Task 1

a)

public class IntegerSquareRoot {

// Function to find the floor square root of x

public static int floorSqrt(int x) {

if (x == 0 || x == 1) {

return x;

}

int low = 1, high = x / 2, ans = 0;

while (low <= high) {

int mid = low + (high - low) / 2;

// To avoid overflow, use long for multiplication

long sq = (long) mid \* mid;

if (sq == x) {

return mid; // exact square root

} else if (sq < x) {

ans = mid; // store floor value

low = mid + 1;

} else {

high = mid - 1;

}

}

return ans;

}

public static void main(String[] args) {

int x1 = 10;

int x2 = 25;

int x3 = 37;

System.out.println("Square root of " + x1 + " = " + floorSqrt(x1)); // 3

System.out.println("Square root of " + x2 + " = " + floorSqrt(x2)); // 5

System.out.println("Square root of " + x3 + " = " + floorSqrt(x3)); // 6

}

}

b)

public class UglyNumberUtils {

// Already above:

public static boolean isUgly(int n) {

if (n <= 0) return false;

int[] primes = {2, 3, 5};

for (int p : primes) {

while (n % p == 0) n /= p;

}

return n == 1;

}

// O(n) time, O(n) space — very fast up to large n

public static int nthUglyNumber(int n) {

int[] dp = new int[n];

dp[0] = 1; // first ugly number

int i2 = 0, i3 = 0, i5 = 0;

int next2 = 2, next3 = 3, next5 = 5;

for (int i = 1; i < n; i++) {

int next = Math.min(next2, Math.min(next3, next5));

dp[i] = next;

if (next == next2) { i2++; next2 = dp[i2] \* 2; }

if (next == next3) { i3++; next3 = dp[i3] \* 3; }

if (next == next5) { i5++; next5 = dp[i5] \* 5; }

}

return dp[n - 1];

}

// Demo

public static void main(String[] args) {

int[] tests = {1, 6, 8, 14, 0, -5};

for (int t : tests) {

System.out.println(t + " -> " + isUgly(t));

}

System.out.println("10th ugly number: " + nthUglyNumber(10)); // 12

System.out.println("150th ugly number: " + nthUglyNumber(150)); // 5832

}

}

c)

public class ArrayProduct {

// Function to calculate product of array elements

public static long productOfArray(int[] arr) {

long product = 1; // use long to avoid overflow for big values

for (int num : arr) {

product \*= num;

}

return product;

}

// Demo

public static void main(String[] args) {

int[] arr1 = {1, 2, 3, 4, 5};

int[] arr2 = {10, -2, 3};

int[] arr3 = {7};

System.out.println("Product of arr1 = " + productOfArray(arr1)); // 120

System.out.println("Product of arr2 = " + productOfArray(arr2)); // -60

System.out.println("Product of arr3 = " + productOfArray(arr3)); // 7

}

}