EO C232.02 – IDENTIFY THE CHARACTERISTICS OF ROCKET ENGINES

1. **Performance**: Identify the Characteristics of Rocket Engines

2. **Conditions**:

   a. Given:

      (1) Supervision; and

      (2) Assistance as required.

   b. Denied: N/A.

   c. Environmental: Suitable classroom facilities or training area large enough to accommodate the entire group.

3. **Standard**: In accordance with specified references, the cadet shall identify the characteristics of rocket engines, to include:

   a. general rocket theory; and

   b. liquid and solid fuel oxidization methods.

4. **Teaching Points**:

TP	Description	Method	Time	Refs
TP1	Explain aspects of reactive thrust in various methods of propulsion, to include: a. jet systems; b. propeller systems; c. wheeled vehicles; and d. walking.	Interactive Lecture	5 min	C3-087 C3-016 (pp. 13–17) C3-037
TP2	Have the cadets explore Newton's third law of motion by staging and operating balloon rockets on a string, followed by a discussion.	In-Class Activity	20 min	C3-016 (pp. 63–64) C3-057 (pp. 42)
TP3	Explain how rocket systems operate in space because they are self-contained and require no atmospheric oxygen.	Interactive Lecture	5 min	C3-016 (pp. 18–24)
TP4	Explain the differences between solid-fuel and liquid-fuel rocket engine systems, to include: a. construction; b. vehicle applications; and c. fuels and oxidation.	Interactive Lecture	10 min	C3-016 (pp. 5–12)

TP	Description	Method	Time	Refs
TP5	Discuss launch vehicles, to include: a. American; b. Russian; c. European; and d. Chinese.	Interactive Lecture	15 min	C3-100 C3-112 C3-113 C3-114

5. **Time**:

a.	Introduction / Conclusion:	5 min
b.	Interactive Lecture:	35 min
c.	In-Class Activity:	20 min
d.	Total:	60 min

6. **Substantiation**:

a. An interactive lecture was chosen for TP1, TP3, TP4 and TP5 to introduce characteristics of rocket engines and give an overview of them.

b. An in-class activity was chosen for TP2 as it is an interactive way to provoke thought and stimulate an interest among cadets.

7. **References**:

a. C3-016 (ISBN EG-2003-01-108-HQ) NASA. (2003). *Rockets: A Teacher's Guide With Activities in Science, Mathematics, and Technology.* Washington, DC: NASA.

b. C3-037 *Space Exploration.* (2006). Retrieved 25 May 2006, from http://www.space.gc.ca/asc/eng/exploration/exploration.asp.

c. C3-057 (ISBN 10-1-59647-055-0) Sobey, E. (2006). *Rocket-powered Science.* Tucson, AZ. Good Year Books.

d. C3-087 NASA Glenn Research Center. *Propulsion Index.* Retrieved 21 February 2007, from http://www.grc.nasa.gov/WWW/K-12/airplane/shortp.html.

e. C3-088 NASA Glenn Research Center. *Beginner's Guide to Rockets.* Retrieved 21 February 2007, from http://exploration.grc.nasa.gov/education/rocket/bgmr.html.

f. C3-100 China In Space. *The Long March Space Rockets.* Retrieved 26 February 2007, from http://www.spacetoday.org/China/ChinaRockets.html.

g. C3-112 Federal Space Agency. *Roket1Show.* Retrieved 26 February 2007, from http://www.roscosmos.ru/RoketsMain.asp.

h. C3-113 European Space Agency. *ESA Launch Vehicles.* Retrieved 26 February 2007, from http://www.esa.int/esaCP/index.html.

i. C3-114 NASA. *Countdown! NASA Launch Vehicles and Facilities.* Retrieved 27 February 2007, from http://www-pao.ksc.nasa.gov/kscpao/nasafact/count1.htm#nasa.

8. **Training Aids**:

   a. Presentation aids (e.g. whiteboard/flipchart/OHP) appropriate for the classroom/training area; and

   b. Slides of American, Russian, European and Chinese launch vehicles.

9. **Learning Aids**:

   a. Balloons;

   b. String;

   c. Straw;

   d. Tape; and

   e. Paper or Styrofoam cup.

10. **Test Details**: N/A.

11. **Remarks**:

   a. It is recommended that the two periods required for this EO be scheduled consecutively.

   b. Website references should be made available for cadets to explore on their own time.

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