

The Ultimate* Particle Motion Problem—that uses a table

* in my humble opinion



Harry Potter rides a thestral back and forth along a straight path in the Forbidden Forest.

The table below gives values for the velocity and acceleration of the pair for selected values of time t . Both velocity and acceleration are differentiable functions of time t . Use the data in the table to answer the following problems.

Time, t [seconds]	0	10	30	60
$v(t)$ m/sec	10	-20	20	40
$a(t)$ m/sec^2	0	-10	10	-20

(A) Use a Right Riemann Sum to estimate $\int_0^{60} v(t) dt$. Explain the meaning of the definite integral in the context of this problem. Indicate units.

(B) Approximate the total distance traveled for $0 \leq t \leq 60$ using a trapezoidal sum. Indicate units.

(C) Is the speed increasing at time $t = 10$? Justify.

(D) Is the speed increasing at time $t = 30$? Justify.

(E) Is the speed increasing at time $t = 60$? Justify.

(F) Determine the value of $\int_0^{60} a(t) dt$. Indicate units and explain the meaning of the definite integral in the context of this problem.

(G) Given that the initial position of the thestral and Harry is at 6 meters, find the position of the thestral at time $t = 30$.

(H) Given that the initial position of the thestral and Harry is at 6 meters, find the position of the thestral at time $t = 60$.

(I) Find the average acceleration over the time interval $0 \leq t \leq 60$

(J) Use a Left Riemann Sum to estimate the average velocity over the time interval $0 \leq t \leq 60$

(K) Set up but do not evaluate an integral that finds the average speed during the time interval $0 \leq t \leq 60$

(L) At time $t = 10$ is the pair moving left or right? Justify.

(M) At time $t = 60$ is the pair moving left or right? Justify.