

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

第一部分：單選題，每題 5 分，答錯不倒扣，共 55 分。

選擇題請於答案卷標明題號並依順序作答（無需寫出計算過程）。

1. A man stands on a bathroom scale that indicates his weight is W . The man is standing on the scale inside an elevator when it is at rest. What will the scale read when the elevator is moving upward at a constant velocity v ?
 - (a) The scale will read a value that is slightly less than W .
 - (b) The scale will read a value that is slightly greater than W .
 - (c) The scale will read the same value W .
 - (d) The scale will read a value that is much greater than W .
 - (e) The scale will read zero newtons.
2. A steel ball is whirled on the end of a chain in a horizontal circle of radius R with a constant period T . If the radius of the circle is then reduced to $0.75R$, while the period remains T , what happens to the centripetal acceleration of the ball?
 - (a) The centripetal acceleration increases to 1.33 times its initial value.
 - (b) The centripetal acceleration increases to 1.78 times its initial value.
 - (c) The centripetal acceleration decreases to 0.75 times its initial value.
 - (d) The centripetal acceleration decreases to 0.56 times its initial value.
 - (e) The centripetal acceleration does not change.
3. A wave is described by the equation $y = 0.020 \sin(3.0x - 6.0t)$, where the distances are in meters and time is measured in seconds. Using the wave equation, determine the speed of this wave?
 - (a) 0.50 m/s, (b) 0.75 m/s, (c) 1.0 m/s, (d) 2.0 m/s, (e) 4.0 m/s
4. Block A has a mass m and block B has a mass $2m$. Block A is pressed against a spring to compress the spring by a distance x . It is then released such that the block eventually separates from the spring and it slides across a surface where the friction coefficient is μ_k . The same process is applied to block B. Which one of the following statements concerning the distance that each block slides before stopping is correct?
 - (a) Block A slides one-fourth the distance that block B slides.
 - (b) Block A slides one-half the distance that block B slides.
 - (c) Block A slides the same distance that block B slides.
 - (d) Block A slides twice the distance that block B slides.
 - (e) Block A slides four times the distance that block B slides.

5. Three events are observed at a baseball game:

I. A baseball is thrown by a pitcher. It starts from rest and is traveling at +38 m/s as it flies toward the catcher.

II. A baseball is traveling at +38 m/s when it enters the catcher's glove and stops.

III. A baseball is traveling at +38 m/s when it hits a wall and bounces away from the wall at -38 m/s.

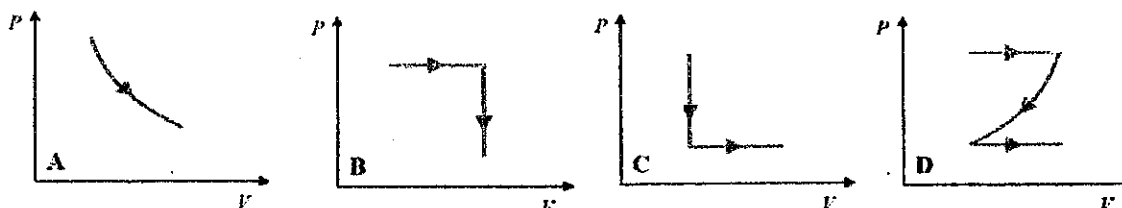
The change in the momentum of the baseball has the largest magnitude in which case(s)?

(a) I only, (b) II only, (c) III only, (d) I and II only, (e) II and III only

6. A woman stands on a platform with a diameter D_1 that acts as a piston. The combined mass of the woman and the piston is 75 kg. The piston pushes downward on a reservoir of oil that supports a second platform with a diameter D_2 on which 12 women are standing. The combined mass of the second platform and the 12 women is 780 kg. Both platforms are at the same height during this demonstration; and they are at rest. What is the ratio D_2/D_1 ?

(a) 2.4, (b) 3.2, (c) 4.8, (d) 10, (e) 12

7. Consider the following pressure-volume graphs. Which of these graphs represents the behavior of a gas undergoing free expansion?



