Linear Motion – Kinematics

A Physics Linear Motion

1. A car accelerates from 0–60 mph in 8 sec
   (a) What is its average acceleration (m/s²)? (4)
   (b) How far does it travel in this time?

60 mph ≈ 25 m/s
g = 10 m/s² ↓

2. A car driver, travelling at 20 m/s, sees a lorry stopped 50 m ahead of him.
   (a) What deceleration (a < 0) is necessary to stop just short of the lorry? (2)
   (b) How long does the car take to come to a stop? (2)
   (c) What is the car's speed ... 1 m from the lorry? (2)
   ... 1 s before coming to rest? (1) [7]

3. A person throws a stone vertically up, and it reaches a height of 60 m. Find...
   (a) the initial upward velocity. (2)
   (b) the time to reach the maximum height (2)
   (c) the height at 2.0 sec (2)
   (d) the two velocities at height 40 m. (3) [9]

4. Starting from rest, a car travels for 2 minutes with an acceleration of + 0.3 m/s². Then the speed is kept constant, until the car is brought to rest with an acceleration of −0.6 m/s².
   (a) what is the steady speed? (2)
   (b) what does "a = −0.6 m/s²" mean? (2)
   (c) what is the time to slow down? (2)
   (e) Sketch the v/t graph for the journey (6)
   (d) If the total distance covered is 4500 m, calculate the total journey time. (3) [15]

5. Sketch ... distance/time, velocity/time and acceleration/time graphs for... (a) a milk float moving from house to house (6)
   (b) a 100 m sprinter, accelerating to speed, and holding that speed to the end of the race (6)
   (c) a ball dropped on to a floor, and bouncing twice. (6)

Linear Motion — Answers

#Physics Linear motion

1. (a) $a = \Delta v / t = 25/8 = \underline{3.1}$ (2 S.F.) m/s² (2)

(b) $s = ut + \frac{1}{2}at^2 \rightarrow s = \frac{1}{2}at^2 = \underline{100\ m}$ (2)

(or $v^2 = u^2 + 2as \rightarrow s = v^2/2a = 100m$). [4]

2. (a) use $v^2 = u^2 + 2as$ ① $\rightarrow a = v^2 - u^2 / 2s = 0 - \frac{20^2}{25} = \underline{-4\ m/s^2}$ (① ①)

(b) use $v = u + at \rightarrow t = v - u / a = 0 - 20 / -4 = 5$ s. (2)

(c) (i) use $v^2 = u^2 + 2as \Rightarrow v$ (1m away) $= 20^2 + 2(-4)49 = \underline{+8\ m/s}$

(ii) use $v = u + at \rightarrow v$ (1 sec before stop) $= 20 - (4 \times 4.5) = \underline{4\ m/s}$ ← THINK !!

If $v = 0$ at 5 sec, then $v = +4$ at 4 sec. [7]

3. (a) $v^2 = u^2 + 2as \rightarrow u^2 = v^2 - 2as = 0 - 2 \times 10 \times -60$

so $u = \underline{34.6\ m/s}$ ↑ /2

(b) use $v = u + at \rightarrow t = v - u / a = 0 - (-34.6) / +10$

$= \underline{3.46\ s}$ /2

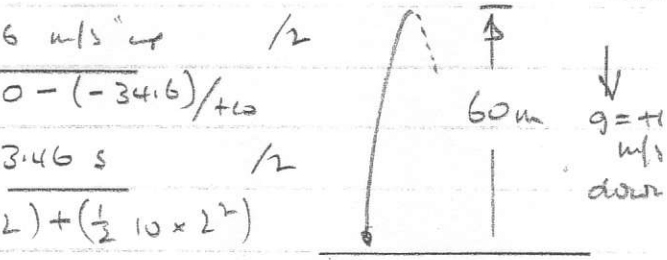
(c) use $s = ut + \frac{1}{2}at^2 = (-34.6 \times 2) + (\frac{1}{2} 10 \times 2^2)$

$= \underline{-49.2\ m/s}$ ∴ stone still going up. /2

(d) use $v^2 = u^2 + 2as = (-34.6)^2 + (2 \times 10 \times -40) = +397$ (!!) /3

so v at 40 m $= \sqrt{397} = \underline{+20\ m/s\ down}$ or $\underline{-20\ m/s\ up}$.

