

PHYSICS 204

FINAL EXAM (two hours)

29 JAN 1996

NAME : _____ ID# _____ Sect _____

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section 2.	9MWF	Dr. Trad
section 3.	10MWF	Ms. Rahhal-Arabi
section 4.	11MWF	Dr. Katul
section 5.	12 MWF	Dr. Bodakian

Conversion factors and physical constants

- 1 atm = 1.01×10^5 Pa = 760 mmHg
- 1 calorie = 4.186 Joules
- Density of blood $\rho = 1.06 \times 10^3$ kg/m³
- Viscosity of blood $\eta = 4.0 \times 10^{-3}$ N.s/m²
- acceleration due to gravity $g = 9.8$ m/s²
- Young's modulus $Y_{Al} = 7.0 \times 10^{10}$ N/m²
- $Y_{Cu} = 12 \times 10^{10}$ N/m²
- Coefficient of linear expansion $\alpha_{Cu} = 17 \times 10^{-6}$ K⁻¹
- Stefan's Constant $\sigma = 5.67 \times 10^{-8}$ W/m².K⁴
- Universal gas constant $R = 8.31$ J/mol.K
- Boltzman constant $k = 1.38 \times 10^{-23}$ J/K
- Avogadro's number $N_A = 6.023 \times 10^{23}$ molecules/mol

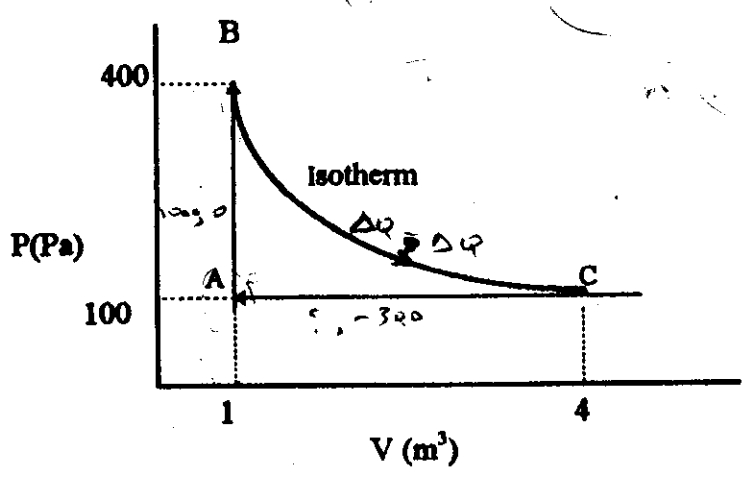
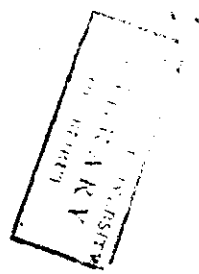


Fig .1



$\theta = \Delta \theta$

PART A (30 %) Encircle correct answer or provide it

1. If r is the ratio of the speed of sound and the molecular rms speed in a gas then for any gas
- a) $r > 5/9$ b) $r = 1.0$ c) $0 < r < 1/3$ d) $1/3 < r < 5/9$
- e) none of the above, my answer is _____
2. Using a soap solution for which the surface tension is 0.025 N/m , a child blows a soap bubble of radius 1.1 cm . The energy expended in stretching the bubble surface is (in μJ)
- a) 9.5 b) 71 c) 38 d) 18
- e) none of the above, my answer is _____
3. Two weights W_1 and W_2 are hung from wires of equal length. The wire supporting W_1 is of aluminum diameter 1.6 mm and that supporting W_2 is of copper diameter 1.0 mm . If both wires stretch by the same amount, the ratio $W_1/W_2 =$ _____
4. In an isobaric process the density of a gas is
- (a) proportional to temperature T (b) independent of T (c) proportional to $1/T$
5. The optical device(s) which can produce both real and virtual images of a real object is (are):
- (a) convex lens (b) concave lens (c) convex mirror (d) concave mirror (e) plane mirror
- f) none of the above.
6. It is necessary to coat a glass lens with a nonreflecting layer. If the wavelength of the light in the coating is λ , the best choice is a layer of material having an index of refraction between those of glass and air and minimum thickness of
- a) λ b) $\lambda / \sqrt{2}$ c) $\lambda/2$ d) $\lambda/4$



Part B (70%) Encircle correct answer or provide solution

I- Suppose that a whisper has an intensity level of 20 dB at a distance of 0.60 m from the speaker's mouth. At what distance will this whisper be just below your threshold of hearing? (in m)

- a) 5.3 b) 4.2 c) 3.1 d) 2.0
e) none of the above, my answer is _____

II- A heat engine utilizes the cycle shown in Fig. 1. where process BC is isothermal.

1. Fill in the missing entries in the following table (SI units)

	$\Delta Q(J)$	$\Delta W(J)$	$\Delta U(J)$
A \rightarrow B	1000	0	1000
B \rightarrow C		-	
C \rightarrow A		-	

2. The efficiency of the engine is _____

III- The radiative power of a hot body can be trebled by trebling its temperature. Find this temperature.

