An Introduction to Mechanical Engineering 4th edition Wickert Solutions Manual

SKU: 9781305635135-SOLUTIONS

Chapter 2
Solutions

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P2.1: Give three examples of engineered products that must be circular in shape and explain why. Any ball is not allowed as an answer!

Examples include:

- DVD's
- CD's
- manhole covers
- railroad advance warning signs
- wheel (for flat roads)
- axles
- bullet cross-section (balanced for stable flight)
- European speed limit sign
- any shape with minimized arc length/surface area for given area/volume
- optimized pressure vessel cross sections
- US coin
- lens (part of circle)
- optimal nozzle/diffuser (no edge effects)
- optimal capillary tube
- optimal suction cup
- traffic circle
- thrown pot (on potting wheel)

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P2.2: Give three examples of engineered products that must be triangular in shape and explain why.

Examples include:

- yield signs
- the triangle instrument
- billiards rack
- knife blade (cross-section)
- supports for finishing wood (pyramids or cones, must come to a point)
- splitting wedge
- handicap ramp viewed from side (to meet code)
- three equally spaced instances per rotation cam
- 30°-60°-90° or 45°-45°-90° drafting triangle
- one of six identical pieces that can be assembled into a hexagon
- chisel point

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P2.3: Give three examples of engineered products that must be rectangular in shape and explain why.

Examples include:

- A size (or any other standard size) sheet of paper
- four equally spaced instances per rotation cam
- football/soccer field (civil engineered)
- US speed limit sign
- US dollar bill

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P2.4: Give three examples of engineered products that must be green in color.

Examples include:

- fake plant/turf (imitate actual plant)
- John Deere product (branding)
- Cameron Compressor (branding)
- Green (traffic) light
- European recycling bin
- Kermit the frog paraphernalia (branding)

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P2.5: Give three examples of engineered products that must be black in color.

Examples include:

- background for one way signs and night speed limit signs
- theater bins/supports (disappears in dark)
- stealth fighter (better "bounce" characteristics)
- ninja suit (stealth at night)
- black paint
- black ink
- backing for solar water heating

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P2.6: Give three examples of engineered products that must be transparent.

Examples include:

- contact lenses (over pupil portion)
- glasses (spectacles)
- (camera) lens (any tint causes loss of quality/information)
- microscope slide and slide cover

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P2.7: Give three examples of engineered products that have a specific minimum weight but no specified maximum weight, and specify the approximate minimum weight.

Examples include:

- helium balloon holder (minimum weight will depend upon how many helium balloons are being held)
- non-wedge based door stop (minimum weight based on friction coefficient)
- racecar (minimum weight based on racing regulations)
- competition bike (minimum weight based on racing regulations)

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P2.8: Give three examples of engineered products that have to be precisely a certain weight, and provide the weight.

Examples include:

- balancing weight for car wheel
- coins (weight used to count coins in some automated machines)
- precious metal coins (weight dictates worth)
- exercise weights (15 lb weight must be 15 lb)

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P2.9: Give three examples of engineered products that fulfill their designed purpose by failing or breaking.

Examples include:

- saw stop mechanism (http://www.sawstop.com/)
- crumple zone in car
- bumper (foam insert) in car
- bike helmet
- frangible bullets (split up when they hit anything other than flesh) to protect bystanders
- stress indicating paint has fluorescent dyes capsules that split under known deflections (http://www.newscientist.com/blog/invention/2007/10/stress-sensitive-paint.html)
- some meds are packaged in glass bottles that you break to open
- cover on a "pit trap" breaks when weight is applied
- fire suppression sprinkler detection device (solder connect melts or glass connection shatters)

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P2.10: Give three examples of engineered products that are designed to work well over a million times.

Examples include:

- Roads
- Bridges
- Engine components (if each Otto cycle is a "use")
- Fuses
- Door hinges
- 3-D shutter glasses (the shutters)

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P2.11: List three products that can be used equally well by people with and without visual impairments, and explain why.

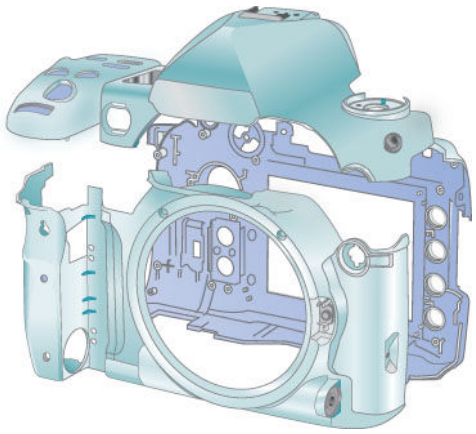
Examples include:

- Silverware
- Chairs
- Drinking Cups
- Headphones
- Bed
- Drawers
- Emergency response necklace (one button, worn around neck to locate) http://inventorspot.com/articles/one_touch_911_dialer_calls_help_you_30719
- Sight and sound cross walk guides
- Fire alarm (day to day use, not installation and maintenance)
- Automatic doors (and other motion detectors)

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P2.27: For the magnesium camera body shown, provide an explanation for which processes you think were used in its manufacture and why.



This was most likely manufactured using a die cast procedure because of the material and geometric detail in the pieces including a number of inclusions. Certain features could have been machined, and some polishing/grinding operations may have been used.

