Physics
Final Exam Practice Part III

Name: Answers

★ The amount of time elapsed between frames is always $0.\overline{33}$ seconds. (for ordinary video)

How to find…

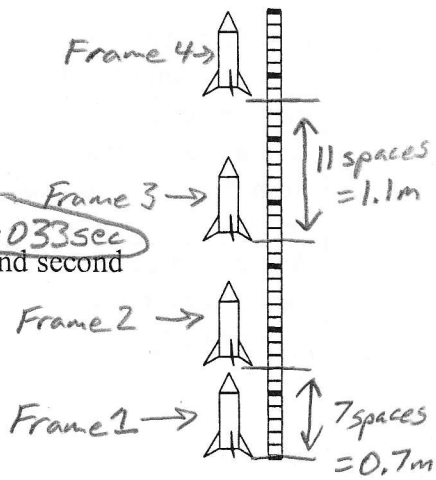
always 30 frames/sec

Distance Traveled = count the spaces on the meter stick, and multiply by 0.1m.
Change in Time (Δt) = count frame "steps" and divide that number of frame steps by the frame rate (# of frames per second)
Velocity = distance traveled / elapsed time
Change in Velocity (Δv) = second velocity minus first velocity
Acceleration (a) = Δv/Δt
Force = ma

**Note: There's no such thing as "frame 1 ½." However, "frame 1 ½" is the easiest way to describe the position half way between frame 1 and frame 2. So, even though there really is no "frame 1 ½," that term will be used to describe the interval between frames.

Practice (set 1) : Figure 1 shows pictures of a rocket taken with a movie camera. The frame rate is 30fps (frames per second). The stick next to the rocket is marked in 10cm (0.1m) increments. In Figure 1, you can see four video frames.

Fig 1



1. How far did the rocket move between the first and second frames?

7 spaces (0.1m/space) = 0.7m

2. What was the change in time between the first and second frames?

Δt = Frame 2 − Frame 1 = 1 frame step 1 frame step ÷ 30 frames/sec = 0.033 sec

3. What was the rocket's average velocity at frame 1 ½ (between the first and second frames)? (in m/s ~~and mph~~)

$V = \frac{d}{t} = \frac{0.7m}{0.033 sec} = 21 m/s$

4. How far did the rocket move between the third and fourth frames?

11 spaces (0.1 m/space) = 1.1m

5. What was the change in time between the third and fourth frames?

Δt = Frame 4 − Frame 3 = 1 frame step 1 frame step ÷ 30 frames/sec = 0.033 sec

6. What was the rocket's average velocity at frame 3 ½ (between the third and fourth frames)? (in m/s and mph)

$V = \frac{d}{t} = \frac{1.1m}{0.033 sec} = 33 m/s$

7. What was the change in time (Δt) between frame 1 ½ and frame 3 ½?

Δt = Frame 3½ − Frame 1½ = 2 frame steps 2 frame steps ÷ 30 frames/sec = 0.066 sec

8. What was the change in velocity (Δv) between frame 1 ½ and frame 3 ½?

ΔV = Final V − Initial V = 33 m/s − 21 m/s = 12 m/s

9. What was the rocket's acceleration between frame 1 ½ and frame 3 ½?

$a = \frac{\Delta V}{\Delta t} = \frac{12 m/s}{0.066 sec} = 182 m/s^2$

10. If the rocket's average mass between frames 1 ½ and 3 ½ was 0.4kg, what was average force that was accelerating the rocket?

acceleration mass

$F = ma = (0.4kg)(182 m/s^2) = 73N$

★ Some blocks may have slightly different figures, so your answers will differ

	Fig 2	Fig 3	Fig 4	Fig 5	Fig 6	Fig 7
Distance traveled between first two frames	0.5m	0.6m	0.5m	0.6m	1m	1m
Time elapsed between first two frames	0.033s	0.033s	0.033s	0.033s	0.033s	0.033s
Velocity at frame 1 ½	15m/s	18m/s	15m/s	18m/s	30m/s	30m/s
Distance traveled at max velocity	0.7m	1.1m	0.7m	1.2m	1.6m	1.9m
Time elapsed at max velocity	0.033s	0.033s	0.033s	0.033s	0.033s	0.033s
Maximum velocity	21m/s	33m/s	21m/s	36m/s	48.5m/s	58m/s
Δv from frame 1 ½ to max velocity	6m/s	15m/s	6m/s	18m/s	18.5m/s	28m/s
Δt from frame 1 ½ to max velocity	0.066s	0.1s	0.066s	0.1s	0.066s	0.1s
Average acceleration from frame 1 ½ to max velocity	92m/s²	152m/s²	92m/s²	182m/s²	276m/s²	273m/s²
Average force of rocket thrust from frame 1 ½ to max velocity	28N	30N	37N	64N	138N	110N