[9]

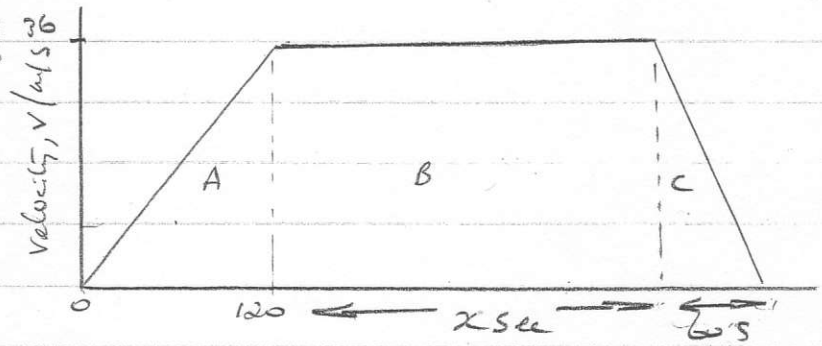


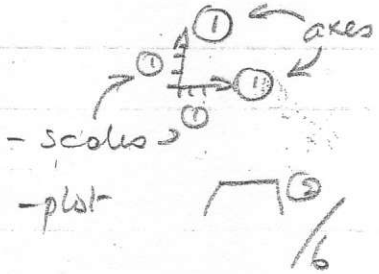
4. (a) $v_{steady} = u + at = 0 + 0.3 \times 120 = \underline{36\ m/s}$ /2

(b) $a = -0.6\ m/s^2$ means deceleration ①, speed reduces by 0.6 m/s² each sec ①.

(c) time to stop $v = u + at \rightarrow t = v - u / a = 0 - 36 / -0.6 = \underline{+60\ sec}$ /2

(d) (e)





(d) Total distance travelled = area under graph

$= A + B + C$

$= (\frac{1}{2} \times 120 \times 36) + (x \times 36) + (\frac{1}{2} \times 60 \times 36)$

area of Δ = ½ base × height ①

$4500 = 2160 + 36x + 1080$

so $x = 2160 / 36 = \underline{35\ s}$

[15]