(a) A, (b) B, (c) C, (d) D, (e) None of the graphs represent a gas undergoing free expansion.

8. Gauss' law may be written: $\Phi = \oint \vec{E} \cdot d\vec{A} = q/\epsilon_0$. Which of the following statements concerning the charge q is true?

(a) The charge q is the sum of all charges.

(b) The charge q is the sum of all charges on the Gaussian surface.

(c) The charge q is the sum of all charges inside the Gaussian surface.

(d) The electric field due to q is zero inside the Gaussian surface.

(e) The charge q is the amount of charge present whenever the electric field is constant.

9. An electron traveling due east in a region that contains only a magnetic field experiences a vertically downward force, toward the surface of the earth. What is the direction of the magnetic field?

(a) upward, away from the earth, (b) downward, toward the earth, (c) due north,

(d) due west, (e) due south.

10. A special microscope has been set up that allows the user to view a specimen using light from among the colors listed below. Which of these would you choose to use for the best resolution?
(a) yellow, (b) red, (c) violet, (d) blue, (e) green.
11. When the photoelectric effect experiments were performed, one effect was inconsistent with classical physics. What was it?
(a) The fact that electrons could form a current within a vacuum.
(b) The kinetic energy of the ejected electrons increased as the frequency of light increased.
(c) The fact that light could free electrons from the surface of a metal.
(d) The kinetic energy of the ejected electrons increased as the wavelength of light decreased.
(e) The kinetic energy of the ejected electrons did not vary with light intensity.

第二部分：計算題，3 題，共 45 分。

計算題請依題號次序作答，並寫出計算過程。

1. (20%) A 250 g block is dropped onto a relaxed vertical spring that has a spring constant k of 0.75 N/cm. The block becomes attached to the spring and compresses the spring 12 cm before momentarily stopping. While the spring is being compressed, what work is done on the block by (a) the gravitational force on it and (b) the spring force? (c) What is the speed of the block just before it hits the spring? (Assume that friction is negligible.)

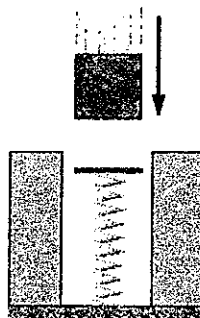


Figure 1

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2. (15%) Referring to the Fig.2, a conducting rectangular solid of dimensions $d_x = 5.00$ m, $d_y = 3.00$ m, and $d_z = 2.00$ m moves at constant velocity $\vec{v} = (20.0\text{ m/s})\hat{i}$ through a uniform magnetic field $\vec{B} = (30.0\text{ mT})\hat{j}$. What are the resulting (a) electric field within the solid and (b) potential difference across the solid?

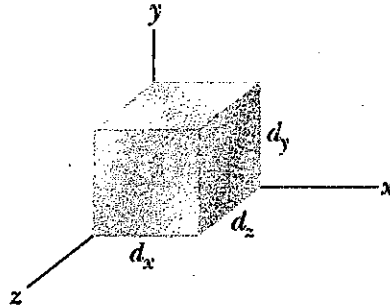


Figure 2

3. (10%) Referring to the Fig.3, light is incident perpendicular on a thin layer of material 2 that lies between (thicker) material 1 and 3. (The rays are plotted obliquely only for clarity.) Part of light ends up in material 3 as rays r_3 (the light does not reflected into material 2) and r_4 (the rays reflected twice inside material 2). The waves r_3 and r_4 interfere to be minimum. The refractive index of three materials are, $n_1 = 1.55$, $n_2 = 1.63$, and $n_3 = 1.33$, respectively. The wavelength of the incident light is 612 nm. Find the third least thickness of the thin layer, L .

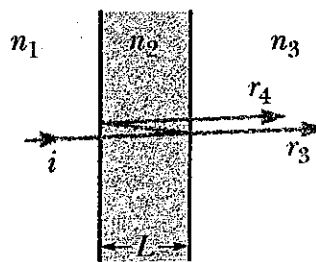


Figure 3