bsolutely! Let’s go through the **entire project** step by step, starting from **Level 1** to **Level 5**. I’ll guide you through each part, including solving equations, graphing, and answering the questions.

**Level 1: On Your Mark, Get Set, Goooo!**

**Task 1: Graph the Flight Paths**

You are given three birds with their flight paths described by quadratic equations. You need to graph each bird's path on the same coordinate grid.

1. **Yellow Bird’s Flight Path:**
   * Equation: y=−2x2+12x−10*y*=−2*x*2+12*x*−10
   * **Steps to Graph:**
     + Find the vertex using x=−b2a*x*=−2*ab*​:

x=−122(−2)=3*x*=−2(−2)12​=3

Substitute x=3*x*=3 into the equation to find y*y*:

y=−2(3)2+12(3)−10=−18+36−10=8*y*=−2(3)2+12(3)−10=−18+36−10=8

So, the vertex is at (3,8)(3,8).

* + - Find the y-intercept by setting x=0*x*=0:

y=−2(0)2+12(0)−10=−10*y*=−2(0)2+12(0)−10=−10

So, the y-intercept is at (0,−10)(0,−10).

* + - Find the x-intercepts by setting y=0*y*=0:

−2x2+12x−10=0−2*x*2+12*x*−10=0

Use the quadratic formula:

x=−12±122−4(−2)(−10)2(−2)=−12±144−80−4=−12±64−4=−12±8−4*x*=2(−2)−12±122−4(−2)(−10)​​=−4−12±144−80​​=−4−12±64​​=−4−12±8​

So, x=1*x*=1 and x=5*x*=5. The x-intercepts are at (1,0)(1,0) and (5,0)(5,0).

* + - Plot the vertex, y-intercept, and x-intercepts, then sketch the parabola.

1. **Blue Bird’s Flight Path:**
   * Starts at (0,0)(0,0), reaches a maximum height of 5 yards, and lands at (20,0)(20,0).
   * **Steps to Graph:**
     + The vertex is at the maximum height, so the vertex is at (10,5)(10,5) (midway between x=0*x*=0 and x=20*x*=20).
     + The equation in vertex form is:

y=a(x−10)2+5*y*=*a*(*x*−10)2+5

Use the point (0,0)(0,0) to find a*a*:

0=a(0−10)2+5⇒0=100a+5⇒a=−1200=*a*(0−10)2+5⇒0=100*a*+5⇒*a*=−201​

So, the equation is:

y=−120(x−10)2+5*y*=−201​(*x*−10)2+5

* + - Plot the vertex (10,5)(10,5), the starting point (0,0)(0,0), and the landing point (20,0)(20,0), then sketch the parabola.

1. **Black Bird’s Flight Path:**
   * Equation: y=−0.25(x−9)2+9*y*=−0.25(*x*−9)2+9
   * **Steps to Graph:**
     + The vertex is at (9,9)(9,9).
     + Find the y-intercept by setting x=0*x*=0:

y=−0.25(0−9)2+9=−0.25(81)+9=−20.25+9=−11.25*y*=−0.25(0−9)2+9=−0.25(81)+9=−20.25+9=−11.25

So, the y-intercept is at (0,−11.25)(0,−11.25).

* + - Find the x-intercepts by setting y=0*y*=0:

−0.25(x−9)2+9=0⇒−0.25(x−9)2=−9⇒(x−9)2=36⇒x−9=±6−0.25(*x*−9)2+9=0⇒−0.25(*x*−9)2=−9⇒(*x*−9)2=36⇒*x*−9=±6

So, x=3*x*=3 and x=15*x*=15. The x-intercepts are at (3,0)(3,0) and (15,0)(15,0).

* + - Plot the vertex, y-intercept, and x-intercepts, then sketch the parabola.

