

The Craftsman's Questionable Son

Setting: King Hiero II's Court; a really long time ago.

King: (Already on stage, seeing Archimedes enter) Archimedes! It is good to see you my old friend.

Archimedes: And a pleasure to see you as well, my Lord

King: Archimedes, I've got another problem with my crowns. The craftsman you proved honest 3 years ago has recently retired and left his trade in the hands of his son, Guido. Although I trusted the craftsman with many commissions after your density demonstration, I trust his son Guido about as far as I could throw him!

Archimedes: Well, then I have good news for my Majesty today! With the latest lever powered war machine I've designed – you alone can wing Guido a good 300 to 400 cubits...

King: (Raising his hand for silence) Enough of your levers and war machines, Archimedes. Today is not a day for levers and war machines, save these stories for the long winter nights around the hearth fire, or perhaps for when we are at war.

King: Here is the problem I wish you to bend your mind around today. I commissioned Guido to make two different crowns and provided exactly enough gold for the forging. However, when Guido presented the finished pieces to me, he had gold left over! Guido claims that he has invented a new alloy, a mixture of gold and other metals. This new alloy is much better for crowns since it strengthens the metal against nicks and dings – thereby decreasing the maintenance cost I have to pay to keep my crowns looking their finest.

King: (Holding up an all alloy crown, gives it to Archimedes) Look here Archimedes, this is a crown Guido forged out of his new alloy but without any gold. Its a ruddy, ugly beast of a crown and I wouldn't be caught dead wearing it; but I've had all seven of my acrobats balance their entire weight on the thing and it did not bend! I've had it dropped from the tallest towers in the City, yet it does not have a ding on it yet!

Archimedes: This is fascinating, Guido sounds like a master craftsman indeed! With such skill and technology, what is my Majesty's concern?

King: (Shaking his head) If it were your gold, I'm sure you would have seen the problem in an instant! How can I be sure the amount of gold in the two crowns agrees with how much I provided to Guido, and how much he returned to me? If the crowns contain 50% of the gold I provided to Guido, but he only returned 20% of what I provided, then he has stolen 30% of the gold he was given!

Archimedes: Your right! It's a good thing it wasn't my gold!

King: And, as if that is not enough of a headache, Guido has told me he may have used different ratios of gold to the other metals based on the intended use of the crown. The crown I plan to wear day to day has more of the durable metals but isn't as shiny, the crown I had commissioned for special occasions has a higher percentage of gold to make sure its luster is noticed by everyone at our festivals.

King: Archimedes, I want you to take these two crowns that Guido has forged and tell me how much gold is in them – and I want to know *precisely*. If only 2 or 3 percent of the gold is missing I can chalk that up to an inefficient manufacturing processes (after all, this is 200BC!) but if too much gold is missing, I'll have Guido banished from my Kingdom.

Archimedes: (Thinks for a moment) Your Majesty, this is an intriguing variation of the problem you presented to me 3 years ago, and I believe I can determine the exact amount of gold in the two crowns provided that Guido's new 'alloy' is merely a *physical* mixture of gold and other metals.

For my investigation, I'll need 4 things: the two crowns Guido had forged for the King, the dull, ugly, pure alloy crown Guido has cast to demonstrate his new alloy, and the gold crown I tested 3 years ago which proved Guido's father an honest craftsman. Be so kind to have these items delivered to my laboratory this afternoon. And now, I have much thinking to do, so with your permission I'll take my leave. (Archimedes bows and turns towards the exit)

King: Wait Archimedes! Don't you want to know how much gold I gave Guido and how much he returned to me?

Archimedes: (Turns back to the King) Your Majesty, those two facts won't help me determine how much gold is in the two new crowns. Those amounts will be used, along with the result of my calculations and measurements, to determine if Guido is an honest craftsman – but that is simple arithmetic your accountants can perform. The sticky part of this problem is learning how much gold these new crowns contain – it is for this question alone that I must devise a solution. (Archimedes exits)

King: (To audience) Well, I just hope he doesn't wake up the neighborhood with his EUREKA! EUREKA! nonsense again. Oy, the phone calls I got 3 years ago! (King exits)