Kinematic Problem Set 1

AP Physics

① $\bar{v} = \frac{d}{t}$

Ⓐ $t = \frac{d}{\bar{v}} = \frac{90\text{mi}}{55\text{mi/hr}} = 1.64\text{hr}$ Ⓑ $t = \frac{d}{\bar{v}} = \frac{90\text{mi}}{70\text{mi/hr}} = 1.29\text{hr}$

$1.64 - 1.29\text{hr} = \boxed{0.350\text{hr}}$

② $v = 40\text{km/hr}$ $t = 2\text{sec}$ $v = \frac{d}{t}$ $d = vt = 40\text{km/hr}\left(\frac{1\text{hr}}{3600\text{s}}\right)2\text{s} = \boxed{0.0222\text{km}}$

③ $0.9144\text{m} = 1\text{yd}$ $v = \frac{d}{t} = \frac{(100\text{yd})(0.9144\text{m/yd})}{9.1\text{s}} = 9.73\text{m/s}$

$t = \frac{d}{v} = \frac{100\text{m}}{9.73\frac{\text{m}}{\text{s}}} = \boxed{10.3\text{sec}}$

④ $v = c = 3.0\times10^8\text{m/s}$

Ⓐ $d = vt = \left(3.0\times10^8\text{m/s}\right)(1\text{yr})\left(\frac{365.24\text{d}}{1\text{yr}}\right)\left(\frac{24\text{hr}}{1\text{d}}\right)\left(\frac{3600\text{s}}{1\text{hr}}\right) = \boxed{9.47\times10^{15}\text{m}}$

Ⓑ $1\text{AU} = 1.49\times10^8\text{km}$ $t = \frac{d}{v} = \frac{1.49\times10^8\text{km}\left(\frac{1000\text{m}}{1\text{km}}\right)}{3.0\times10^8\text{m/s}} = \boxed{497\text{sec}}$ 8.27 min

Ⓒ $\frac{d_c}{d_{AU}} = \frac{9.47\times10^{15}\text{m}}{1.49\times10^{11}\text{m}} = \boxed{63600\text{ AU IN 1 LIGHT YEAR}}$

⑤ $d_G = 400\text{m}$ $t = 45.5\text{sec}$ $v_G = \frac{d}{t} = \frac{400\text{m}}{45.5\text{s}} = 8.79\text{m/s}$

$d_A = 400\text{m}$ $t = 44.0\text{sec}$

$d_{G_L} = 390\text{m}$ $v_G = 8.79\text{m/s}$ $t = \frac{d}{v} = \frac{390\text{m}}{8.79\frac{\text{m}}{\text{s}}} = 44.37\text{sec}$

$44.37 - 44.0 = .37\text{sec}$

$d = vt = (8.79\text{m/s})(.37\text{s})$

AMERICAN WINS BY → $\boxed{d = 3.25\text{m}}$

⑥ $v_B = 20\text{m/s}$ $d_B = 20\text{m}$ $t = \frac{d_B}{v_B} = \frac{20\text{m}}{20\frac{\text{m}}{\text{s}}} = 1\text{sec}$

$v_R = 7\text{m/s}$ $d_R = ?$ $d_R = v_R t = (7\text{m/s})(1\text{s}) = \boxed{7\text{m}}$

⑦ $d_W = 1500\text{m}$ $t_W = 250\text{s}$ $v_W = \frac{d}{t} = \frac{1500\text{m}}{250\text{s}} = 6\text{m/s}$

$t_m = \frac{d_W}{v_W} = \frac{1200\text{m}}{6\text{m/s}} = 200\text{s}$

$d_L = 900\text{m}$ $t_L = 200\text{s}$ $v_L = \frac{d_L}{t_L} = \frac{900\text{m}}{200\text{s}} = 4.5\text{m/s}$

$t_L = \frac{d}{v_L} = \frac{1500\text{m}}{4.5\text{m/s}} = 333\text{sec} = 5\text{min }33\text{sec}$

⑧ $v_B = 4\text{ km/hr}$ $d_B = \frac{400\text{m}}{2} = 200\text{m}$ $t_B = \frac{d_B}{v_B} = \frac{200\text{m}\left(\frac{1\text{km}}{1000\text{m}}\right)}{4\text{ km/hr}} = 0.05\text{hr}$

$v_d = 30\text{km/hr}$ $t_d = 0.05\text{hr}$ $d = v_d t_d = (30\text{km/hr})(0.05\text{hr}) = \boxed{1.5\text{km}}$

