**ALBEDO & TEMPERATURE**

1. Define *albedo \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

2. Of the following pairs, circle the surface with the higher albedo:

 a. White T-Shirt Black T-Shirt

 b. Ocean Sea Ice

 c. Forest Canopy Snow

 d. Fresh snow 5-day old snow

 e. Grass Mirror

3. The following table contains the data collected by four groups on 9-Nov-2012 over dead grass, blacktop, and melting snow piles left behind by a plow truck. A cloud passed overhead while groups #2 and #4 made their outgoing solar radiation measurements over the snow piles. Study the table, and then answer the questions on the next page.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Group # | Group 1 | Group 2 | Group 3 | Group 4 |
| Date | 9-Nov-12 | 9-Nov-12 | 9-Nov-12 | 9-Nov-12 |
| Time Start | 11:50 | 11:50 | 11:50 | 11:50 |
| Time End | 11:55 | 12:00 | 11:59 | 11:58 |
| Cloud | PCL | PCL | PCL | PCL |
| Solar Radiation (W/m2) |
| Grass In | 611 | 606 | 616 | 611 |
| Grass Out | 107 | 105 | 137 | 141 |
| Black Top In | 218 | 55 | 580 | 527 |
| Black Top Out | 16 | 4 | 38 | 40 |
| Snow In | 224 | 121 | 151 | 110 |
| Snow Out | 143 | 45 | 108 | 37 |
| Surface Temperature (oF) |
| Grass Surface Temp  | 48.6 | 8.4 | 42.8 | 49.1 |
| Pavement Surface Temp | 62.7 | 13.8 | 59.6 | 63.6 |
| Snow Surface Temp | 26.6 | -2.9 | 27.1 | 32.2 |
| Snow Depth | 7 | 7.5 | 20 | 9 |
| Tare Weight of Empty Tube and caps(lb) | 1.205 | 1.205 | 1.205 | 1.205 |
| Weight (lb) | 1.52 | 1.6 | 1.72 | 1.54 |
| Snowing? | No | no | no | No |
| Snow last 24 hr? | Yes | yes | yes | Yes |
| Melt? | Yes | yes | yes  | Yes |

PCL = Partly Cloudy (30%-70% cloud cover)

1. **Temperature.** One of the groups above recorded their surface temperature data in oC. Identify the group and convert these values to oF using the following equation:

 oF = (oC\*9/5)+32

 Group # \_\_\_\_\_\_\_\_

 Grass (oF) =

 Black Top (oF) =

 Snow (oF) =

1. **Albedo.** Recall that the equation for albedo is ***Sout/Sin***, where *Sout* is the outgoing (or reflected) solar radiation and *Sin* is the incoming solar radiation. Using the data in the table above, calculate the albedo for grass, black top, and snow:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Group 1 | Group 2 | Group 3 | Group 4 |
| Grass |  |  |  |  |
| Black Top |  |  |  |  |
| Snow |  |  |  |  |

 Snow albedo typically ranges from 0.6 -0.9. How do the snow albedo values calculated above compare to this range?

 What are some factors that could cause snow albedo to be at the lower end of the range?

1. **Density.** Recall that the equation for density is mass/volume.

What is the **mass** of the snow inside the snow tube for *Group 2*? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Convert the mass of the snow to kg using the following equation:

1 lb= 0.45 kg

What is the **volume** of snow inside the cylinder for *Group 2*? Use the following formula:

Vcylinder = π\*r2\*h

 where π = 3.1415,

r = the radius (inches) of the *inside* of the tube, or diameter of the *inside* of the tube divided by 2.

h = the height of the cylinder filled with snow, or snow depth (in).

What are the units of volume? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Convert the volume you calculated to m3 \_\_\_\_\_\_\_\_\_\_\_\_\_.

 [1 inch = 0.0254 m]

Lastly, calculate the density of the snow in kg/m3 for *Group 2*.

Snow density typically ranges from 100 kg/m3 to 500 kg/m3. How does your snow density value compare to typical snow?

What is the density of liquid water in kg/m3? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

[round to nearest whole number & assume average winter air temperatures between 32 oF and 50 oF]

Convert the snow density in kg/m3 to a percent (i.e., what percentage of the tube filled with snow is actually snow and not air pockets?)

Example: 350 kg/m3 divided by 1000 kg/m3 is 35%