私立臺北醫學院 89 學年度第 一 學期 期中 (期末) 考試 命(試) 題紙

系級	科目	授課教師	考試日期	學號	姓名
公一	普通物理學	蔡文鋒	90年1月10日第3.4節		

※①請注意本試題共____張。如發現頁數不足及空白頁或缺印，應當場請求補齊，否則缺少部份概以零分計。
②每張試題卷務必填寫(學號)、(姓名)。

教務處公佈專用

(1) Assume that U, c_v, and c_p respectively represent the internal energy, the molar specific heat at constant volume and the molar specific heat at constant pressure of an ideal gas system in a state of (pressure P, volume V, temperature T) . As the gas system of n moles absorbs a heat quantity dQ , it has the volume change dV, the pressure change dP, the temperature change dT , and the internal energy change dU. R is the universal gas constant. Complete the following mathematical forms for describing this ideal gas system .

(a) The work dW done by the gas system on the surroundings is dW = ___①___ .

(b)The first law of thermodynamics gives the relationship among dQ , dU , and dW as ___②___ . Thus the first law of thermodynamics gives the relationship among dQ , dU , and dV as ___③___ .

(c) Using dQ , dT, and n , give the definitions respectively for c_v, and c_p : c_v = __④___ ; c_p = ___⑤____ . And give the relationship between c_v, and c_p : ___⑥___ .

(d) Using n , c_v, and dT , give the measurement for dU : ___⑦____ .

(e) The first law of thermodynamics gives the relationship among dQ , dT , and dV as ___⑧____ . And the first law of thermodynamics gives the relationship among dQ , dT , and dP as ___⑨___ .

(f) The value γ for the gas system is defined by c_v, and c_p as : γ = ___⑩___ .

The γ value for air is about ___⑪___ .

(g) As the gas system undergoes an adiabatic process, the value dQ = ___⑫____ and the values of P , V , and γ are satisfied by the equation : _____⑬____ .

(2) The mass density of hydrogen iodide (HI) gas at STP (0℃, 1 atm) is about 5.79 g / liter.

(a) Write down the formula for sound speed and calculate the sound speed V_0 as the sound wave propagates in HI at STP. (b) Write down the empirical formula for the sound speed V at temperature T℃ and indicate how the sound speed depends on temperature . (c) What is the sound speed as the sound wave propagates in HI gas at 25℃ and 1 atm ?

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(3) Assume that the sound speed in human fat is about 1.5 km/ s and the human fat has a width of about 5 mm. (a) Determine the frequency of the incident sound which can be used to obtain high resolution for imaging . (b) Is this incident sound in the range of ultrasound ? Give the definition of ultrasound and then explain your answer.

(4) (a) What is the range of the audible intensities in our acoustic environment. (b) Give the definition of sound intensity level β (IL) in unit of dB . (c) Find the β values in unit of dB for the range of the audible intensities in our acoustic environment.

(5) A 5000-watt sound power is emitted uniformly in all directions from the speakers at a rock concert at a temperature of 15℃ in the park. Assume that the sound spreads hemispherically with minimal absorption in the air. (a) Estimate the sound intensity I in watts / m^2 and the sound intensity level β in dB received by a person at a distance of 100 m from the speaker.

(b) If this person's eardrum has an area of $65mm^2$, how much sound energy is incident on his eardrum in 30 minutes ? (Hint : Use the definition for intensity to find your answers .)

(6) Two independent sound sources individually produce intensity levels of 70 dB and 50 dB at some point. (a) Find the total intensity I in unit of watts / m^2 at that point. (b) Find the total intensity level β in unit of dB. (c) Is the sound perceptional at that point ? Give the range of the perceptional for the sound intensity level and then explain your answer .

(7) Explain how the Doppler effect can be used to aid police in detecting speeding drivers.

(8) The average speed of sound in blood is 1570 m / s. The transmitter crystal emits 0.2-MHz sound waves in a Doppler flow meter. If a frequency shift of 100 Hz is measured by the receiver crystal, estimate the average velocity of the red cell moving in the blood vessel.

(9) Assume that a patient has blood pressure of 160 mm-Hg. Convert his blood pressure into the other useful units for fluid pressure as follows :

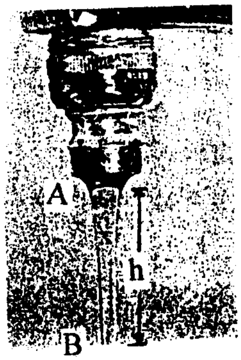
160 mm-Hg = __①__ torrs = __②__ atm = __③__ nt/m^2 = __④__ hp = __⑤__ mb

(Please show your detail calculations for each of your answers in your answer sheet.)

(10) Give the following physical meanings :

(a) A steady fluid flow means that ___①___. (b) An incompressible fluid flow means that ___②___. (c) An ideal fluid means that the fluid is ___③___ .

