

國立中正大學 104 學年度學士班二年級轉學生招生考試試題

地球與環境科學系、物理學系

學系別：化學暨生物化學系、電機工程學系

科目：普通物理

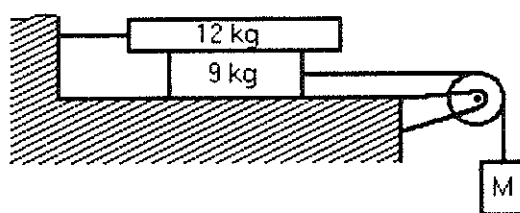
機械工程學系、通訊工程學系

第 2 節

第 1 頁，共 5 頁

(一) 選擇題 (50%)

1) A system comprising blocks, a light frictionless pulley, and connecting ropes is shown in the figure below.



The 9 kg block is on a smooth horizontal table ($\mu = 0$). The surfaces of the 12 kg block are rough, with $\mu_k = 0.30$. The mass M is set at 5.0 kg. It accelerates downward when it is released. The acceleration of mass M is closest to:

- A) 1.0 m/s^2
- B) 1.2 m/s^2
- C) 1.4 m/s^2
- D) 1.6 m/s^2
- E) 1.8 m/s^2

- 2) A spherical ball of lead (density 11.3 g/cm^3) is placed in a tub of mercury (density 13.6 g/cm^3). Which answer best describes the result?
- A) The lead ball will float with about 83% of its volume above the surface of the mercury.
 - B) The lead ball will float with its top exactly even with the surface of the mercury.
 - C) The lead ball will float with about 17% of its volume above the surface of the mercury.
 - D) The lead will sink to the bottom of the mercury.
 - E) None of the above.

- 3) Which of the following is an accurate statement?
- A) A system like a vibrating string has only one possible frequency.
 - B) In order for a singer to break a wine glass by singing, she must adjust the amplitude of the sound she makes so that it is exactly equal to the amplitude of vibration of the wine glass.
 - C) The fundamental frequency of a system is the name given to the highest possible frequency at which the system will naturally vibrate.
 - D) The sound in an organ pipe can vibrate at an infinite number of frequencies.

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4) In a 35 mm single lens reflex camera (SLR) the distance from the lens to the film is varied in order to focus on objects at varying distances. Over what range must a lens of 40 mm focal length vary if the camera is to be able to focus on objects ranging in distance from infinity down to 1.1 m from the camera?

- A) 1.51 mm
- B) 1.21 mm
- C) 4.53 mm
- D) 6.04 mm
- E) 2.11 mm

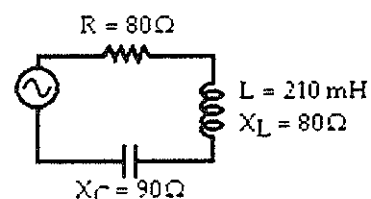
5) An important feature of the Carnot cycle is that

- A) its efficiency can be 100%.
- B) its efficiency depends only on the absolute temperature of the hot reservoir used.
- C) its efficiency is determined by the temperatures of the hot and cold reservoirs between which it works and by the properties of the working substance used, and on nothing else.
- D) it is an example of an irreversible process that can be analyzed exactly without approximations.
- E) no engine can be more efficient than a Carnot engine operating between the same two temperatures.

6) Which of the following changes would increase the separation between the bright fringes in the diffraction pattern formed by a diffraction grating?

- A) Increase the wavelength of the light used.
- B) Increase the separation between the slits.
- C) Immerse the apparatus in water.
- D) None of these.