So Total journey time $= 120 + 35 + 60 = \underline{215\ s}$ /3

Linear Motion 1/2

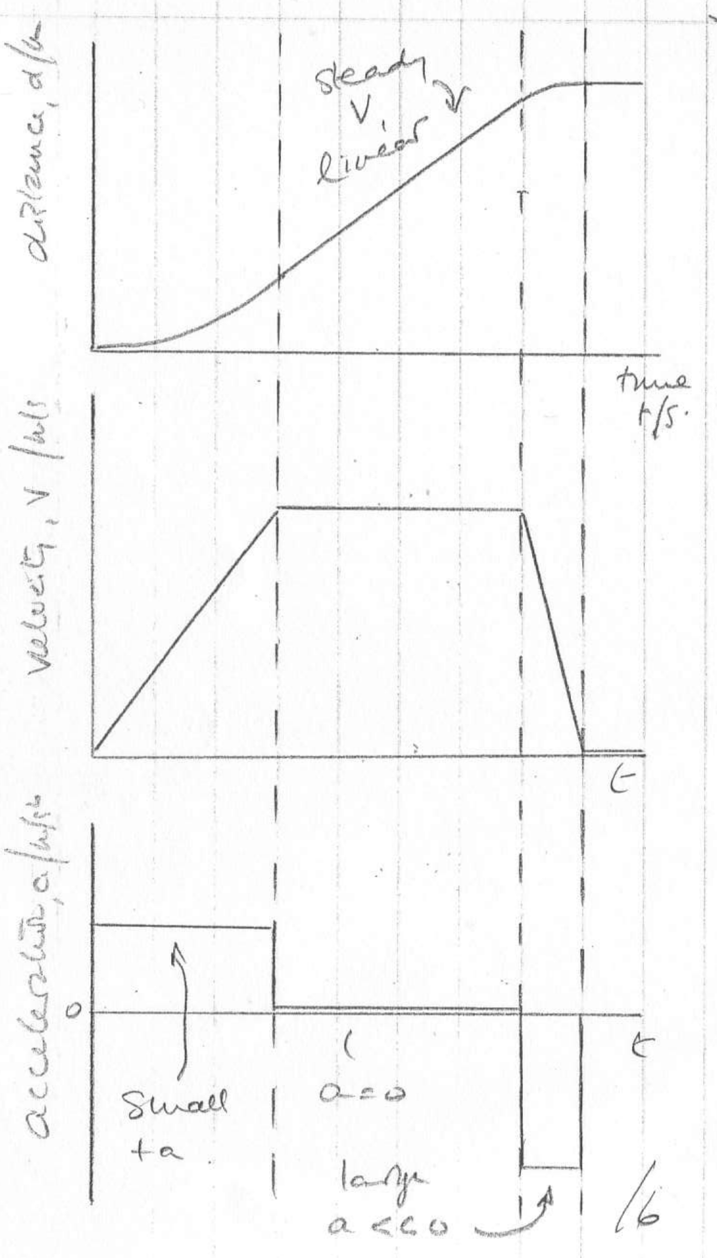
ANSWERS

Aphysics in Linear motion

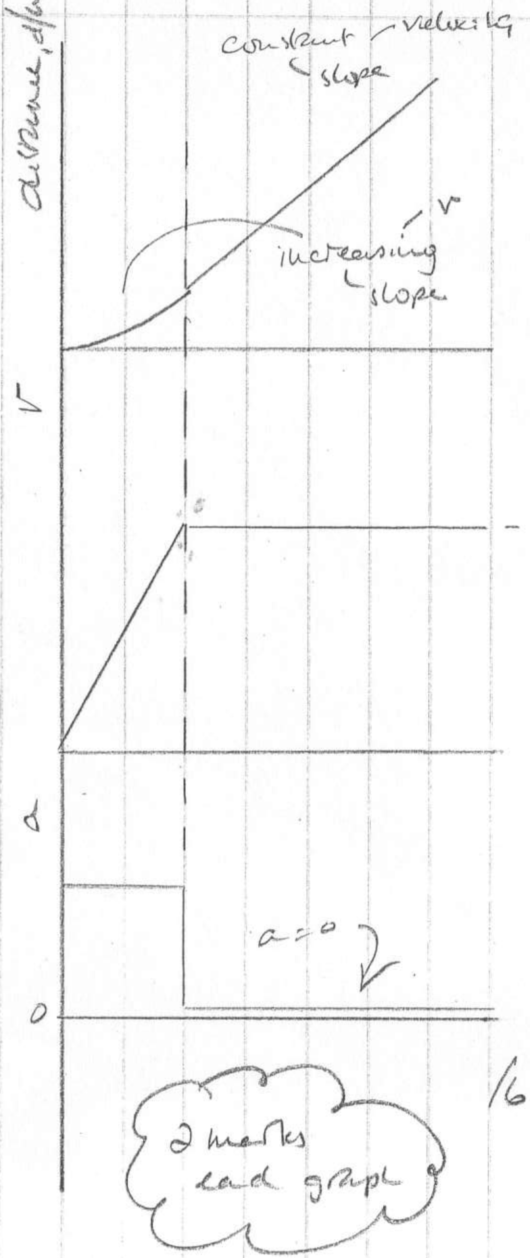
TM 1.98

5. Sketch graphs of . . .

(a) the mile flyer



(b) the sprinter



(c) bouncing ball