KINEMATIC PROBLEM SET 2 — AP PHYSICS

① $d_1 = 60\text{km}$, $v_1 = 30\text{km/hr}$, $t_1 = \frac{d_1}{v_1} = \frac{60\text{km}}{30\text{km/hr}} = 2.0\text{hr}$

$d_2 = 60\text{km}$, $v_2 = 60\text{km/hr}$, $t_2 = \frac{d_2}{v_2} = \frac{60\text{km}}{60\text{km/hr}} = 1.0\text{hr}$

$d_T = d_1 + d_2 = 60\text{km} + 60\text{km} = 120\text{km}$

$t_T = t_1 + t_2 = 2 + 1\text{hr} = 1.5\text{hr}$

$\bar{v}_{avg} = \frac{d_T}{t_T} = \frac{120\text{km}}{3.0\text{hr}} = \boxed{40\text{km/hr}}$

② $v_1 = 40\text{km/hr}$, $d_1 = .5$, $t = \frac{d_1}{v_1} = \frac{.5}{40\text{km/hr}}$, $t = .0125\text{hr}$

$d_2 = .5$, $\bar{v} = 60\text{km/hr}$, $d_T = 1$, $t = \frac{1}{60\text{km/hr}} = .0166$

$t_2 = .0166 - .0125\text{hr} = .00416\text{hr}$

$v_2 = \frac{d_2}{t_2} = \frac{0.5\text{km}}{0.00416\text{hr}} = \boxed{120\text{km/hr}}$

③ $d_T = 200\text{km}$, $\bar{v} = 50\text{km/hr}$, $t_T = \frac{d_T}{\bar{v}} = \frac{200\text{km}}{50\text{km/h}} = 4\text{hr}$

$d_1 = 100\text{km}$, $v_1 = 40\text{km/hr}$, $t_1 = \frac{d_1}{v_1} = \frac{100\text{km}}{40\text{km/hr}} = 2.5\text{hr}$

$t_2 = t_T - t_1$, $4 - 2.5\text{hr} = 1.5\text{hr}$

$d_2 = 100\text{km}$, $v_2 = \frac{d_2}{t_2} = \frac{100\text{km}}{1.5\text{hr}}$

$\boxed{66.7\text{km/hr}}$

④ $100.\text{m} = .0621\text{mi}$, $1.609\text{km} = 1\text{mi}$

$v = \frac{d}{t}$, $\frac{(100\text{m})\left(\frac{1\text{km}}{1000\text{m}}\right)\left(\frac{1\text{mi}}{1.609\text{km}}\right)}{10.2\text{s}\left(\frac{1\text{hr}}{3600\text{s}}\right)} = \frac{.0621\text{mi}}{.00283\text{hr}}$

$\boxed{21.9\text{mi/hr}}$

⑤ $v_1 = 70\text{km/hr}$, $v_2 = 0$, $v_3 = 90\text{km/hr}$

$t_1 = 1\text{hr}$, $t_2 = .33\text{hr}$, $t_3 = \frac{d_3}{v_3} = \frac{70\text{km}}{90\text{km/hr}} = .77$, $t_T = 2.11$

$d_1 = \frac{v_1}{t} = \frac{70\text{km/h}}{1\text{hr}}$, $d_2 = 0$, $d_3 = d_1 = 70\text{km}$, $d_T = 140\text{km}$

$= 70\text{km}$

(A) $\bar{s} = \frac{d}{t} = \frac{140\text{km}}{2.11\text{hr}} = 66.3\text{km/hr}$

(B) $\bar{v} = \frac{d}{t} = \frac{70\text{km} + -70\text{km}}{2.11\text{hr}} = 0\text{km/hr}$

(C) 140km

(D) $t_T = 1 + .5 + t_3 = 2.11$, $t_3 = .61$

$v_3 = \frac{d_3}{t_3} = \frac{70\text{km}}{.61\text{hr}} = \boxed{115\text{km/hr}}$

KINEMATIC PROBLEM SET 3 — AP PHYSICS

① A) $s = \frac{d}{t} = \frac{21m + 27m}{30min\left(\frac{60s}{1min}\right)} = 0.0266\ m/s$

B) $\vec{d} = \sqrt{21^2 + 27^2} = 34.2$ $\quad \vec{v} = \frac{\vec{d}}{t} = \frac{34.2}{1800s} = 0.019\ m/s$

② $v = \frac{d}{t} = \frac{1.50km \cdot \frac{1000m}{1km}}{1.10min\left(\frac{60s}{1min}\right)} = 22.7\ m/s$

THE VELOCITY IS NOT CONSTANT DUE TO THE BIKER CHANGING DIRECTION AS HE GOES AROUND THE OVAL TRACK.

