Exam: KINEMATICS	
Name:	**Course:**

① a) acceleration = slope

1st interval ... $a_1 = \text{slope} = \frac{12-0}{2-0} = 6\ m/s^2$

2nd interval ... $a_2 = \text{slope} = 0$

3rd interval ... $a_3 = \text{slope} = \frac{18-12}{8-6} = 3\ m/s^2$

4th interval ... $a_4 = \text{slope} = \frac{-16-18}{14-8} = -5.67\ m/s^2$

b) displacement = area

1st interval ... $\Delta x_1 = A_1 = \frac{1}{2} \times 2 \times 12 = 12\ m$

2nd interval ... $\Delta x_2 = A_2 = 12 \times 4 = 48\ m$

3rd interval ... $\Delta x_3 = A_3 = (12 \times 2) + (\frac{1}{2} \times 2 \times 6) = 30\ m$

4th interval ... $\Delta x_4 = A_4 = (\frac{1}{2} \times 3.17 \times 18) - (\frac{1}{2} \times 2.83 \times 16) = 5.89\ m$

Total displacement ... $\boxed{\Delta x = 95.89\ m}$

c) When the body stops ... $v = 0$

$$-5.67 \frac{m}{s^2} = \frac{0 - 18\ m/s}{t - 8s} \rightarrow -5.67t + 45.36 = -18 \rightarrow$$

$$\rightarrow t = \frac{-18 - 45.36}{-5.67} = 11.17\ s \qquad \boxed{t = 11.17\ s}$$

② ⓐ $V_A = 72\ \frac{Km}{h} \times \frac{1h}{3600s} \times \frac{1000\ m}{1\ Km} = 20\ \frac{m}{s}$

$$\left.\begin{array}{l} x_A = 2000 - 20t \\ x_B = t^2 \end{array}\right\} \quad x_A = x_B \quad 2000 - 20t = t^2$$

$$t^2 + 20t - 2000 = 0 \rightarrow t = \frac{-20 \pm \sqrt{400 + 8000}}{2} \rightarrow \boxed{t = 35.83\ s}$$

ⓑ $x_A = x_B = 2000 - (20 \times 35.83)$

$\hookrightarrow \boxed{x_A = x_B = 1283.4\ m}$

ⓒ $V_A = -20\ m/s$

$V_B = 2\ \frac{m}{s^2} \times 35.83 s = 71.66\ \frac{m}{s}$

③ ⓐ $\boxed{\vec{r} = (80 + 50t - 5t^2)\,\vec{j}\ \ (m)}$

ⓑ $\boxed{\vec{v} = (50 - 10t)\,\vec{j}\ \ (m/s)}$

ⓒ Maximum height ... $v = 0$

$50 - 10t = 0 \rightarrow t = 5\ s$

$y = 80 + 50 \times 5 - 5 \times 25 = \boxed{205\ m}$

d) The body hits the floor ... $y = 0$

$80 + 50t - 5t^2 = 0 \rightarrow t^2 - 10t - 16 = 0$

$t = \frac{10 \pm \sqrt{100 + 64}}{2} \rightarrow t = 11.4\ s$

$\vec{v} = (50 - 10 \times 11.4)\,\vec{j}\ (m/s) = -64\,\vec{j}\ (m/s)$

(4) (a) $\vec{r} = 50t\,\vec{i} + (40-5t^2)\vec{j}$ (m)

(b) maximum distance ... $y=0$

$40-5t^2=0 \rightarrow t=\sqrt{\frac{40}{5}} = 2.83\ s$

$x = 50 \times 2.83 = 141.5\ m$ $\boxed{x_{max} = 141.5\ m}$

(c) The trajectory:

$x = 50t$ $\Big\}$ $t = \frac{x}{50}$

$y = 40-5t^2$ $\Big\}$

$\hookrightarrow y = 40-5\left(\frac{x}{50}\right)^2 \rightarrow \boxed{y = 40 - \frac{x^2}{500}}$

(d) $\vec{v} = 50\,\vec{i} - 10t\,\vec{j}$ (m/s)

$\downarrow t = 1.5\ s$

$\vec{v} = 50\frac{m}{s}\vec{i} - 15\frac{m}{s}\vec{j}$

$|\vec{v}| = \sqrt{50^2 + (-15)^2} = \boxed{52.2\frac{m}{s}}$

$\cos\alpha = \frac{50}{52.2} = 0.958 \rightarrow \boxed{\alpha = -16.7^\circ}$