Physics 161 Fall 2010 Exam 2
Numbers will be changed on the real exam.
Closed book closed notes calculators OK.
Temperatures in Kelvin, heats / energies are in J,
entropies in J/K

A monatomic ideal gas is taken around the reversible cycle
shown. *One segment is isothermal; one is adiabatic; one is
isochoric.*

$ac: \quad pV^\gamma = const.$

$P_c = P_A \left(\frac{V_A}{V_c}\right)^\gamma$

$= 315 \ N/m^2$

	A	B	C
P	1000 N/m^2	500	315
V	1 m^3	2	2
T	1000 K	1000	630 K

1&2. What is the work done *by* the gas on path AB? [Answer 1] x 10^{answer2} $nRT \ln 2 = 693 \ J$

3&4. What is the volume of the gas at C (in m^3)? [Answer 3] x 10^{answer4} 2

5&6. What is the heat removed from the gas on path BC? [Answer 5] x 10^{answer6} $Q = nC_V(T_f - T_i) = +\frac{3}{2}nR(-370)$

7&8. What is the work done *on* the gas on path CA? [Answer 7] x 10^{answer8} with $pV = nRT$ @ $nR = 1$

9] This is an (A) engine or (B) refrigerator. $Q_{TOT} = Q_{AB} + Q_{BC} + 0$ $Q_{BC} = -555 \ J$
$= 693 J - 555 J = 138 J$

10&11] What is the efficiency, in %?
$e = 138/693 = 20\%$ $W_{TOT} = 138 J = 693 J + W_{CA}$ $W_{CA} = -555 J$. ans. $= +555 J$.

Substance P melts at 200K. The latent heat of fusion is 120 J/g.
20 g of substance P is immersed in a very large oil bath at 300K.

12&13. What is the increase in entropy when substance P has melted, but is still at 200K? (at 200K / of P.)
$\Delta S_P = 20 \times 120/200 = 12 \ J/K$

14&15. What is the decrease in entropy in the oil bath? You may assume that the change in
temperature of the oil bath is negligible.
$\Delta S_{bath} = -20 \times 120/300 = 8 \ J/K$

16. This process is thermodynamically
A] reversible   B] irreversible   C] cannot determine

17. A finite (not infinitesimal) test charge is brought near a neutral, insulating sphere. The electric
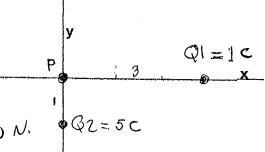force on the charge is
A] zero
B] weakly repulsive
C] weakly attractive
D] strongly repulsive
E] strongly attractive

18&19. The electric force on a test charge P caused
by point charge Q1 alone is 36 N. What is the
magnitude of the total electric force (in N) when Q2
is added at the point shown?

$Q1 = 1C$

$Q2 = 5C$

$F_{q_2} = 5 F_{q_1} \times \frac{3^2}{1^2} = 45 F_{q_1} = 1620 \ N.$

$F_{TOT} = \sqrt{1620^2 + 36^2} = 1620.3 \ N.$