University Physics A(2) 2014

Worksheet #11: Gases and Engines

Name (名字): Student number (学号):

Problems Show all working.

(1) [M&I.13.P.21] You are on a spacecraft measuring 8 m by 3 m by 3 m when it is struck by a piece of space junk (垃圾), leaving a circular hole of radius 4 mm. About how much time do you have to repair the hole? Explain whatever approximations you make.

(2) (a)[M&I.13.X.24] If you expand the volume of a gas containing N molecules to twice its original volume, while maintaining a constant temperature, how much energy transfer due to a temperature difference is there from the surroundings?

(b) [M&I.13.X.25] If you compress a volume of helium containing N atoms to half its original volume in a well-insulated (保温的) container, what is the ratio of the final pressure to the initial pressure? [i.e. P_2/P_1 = ?]

(3) [M&I.13.P.27] A horizontal cylinder (圆柱) 10 cm in diameter contains helium gas (He) at room temperature and atmospheric pressure. A piston keeps the gas inside a region of the cylinder 20 cm long.

(a) If you *quickly* pull the piston outward a distance of 12 cm, what is the approximate temperature of the helium immediately afterward? What approximations did you make?

(b) How much work did you do, including the sign (i.e. positive or negative)? (HINT: you need to consider the outside air as well as the inside helium.)

(c) Immediately after the pull, what force must you exert on the piston to hold it in position (with the helium enclosed in a region that is 20 + 12 = 32 cm long)?

(d) You wait while the helium slowly returns to room temperature, holding the piston at its current location. After this wait, what force do you have to exert to hold the piston in position?

(e) Next, you very *slowly* allow the piston to move back into the cylinder, stopping when the region helium gas is 25 cm long. What force must you exert to hold the piston at this position? What approximations did you make?