Materials science

Key

Your test will be composed of a lab component as well as a knowledge test. You will be testing evaporation rates and some of the liquids may take an extended amount of time to evaporate so do not wait until all the drops have evaporated to start the test portion or you may not get done.

1) Obtain a well plate and lamented paper. You will be testing evaporation rates of 5 liquids. You will graph three alcohols, also an alkane and water will be observed for comparison purposes and will not be placed in your graph so data for these will not need to be as precise.
2) Place one drop of water in the well plate and note the time it was placed in the well plate on the wall clock. Exact seconds will not need to be recorded as this data will only be used for qualitative comparison.
3) Use the well plates as your evaporation surface and only one drop of each alcohol for your data. You may wish to practice dispensing a single drop into the storage container first as obtaining one drop can be a bit challenging if you have not done it before. Time how long it takes each drop to completely evaporate.
4) Create a graph of evaporation rates versus molar mass for methanol(CH_3OH), ethanol(CH_3CH_2OH) and n-proponal($CH_3CH_2CH_2OH$). (+2)
5) Graph your results. What is the trend you see? ↑mass ↑evaporation Propose as reason for the trending you observed. (+1)

(+1) As molar mass increases the dispersion force increases.

6) Given what you have graphed predict the amount of time you expect it should take for butanol($CH_3CH_2CH_2CH_2OH$) to evaporate .(Show your work, you are allowed to use linear regression but you must show your work including all values.)

- graph x- molar mass y - time
- butanol consistent with graph or linear regressio

7) If hexane has the same type of intermolecular attractions as the alcohols you should be able to use your graph to determine the possible evaporation rate of hexane C_6H_{14}. Write the predicted evaporation time for hexane from your alcohol graph. Use a drop of hexane. Explain any differences you observe between the predicted evaporation times from the graph and your actual results.

→ hexane consistent with graph or linear regressions

(+3 +2) for hexane greater attraction dispersion hexane is much faster due to only having dispersion attraction.

8) The water drop may not have evaporated as of yet. Explain any differences you may see between waters predicted evaporation time from the alcohol graph and what you are actually observing.

→ water molar mass consistent with graph

→ Water has a much larger amount of hydrogen bonding (+3) H_2O attraction greater (+2) H-bonds

In this portion you will be given 5 examples of solid materials and fill in the qualitative the table below. Then answer the questions about each substance. A hint sheet is provided with the structure of some of the less commonly known formulas. (+10)

SOLID LARGE	Conductivity	Brittleness
Quartz (Sand) (SiO_2)	none +1	yes +1
Sodium Chloride	none +1	yes +1
Aluminum	highly +1	no +1
Sugar	none +1	yes +1
Stearic Acid	none +1	no +1

Answer the following questions about quartz.

+1 1) The predominant type of bonding or attraction that holds quartz in a solid state is....

a. Metallic bonding
b. Covalent network bonding
c. Hydrogen bonding
d. London dispersion forces
e. Ionic bonding
f. None of the above

+1 2) Circle all that apply. Quartz would be expected to be soluble in ...

a. Water
b. Hexane
c. Ethanol
d. All of the above
e. None of the above

+1 3) Based on its bonding or attraction the melting point of quartz would be expected to be...

a. Extremely high (over 1,000°C)
b. High(500°C to 1,000°C)
c. Moderate (200°C to 500°C)
d. Low (50°C to 200°C)
e. Bonding or attraction has no effect on melting point.

+1 4) True or False Quartz will conduct electricity when dissolved in distilled water.

+1 5) True or False Quartz will have an extremely low volatility.

+1 6) The most likely packing structure for quartz is

a. FCC
b. BCC
c. HCP
d. Commonly demonstrates all of the above
e. The material does not not demonstrate a packing structure.

