Name(s): ANSWER KEY Date:_____

Team name: _____

JP Stevens High School:
Remote Sensing

Scoring: Part I - _____/18

Part II - _____/40

Part III - _____/16

Part IV - _____/14

Part V - _____/93

Total: _____/181

I. History (3 pts each)

1. What is the name of the first satellite?
    a. Suomi NPP
    b. Kalpana-1
    c. CALIPSO
    d. Sputnik 1

2. Remote sensing unofficially began when this scientist took aerial photographs from a balloon.
    a. Arthur Rudolph
    b. Ludwig Roth
    c. Konrad Dannenberg
    d. Felix Tournachon

    Tiebreak Name the country in which this took place ____France_____

3. What is the name of the US' first satellite?
    a. JERS-1
    b. SARAL
    c. Explorer 1
    d. XMM-Newton

4. Which satellite took the first photograph of earth from space?
    a. Explorer-1
    b. Explorer-2
    c. Explorer-5
    d. Explorer-6

5. Who was the rocket scientist who led Project Orbit in 1955?
    a. Robert H. Goddard
    b. Wernher von Braun
    c. Walter Dornberger
    d. Ernst Stuhlinger

6. As of 2017, how many Landsat missions have taken place?
    a. 6
    b. 7
    c. 8
    d. 9

II. Instruments (4 pts each)

7. What is an ASTER?
    a. Advanced Spaceborne Thermal Emission and Reflection Radiometer
    b. Advanced Spatial Thermal Emission and Refraction Radiometer
    c. Advanced System Thematic Emission and Refraction Radar
    d. Advanced Spaceborne Thermal Emission and Reflection Radar

8. What is an AVHRR?
    a. Airborne Visual High Resolution Radar
    b. Advanced Very High Resolution Radiometer
    c. Along Very High Reflection Radiometer
    d. Advanced Visual High Resolution Radar

9. What is a RAR?
    a. Radial Aperture Radiometer
    b. Real Aperture Radar
    c. Refracting Aperture Radiometer
    d. Radial Aperture Radar

10. What is a MODIS?
    a. Modulating-resolution Imaging Spectroradiometer
    b. Moderate-ranging Imaging Spectrometer
    c. Moderate-resolution Imaging Spectroradiometer
    d. Modern-resolution Isolating Spectro-Radar

11. What is an ALI?
    a. Advanced Land Imager
    b. Aerial Land Imager
    c. Airborne Land Imager
    d. Airborne Light Imager

12. What does a CERES measure?
    a. Broadband radiative energy flux
    b. Spectral content of the incident electromagnetic radiation
    c. Backscattered radiation
    d. Height of the instrument platform above the surface

13. What is the principal objective of an ATSR?
    a. Monitoring ocean primary production and phytoplankton processes
    b. Measuring cloud properties
    c. Providing data and information concerning global Sea Surface Temperature (SST)
    d. Locating objects and measuring elevation

14. Which of these instruments was introduced in the Landsat Program?
    a. SeaWiFS
    b. MSS
    c. VTIR
    d. CZCS

15. What types of waves are used in modern-day radars?
    a. Gamma rays
    b. Radiowaves
    c. Microwaves
    d. X-rays

16. Which of the following radiometers measures the intensity of radiation in multiple wavelength bands?
    a. imaging radiometer
    b. spectrometer
    c. scatterometer
    d. spectroradiometer

17. How does a whiskbroom scanner differ from a pushbroom scanner?
    a. functions along track rather than across track
    b. receives a stronger signal because it looks at each pixel area for longer
    c. mirror moves back and forth
    d. if not calibrated, the detectors may reveal stripes in data due to varying sensitivities

18. Which of the following properties characterize an optical sensor?
    a. uses visible and UV sensors
    b. spectral, radiometric, and geometric performance
    c. depends on both reflected solar radiation and its own energy to form images
    d. classified based on a range of 1 to 1000 spectral bands

19. This type of RaDAR stores sequentially received signals in memory over time and adds them:
    a. pulse
    b. continuous-wave
    c. synthetic aperture
    d. planar

