Instructions

- Write the names and student ids of all members of the group on the first answer sheet. You should show your work carefully – most of the points depend on your problem solving process.
- Multiple solution pages are provided – you may or may not wish to use all of them, but your answer should be written legibly.
- Solutions to the problems should begin from the following basic physical principles:
  - If \( x(t) \) is the position of the object as a function of time than velocity is \( v(t) = \frac{dx}{dt} \) and acceleration is \( a(t) = \frac{d^2x}{dt^2} \).
  - When the acceleration is a constant \( a \) then \( x(t) = x_0 + v_0 t + \frac{1}{2} at^2 \).
- Show all steps in the derivation of the answers. Make sure you write neatly and orderly. It is YOUR RESPONSIBILITY to make sure that the grader understands your solution. S/he will not give full points if they can not follow the solution, even if the final answer is correct.
- The acceleration due to gravity on Earth is 9.8 m/s².
- You can discard this page – it does not need to be handed in.

Problem (25 points)

You have a summer job working for a University research group designing a lunar probe to look for liquid water deep inside a crater. After the probe collects its data, it must transmit it back to the waiting science team on Earth. The crater is so deep that the probe can’t transmit directly back to Earth, so the plan is to launch a rocket out of the crater to transmit the data. Your task is to determine the necessary acceleration for the rocket. It will be launched straight up with a constant acceleration until its fuel is gone 20 seconds later. To be able to complete the data transmission, it is expected that the flight must be 7 minutes long before the rocket crashes back into the moon. You recall that the acceleration due to gravity on the moon is one-sixth of that on Earth. Your research advisor tells you that you can assume the starting and ending altitudes of the flight will be the same.
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Diagram the Problem and Summarize the Available Information
Plan the Solution

Calculate the Solution

Evaluate the Answer