

StellarXplorers Qualification Round 3 (QR3) Quiz Study Guide

The Quarterfinals/Prestige Round Quiz will come from Chapter 9, Sections 9.1 – 9.3, and Chapter 14, Sections 14.1 – 14.3, in the Understanding Space textbook. The correct answers will be based on information found in the textbook.

Chapter 9

Section 9.1

1. Know the definitions of solar day and sidereal day and how they compare to each other.
2. Know the definitions of Local Solar Time, Local Sidereal Time, and Greenwich Mean Time.

Section 9.2

3. Understand how the orbit inclination determines the number of launch windows per day from a specified launch site.
4. The Launch Window Sidereal Time (LWST) is a function of two angles. Know which angles and their definitions.

Section 9.3

5. Be able to explain what occurs in each of the four distinct phases from the launch pad to orbit: Vertical Ascent, Pitch Over, Gravity Turn, and Vacuum Phase.
6. The Earth's rotation provides a launch site with a tangential velocity in the eastward direction. Understand the benefits of launching from a site near the Equator, such as Kourou (5° N latitude) compared to launching from Kennedy Space Center (28° N latitude).
7. Know the definitions of the following velocities: Burnout Velocity (V_{bo}), Design Velocity (ΔV_{design}), Velocity Needed (ΔV_{needed}), and Velocity Launch Site ($V_{launch\ site}$).

Chapter 14

Section 14.1

8. Know the definitions of the following terms: mass flow rate, effective exhaust velocity, impulse, total impulse, specific impulse.
9. Be able to define the terms of the thrust equation: $F = \dot{m}C$
10. Be able to identify the Ideal Rocket Equation.
11. Know the definitions of the following properties of a perfect gas: Adiabatic Flow, Reversible Flow, Frozen Flow, and Steady Flow.
12. Know the conditions for the following nozzle expansion: Under-expansion, Ideal-expansion, Over-expansion.
13. For electrostatic rockets, know which parameters result in a higher thrust and which parameters result in higher specific impulse.

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Section 14.2

14. Know the advantages and disadvantages of a pressure-fed propellant delivery system compared to a pump-fed propellant delivery system.
15. Know how pressure transducers, pressure-relief valves, and check valves work in a pump-fed propellant delivery system.
16. Know examples of hypergolic propellants.
17. Know the advantages and disadvantages of Monopropellant and Bipropellant Rockets.
18. Be able to explain the thrust curves for different types of solid propellant grain designs and know which type was used on the Space Shuttle.
19. Be able to identify typical propellants for Solid Rockets.
20. Be able to compare the relative specific impulse and thrust of the following rocket types: resistojet, arcjet, electro-thermal, and nuclear thermal.
21. Explain how the following types of electrodynamic rockets produce thrust: Electrostatic Rocket and Electromagnetic Rocket.
22. Know how the Hall Effect Thruster and Pulsed Plasma Thruster work.
23. Explain how a tether can be used to increase a payload's apogee altitude.

Section 14.3

24. During launch, first stage rockets go from sea level to a near vacuum in a few minutes. Know how typical nozzles are designed to achieve ideal expansion during this phase.
25. Know what percentage of a typical launch vehicle's liftoff mass is propellant.
26. Know the advantages and disadvantages of staging on launch vehicles.