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Continuing Education Course #298
Temperature Control for Spacecraft

1. What are the primary sources of external heat for LEO, HEO, and GEO spacecraft?
 - a. direct sun
 - b. reflected sun from earth
 - c. infrared energy emitted from earth
 - d. all of the above

2. Which heat energy transfer method does an MLI blanket "ideally" use to transfer heat?
 - a. convection
 - b. conduction
 - c. radiation
 - d. none of the above

3. Which of the following makes black paint an ideal thermal control surface for internal spacecraft components?
 - a. its near thermal equilibrium characteristic
 - b. its low emittance
 - c. its low absorptance
 - d. none of the above

4. Because of white paints and optical solar reflectors low ratio of absorptance to emittance, they are effectively used as _____ surface?
 - a. a grounding
 - b. an insulator
 - c. a radiating
 - d. an absorbing

5. White painted surfaces _____ increases over time if exposed to UV radiation in low earth orbit?
 - a. absorptance
 - b. emittance
 - c. resistance
 - d. reflectance

6. Aluminized Kapton and optical solar reflector surfaces degrade thermally over time due to the abundance of the chemical _____ encountered by spacecraft in low earth orbit?
 - a. CO
 - b. H
 - c. O
 - d. C

7. Which of the following is NOT related to thermal degradation due to increased absorption, but can degrade a thermal control surface by reducing its total surface area?

- a. UV radiation
- b. atomic oxygen
- c. charged particles - protons and electrons
- d. space debris impacts

8. Which are key characteristics a radiator's thermal control coating should have for effective and reliable heat rejection into space?

- a. high emissivity
- b. low absorptivity
- c. stability
- d. all of the above

9. Which layer of an MLI blanket should be made of a material that should not be too temperature sensitive to solar energy?

- a. external (space facing)
- b. insulator
- c. separator
- d. internal (spacecraft facing)

10. What key element in an MLI blanket is needed to reduce conductivity between insulating sheets?

- a. p type semiconductor
- b. n type semiconductor
- c. insulator
- d. separator

11. Doublers work by conducting heat _____ to reduce temperatures.

- a. vertically
- b. horizontally
- c. laterally
- d. diagonally

12. Ideally you want all thermal control on spacecraft to be passive in order to conserve electrical power for payload use.

- a. True
- b. False

13. Which active thermal control methods do NOT require electrical power to operate?

- a. heat pipes and pumped fluid loops
- b. heat pipes and radioisotope heater units
- c. radioisotope heater units and thermoelectric coolers
- d. thermoelectric coolers and louvers

14. What electrical component is commonly used to measure temperatures throughout a spacecraft?

- a. resistors
- b. thermistors
- c. p type semiconductor
- d. n type semiconductor

15. Heat pipes change the chemical state of its working fluid from a 1) _____ to a 2) _____ to transfer heat from one location to another.

- a. 1) liquid, 2) gas
- b. 1) gas, 2) liquid
- c. 1) solid, 2) gas
- d. 1) solid, 2) liquid

16. Pumped fluid loops are commonly used with _____ to remove heat, similar in concept to how an automobile cools its engine.

- a. a louver
- b. an MLI blanket
- c. a radiator
- d. a thermoelectric coolers

17. Electric heaters apply current to _____ element to create heat, and works similar to an automobiles rear window defogger/defroster.

- a. a radioactive
- b. a resistive
- c. an emissive
- d. an absorptive

18. Radioisotope heater units (RHUs) use a nuclear fuel, a constant heat source, that can be employed with a rotating cylinder to provide thermal control by exposing the 1) _____ towards space to release heat, or the 2) _____ towards space to retain heat.

- a. 1) radiator, 2) MLI blanket
- b. 1) MLI blanket, 2) radiator
- c. 1) heat pipe, 2) louvers
- d. 1) louvers, 2) heat pipe

19. Thermoelectric coolers work by applying a DC voltage across two dissimilar semiconductor materials to create a _____.

- a. p type semiconductor
- b. n type semiconductor
- c. thermistor
- d. thermocouple

20. Louvers are commonly used with radiators to control _____, and functions similar to a home's venetian blinds.

- a. emissivity
- b. absorptivity
- c. conductivity
- d. reflectivity

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