^3\text{ m/s}$ . Calculate the angular frequency.
- (A)  $6.01 \times 10^5\text{ rad/s}$   
(B)  $6.21 \times 10^5\text{ rad/s}$   
(C)  $6.28 \times 10^5\text{ rad/s}$   
(D)  $6.42 \times 10^5\text{ rad/s}$   
(E)  $6.83 \times 10^5\text{ rad/s}$
11. At what temperature is the Fahrenheit scale reading equal to twice that of the Celsius scale?
- (A)  $300^\circ\text{F}$   
(B)  $310^\circ\text{F}$   
(C)  $320^\circ\text{F}$   
(D)  $330^\circ\text{F}$   
(E)  $340^\circ\text{F}$
12. What is the average translational kinetic energy of nitrogen molecules at 1600 K? ( $k = 1.8 \times 10^{-23}\text{ J/K}$ )
- (A)  $5.11 \times 10^{-20}\text{ J}$   
(B)  $6.87 \times 10^{-20}\text{ J}$   
(C)  $4.62 \times 10^{-20}\text{ J}$   
(D)  $3.99 \times 10^{-20}\text{ J}$   
(E)  $3.31 \times 10^{-20}\text{ J}$
13. What is the internal energy of 1.0 mol of an ideal monatomic gas at 273K?  
( $R=8.31\text{ J/mol}\cdot\text{K}$ )

- (A)  $3.4 \times 10^3$  J
- (B)  $4.4 \times 10^3$  J
- (C)  $5.4 \times 10^3$  J
- (D)  $6.4 \times 10^3$  J
- (E)  $7.4 \times 10^3$  J

14. A stone is catapulted at time  $t=0$ , with an initial velocity of magnitude 30.0 m/s and at an angle of  $30.0^\circ$  above the horizontal. What is the magnitude of the vertical component of its displacement from the catapult site at  $t=2.0$  s?

- (A) 5.2 m
- (B) 10.4 m
- (C) 16.8 m
- (D) 25.1 m
- (E) 49.6 m

15. An elevator cab that weighs 28000.0 N moves upward. What is the tension in the cable if the cab's speed is increasing at a rate of  $1.4 \text{ m/s}^2$ ?

- (A) 13000.0 N
- (B) 17000.0 N
- (C) 20000.0 N
- (D) 24000.0 N
- (E) 32000.0 N

16. A person pushes horizontally with a force of 300 N on a 50 kg crate to move it across a level floor. The coefficient of kinetic friction between the crate and the floor is 0.4. What is the magnitude of the acceleration of the crate?

- (A)  $2.08 \text{ m/s}^2$
- (B)  $4.53 \text{ m/s}^2$
- (C)  $6.84 \text{ m/s}^2$
- (D)  $8.25 \text{ m/s}^2$
- (E)  $9.92 \text{ m/s}^2$

17. An ice block floating in a river is pushed through a displacement  $\vec{d} = (25 \text{ m})\hat{i} - (14 \text{ m})\hat{j}$  along a straight embankment by rushing water, which exerts a force  $\vec{F} = (52 \text{ N})\hat{i} + (15 \text{ N})\hat{j}$  on the block. How much work does the force do on the block during the displacement?

- (A) 550 J    (B) 610 J    (C) 830 J    (D) 1090 J    (E) 1510 J

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18. A 100 kg block is pulled at a constant speed of 5.0 m/s across a horizontal floor by an applied force of 128 N directed  $60.0^\circ$  above the horizontal. What is the rate at which the force does work on the block?
- (A) 112 W  
(B) 160 W  
(C) 320 W  
(D) 510 W  
(E) 640 W
19. A 5.0 g marble is fired vertically upward using a spring gun. The spring must be compressed 7.0 cm if the marble is to just reach a target 20 m above the marble's position on the compressed spring. What is the spring constant of the spring?
- (A) 100 N/m  
(B) 200 N/m  
(C) 300 N/m  
(D) 400 N/m  
(E) 500 N/m
20. A pendulum consists of a 2.0 kg stone swinging on a 5.0 m string of negligible mass. The stone has a speed of 10.0 m/s when it passes its lowest point. What is the speed when the string is at  $60.0^\circ$  to the vertical?
- (A) 7.1 m/s  
(B) 9.2 m/s  
(C) 11.5 m/s  
(D) 16.8 m/s  
(E) 20.9 m/s

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

21. A hockey puck of mass  $m$  traveling along the  $x$  axis at 4.5 m/s hits another identical hockey puck at rest. If after the collision the second puck travels at a speed of 3.5 m/s at an angle of  $30^\circ$  above the  $x$  axis, what is the final velocity of the first puck?
- (A) 1.0 m/s,  $30^\circ$  below the  $x$  axis  
(B) 2.3 m/s,  $50^\circ$  below the  $x$  axis  
(C) 2.8 m/s,  $60^\circ$  below the  $x$  axis  
(D) 3.0 m/s,  $45^\circ$  below the  $x$  axis  
(E) not enough information

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22. A disk has a rotational inertia of  $6.0 \text{ kg}\cdot\text{m}^2$  and a constant angular acceleration of  $2.0 \text{ rad/s}^2$ .

