

**Problem** [10pt] We assume the Earth is the only celestial object, and that it has no atmosphere. It does not rotate either. A spacecraft is launched from the Earth at different angles at the escape velocity (that is, the minimum velocity for the spacecraft to move infinitely far from the Earth). The spacecraft is launched at four different angles from the Earth's surface, as shown in Fig. 1.

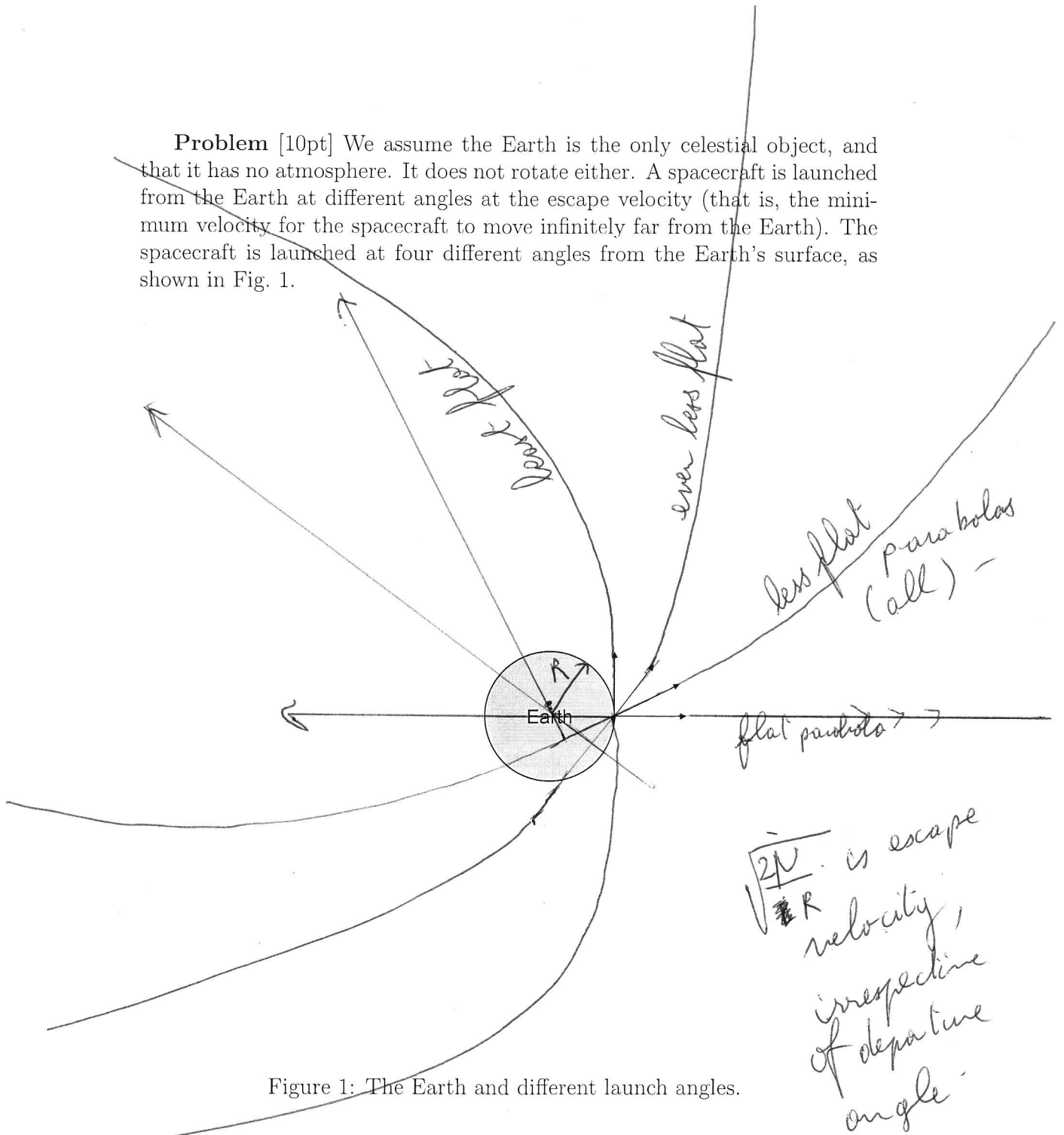


Figure 1: The Earth and different launch angles.

1. [5pt] For each launch angle, give an expression of the escape velocity

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what matters is total energy  $E = \frac{1}{2} m v^2 - \frac{K}{r} \equiv 0$