③ $t_s = \frac{d}{v_s} = \frac{2.50km\left(\frac{1000m}{1km}\right)}{340m/s} = 7.35\ sec$ $\quad t_L = \frac{d}{v_L} = \frac{(2.50km)\left(\frac{1000m}{1km}\right)}{3\times10^8 m/s} = 8.33\times10^{-6}\ s$

$7.35 - 0.00000833\ sec$

NO DIFFERENCE IF YOU CONSIDER LIGHT @ ∞ SPEED

④ A) AB $v = \frac{\Delta d}{t} = \frac{1-1m}{1-0s} = 0m/s$ $\quad$ DE $v = \frac{\Delta d}{t} = \frac{7-9m}{6-4.5s} = -1.33m/s$

BC $= v = \frac{\Delta d}{t} = \frac{7-1m}{3-1s} = 3m/s$ $\quad$ EF $v = \frac{\Delta d}{t} = \frac{2-7m}{9-6s} = -1.67m/s$

CD $= v = \frac{\Delta d}{t} = \frac{9-7m}{4.5-3} = 1.33m/s$ $\quad$ FG $= v = \frac{\Delta d}{t} = \frac{2-2m}{11-9s} = 0m/s$

B) AB; FG ARE UNIFORM
BC, CD, DE, EF ARE NOT UNIFORM

C) SLOPE OF A LINE ON A d vs t GRAPH SHOWS VELOCITY. THE SLOPE AT THE "PEAK" OF THE GRAPH IS ZERO. SO THE VELOCITY @ POINT D IS ZERO.

⑤ $t = \frac{d}{v} = \frac{1mi}{65mi/hr} = .0154hr\left(\frac{3600s}{1hr}\right) = 55.4\ sec$

$\bar{v} = \frac{d}{t} = \frac{1mi}{65s\left(\frac{1hr}{3600s}\right)} = 55.4mi/hr$

⑥ $s = \frac{d}{t}$ $\quad t_T = \frac{d}{8.9km/s}$ $\quad t_L = \frac{d}{5.1km/s}$ $\quad d = 872\ km$

$\Delta t = t_L - t_T = \frac{d}{5.1km/s} - \frac{d}{8.9km/s} = 73s$

⑦ 6hr 42min & 8sec = 6.70hr $\quad$ 2hr 56min & 12s = 2.69h

A) $s = \frac{d}{t} = \frac{500mi}{6.70hr} = 74.6mi/hr$ $\quad s = \frac{d}{t} = \frac{500mi}{2.69hr} = 185.9mi/hr$

B) $\frac{185.9 - 74.6mi/hr}{74.6mi/hr} \times 100\% = 149\%$

⑧ A) SPEED

$0\text{-}2s\ \frac{2-0m}{2-0s} = 1m/s$ $\quad 2\text{-}3s\ \frac{2-2m}{3-2s} = 0m/s$

$3\text{-}4.5\ \frac{4-2m}{4.5-3s} = 1.3m/s$ $\quad 4.5\text{-}6.5\ \frac{4-(-1.5m)}{6.5-4.5s} = 2.8m/s$

$6.5\text{-}7.5\ \frac{-1.5-(-1.5m)}{7.5-6.5s} = 0m/s$ $\quad 7.5\text{-}9\ \frac{0-(-1.5m)}{9-7.5s} = 1.0m/s$

B) VELOCITY

$0\text{-}2s\ \frac{2-0m}{2-0s} = 1m/s$ $\quad 2\text{-}3\ \frac{2-2m}{3-2s} = 0m/s$

$3\text{-}4.5\ \frac{4-2m}{4.5-3s} = 1.3m/s$ $\quad \frac{-1.5-4m}{6.5-4.5} = -2.8m/s$

$6.5\text{-}7.5\ \frac{-1.5m-(-1.5m)}{7.5-6.5s} = 0m/s$ $\quad \frac{0-(-1.5m)}{9-7.5s} = 1.0m/s$

C) $v_{1.5sec} = 1.0m/s$ $\quad v_{2.5s} = 0m/s$ $\quad v_{4.5s} = 0m/s$ $\quad v_{6s} = -2.8m/s$

D) $v_{4.5\text{-}9} = \frac{0-4m}{9s-4s} = -0.89m/s$