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P2.28: For the aluminum structural member shown, provide an explanation for which processes you think were used in its manufacture and why.



This was most likely manufactured using an extrusion process because of the material and constant cross section geometry of the member. Shorter pieces could be die cast, although longer pieces are most certainly extruded. Machining could be another option for very small pieces, although machining would be much more time consuming for a part like this.

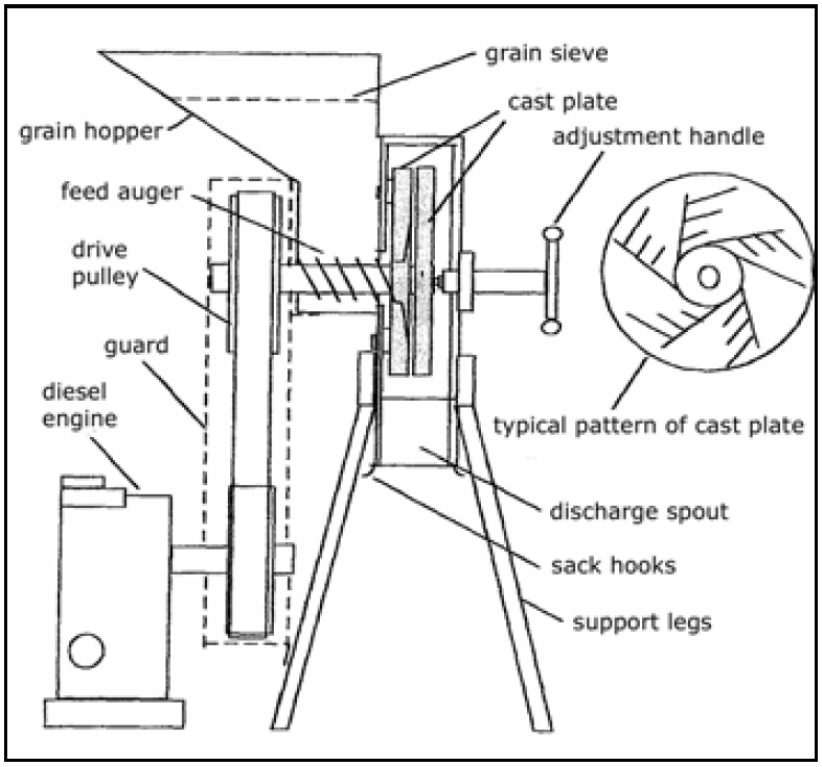
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P2.31: Given the following components and clues, determine what product(s) they describe.

- Diesel engine
- Pulley
- Heat from friction limits the engine power that can be used
- Most components are cast iron or steel
- Most manufacturers are in Europe, Asia, and Africa
- Applied pressure can be manually adjusted
- Auger
- Africa is one place this is commonly used
- Sieve
- Operates using shear forces

These clues describe a Grain Mill (also known as a Plate Mill or Disc Mill). These kinds of small mills are very important machines for many communities in Africa as they make a labor-intensive task much easier and quicker. A picture of one such mill is given below. This is taken from a manual for such mills which can be found here: http://www.fao.org/docrep/016/j8482e/j8482e.pdf.



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P2.32: Using a product currently in your possession or near you, develop ideas for how it could be re-designed to improve its function or decrease its cost. Come up with as many ideas as possible.

Depending upon the complexity and age of the product chosen, we would expect students to develop at least a dozen ideas to improve the product's function or lower its cost. They should also be as specific as possible. For instance, if a student recommends that a product's color be changed, have them state which color would they recommend and explain why.

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P2.33*: As a group, identify a product that is at least one decade old and research the global, social, environmental, and economic factors that may have impacted its design (e.g., shape, configuration, materials, manufacturing) given its intended market, price, and function. Prepare a technical report that describes each set of factors using appropriate evidence from your research sources (e.g., the product itself, specification sheets, user manual, company website, user reviews).

This report should explain each category of factors and describe what evidence was used to determine each factor. Examples of each category for some hypothetical products are shown below:

Global
A vehicle model may be rounder and smaller because it was primarily going to be marketed in Europe where smaller cars are much more common due to the parking limitations in the urbanized populations.

Social
Many features of the product were designed to be colored green to reflect a sense of nature, health, and beauty in the consumers.

Environmental
The product contained certain chemicals in the electronics that are now understood to be significant environmental threats in landfills. However, when the product was designed and manufactured, the industry was not aware of these impacts. Such products are now either designed without these chemicals, or recycling regulations are being developed to minimize the impact on future landfills.

Economic
A product is made of a number of steel parts because it was manufactured around 2001 when the price of steel was low. The price of steel has almost tripled since then and current version of the product do not contain as much steel.

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P2.34*: As a group, develop a list of "bad" designs that you think are inefficient, ineffective, inelegant, or provide solutions to problems that are not worth solving. These can be products, processes, systems, or services. Prepare a two minute presentation on these designs.

The more personal experience they have with their "bad" designs, the better. There are websites that are a collection of bad products, but this is not where they should find their answers. They should think about their own experiences with consumer products in all areas of their lives and reflect on which products frustrated them from a usability, cost, or functional perspective.

If the two minute presentations are required, they could be done in a single class. Also, putting a strict time limit on the presentations makes the students have to determine what the most important information is to present and how to present in a timely and effective manner. This is a critical professional skill they need to start developing.

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