20. Which of the following instruments features eight spectral bands?
    a. LiDAR
    b. MSS
    c. SeaWiFS
    d. TM

III. Miscellaneous (4 pts each)

21. What parts of earth would have the highest albedos?
    a. Mountains
    b. Deserts
    c. Tundras
    d. Savannas

22. What is the primary focus of GCOM-W1 “SHIZUKU”?
    a. Measuring atmospheric gas levels
    b. Studying the impact of clouds and air particles on the climate
    c. Monitoring ocean levels
    d. Studying the water cycle

23. Cloud formation frequency is most strongly dependent upon:
    a. Carbon dioxide concentration
    b. Current precipitation
    c. Cloud condensation nuclei
    d. Air temperature

24. What is the second most prevalent greenhouse gas?
    a. Water vapor
    b. Methane
    c. Carbon Dioxide
    d. Ozone

25. What is the best definition for blackbody.
    a. A hypothetical ideal radiator that absorbs and re-emits all incident energy.
    b. Any body that emits radiation at each wavelength less than one to that emitted by a bluebody at the same temperature.
    c. Any body that emits radiation at each wavelength greater than one to that emitted by a graybody at the same temperature.
    d. A black hole.

26. If an image has high backscatter, what does it say about the landscape being imaged?
    a. Rough surface
    b. High vegetation
    c. Barren landscape
    d. Presence of water

27. What is another name for the weakening of light beams by scattering or absorption?
    a. Diffraction
    b. Attenuation
    c. Deamplification
    d. Dispersion

IV. Matching: Match each type of energy to its corresponding use. (2 pts each)

27. __b__ Gamma rays and x-rays
28. __c__ Short Wave Infrared (SWIR)
29. __f__ Thermal Infrared (TIR)
30. __a__ Microwaves
31. __g__ Near Infrared (NIR)
32. __d__ Visible light
33. __e__ Ultraviolet light

a. Used in radar.
b. Not suitable for remote sensing because they are absorbed by the Earth's atmosphere.
c. Used in determining spectral signatures of objects.
d. Helps satellites detect colors that the human eye can see.
e. Not suitable for remote sensing because it is blocked by the ozone layer.
f. Used in determining the temperature of an object.
g. Used in monitoring vegetation

V. Short Answer

34. What is remote sensing? (5 pts)

Remote sensing is the measurement, identification, and analysis of the characteristics of objects without direct contact

35. Describe the difference between active and passive sensing. (8 pts)

Active sensing occurs when radiation is produced by the satellite on its own, whereas passive sensing uses radiation already available to collect information.
Both specific aspects of active and passive must be stated to gain points. No half credit

36. Why is the sky blue during the day? (6 pts)

The blue color of the sky is caused by the scattering of sunlight off the individual molecules in the atmosphere. This scattering is called Rayleigh scattering, which is particularly effective at short wavelengths, corresponding to the blue end of the visual spectrum.

37. Name 4 of the currently active satellites part of the A-Train EOS satellite constellation. (3 pts. each; 12 pts total)

Any 4 of the following: OCO-2, GCOM-W1 “SHIZUKU”, Aqua, CloudSat, CALIPSO, Aura

38. What graphical indicator is this image an example of? (4 pts)

NDVI (Normalized Difference Vegetation Index)

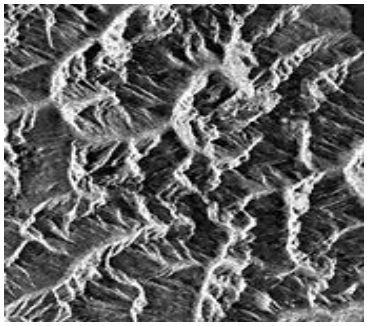
39. What is the purpose of the indicator pictured in (38)? What does an index of 0 suggest using this technique? Give an example of a number that cannot be a value using this technique. (3 pts. each; 9 pts total)

NDVI is used to assess whether the targeted area contains live vegetation.
An NDVI of 0 suggests that the area has no vegetation.
Any number $x>1$ or $x<-1$ cannot be a NDVI value.