Solution

7. Dispersion by a diffraction grating is a consequence of
- the dependence of wavelength of the incident light on the index of refraction
 - the interference of many coherent sources
 - the dependence of frequency of incident light on index of refraction
 - interference of many incoherent sources.
8. A transverse sine wave has an amplitude $A = 0.50$ cm and a wavelength $\lambda = 30$ cm. Its displacement at position $x = 10$ cm is (in cm)
- 0.25
 - 0.43
 - 0.36
 - 0.5
 - none of the above, my answer is _____
9. Light propagation through an endoscope can be explained by
- refraction
 - diffraction
 - dispersion
 - total internal reflection
10. A solid block of wood ($\rho = 0.7$ g/cm³) floats on water. The fraction of its volume above the surface of water is (in %)
- 60
 - 40
 - 30
 - 10
 - none of the above, my answer is _____
11. A copper wire is 305 cm long at 72° F. Its length at 30° F is ΔL =
- 2.2 mm shorter
 - 1.2 mm shorter
 - 2.2 mm longer
 - 1.2 mm longer
 - none of the above, my answer is _____
12. The skin temperature of a nude person, sitting in a room at 20°C, is 28°C. If the total surface area of the body is 1.9 m² and the emissivity and absorbtivity of human skin is 0.97, the net rate of heat loss by radiation from the person's body is (in W)
- 46
 - 58
 - 66
 - 76
 - none of the above, my answer is _____

I- Water at a pressure of 0.30 atm flows through a horizontal pipe of 2.0 cm diameter at a flow rate $Q = 0.20 \text{ L/s}$. At one point in the pipe there is an obstruction that reduces the cross-sectional area to 0.80 cm^2 . The pressure in the constricted area is (in kPa)

- a) 57 b) 40 c) 27 d) 17
 e) none of the above, my answer is _____

II- A myopic eye has a near point 15 cm and a far point 33 cm.

1. The power of the lens that corrects the distance vision is (in D)

- a) + 2.0 b) -2.0 c) + 1.5 d) -1.5
 e) none of the above, my answer is _____

2. The range of clear vision is (in cm)

- a) before correction _____
 b) after correction: _____

III- A balloon occupies a volume of 16 m^3 when filled with helium at STP. How much heat is required to raise the temperature of the gas to 60°C if the balloon expands at atmospheric pressure.

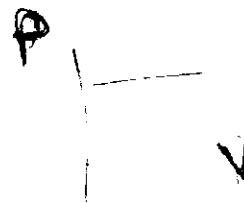
Solution

$V = 16 \text{ m}^3$
 $P = 1 \text{ atm}$

$n_1 V_1 = n_2 V_2$

$\frac{(P_1 \cdot P_2) T V^{\gamma}}{8 L n}$

Pressure



I- A string is fixed between two supports separated by 0.80 m. If the string is under tension of 300 N and the resonance frequency of its 3rd overtone is 1200 Hz, then its linear density is (in g/m)

- a) 0.73 b) 2.6 c) 1.3 d) 0.32
- e) none of the above, my answer is _____

II- Railroad tracks are spaced 1.7 m apart. If the diameter of the eye pupil is 3 mm and the average wavelength of daylight is 500 nm

1. The minimum angular separation for which the rails are just resolved by the eye is (in milliradian)

- a) 0.18 b) 0.24 c) 0.19 d) 0.25
- e) none of the above, my answer is _____

2. A passenger in an airplane can just resolve the two rails when the plane reaches a height of (in km)

- a) 5.7 b) 8.4 c) 7.5 d) 9.1
- e) none of the above, my answer is _____

III- A patient is given sucrose intravenously. Her venous pressure is 18 mmHg and the elevation difference between the intravenous needle and the sucrose bottle is 0.80 m. If the rate of sucrose flow is to be 2.0 mL/min, what should the diameter of the 4.0-cm long needle be? (Assume sucrose solution to have the same density and viscosity as blood.)

Solution

I- An optical system consists of two thin lenses in series, L_1 ($f_1 = +10$ cm) and L_2 ($f_2 = -5.0$ cm) separated by 10 cm. An object 2.0 cm long is placed 25 cm from L_1 .

1. The distance of the final image from L_2 is (in cm)

- a) -17 b) 10 c) 12 d) 25

e) none of the above, my answer is _____

2. The image is:

a) real, inverted, reduced b) virtual, inverted, reduced

c) real, erect, magnified d) virtual, erect, magnified

e) none of the above, my answer is _____

3. The magnification of the system is _____

II- Two cars are driving on the same road in opposite directions. The speed of the first car is 90 km/h and that of the second is 60 km/h. The horns of both cars emit tones of the same frequency 424 Hz. Calculate the frequency that each driver hears coming from the other car (speed of sound in air 331 m/s).

Solution

$$v = 90 \text{ km/h} \rightarrow \frac{90000}{3600} = 25 \text{ m/s}$$

$$v = 60 \text{ km/h} \rightarrow \frac{60000}{3600} = 16.67 \text{ m/s}$$

$$f_s = 424 \text{ Hz}$$

$$f = 424 \text{ Hz}$$