SOLUTIONS ⇒ MAXIMUM/MINIMUM PROBLEMS

1. $h = -5t^2 + 50t + 40$

To find the solutions to "a" and "b" we will need to locate the vertex by completing the square.

① $h - 40 = -5t^2 + 50t$
② $h - 40 = -5(t^2 - 10t)$
③ $h - 40 - 125 = -5(t^2 - 10t + 25)$
④ $h - 165 = -5(t-5)^2$
⑤ $h = -5(t-5)^2 + 165$ (SF)

Vertex $(\underset{\text{Time}}{5}, \underset{\text{Height}}{165})$

a) It would take the object 5 seconds to reach its maximum height.

b) The maximum height reached by the object is 165 m.

2. $h = -4.9t^2 + 9.8t$

② $h = -4.9(t^2 - 2t)$
③ $h - 4.9 = -4.9(t^2 - 2t + 1)$
④ $h - 4.9 = -4.9(t-1)^2$
⑤ $h = -4.9(t-1)^2 + 4.9$ (SF)

Vertex $(\underset{\text{Time}}{1}, \underset{\text{Height}}{4.9})$

a) The ball reaches a maximum height of 4.9 m after 1 second.

b) After 1 bounce ⇒ 60% of 4.9 m
$= 0.60 \times 4.9\text{ m}$
$= 2.94\text{ m}$.

After 2 bounces ⇒ 60% of 2.94 m
$= 0.60 \times 2.94\text{ m}$
$= 1.76\text{ m}$

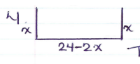
Two bounces later, the ball will reach a maximum height of 1.76 m.

3. $h = -4.9t^2 + 19.6t$

② $h = -4.9(t^2 - 4t)$
③ $h - 19.6 = -4.9(t^2 - 4t + 4)$
④ $h - 19.6 = -4.9(t-2)^2$
⑤ $h = -4.9(t-2)^2 + 19.6$ (SF)

Vertex $(\underset{\text{Time}}{2}, \underset{\text{Height}}{19.6})$

The fire hydrant reaches a maximum height of 19.6 m.



$P = 24\text{ m}$
Let x = width
Then $24 - 2x$ = length
Area = length × width
$y = (24 - 2x)(x)$
↳ Place in General Form!
$y = 24x - 2x^2$ (Rearrange)
$y = -2x^2 + 24x$ (GF)

② $y = -2(x^2 - 12x)$
③ $y - 72 = -2(x^2 - 12x + 36)$
④ $y - 72 = -2(x-6)^2$
⑤ $y = -2(x-6)^2 + 72$ (SF)

Vertex $(\underset{\text{Length}}{6}, \underset{\text{Area}}{72})$

We now know that the maximum area of 72 m^2 occurs when the width is 6 m.

To determine the length: $\frac{72\text{ m}^2}{6\text{ m}}$
$= 12\text{ m}$.

Therefore, the dimensions of his flower garden will be 6 m × 12 m.

5.

$P = 100$ m

Let x = width

Then $100 - 2x$ = length

Area = length x width

$y = (100 - 2x)(x)$

↳ Place in General Form.

$y = 100x - 2x^2$ (Rearrange)

$y = -2x^2 + 100x$ (GF)

② $y = -2(x^2 - 50x)$

③ $y - 1250 = -2(x^2 - 50x + 625)$

④ $y - 1250 = -2(x - 25)^2$

⑤ $y = -2(x - 25)^2 + 1250$ (SF)

Vertex $(25, 1250)$

width area

We now know that the maximum area of $1250\ m^2$ occurs when the width is 25m.

To determine the length: $\frac{1250m^2}{25m} = 50m$

⇒ Dimensions of swimming area will be 50m x 25m.