國立高雄大學 111 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：111.12.29(星期四)

考試時間：17：10-19：10

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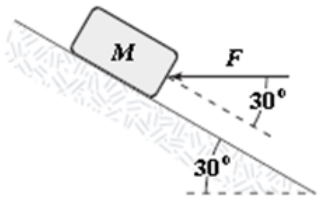
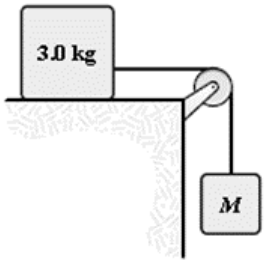
<第一部份-基礎題型 1-20 共 20 題，每題 2.5 分，共 50 分>

1. A block is pushed up a frictionless 30^{O} incline by an applied force as shown. If F = 25 N and M = 3.0 kg, what is the magnitude of the resulting acceleration of the block?
   (A) 2.3 m/s^2 (B) 4.6 m/s^2 (C) 3.5 m/s^2 (D) 2.9 m/s^2 (E) 5.1 m/s^2



2. The system shown is released from rest and moves 50 cm in 1.0 s. What is the value of M? All surfaces are frictionless.
   (A) 0.42 kg
   (B) 0.34 kg
   (C) 0.50 kg
   (D) 0.59 kg
   (E) 0.68 kg



3. A 2.0-kg block slides on a rough horizontal surface. A force (magnitude P = 4.0 N) acting parallel to the surface is applied to the block. The magnitude of the block's acceleration is 1.2 m/s^2. If P is increased to 5.0 N, determine the magnitude of the block's acceleration.
   (A) 2.1 m/s^2 (B) 2.3 m/s^2 (C) 1.9 m/s^2 (D) 1.7 m/s^2 (E) 3.2 m/s^2

4. A 2.0-kg particle has an initial velocity of $(5\hat{\imath} - 4\hat{\jmath})$ m/s. Some time later, its velocity is $(7\hat{\imath} + 3\hat{\jmath})$ m/s. How much work was done by the resultant force during this time interval, assuming no energy is lost in the process?
   (A) 19 J (B) 49 J (C) 17 J (D) 53 J (E) 27 J

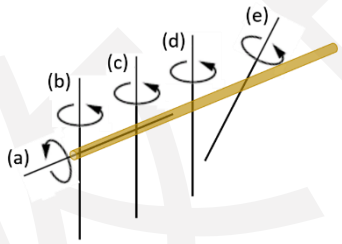
5. Equal amounts of work are performed on two bodies, A and B, initially at rest, and of masses M and $2M$ respectively. The relation between their speeds immediately after the work has been done on them is
   (A) $v_A = \sqrt{2}v_B$ (B) $v_A = 2v_B$ (C) $v_A = v_B$ (D) $v_B = \sqrt{2}v_A$ (E) $v_B = \sqrt{2}v_A$

6. A particle is subject to the potential $U = 2x^2 + 6y$. What is the value of the y component of the force on the particle at the point (x, y) = (2.0, 3.0)?
   (A) 24 N (B) -24 N (C) 14 N (D) -14 N (E) 28 N

7. A 10-kg block on a rough horizontal surface is attached to a light spring (force constant = 1.4 kN/m). The block is pulled 8.0 cm to the right from its equilibrium position and released from rest. The frictional force between the block and surface has a magnitude of 30 N. What is the kinetic energy of the block as it passes through its equilibrium position?
(A) 4.5 J (B) 2.1 J (C) 6.9 J (D) 6.6 J (E) 4.9 J

8. An external force is acting on an object with a mass of 2 kg. The speed of the object changes from 3 m/s to 4 m/s. How much work is done by the external force?
(A) 5 J (B) 7 J (C) 10 J (D) 14 J. (E) 20 J

9. A rotating stick, as shown in the figure below, which one has the largest rotational inertia?



10. A wheel is rotating with a constant angular acceleration. After 25 revolutions, the angular velocity changes from 100 rev./s^2 to 150 rev./s^2 What is the value of angular acceleration?
(A) 50 rev./s^2 (B)100 rev./s^2 (C) 150 rev./s^2 (D) 200 rev./s^2 (E) 250 rev./s^2

11. Which of the following statements about "angular momentum" is false?
(A) A particle moving at a constant velocity has angular momentum that does not change with time for any rotating axis.
(B) A particle with linear momentum must have angular momentum for a fixed point.
(C) Changing the position of the rotating axis of a rigid body will change its angular momentum.
(D) The angular momentum of a particle must be perpendicular to its linear momentum.
(E) The angular momentum of a particle moving in a circular motion at a constant velocity is a constant value.