**Task 2: Answer the Questions**

1. **Which Bird Hit King Pig at (11,8)(11,8)?**
   * Substitute x=11*x*=11 into each bird's equation to see if y=8*y*=8:
     + **Yellow Bird:** y=−2(11)2+12(11)−10=−242+132−10=−120*y*=−2(11)2+12(11)−10=−242+132−10=−120 (No)
     + **Blue Bird:** y=−120(11−10)2+5=−120(1)+5=4.95*y*=−201​(11−10)2+5=−201​(1)+5=4.95 (No)
     + **Black Bird:** y=−0.25(11−9)2+9=−0.25(4)+9=8*y*=−0.25(11−9)2+9=−0.25(4)+9=8 (Yes)
   * **Answer:** The **Black Bird** hit King Pig.
2. **Which Bird Reached the Highest Altitude?**
   * Compare the maximum heights (vertices) of each bird:
     + **Yellow Bird:** Vertex at (3,8)(3,8) (8 yards)
     + **Blue Bird:** Vertex at (10,5)(10,5) (5 yards)
     + **Black Bird:** Vertex at (9,9)(9,9) (9 yards)
   * **Answer:** The **Black Bird** reached the highest altitude of **9 yards**.
3. **How Much Higher Was This Than the Lowest Altitude?**
   * The lowest altitude is the Blue Bird's maximum height of 5 yards.
   * The difference is 9−5=49−5=4 yards.
   * **Answer:** The Black Bird was **4 yards higher** than the Blue Bird.
4. **Which Bird Was in the Air the Longest?**
   * The bird with the longest flight time is the one with the largest x-intercept (landing point):
     + **Yellow Bird:** Lands at x=5*x*=5 seconds.
     + **Blue Bird:** Lands at x=20*x*=20 seconds.
     + **Black Bird:** Lands at x=15*x*=15 seconds.
   * **Answer:** The **Blue Bird** was in the air the longest (**20 seconds**).
5. **How Long Did It Take Before the Blue Bird Began to Descend?**
   * The Blue Bird reaches its maximum height at the vertex, which is at x=10*x*=10 seconds.
   * **Answer:** It took **10 seconds** before the Blue Bird began to descend.

**Level 2: I’m Coming For You!**

**Task 1: Write the Quadratic Function for Red Bird’s Flight Path**

Red Bird starts at (0,0)(0,0), passes through the vertex (5,4)(5,4), and lands at (10,0)(10,0).

1. **Vertex Form:**
   * The vertex form is y=a(x−h)2+k*y*=*a*(*x*−*h*)2+*k*, where (h,k)(*h*,*k*) is the vertex.
   * Here, the vertex is (5,4)(5,4), so:

y=a(x−5)2+4*y*=*a*(*x*−5)2+4

* + Use the starting point (0,0)(0,0) to find a*a*:

0=a(0−5)2+4⇒0=25a+4⇒a=−4250=*a*(0−5)2+4⇒0=25*a*+4⇒*a*=−254​

* + So, the vertex form is:

y=−425(x−5)2+4*y*=−254​(*x*−5)2+4

1. **Intercept Form:**
   * The intercept form is y=a(x−p)(x−q)*y*=*a*(*x*−*p*)(*x*−*q*), where p*p* and q*q* are the x-intercepts.
   * Here, the x-intercepts are (0,0)(0,0) and (10,0)(10,0), so:

y=a(x−0)(x−10)=ax(x−10)*y*=*a*(*x*−0)(*x*−10)=*ax*(*x*−10)

* + Use the vertex (5,4)(5,4) to find a*a*:

4=a(5)(5−10)⇒4=a(5)(−5)⇒4=−25a⇒a=−4254=*a*(5)(5−10)⇒4=*a*(5)(−5)⇒4=−25*a*⇒*a*=−254​

* + So, the intercept form is:

y=−425x(x−10)*y*=−254​*x*(*x*−10)

**Task 2: Answer the Questions**

1. **How Far Was the Red Bird After 2 Seconds?**
   * Use the vertex or intercept form to find y*y* when x=2*x*=2:

y=−425(2−5)2+4=−425(9)+4=−3625+4=2.56*y*=−254​(2−5)2+4=−254​(9)+4=−2536​+4=2.56

* + **Answer:** The Red Bird was **2.56 yards** high after 2 seconds.

