Physics B
Section II

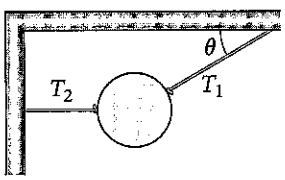
Time—90 minutes
7 Questions

Directions: Answer all seven questions, which are weighted according to the points indicated. The suggested time is about thirteen minutes for answering each question. Each question is worth 10 points. The parts within a question may not have equal weight. Show all your work in this booklet in the spaces provided after each part, NOT in the green insert.

Reference sheets: You may use "Table of Information for 2004 and 2005" and "Advanced Placement Physics B Equations for 2004 and 2005" for Section II.

Calculators: You may use an approved calculator for Section II.

1.



(10 points)
A circular sign is held aloft by two virtually massless ropes, as shown above.
(a) Draw a free body diagram for the sign, resolving the vertical and horizontal forces into their components.
(b) If the sign's mass is 5 kg and $\theta = 30°$, find the tension of each rope.
(c) If the left rope is cut, and the resulting motion of the sign is a simple pendulum with a period of 1.8 seconds, find the length of the T_1 rope.

2. (10 points)
A projectile is launched at 781 km/h at a 50.0° angle from the horizontal from a rooftop 765 meters from the ground.
(a) What are the vertical and horizontal components of the initial velocity vector in standard SI units?
(b) What will be the maximum height it attains above the building?
(c) What will be its horizontal distance when it hits the ground?
(d) At what angle should the projectile be fired using the same magnitude initial velocity so that it hits a target that is 2.5 km away and at the same height as the rooftop?

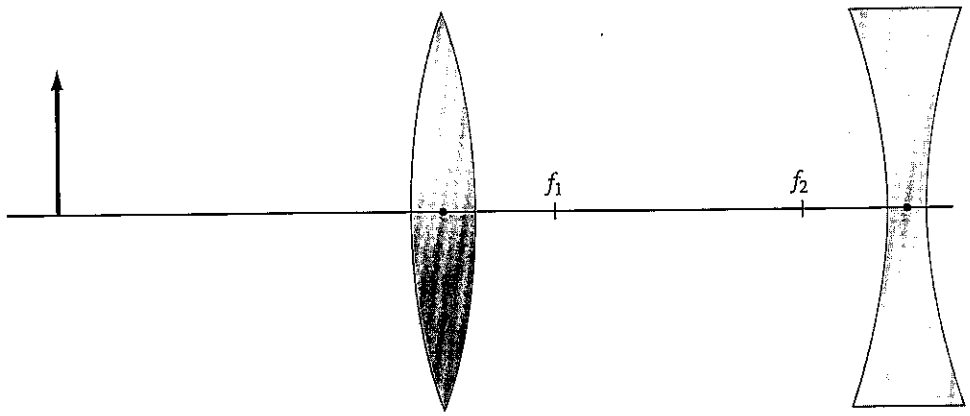
GO ON TO THE NEXT PAGE

3. (10 points)
The fluid velocity is measured at several points along the path of a pipe system that carries a liquid with a density of 0.55×10^3 kg/m^3.
   (a) What is the fluid velocity in a pipe with a 0.01 m radius at a point 25 meters above its intake pipe? The intake pipe has a 0.04 m radius and the fluid flows through it at a speed of 0.88 m/s at 3.2 atm.
   (b) What is the pressure in the pipe described above?
   (c) What is the pressure in the output pipe if it has the same dimensions given above but is at the same height as the intake pipe?

4. (10 points)
Draw four circuit diagrams using four 4 Ω resistors connected to a potential difference of 40 V to draw the following currents.
   (a) 2.5 A
   (b) 4 A
   (c) 10 A
   (d) 40 A
   (e) In general, how are resistance, potential difference, and current related?
   (f) What is the power used by each of these circuits?

5. (10 points)
A researcher conducts experiments to test the interactions of lengths of current-carrying wires and magnetic fields.
   (a) If a 24 cm wire is placed in a uniform 12 T magnetic field at 40° from the parallel, what current in the wire will produce a force of 26 N on the wire?
   (b) What is the maximum force that can be produced if the length, current, and magnetic field strength remain constant? How can this maximum force be obtained?
   (c) When this wire is not in the external magnetic field, what is the strength of the magnetic field due to the current at a point 30 cm from the wire?
   (d) When this wire is not in the external magnetic field, what is the force between this wire and an identical one carrying the same current in the same direction if they are 2 cm apart?
   (e) Draw a diagram of #5d and describe the direction of force.

6. (10 points)
Two lenses are arranged as shown on the next page.
   (a) If an object of height H meters is placed 16 cm from a convex lens of focal length 5 cm, which is, in turn, 16 cm from a concave lens of focal length 4 cm, what is the resulting image height?
   (b) On the diagram above, draw two distinct light rays from the top of the object to the final image through both lenses.
   (c) Justify the use of geometric optics for problem solving with regard to the wave theory of light.
   (*Note:* The diagram is not to scale.)



7. (10 points)
Experiments have produced evidence alternately bolstering each of two contradictory theories regarding the nature of light.
   (a) Briefly describe these two theories.
   (b) Describe what each theory predicts for the phenomenon of diffraction, and explain which theory accurately models the behavior of light that is observed.
   (c) Describe what each theory predicts for the phenomenon of the photoelectric effect, and explain which theory accurately models the behavior of light that is observed.
   (d) Describe what each theory predicts for the phenomenon of interference, and explain which theory accurately models the behavior of light that is observed.
   (e) How are these two theories reconciled?