Remote Sensing Key

Science Olympiad North Regional Tournament at the University of Florida

Instructions:

- DO NOT BEGIN UNTIL GIVEN PERMISSION
- You will have 50 minutes to complete the exam
- You may separate the test
- Use appropriate significant figures for full credit in your final answer

Allowable materials:

- Scientific Calculator
- Pens and Pencils
- Rulers and Protractors
- Four (4) 8.5" x 11" note sheets

PART 1

1. A, C, D
2. A
3. C
4. A
5. C
6. D
7. D
8. B
9. C
10. B
11. Shorter wavelengths of the visible spectrum are scattered more than other (longer) wavelengths
12. Active sensors require an external source of power to operate (provide their own energy to take measurements). Passive sensors detect natural emissions.
13. 150×10^{12} Hz or 150 THz
14. 99.4×10^{-21} J
15. 0.621 eV
16. B
17. D
18. $$\frac{P}{A} = \sigma T^4$$
$$P = \sigma T^4 \times 4\pi r^2$$
$$P = (5.67\times10^{-8})(100 + 273)^4\times(4\pi)(2.2^2)$$
P = 66.8 KW or 6.68×10^4 W
19. 501.6×10^{-12} m
20. X-rays
21. No
22.
    A. GPS
    B. $$Velocity = Distance \div Time$$
    $$c = (10{,}500 - x) \div (33.0\times10^{-6})$$
    $$x = 600\text{m}$$
23.
    A. Passive
    B. Active
    C. Passive
    D. Passive
    E. Active
24. Use of values for precipitation 0.75<x<1.0 are acceptable.
    $$V = A\times h$$
    $$V = (0.875)(\sqrt{44824.90}\times5280\times12)^2$$
    $$V = 160 \times 10^{12} \pm 12.5\%\ in^3$$
25. Precipitation RADAR

PART 2

26. True color
27. MODIS
28. Glacier
29. Acceptable percentile range: 25-35% (5% error). Total area of image: $470 \pm 5\%$ mi^2. $0.3\times470 = \mathbf{141 \pm 14\ mi^2}$
30. Ocean Ice: $30\% \pm 5\%$, Open Ocean: $20\% \pm 5\%$, Bare Soil: $50\% \pm 5\%$. $0.3\times0.5 + 0.2\times0.06 + 0.5\times0.17 = \mathbf{0.25 \pm 0.04}$
31. Glacier recession/melting
32. Positive feedback loop; Temperature increases -> Polar Ice recedes -> Albedo decreases -> Temperature increases

33. True color
34. MODIS
35. Snow
36. Smoke
37. Spot fires
38. Sea surface topography
39. B
40. Understanding of ocean circulation and its effect of global climate
41. DORIS
42. Differences in elevation of sea surface
43. Pseudo-color
44. Tidal forces of the Moon and the Sun acting on the Earth
45. Direction of ocean currents
46. CERES
47. More direct exposure to radiation
    Lower average albedo
    Longer exposure to radiation during the year
48. Arid land – Sahara Desert as well as other deserts. Sand has a high albedo
49. GOES-16
50. A
51. B, C, D
52. None of the above
53. Blue, Yellow, Red
54. High reflectance of land due to sand
55. Missing data points

PART 3

56. E
57. F
58. A
59. B
60. C
61. E, B, D, F, C, A
62. A, B, C, D, E
63. C
64. A
65. Decrease
66. Increase
67. Livestock enteric fermentation (CH4)
    Volcanic degassing – CO2
68. Burning of fossil fuels & deforestation – Co2 and small quantities of CH4 and N2O
    Use of CFCs (chlorofluorocarbons); burning halocarbons
    Agricultural activities (fertilizer use) (N2O)
    Deforestation (CO2 released from forest burning, lower forest carbon intake)
    Landfills (CH4)
    Wastewater treatment (CH4, N2O)
    Industrial processes (HFCs, PFCs, SF6)
69. Aerosols scatter and reflect sunlight, increasing albedo, cooling atmosphere

70. Aerosols affect formation of cloud droplets; more cloudiness and higher albedo, cooling the earth

71. A relative measure of how much heat a greenhouse gas traps in the atmosphere

72. $$\frac{10}{1{,}000} * 121.0 = 1.21\ tonnes\ CO2\ equivalent$$

73. Evaporation and Precipitation

74. Temperate latitudes (40 - 50 degrees North and South), near coasts and in equatorial regions

75. At about 25 - 30 degrees North and South latitude, at ocean centers and in enclosed seas

76. True

77. True

78. Mid-Wavelength Infrared Radiation

79. Long-Wavelength Infrared Radiation

80. CO2

81. H2O

PART 4

82. $$P = 4\pi R_E^2 * \sigma T^4$$

83. $$P = F_S * \pi r^2$$

84. $$F_s * \pi r^2 = 4\pi r^2 * \sigma T^4$$

$$T_{eff} = \sqrt[4]{\frac{F_s}{4\sigma}}$$

$$T_{eff} = \sqrt[4]{\frac{1379}{4 * 5.670 * 10^{-8}}}$$

$$T_{eff} = 279.2K - 273.15 = 6.092°C$$

85. $$F_s * \pi r^2 * (1 - \alpha) = 4\pi r^2 * \sigma T^4$$

$$T_{eff} = \sqrt[4]{\frac{F_s * (1 - \alpha)}{4\sigma}}$$

$$T_{eff} = \sqrt[4]{\frac{1379 * (1 - 0.3000)}{4 * 5.670 * 10^{-8}}}$$

$$T_{eff} = 255.4K - 273.15 = -17.73°C$$

86. Less Accurate

87. $$F_s * \pi r^2 * (1 - \alpha) = 4\pi r^2 * \sigma T^4 * \varepsilon$$

$$T_{eff} = \sqrt[4]{\frac{F_s * (1 - \alpha)}{4\sigma\varepsilon}}$$

$$14.8 + 273.15 = \sqrt[4]{\frac{1379 * (1 - 0.3000)}{4 * 5.670 * 10^{-8} * \varepsilon}}$$

$$\varepsilon = 0.619$$

88. Increasing ε increases temperature.

Decreasing ε decreases temperature.