Answers to exercises in the textbook

Q) E26

	Design 2	Design 3	Design 5
Advantages (PROS)	Execution and performance of the code is good Good memory usage compared to the others Instances are created efficiently compared to others	Efficiency is great Code is simple	Efficient code because it takes less time to create instances (thanks to the subclasses) Is great all around since it uses abstract superclasses involving designs 2 and 3 as subclasses
Disadvantages (CONS)	Code is not efficient Slower code	Consumes too much memory compared to the previous designs	Too much memory usage/consumption Code is complex

Q) E28-E30:

Sample Output:

```
Saffats-MacBook-Air:design5 saffataziz$ javac PointCPTest.java
Saffats-MacBook-Air:design5 saffataziz$ java PointCPTest
Random numbers object constructor median time for cartesian for PointCP 42ns
Random numbers object constructor median time for cartesian for PointCP2 42ns
Random numbers object constructor median time for cartesian for PointCP3 42ns

 Random numbers object constructor median time for Polar for PointCP 41ns
Random numbers object constructor median time for Polar for PointCP2 42ns
Random numbers object constructor median time for Polar for PointCP3 0ns

Median time for calling all the methods for Cartesian PointCP 209ns
Median time for calling all the methods for Cartesian PointCP2 250ns
Median time for calling all the methods for Cartesian PointCP3 125ns

Median time for calling all the methods for Polar PointCP 250ns
Median time for calling all the methods for Polar PointCP2 250ns
Median time for calling all the methods for Polar PointCP3 125ns
Saffats-MacBook-Air:design5 saffataziz$
```

Description:

We declared private static variables that were long array that would store the time for each interaction. There are 12 arrays, 6 of them are for the total time all methods are called for each design. Then the other 6 are for random values for the object construction for the designs.The length of these arrays are 10 million, which is also the amount of iterations.

For the first part of testing we recorded the time for how long it would take for object construction for PointCP, PointCP2, and PointCP3. This was done randomizing the values for x, rho, y, and theta. Their cartesian type and polar were done separately (so they were constant in their respective part), but their values were random each iteration.

For the second part of testing, we recorded the time it takes for a design object to call all the methods. We just had the 3 design objects that got initialized with constant values. Then we iterated 10 million times, called all the methods for each instance of the objects and stored it in their respective array.

Then we sorted all the arrays and printed the median values which is the 5 millionth value.

Table:

Time operation	Design 1	Design 2 (Through Design 5)	Design 3(Through Design 5)
Random Values for Polar (In nano second)	42	42	42
Random Values for Cartesian (In nanoseconds)	41	42	0
Total time to call all the methods for Polar (In nanoseconds)	250	250	125
Total time to call all the methods for Cartsian (In nanoseconds)	209	250	125

Discussion:

As we can see in the table above, the total time to call all the methods for Polar (In nanoseconds) in design 1 is the same as design 2 (through design 5). But, when we check the total time to call all the methods for Polar (In nanoseconds) for design 3 (through design 5) we notice that there is a difference of around 125 ns. This means that the total time to call all the methods for Polar in design 1 and design 2 (through design 5) takes twice as long as design 3 (through design 5) does. So, we can say that design 3 is significantly quicker than designs 1 and 2.

In addition, for the total time to call all the methods for Cartsian in design 1, we got 209 ns, in design 2 we got 250 ns and in design 3 we got 125 ns. We may infer that design 2 takes the longest, design 3 is the fastest and design 1 is in between designs 2 and 3.