First Letter of Last Name: ☐

The University of British Columbia
Midterm 1 - October 16, 2007
Physics 153
Elements of Physics **TIME:** 50 minutes

**CANDIDATE'S NAME:** _____
Last Name First Name or Initials

**SIGNATURE:** _____

**STUDENT NUMBER:** _____

**THIS EXAMINATION CONSISTS OF 3 QUESTIONS AND TOTAL OF 4 PAGES. CHECK TO ENSURE THAT THIS PAPER IS COMPLETE.**

**INSTRUCTOR'S NAME:** _____

**SECTION NUMBER:** _____

(a) Each candidate should be prepared to produce, upon request, his/her library/AMS card, driver's licence or other photo ID.

(b) Read and observe the following additional rules:

No candidate shall be permitted to enter the examination room after the expiration of one-half hour, or leave during the first half-hour of the examination.

Candidates are not permitted to ask questions of the invigilators, except in cases of supposed errors or ambiguities in examination questions.

**CAUTION:** Candidates guilty of any of the following, or similar, dishonest practices shall be immediately dismissed from the examination and shall be liable to disciplinary action.

(a) Making use of any books, memoranda, programmable calculators, audio or video cassette players or other memory aid devices ( ie PDAs or cell phones ) not specifically authorized by the examiners.

(b) Speaking or communicating with other candidates.

Each Question is worth a total of 10 points:

| 1 | 2 | 3 |
|---|---|---|
| _____ / 10 | _____ / 10 | _____ / 10 |

Total score is out of 30 points. Total: _____ / 30

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1. A steel rod 0.350 m long and an aluminum rod 0.250 m long, both with the same diameter, are placed end to end between rigid supports with no initial stress in the rods at -20 $^{\circ}C$. The temperature of the rods is now raised to 40 $^{\circ}C$. The length of the combined rod remains the same because of the rigid supports, but the lengths of the individual rods do not. $\alpha_{\text{steel}} = 1.2 \times 10^{-5}(^{\circ}C)^{-1}$, $\alpha_{\text{Al}} = 2.4 \times 10^{-5}(^{\circ}C)^{-1}$, $Y_{\text{steel}} = 20 \times 10^{10}\ Pa$, and $Y_{\text{Al}} = 7 \times 10^{10}\ Pa$

a) Find the length of each rod at 40 $^{\circ}C$.
b) Find the stress in each rod at 40 $^{\circ}C$.

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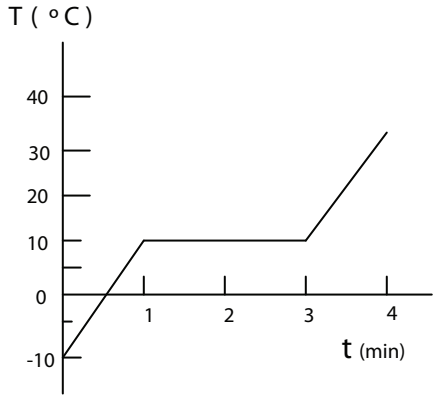
2. (a) An engineer heats a 500 g unknown solid sample at the rate of 10.0 kJ/min starting at $t = 0$ while recording its temperature as a function of time. The data are plotted in the graph shown.

(i) Determine the latent heat of fusion for this solid.
(ii) Determine the specific heat of the solid state of the material.




(b) A copper pot with a mass of 0.500 kg contains 0.170 kg of water at a temperature of $20.0°C$. A 0.250 kg block of iron at $85.0°C$ is dropped into the pot. Determine the final temperature. Assume no heat is lost to the surroundings.
$c_{\text{Cu}} = 385\frac{J}{\text{kgK}}$, $c_{\text{water}} = 4190\frac{J}{\text{kgK}}$, and $c_{\text{Fe}} = 450\frac{J}{\text{kgK}}$

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3. An ideal monatomic gas with initial temperature 200 K at point $a$ follows the cycle $a \to b \to c \to a$.
a) What is the temperature at $b$?
b) How much work is done for this cycle?
c) How much net heat is added or removed from the gas in the process $b \to c$?
d) Specify if the heat is added or removed in part c).
Note: all curves are straight lines in the PV diagram below.