+1 7) The predominant type of bonding or attraction that holds sodium choride in a solid state is....

g. Metallic bonding
h. Covalent network bonding
i. Hydrogen bonding
j. London dispersion forces
k. Ionic bonding
l. None of the above

+/ 8) Circle all that apply. Sodium chloride would be expected to be soluble in ...

f. Water
g. Hexane
h. Ethanol
i. All of the above
j. None of the above

+/ 9) Based on the bonding or attraction the melting point of sodium chloride would be expected to be...

f. Extremely high (over 1,000°C)
g. High(500°C to 1,000°C)
h. Moderate (200°C to 500°C)
i. Low (50°C to 200°C)
j. Bonding or attraction has no effect on melting point.

+/ 10) True or False sodium chloride will conduct electricity when dissolved in distilled water.

+/ 11) True or False sodium chloride will have an extremely low volatility.

+/ 12) The most likely packing structure for sodium chloride is

f. FCC
g. BCC
h. HCP
i. Commonly demonstrates all of the above
j. The material is more likely to be an amorphous material.

+/ 13) The predominant type of bonding or attraction that holds aluminum in a solid state is....

m. Metallic bonding
n. Covalent network bonding
o. Hydrogen bonding
p. London dispersion forces
q. Ionic bonding
r. None of the above

+/ 14) Circle all that apply. Aluminum would be expected to be soluble in ...

k. Water
l. Hexane
m. Ethanol
n. All of the above
o. None of the above

+1 15) Based on the bonding or attraction the melting point of aluminum would be expected to be...

k. Extremely high (over 1,000°C)
l. High(500°C to 1,000°C)
m. Moderate (200°C to 500°C)
n. Low (50°C to 200°C)
o. Bonding or attraction has no effect on melting point.

+1 16) True or False aluminum will conduct electricity when dissolved in distilled water.

+1 17) True or False aluminum will have an extremely low volatility.

+1 18) The most likely packing structure for aluminum is

k. FCC
l. BCC
m. HCP
n. Commonly demonstrates all of the above
o. The material is more likely to be an amorphous material.

+1 19) The predominant type of bonding or attraction that holds sugar in a solid state is....

s. Metallic bonding
t. Covalent network bonding
u. Hydrogen bonding
v. London dispersion forces
w. Ionic bonding
x. None of the above

+1 20) Circle all that apply. Sugar would be expected to be soluble in ...

p. Water
q. Hexane
r. Ethanol
s. All of the above
t. None of the above

must have max also here Ethanol

+1 21) Based on the bonding or attraction the melting point of sugar would be expected to be...

p. Extremely high (over 1,000°C)
q. High(500°C to 1,000°C)
r. Moderate (200°C to 500°C)
s. Low (50°C to 200°C)
t. Bonding or attraction has no effect on melting point.

+1 22) True or False sugar will conduct electricity when dissolved in distilled water.

+1 23) True or False sugar will have an extremely low volatility.

+1 24) The predominant type of bonding or attraction that holds stearic acid in a solid state is....

y. Metallic bonding
z. Covalent network bonding
aa. Hydrogen bonding
(bb) London dispersion forces
cc. Ionic bonding
dd. None of the above

+1 25) Circle all that apply. Stearic acid would be expected to be soluble in ...

u. Water
(v.) Hexane
(w.) Ethanol
x. All of the above
y. None of the above

must have hexane
may have ethanol as well

+1 26) Based on the bonding or attraction the melting point of stearic acid would be expected to be...

u. Extremely high (over 1,000°C)
v. High(500°C to 1,000°C)
w. Moderate (200°C to 500°C)
(x.) Low (50°C to 200°C)
y. Bonding or attraction has no effect on melting point.

+1 27) True or False stearic acid will conduct electricity when dissolved in distilled water.

+1 28) True or False stearic acid will have a high volatility.

+1 29) The most likely packing structure for aluminum is

(p.) FCC
q. BCC
r. HCP
s. Commonly demonstrates all of the above
t. The material is more likely to be an amorphous material.

written
+45 pts

Using the original list of solids select those that best match the listed property or use. More than one material may be used.