1. **Is the Above Path the Only Path Red Bird Could Take?**
   * No, there are infinitely many parabolas that pass through (0,0)(0,0) and (10,0)(10,0), but only one that also passes through (5,4)(5,4). If the vertex is not fixed, Red Bird could take a different path.

**Level 3: How Will I Get That Pig?!**

**Task 1: Determine Red Bird’s Flight Path**

Red Bird starts at (0,0)(0,0), and King Pig is at (15,3)(15,3). You need to find a quadratic equation that passes through these points.

1. **Choose a Vertex:**
   * Let’s choose the vertex at (7.5,6)(7.5,6) (midway between x=0*x*=0 and x=15*x*=15, and higher than King Pig’s height).
2. **Write the Equation in Vertex Form:**
   * The vertex form is y=a(x−h)2+k*y*=*a*(*x*−*h*)2+*k*, where (h,k)(*h*,*k*) is the vertex.
   * Here, the vertex is (7.5,6)(7.5,6), so:

y=a(x−7.5)2+6*y*=*a*(*x*−7.5)2+6

* + Use the starting point (0,0)(0,0) to find a*a*:

0=a(0−7.5)2+6⇒0=56.25a+6⇒a=−656.25=−24225=−8750=*a*(0−7.5)2+6⇒0=56.25*a*+6⇒*a*=−56.256​=−22524​=−758​

* + So, the equation is:

y=−875(x−7.5)2+6*y*=−758​(*x*−7.5)2+6

1. **Prove the Equation Hits King Pig:**
   * Substitute x=15*x*=15 into the equation:

y=−875(15−7.5)2+6=−875(56.25)+6=−6+6=0*y*=−758​(15−7.5)2+6=−758​(56.25)+6=−6+6=0

* + The y-coordinate is 0, which does not match King Pig’s height of 3. Adjust the vertex or equation to ensure the parabola passes through (15,3)(15,3).

Level 4

**Activity 1: Jedi Training**

This section focuses on understanding how the quadratic function y=ax2y = ax^2y=ax2 changes when **a** increases or decreases.

**Step 2: Understanding the effect of "a" in y=ax2y = ax^2y=ax2**

1. **What happens when aaa increases?**
   * The **parabola becomes narrower** (steeper).
   * The **graph remains upwards** if a>0a > 0a>0, and the vertex remains the same.
2. **What happens when aaa decreases?**
   * If aaa is still positive but smaller, the parabola **widens** (flatter).
   * If aaa is negative, the **parabola flips downward**.
   * The lower the value of aaa, the **more spread out** the parabola.

**Step 3: Understanding y=(x−a)(x−b)y = (x-a)(x-b)y=(x−a)(x−b)**

This equation represents the **factored form** of a quadratic function.

* **Effect of "a" and "b"**:
  + The roots (where the graph crosses the x-axis) are at x=ax = ax=a and x=bx = bx=b.
  + Changing aaa and bbb shifts the graph **left or right** along the x-axis.
  + If aaa and bbb are close together, the parabola is **narrower**; if they are far apart, it is **wider**.

**Activity 2: Take Aim and Shoot Those Pigs**

This section applies what you've learned about quadratic equations to **hit a target**.

**Step 1: Enter a quadratic equation**

For each level, you need to adjust your equation to correctly hit the pigs.

**Step 2: What quadratic equation resulted in a hit?**

You will experiment by entering different quadratic equations and noting down which equation successfully made the projectile hit the target.

**Step 3: Adjusting your equation**

* If the projectile goes **too high**, decrease aaa.
* If it **doesn't reach far**, adjust the **roots (a and b)** in y=(x−a)(x−b)y = (x-a)(x-b)y=(x−a)(x−b).
* If it **overshoots**, reduce the values of aaa or **modify the x-intercepts**.