7) A series ac circuit is shown. The inductor has a reactance of 80 ohms and an inductance of 210 mH. An 80 ohm resistor and a capacitor whose reactance is 90 ohms are also in the circuit. The rms current in the circuit is 2.0 A. In the figure below, the voltage amplitude across the capacitor is closest to:



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- A) 180 V
- B) 110 V
- C) 320 V
- D) 250 V
- E) 400 V

8) Three light bulbs, A, B, and C, have electrical ratings as follows:

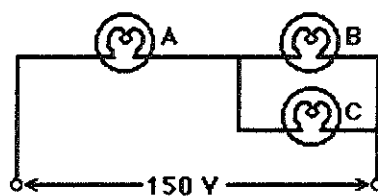
Bulb A - 85 W, 1.1 A

Bulb B - 80 V, 205 W

Bulb C - 120 V, 0.9 A

The three bulbs are connected in a circuit, which is across a 150-V line, as shown.

Assume the filament resistances of the light bulbs are constant and independent of operating conditions. In figure below, the equivalent resistance of the circuit is closest to:

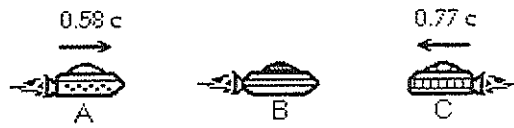


- A) 76 Ω
- B) 96 Ω
- C) 110 Ω
- D) 130 Ω
- E) 150 Ω

9) A certain electromagnetic field traveling in vacuum has a maximum electric field of 1200 V/m. What is the maximum magnetic field of this wave?

- A) 3.4×10^{-4} T
- B) 4.0×10^{-6} T
- C) 2.2×10^{-5} T
- D) 9.6×10^{-6} T
- E) 8.7×10^{-6} T

10) Three spaceships A, B, and C are in motion. The commander on ship B observes ship C approaching with a relative velocity of $0.77c$. The commander also observes ship A, advancing in the rear, with a relative velocity of $0.58c$. In the figure below, the velocity of ship C, relative to an observer on ship A, is closest to:



- A) $0.13c$
- B) $0.34c$
- C) $0.93c$
- D) $1.4c$
- E) $2.4c$

(二) 計算與簡答題 (50%)

1. (10 points) A 3.0-kg block sits on top of a 5.0-kg block which is on a horizontal surface. The 5.0-kg block is pulled to the right with a force $F = 20\text{ N}$ as shown in Fig. 1. The coefficient of kinetic friction (μ) is 0.40, what is the acceleration of each block?

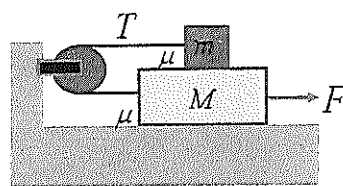


Fig. 1

2. (15 points) A ring of mass M and radius R rolls without slipping down an incline as shown in Fig. 2. (a) Find the linear acceleration of the center of mass. (b) What is the minimum coefficient of friction required for the ring to roll without slipping.

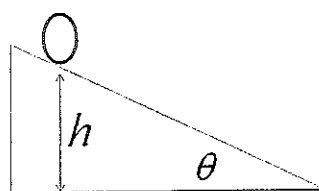


Fig. 2

3. (10 points) The operation of a certain heat engine takes an ideal monatomic gas through a cycle shown as the rectangle on the PV diagram of Fig. 3. Determine the efficiency of this engine.

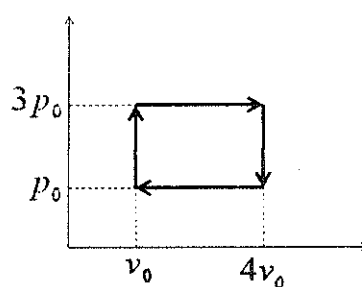


Fig. 3

4. (15 points) A sphere of radius R has a uniform charge density ρ C/m³ except for a spherical cavity of radius a as shown in Fig. 4. (a) Show that the field within the cavity is uniform. (b) What is the magnitude and direction of the field within the cavity?

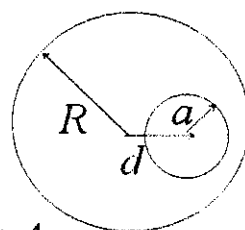


Fig. 4