+1 30) Shows ABAB layering Quartz

+2 31) Shows ABCABC layering Aluminum, NaCl

+1 32) Shows AAA layering —

+1 33) Exhibits the closest type of packing structure. Quartz

+2 34) Shows good malleability Al, Stearic Acid

+1 35) Exhibits good ductility Al

+1 36) Can be used to make detergents Stearic Acid

+1 37) Has a base structure seen in many ceramics. Quartz

+4 38) Exhibits a crystalline lattice structure. Quartz, Al, NaCl, Sugar

+1 39) Has more than one hydrogen bonding sites. Sugar

+1 40) Has layers that may slide past each other when exposed to stress. Al, Stearic Acid (allowed) (must)

41) TIE BREAKER

~~Sketch a unit cell for NaCl~~

Q: List most likely sources of error for evaporation experiment and why it was a problem.

A: Differences in cohesion and adhesion forces lead to difficulty obtaining consistent droplet size.

(+2) Sig Figs (+1) units (+1) Labels

(+5) for averages

				Avg
Methanol	106s	108s	111s	108 s
Ethanol	195s	199s	201s	198 s
n-propanol	285s	289s	280s	285 s
hexane	23s	26s	20s	23 s
water	1921s	1885s	1875s	1894 s

(+1) Molar mass methanol = 32.042

(+1) Molar mass ethanol = 46.068

(+1) molar mass propanol = 60.095

Linear regression or graph (+5) -2 for axis not labeled

$y = 6.3807x - 98.619$

$a = 6.88$

$b = -98.62$

$r^2 = .9999$

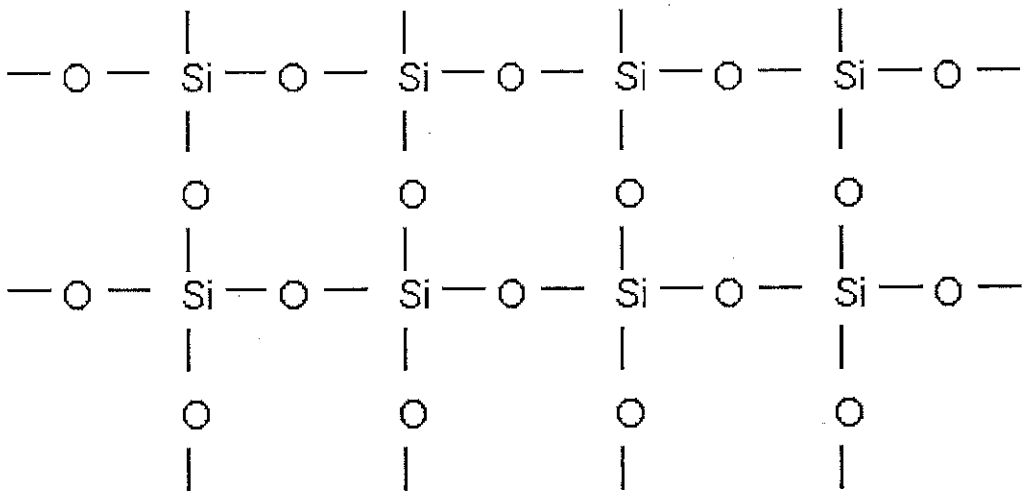
$r = .9999$

Predicted from Linear Regression

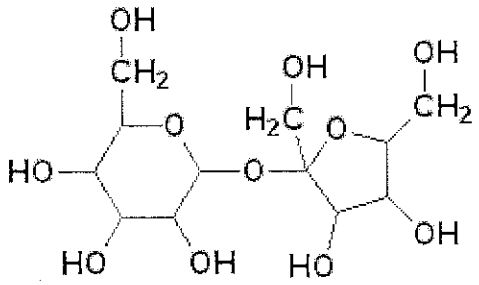
hexane $t = 451$ s (+2)

water $t = 16$ s (+2)

Silicon dioxide



Sucrose



Stearic acid