40. If the surface of the sun is measured at 6000K and the earth is measured at 255K, find the wavelength of the energy for both surfaces. Show all necessary work. (3 pts. for correct answer; 3 pts for work shown; 6 pts. total)

Using the equation $\lambda_{max} = \frac{2898\ \mu m\ K}{T}$
The wavelength of peak energy for the sun would be 2898/6000 = 0.483 µm.
The peak energy for the earth would be 2898/255 = 11.4 µm

41. What form of image distortion is pictured below? What causes this distortion? (3 pts each; 6 pts total)



This image is an example of **foreshortening**. This happens when the radar beam reaches the base of a tall feature (such as a mountain) before the top. Since the distance is measured in slant range, the slope appears compressed.

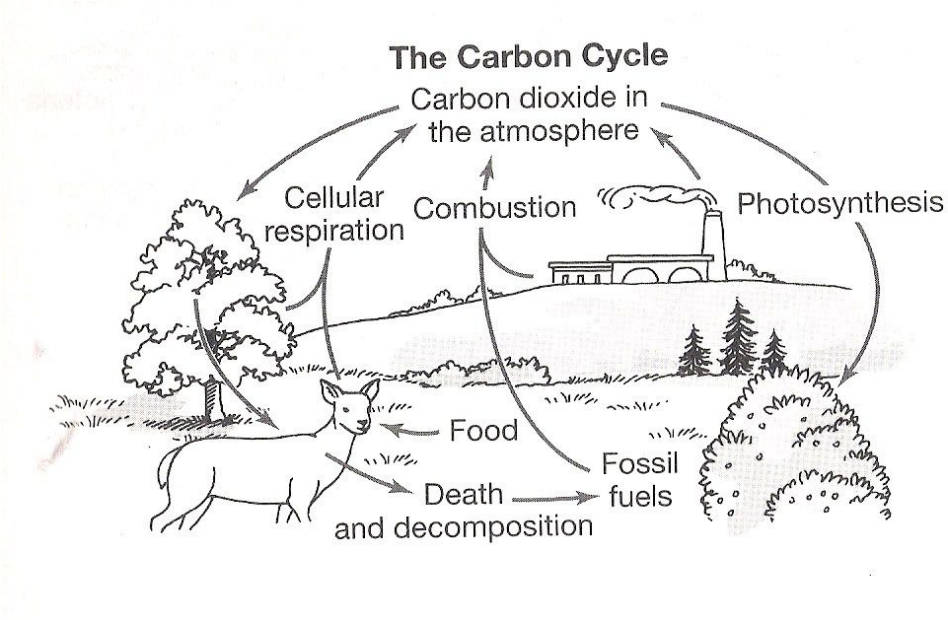
42. What form of image restoration is pictured below? Describe the process used by this technique. (3 pts each; 6 pts total)
*Tiebreaker: give the equation used by this technique

Pictured is an example of **range compression**. It is when an image with a large dynamic range is shortened to have a smaller range.
Tiebreaker answer: y = c*log(1+x)

43. What is the name of the noise seen in the image below? What technique is most effective for fixing it? (4 points for the name, 4 points for the fixing technique; 8 pts total)

The noise pictured above is called **speckle** (also accept **salt-and-pepper noise**). It is most effectively reduced through **median filtering**.

44. Label the steps of the carbon cycle below. Provide a **brief** description of each step underneath the diagram. (2 pt each; 12 pts. total)



No points awarded without description of step

A: carbon dioxide is exchanged between the atmosphere and bodies of water

B: carbon dioxide is released by metabolic processing

C: carbon extracted from plant material is burned for energy

D: plants use carbon dioxide to synthesize foods and release oxygen

E: dead organisms are eaten by decomposers and the carbon from their bodies is returned to the atmosphere as carbon dioxide

F: carbon from decay is stored in the earth

45. If the surface temperature of Venus is given at 750K, find the wavelength of peak energy and draw an appropriate blackbody curve. Show all necessary work. (4 pts. for correct answer; 2 pts. for work shown; 5 pts. for accurate graph; 11 pts. total)

$$\lambda_{max} = \frac{2898\,\mu\text{m}\,K}{750K} = 3.86\,\mu\text{m}$$