

Instructor(s): *N. Sullivan*PHYSICS DEPARTMENT  
Midterm Exam 3

PHY 2004

April 6, 2012

Name (print, last first): \_\_\_\_\_ Signature: \_\_\_\_\_

*On my honor, I have neither given nor received unauthorized aid on this examination.***YOUR TEST NUMBER IS THE 5-DIGIT NUMBER AT THE TOP OF EACH PAGE.**

- (1) **Code your test number on your answer sheet (use lines 76–80 on the answer sheet for the 5-digit number).** Code your name on your answer sheet. **DARKEN CIRCLES COMPLETELY.** Code your UFID number on your answer sheet.
- (2) Print your name on this sheet and sign it also.
- (3) Do all scratch work anywhere on this exam that you like. **Circle your answers on the test form.** At the end of the test, this exam printout is to be turned in. No credit will be given without both answer sheet and printout.
- (4) **Blacken the circle of your intended answer completely, using a #2 pencil or blue or black ink.** Do not make any stray marks or some answers may be counted as incorrect.
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$$g = 9.80 \text{ m/s}^2$$

$$R = 8314 \text{ J/kmole K}$$

1. (5 points) A cubic block of wood floats in water with 11% of its volume above water. If the density of water is 1,000 kg/m<sup>3</sup>, what is the density of the wood?

(1) 990 kg/m<sup>3</sup>      (2) 1100 kg/m<sup>3</sup>      (3) 2200 kg/m<sup>3</sup>      (4) 890 kg/m<sup>3</sup>      (5) 110 kg/m<sup>3</sup>

2. (4 points) A steel beam has a length of 10 m and a cross-sectional area of 1 cm<sup>2</sup>. If the length of the beam changes by 5 mm with an applied force of 10,000 N, what is the Young's modulus of steel?

(1) 200 GPa      (2) 112 GPa      (3) 15 GPa      (4) 2000 GPa      (5) 7,200 GPa

3. (4 points) A 2 m<sup>3</sup> steel gas cylinder contains natural gas at a pressure of 200 kPa at a temperature of 27°C. If the gas is compressed to 300 kPa, what is the final temperature?

(1) 177°C      (2) 300°C      (3) 57°C      (4) 200°C      (5) 427°C

4. (4 points) A 15 m<sup>3</sup> volume of ideal gas is compressed adiabatically. If the work done by the outside force is 2700 J, what is the change in internal energy of the gas?

(1) 0 J      (2) -2700 J      (3) 1350 J      (4) -1350 J      (5) 2700 J

5. (3 points) A 2 meter length of steel changes length by 2.4 mm during the course of a day. If the coefficient of thermal expansion of steel is 12 parts per million per °C, what is the change in temperature of the steel?

(1) 100°C      (2) 24°C      (3) 12°C      (4) 373°C      (5) 273°C

6. (3 points) The heat capacity of an object is 3500 J/kg K. Calculate the amount of heat required to raise the temperature of the object by 1.5°C if its mass is 60 grams.

(1) 315 J      (2) 720 J      (3) 7.5 J      (4) 1350 J      (5) 125 J

7. (5 points) A piece of metal is weighed in air and then weighed while immersed in oil of density 600 kg/m<sup>3</sup>. If the weight in air is 2.2 kg and the weight in the oil is 1.5 kg, calculate the density of the metal.

(1) 1890 kg/m<sup>3</sup>      (2) 8.86 kg/m<sup>3</sup>      (3) 135.1 kg/m<sup>3</sup>      (4) 3.68 kg/m<sup>3</sup>      (5) 1.89 kg/m<sup>3</sup>