12. The crane lifts a 12-meter-long, 1,000-kg homogeneous steel pipe from flat on the ground to a vertical position in 10 seconds. What is the approximate power? (gravitational acceleration, $g \fallingdotseq 10 m/s^2$)
(A) $3x10^2$ W (B) $6x10^2$ W (C) $1.2x10^3$ W (D) $6x10^3$ W (E) $1.2x10^4$ W

13. A binary star system rotates around its center of mass at an angular velocity of ω. Without external force, the distance between the binary stars becomes 1/3 of the original. What does the angular velocity become?
(A) 3ω (B) 6ω (C) 9ω (D) 12ω (E) 15ω

14. A satellite with a mass of m moves in a circular motion with a constant velocity of radius r on the equator around the Earth's axis with an angular momentum of L. What is the kinetic energy of the satellite?
(A) $L^2/2mr^2$ (B) L^2/mr^2 (C) L^2/r^2 (D) $L/2mr$ (E) L/mr

15. An object attached to one end of a spring makes 20 vibrations in 10 seconds. Its angular frequency is:
(A) 0.79 rad/s (B) 1.57 rad/s (C) 2.0 rad/s (D) 6.3 rad/s (E) 12.6 rad/s

16. A wave is described by $y(x,t) = 0.1\sin(3x + 10t)$, where x is in meters, y is in centimeters and t is in seconds. The angular wave number is:
(A) 0.10 rad/m (B) 3π rad/m (C) 10 rad/m (D) 10π rad/m (E) 3.0 rad/m

17. The intensity of sound wave A is 100 times that of sound wave B. Relative to wave B the sound level of wave A is:
(A) –2 db (B) +2 db (C) +10 db (D) +20 db (E) +100 db

18. A column of argon is open at one end and closed at the other. The shortest length of such a column that will resonate with a 200 Hz tuning fork is 42.5 cm. The speed of sound in argon must be:
(A) 85.0 m/s (B) 170 m/s (C) 340 m/s (D) 470 m/s (E) 940 m/s

19. The zeroth law of thermodynamics allows us to define
(A) work
(B) pressure
(C) temperature
(D) thermal equilibrium
(E) internal energy

20.The specific heat of a substance is:

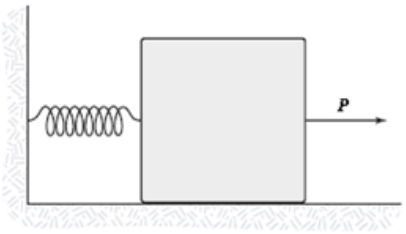
(A) the amount of heat energy to change the state of one gram of the substance
(B) the amount of heat energy per unit mass emitted by oxidizing the substance
(C) the amount of heat energy per unit mass to raise the substance from its freezing to its boiling point
(D) the amount of heat energy per unit mass to raise the temperature of the substance by 1 °C
(E) the temperature of the object divided by its mass

<第二部份：進階題型 1-10 共 10 題，每題 5 分，共 50 分>

1. A 1.5-kg mass has an acceleration of $(4.0\hat{\imath} - 3.0\hat{\jmath})$ m/s^2. Only two forces act on the mass. If one of the forces is $(2.0\hat{\imath} - 1.4\hat{\jmath})$ N, what is the magnitude of the other force?
(A) 4.1 N (B) 6.1 N (C) 5.1 N (D) 7.1 N (E) 2.4 N

2. A force acting on an object moving along the x axis is given by $F_x = (14x - 3.0x^2)$ N where x is in meter. How much work is done by this force as the object moves from $x = -1$ m to $x = +2$ m?
(A) 12 J (B) 28 J (C) 40 J (D) 42 J (E) -28 J

