**Mock Exam AP** **PHYSICS 2 FREE-RESPONSE QUESTIONS**

**AP PHYSICS 2 SECTION II Time—35 minutes 3 Questions**

**Directions: Answer all three questions, which are weighted according to the points indicated. The parts within a question may not have equal weight. Show all your work in this booklet in the spaces provided after each part.**



1. (10 points) A cylinder filled with an ideal gas is fitted with a movable frictionless piston. Initially, the gas is in state A at 20 kPa, 400K, and 0.5 m3. The gas is taken through a reversible thermodynamic cycle as shown in the PV diagram at right (not drawn to scale).
	1. Determine how many moles of gas are in the cylinder.
	2. Calculate the temperature of the gas at the following states:
		1. State B
		2. State C
	3. Determine the ***net*** work done on the gas during the cycle.
	4. Explain whether heat was added to the gas or removed from the gas during the cycle. Justify your answer.
2. (10 marks) Three point charges are situated as shown in the diagram at right.
	1. Find the magnitude of the electric field at the origin due to the three charges shown.
	2. On the diagram at right, draw an arrow to represent the net electric field vector at the origin. Label angle ***theta*** in your diagram.



* 1. Determine the angle theta in your diagram, in degrees.
	2. Calculate the electric potential at the origin.
	3. If an electron is placed at the origin, what electric potential energy does it possess? Answer in units of electron-volts.
1. (10 marks) An experiment is set up such that a beam of monochromatic light passes through a diffraction grating with 3000 lines/cm, creating a diffraction pattern on a screen located 0.1 meter from the grating. The distance between the central maximum and the next nearest bright line on the screen is 1.32 cm.
	1. Determine the wavelength of the incident light.
	2. What is the energy of each incident photon (in eV)?

The incident light is created by a filtered mercury arc lamp. A few energy levels of mercury are shown at right.

* 1. Which electron transition in the lamp is most likely responsible for creation of the photons striking the diffraction grating?
	2. The diffraction grating is replaced with a new grating containing 2000 lines/cm. Does the distance between maxima

\_\_\_ increase

\_\_\_ decrease

\_\_\_ remain the same

Explain your reasoning.