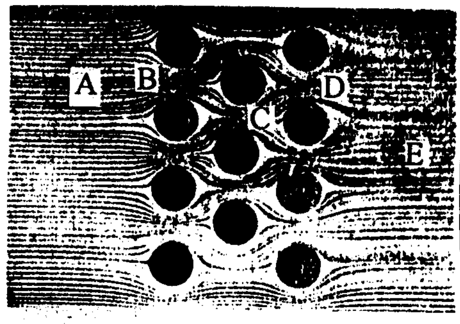
(11) The figure as shown is the water flow from a faucet. Water leaves the faucet in steady and near-vertical flow. Position A represents the outlet of the faucet.



D_0 is the diameter of the water column and v_0 is the flow velocity at position A . Position B is at a downward distance h from the outlet of the faucet. The diameter of the water column is D and the flow velocity is v at position B . The atmospheric pressure is P_a , the gravitational acceleration is g and the water density is ρ .

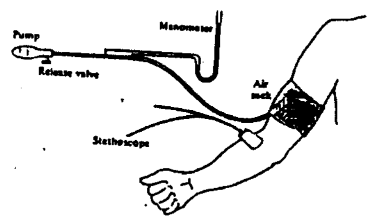
(a) Write down the Bernoulli's equation for positions A and B .
(b) Using the Bernoulli's equation in (a) , find the flow velocity v at B .
(c) Write down the continuity equation for positions A and B .
(d) Using the continuity equation in (c) , find the diameter D at B .
(e) Draw the tube of flow with cross-sections at A and B for this water flow.

(12) The figure as shown is a fluid flowing through an array of cylinders. The flow is from left to right in the figure. The dark lines that illustrate the flow pattern are formed by dye injected into the fluid.



(a) Give the physical meanings for the dark lines.
(b) Compare the flow velocity V_A at position A with the flow velocities V_B, V_C , V_D , and V_E respectively at positions B ,C , D , and E .

(13) The systolic blood pressure (心縮壓) can be measured with the sphygmomanometer (血壓計) by using a U-shaped manometer as the figure shown .



(a) Indicate the appropriate height the air sack should be wrapped around the upper arm. Write down the Bernoull's equation to explain your answer.
(b) Assume that a man of 175 cm in height has normal systolic BP of 120 mm-Hg and his heart has a height of about 130 cm. The atmospheric pressure is 770 mm-Hg . The density of the mercury is13.6 g/cm^3.
(i) What is the height difference h between the two columns of the manometer?
(ii) What are the gauge pressure P_g and the absolute pressure P_a of the man's systolic BP in unit of mm-Hg ?
(iii) Use the Bernoull's equation to estimate his blood pressure in mm-Hg in the brain.
(iv) As the man stands in an elevator which moves upward at an acceleration of 5 m/s^2, estimate his blood pressure in mm-Hg in the brain.
(The gravitational acceleration g = 10 m/s^2.)

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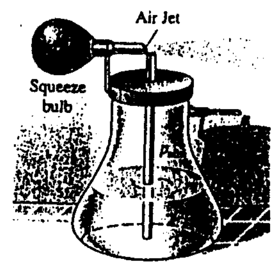
(14) As the figure shown, the water filled in the bottle of the atomizer can be pushed up and dispersed by using the squeeze bulb. Write down the Bernoull's equation to explain the observed phenomenon.



(15) Water flows through a horizontal pipe of cross-sectional area A of 10 cm^2 with a velocity of 5 m/s and a static pressure 1.5 atm . If the pipe narrows down so that it cross-sectional area B becomes 2 cm^2, find (a) the flow velocity, (b) the kinetic pressure , and (c) the static pressure. The mass density of water is 1 g/cm^3.

(16)An artery of radius 0.5 cm carries blood at a flow rate $Q = 10\ cm^3/s$. This artery branches into smaller and smaller blood vessels until finally the blood travels in about 2×10^8 capillaries of radius 500 μm .The mass density of blood is 1.0595 g/cm^3 .
(a) What is the mass flow rate in unit of g/s in a single capillary ? (b)Calculate the flow velocities of the blood in unit of cm/s respectively through the artery and through a single capillary. You will find that there exists a significant velocity drop across the artery and the capillaries because of very small flow rate in each capillary.

(17) The following paragraphs are from " The Physics of Radiation therapy , 2nd ed. , by Fraiz M. Kham (1994) ". Please translate them into Chinese.

Ultrasonic imaging for delineating patient contours and internal structure is becoming widely recognized as an important tool in radiotherapy. Ultrasound may be used to produce images either by means of transmission or reflection.

In most clinical applications, however, use is made of ultrasonic waves reflected from different tissue interfaces. These reflections or echoes are caused by variations in acoustic impedance Z of materials on opposite sides of the interfaces. The larger the difference in Z between the two media, the greater is the fraction of ultrasound energy reflected at the interface. For example, strong reflections of ultrasound occur at the air-tissue, tissue-bone, and chest wall-lung interfaces due to high impedance mismatch.

Attenuation of the ultrasound by the medium also plays an important role in ultrasound imaging. This attenuation takes place as the energy is removed from the beam by absorption, scattering, and reflection. Because the attenuation of energy is very high for born compared with soft tissue, it is difficult to visualize structures lying beyond bone. On the other hand, water, blood, fat, and muscle are very good transmitters of ultrasound energy.