If it starts from rest, the work done during the first 5.0 s by the net torque acting on it is:

- (A) 0 J
- (B) 30 J
- (C) 60 J
- (D) 300 J
- (E) 600 J

23. A force  $\vec{F} = (4.2 \text{ N}) \hat{i} + (3.7 \text{ N}) \hat{j} + (1.2 \text{ N}) \hat{k}$  acts on a particle located at  $x = 3.3 \text{ m}$ . What is the torque on the particle around the origin?

- (A)  $14 \text{ (N}\cdot\text{m)} \hat{i}$
- (B)  $-4.0 \text{ (N}\cdot\text{m)} \hat{j} + 12 \text{ (N}\cdot\text{m)} \hat{k}$
- (C)  $12 \text{ (N}\cdot\text{m)} \hat{k}$
- (D)  $14 \text{ (N}\cdot\text{m)} \hat{i} - 4.0 \text{ (N}\cdot\text{m)} \hat{j} + 12 \text{ (N}\cdot\text{m)} \hat{k}$
- (E) cannot be calculated without knowing the mass of the particle

24. Two particles, each of mass  $m$ , are a distance  $d$  apart. To bring a third particle, with mass  $2m$ , from far away to a resting point midway between the two particles, an external agent must do work equal to:

- (A)  $4Gm^2/d$
- (B)  $-4Gm^2/d$
- (C)  $8Gm^2/d$
- (D)  $-8Gm^2/d$
- (E) zero

25. A violin string 15.0 cm long and fixed at both ends oscillates in its  $n=1$  mode. The speed of waves on the string is 250 m/s, and the speed of sound in air is 348 m/s. What is the frequency of the emitted sound wave?

- (A) 811 Hz
- (B) 833 Hz
- (C) 845 Hz
- (D) 856 Hz
- (E) 72 Hz

26. Calculate the root-mean-square speed of helium atoms at 1000K. (He=4g/mole)

- (A)  $5.4 \times 10^3 \text{ m/s}$
- (B)  $4.8 \times 10^3 \text{ m/s}$
- (C)  $3.7 \times 10^3 \text{ m/s}$
- (D)  $2.9 \times 10^3 \text{ m/s}$
- (E)  $2.5 \times 10^3 \text{ m/s}$



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27. What is the maximum acceleration of a platform that oscillates at amplitude 2.20 cm and frequency 6.60 Hz?
- (A) 37.8 m/s<sup>2</sup>  
(B) 30.1 m/s<sup>2</sup>  
(C) 29.7 m/s<sup>2</sup>  
(D) 28.6 m/s<sup>2</sup>  
(E) 27.4 m/s<sup>2</sup>
28. A boy whirls a stone in a horizontal circle of radius 1.5 m and at height 2.0 m above level ground. The string breaks, and the stone flies off horizontally and strikes the ground after traveling a horizontal distance of 5 m. What is the magnitude of the centripetal acceleration of the stone during the circular motion?
- (A) 31.5 m/s<sup>2</sup>  
(B) 40.8 m/s<sup>2</sup>  
(C) 55.2 m/s<sup>2</sup>  
(D) 71.3 m/s<sup>2</sup>  
(E) 94.6 m/s<sup>2</sup>
29. Only one force is acting on a 3.0 kg particle-like object whose position is given by  $x = 3.0t - 4.0t^2 + 2.0t^3$ , with  $x$  in meters and  $t$  in seconds. Find the work done by the force from  $t = 0$  s to  $t = 2.0$  s.
- (A) 40 J  
(B) 87 J  
(C) 106 J  
(D) 124 J  
(E) 168 J
30. A conservative force  $\vec{F} = (6.0x - 12)\hat{i}$  N, where  $x$  is in meters, acts on a particle moving along an  $x$  axis. The potential energy  $U$  associated with this force is assigned a value of 9 J at  $x = 0$ . What is the maximum positive potential energy?
- (A) 21 J  
(B) 30 J  
(C) 45 J  
(D) 61 J  
(E) 72 J