Instructor(s): *N. Sullivan*PHYSICS DEPARTMENT  
Exam 3

PHY 2004

November 19, 2010

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 $g = 9.80 \text{ m/s}^2$

$R = 8314 \text{ J/kmole/K}$ 

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1. (4 points) In the compression chamber of a diesel engine the volume of a gas mixture initially at  $27^\circ\text{C}$  is compressed by a factor of 20 ( $V_{\text{Final}} = 1/20 V_{\text{Initial}}$ ). If the pressure increases from 1 atmosphere to 50 atmospheres, what is the final temperature?
  - (1)  $477^\circ\text{C}$
  - (2)  $954^\circ\text{C}$
  - (3)  $273^\circ\text{C}$
  - (4)  $0^\circ\text{C}$
  - (5)  $1430^\circ\text{C}$
2. (5 points) A misshapen lump of metal is weighed in air and then weighed while immersed in oil of density  $800 \text{ kg/m}^3$ . If the weight in air is 2.2 kg and the weight in the oil is 1.2 kg, calculate the density of the metal.
  - (1)  $1760 \text{ kg/m}^3$
  - (2)  $2650 \text{ kg/m}^3$
  - (3)  $92 \text{ kg/m}^3$
  - (4)  $36.8 \text{ kg/m}^3$
  - (5)  $13.5 \text{ kg/m}^3$
3. (4 points) A 5 meter length of steel with a cross-sectional area of  $20 \text{ cm}^2$  is compressed with a force of 20,000 N. If the Young's modulus of steel is  $200 \times 10^9 \text{ N/m}^2$ , what is the change in length of the steel beam?
  - (1) 0.25 mm
  - (2) 2.5 cm
  - (3) 5.5 cm
  - (4) 0.11 cm
  - (5) 12.5 mm
4. (5 points) A cylinder of radius  $b$  has a moment of inertia  $I = (1/2)mb^2$ . The cylinder is rolled along a flat horizontal surface at speed  $v$  so that when it hits a ramp, it will travel to a height of 50 cm and then stop. What is the initial speed  $v$  of the cylinder?
  - (1) 2.6 m/s
  - (2) 5.25 m/s
  - (3) 12.2 m/s
  - (4) 1.22 m/s
  - (5) 52.5 m/s
5. (4 points) An object has a moment of inertia of  $2.56 \text{ kg}\cdot\text{m}^2$ . What is the value of the torque needed to accelerate the rotation of the object from rest to a rotation of 5 revolutions per second in 30 seconds?
  - (1)  $2.68 \text{ N}\cdot\text{m}$
  - (2)  $1.34 \text{ N}\cdot\text{m}$
  - (3)  $0.27 \text{ N}\cdot\text{m}$
  - (4)  $4.02 \text{ N}\cdot\text{m}$
  - (5)  $0 \text{ N}\cdot\text{m}$
6. (4 points) A  $5\text{m}^3$  tank of compressed helium gas has an absolute pressure of 4 kPa at a temperature of  $27^\circ\text{C}$ . What is the mass of the helium in the tank? 1 kmole of helium weighs 4 kg.
  - (1) 33 g
  - (2) 13.5 g
  - (3) 1.61 kg
  - (4) 0.35 kg
  - (5) 6.42 kg
7. (4 points) A 100 meter length of steel changes temperature by  $30^\circ\text{C}$  during the course of a day. If the coefficient of thermal expansion of steel is 12 parts per million per  $^\circ\text{C}$ , what is the change in length of the steel?
  - (1) 3.6 cm
  - (2) 7.2 cm
  - (3) 14.4 mm
  - (4) 1.8 m
  - (5) 0.18 cm



Instructor(s): *N. Sullivan*PHYSICS DEPARTMENT  
Midterm Exam 3

November, 2011

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$$g = 9.80 \text{ m/s}^2$$

$$R = 8134 \text{ J/kmole K}$$

1. (4 points) A volume of gas initially at  $37^\circ\text{C}$  is compressed by a factor of 10 ( $V_{\text{Final}} = 1/10V_{\text{Initial}}$ ). If the pressure increases from 112 kPa to 1904 kPa, what is the final temperature?

- (1)  $254^\circ\text{C}$                       (2)  $855^\circ\text{C}$                       (3)  $473^\circ\text{C}$                       (4)  $0^\circ\text{C}$                       (5)  $1250^\circ\text{C}$

2. (5 points) A small piece of rock is weighed in air and then weighed while immersed in oil of density  $800 \text{ kg/m}^3$ . If the weight in air is 21.5 N and the weight in the oil is 11.8 N, calculate the density of the rock.

- (1)  $1750 \text{ kg/m}^3$                       (2)  $202.7 \text{ kg/m}^3$                       (3)  $1.38 \text{ kg/m}^3$                       (4)  $13.68 \text{ kg/m}^3$                       (5)  $9710 \text{ kg/m}^3$

3. (4 points) A 15 meter length of steel with a cross-sectional area of  $20 \text{ cm}^2$  is compressed with a force of 10,000 N. If the Young's modulus of steel is  $200 \times 10^9 \text{ N/m}^2$ , what is the change in length of the steel beam?

- (1) 0.38 mm                      (2) 2.3 cm                      (3) 4.47 mm                      (4) 0.19 cm                      (5) 12.5 mm

4. (4 points) A  $10 \text{ m}^3$  tank of compressed natural gas has an absolute pressure of 400 kPa at a temperature of  $27^\circ\text{C}$ . What is the mass of the gas in the tank? 1 kmole of natural gas weighs 16 kg.  $R = 8134 \text{ J/kmole K}$ .

- (1) 25.6 kg                      (2) 288 g                      (3) 196 g                      (4) 16.1 kg                      (5) 642 kg

5. (4 points) A 200 meter length of steel rail changes temperature by  $30^\circ\text{C}$  during the course of a day. If the coefficient of thermal expansion of steel is 12 parts per million per  $^\circ\text{C}$ , what is the change in length of the steel?

- (1) 72 mm                      (2) 1.44 cm                      (3) 14.4 mm                      (4) 1.8 m                      (5) 3.66 mm

6. (3 points) How much water at  $0^\circ\text{C}$  is required to cool a 200 kg human by  $1^\circ\text{C}$ . The heat capacity of the human body is  $3500 \text{ J/kg/K}$  and the heat capacity of water is  $4184 \text{ J/kg/K}$ .

- (1) 167 kg                      (2) 239 kg                      (3) 83.5 kg                      (4) 23.9 kg                      (5) 200 kg

7. (3 points) An engine operating in an ideal Carnot cycle involves an isothermal compression of  $2 \text{ m}^3$  of helium gas at  $200^\circ\text{C}$  and an isothermal compression of the gas at  $50^\circ\text{C}$ . What is the efficiency of this engine?

- (1) 31.7%                      (2) 75%                      (3) 100%                      (4) 63.4%                      (5) 87%

8. (4 points) A steel cylinder contains helium gas at a gauge pressure of 100 kPa and at a temperature of  $27^\circ\text{C}$ . The gas is heated and moves a piston in the cylinder 8 cm with the pressure held constant. If the area of the piston is  $150 \text{ cm}^2$  and the mass is 7 kg, calculate the work done by the gas.

- (1) 120 J                      (2) 1200 J                      (3) 256 J                      (4) 2560 J                      (5) 0 J