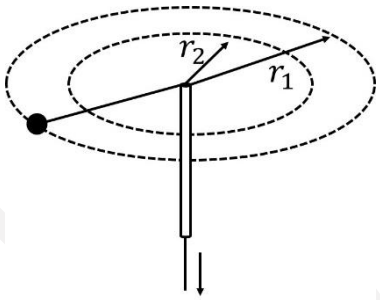
3. A 10-kg block on a horizontal frictionless surface is attached to a light spring (force constant = 0.80 kN/m). The block is initially at rest at its equilibrium position when a force (magnitude P = 80 N) acting parallel to the surface is applied to the block, as shown. What is the speed of the block when it is 13 cm from its equilibrium position?
(A) 0.96 m/s
(B) 0.85 m/s
(C) 0.77 m/s
(D) 0.64 m/s
(E) 0.52 m/s



4. One end of an ideal spring is fixed. An object is tied to the other end of the spring and moves on a frictionless horizontal plane in a simple harmonic motion (SHM). The maximum amplitude of the SHM is R. At what position the object with the elastic potential energy is just half of the kinetic energy?
(A) R/3 (B) R/2 (C) $\sqrt{3}$R/3 (D) $\sqrt{2}$R/2 (E) R

5. A small object of mass m is connected by a light cord and passed through a hollow tube. The tube is held in one hand and turned while the other end of the cord is pulled by the other hand. Initially, the object rotates at a radius of r_1 with a speed of v_1. Then, the cord is pulled down so that the radius of rotation becomes r_2. How much work does the pulling force do?

(A) $mv_1^2r_1^2/r_2^2$
(B) $mv_1^2(r_1^2-r_2^2)/r_1^2$
(C) $mv_1^2(r_1^2-r_2^2)/r_2^2$
(D) $mv_1^2(r_1^2-r_2^2)/2r_1^2$
(E) $mv_1^2(r_1^2-r_2^2)/2r_2^2$



6. A sphere with mass m_1 moves with velocity v, and another sphere with mass m_2 moves with velocity $v/3$ (in the same direction as the sphere m_1) in front of it. After collision elastically, the velocity of sphere m_1 reduces to $v/2$. What is the mass ratio (m_1: m_2)?

(A) 3:4
(B) 5:3
(C) 4:5
(D) 3:5
(E) 4:3

7. A particle moves back and forth along the x axis from $x = -x_m$ to $x = +x_m$, in simple harmonic motion with period T. At time $t = 0$ it is at $x = +x_m$. When $t = 0.75T$:

(A) it is at $x = 0$ and is traveling toward $x = +x_m$
(B) it is at $x = 0$ and is traveling toward $x = -x_m$
(C) it is at $x = +x_m$ and is at rest
(D) it is between $x = 0$ and $x = +x_m$ and is traveling toward $x = -x_m$
(E) it is between $x = 0$ and $x = -x_m$ and is traveling toward $x = -x_m$

8. Here are the equations for the three waves traveling on separate strings. Rank them according to the maxium transverse speed, least to greatest.

wave 1: $y(x,t) = (2.0\text{ mm})\sin[(4.0\text{ m}^{-1})x - (3.0\text{ s}^{-1})t]$
wave 2: $y(x,t) = (1.0\text{ mm})\sin[(8.0\text{ m}^{-1})x - (4.0\text{ s}^{-1})t]$
wave 3: $y(x,t) = (1.0\text{ mm})\sin[(4.0\text{ m}^{-1})x - (8.0\text{ s}^{-1})t]$

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

9. In each of the following two situations a source emits sound with a frequency of 1000 Hz. In situation I the source is moving at 100 m/s toward an observer at rest. In situation II the observer is moving at 100 m/s toward the source, which is stationary. The speed of sound is 340 m/s. The frequencies heard by the observers in the two situations are:
   (A) I: 1417 Hz; II: 1294 Hz
   (B) I: 1417 Hz; II: 1417 Hz
   (C) I: 1294 Hz; II: 1294 Hz
   (D) I: 773 Hz; II: 706 Hz
   (E) I: 773 Hz; II: 773 Hz

10. The heat capacity of object B is twice that of object A. Initially A is at 300 K and B is at 450 K. They are placed in thermal contact and the combination is isolated. The final temperature of both objects is:
   (A) 200 K (B) 300 K (C) 400 K (D) 450 K (E) 600 K