$\qquad$ Student \#: $\qquad$
This test consists of nine pages of questions, a page of useful constants and conversions, a page containing functional group information, and a periodic table. Please ensure that you have a complete test and, if you do not, obtain one from me immediately. There are 56 marks (and three bonus marks) available. Good luck!

1) [2 marks] At $51.55^{\circ} \mathrm{C}$ and 1 bar pressure a compound of formula $\mathrm{OF}_{\mathrm{n}}$ has a density of $2.0000 \mathrm{~g} / \mathrm{L}$. What is the value of $n$ ?
2) [2 marks] My watch is water-resistant to a pressure of 5 bars. Assuming water has a density of $0.9984 \mathrm{~g} / \mathrm{cm}^{3}$, to how many metres of water may I safely take my watch?
3) [4 marks total] A gas mixture consists of three gases (gas $A$, gas $B$, and gas $C$ ). The mole fraction of gas $A$ is 0.2 . There are three moles of gas $B$, and the partial pressure of gas $C$ is 10 atm . If the total pressure of the mixture is 20 atm :
a) [2 marks] Calculate the mole fractions of gases $B$ and $C$.
b) [2 marks] Calculate the partial pressures of gases $A$ and $B$. Give your answers in atm.
c) [3 marks - BONUS] Calculate the moles of gases $A$ and $C$.
4) [4 marks] The following apparatus was assembled:

## Bulb 1:

Volume: 4 litres
Gas: $\mathrm{C}_{2} \mathrm{H}_{2}$
Pressure: 2280 torr

## Bulb 2:

Volume: 6 litres
Gas: $\mathrm{H}_{2}$
Pressure: 1520 torr

The two bulbs were separated by a valve. When the valve was opened, the following reaction occurred:
$\mathrm{C}_{2} \mathrm{H}_{2}(\mathrm{~g})+2 \mathrm{H}_{2}(\mathrm{~g}) \longrightarrow \mathrm{C}_{2} \mathrm{H}_{6}(\mathrm{~g})$

Both bulbs were maintained at a temperature of $945.51^{\circ} \mathrm{C}$ before, during, and after reaction. Calculate the partial pressures of all species after reaction.
5) [3 marks] A gas of formula $\mathrm{SCl}_{n}$ effuses about 30 percent faster than a gas of formula $\mathrm{SCl}_{n+2}$. What is the value of $n$ ?
6) [4 marks] For the molecule

a) The number of bonding pairs of electrons is: $\qquad$
b) The number of non-bonding (lone) pairs of electrons is: $\qquad$
c) The number of sigma bonds is: $\qquad$
d) The number of pi bonds is: $\qquad$
7) [5 marks] Complete the following table for the $\mathrm{OCN}^{-1}$ ion ( C the centre atom):

- Include all non-zero formal charges.
- Circle the "best" resonance form.
- Draw only non-equivalent resonance forms.

I'll mark only what you write in the table; you can use the rest of the page for rough work (if you wish).

| Resonance Form 1 | Resonance Form 2 | Resonance Form 3 |
| :--- | :--- | :--- |
|  |  |  |
|  |  |  |

8) [4 marks] The NO molecule tends to dimerize (attach to another NO molecule) while the $\mathrm{NO}^{+}$ion does not. Give a possible explanation for this using Lewis structures.
9) [2 marks] The OCF 2 molecule ( C the centre atom, other atoms attached only to it) has only one possible Lewis resonance form. Why?
10) [5 marks] Complete the following table for the $\mathrm{SO}_{2} \mathrm{~F}_{2}$ molecule ( S the centre atom):

- Include all non-zero formal charges.
- Circle the "best" resonance form.
- Draw only non-equivalent resonance forms.

I'll mark only what you write in the table; you can use the rest of the page for rough work (if you wish).

| Resonance Form 1 | Resonance Form 2 | Resonance Form 3 |
| :--- | :--- | :--- |
|  |  |  |

11) [10 marks] Give IUPAC (or other acceptable) names for the following compounds:
a)

b)
 (as an ether)
(NOT as an ether)
c)

d)

12) [3 marks] Use the formula $\mathrm{C}_{3} \mathrm{H}_{9} \mathrm{~N}$ to draw one example each of a primary, secondary, and tertiary amine. You do not need to name the compounds you draw, and you may use either the shorthand notation (as discussed in class) or draw all atoms.
13) [8 marks] Give structures consistent with the following names:
a) 1,1-diethyl-4-methoxy-2,2-dimethylcyclohexane
b) 2-chloroethyl ethyl ether
c) 4,4-dibromo-5,5-dimethoxyhexan-2-amine
d) 2,2-difluoro-3-pentylcyclopropanol
