

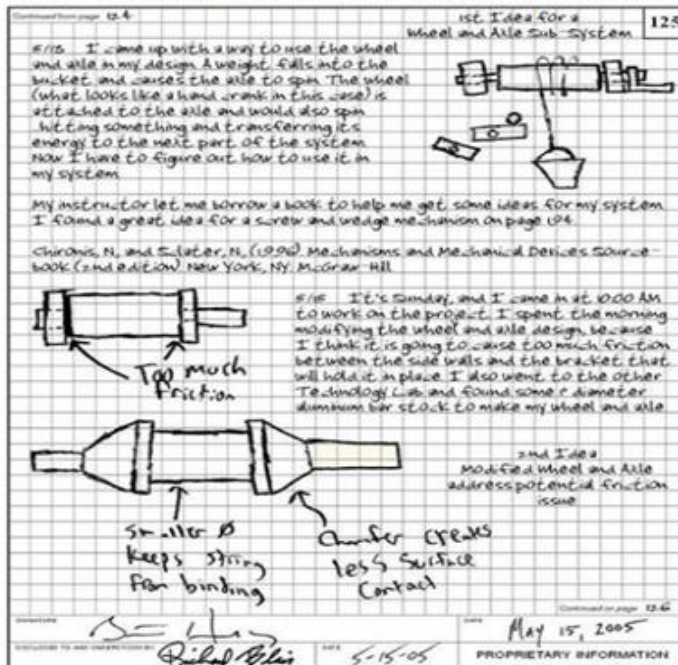
1. Use the list of requirements to answer the question.

- must have a minimum of seven different parts once assembled
- must be the same scale as the engine car
- must be able to attach to the engine car

Which label BEST describes the list of requirements?

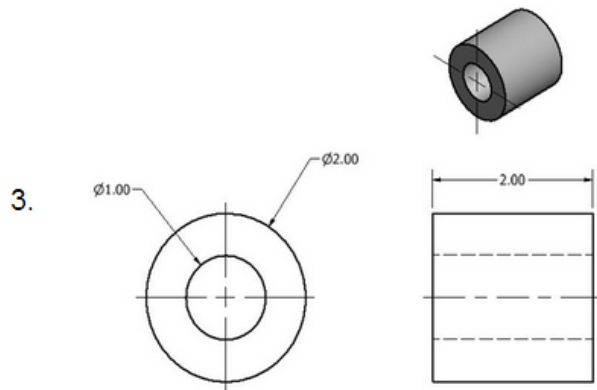
- A) Indicators
- B) Design constraints
- C) Design statement
- D) Deliverables

2. Use the diagram to answer the question.



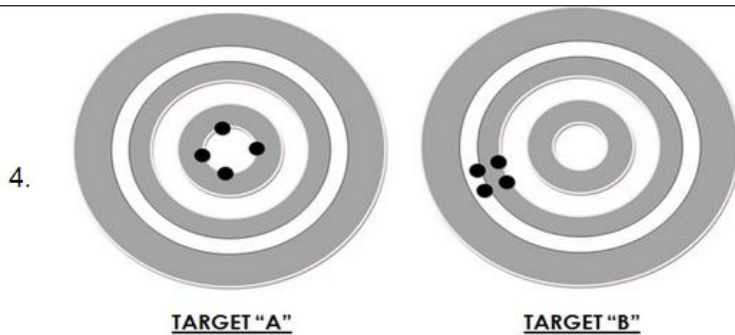
- A) Technical report
- B) Engineering notebook
- C) Design brief
- D) Project portfolio

The page shown in the diagram is taken from a(n):



Calculate the volume of the part shown in the image above.

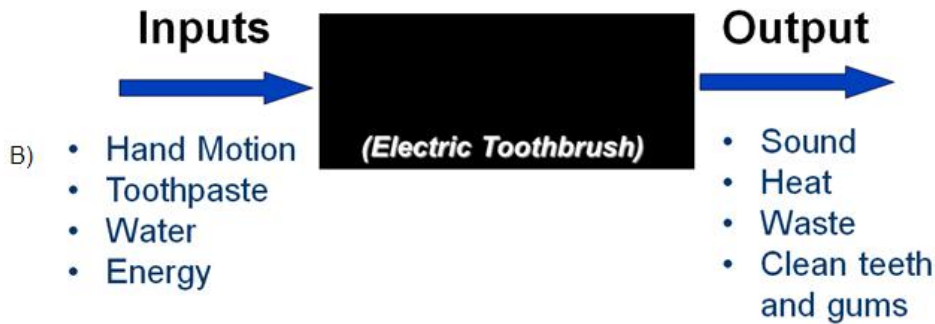
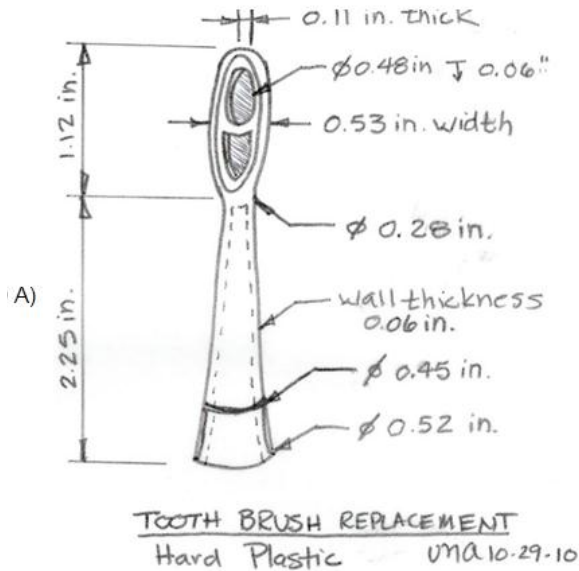
- A) 4.71 in.³
- B) 6.28 in.³
- C) 18.85 in.³
- D) 1.57 in.³



Accuracy is defined as "The ability of a measurement to match the actual value of the quantity being measured." Precision is defined as "The ability of a measurement to be consistently reproduced". The images each show four attempts to approximate the center of the target, illustrating the concept of accuracy and precision. Based on the images, select the correct statement about precision and accuracy.

- A) Target "A" and Target "B" both depict similar accuracy
- B) Target "B" depicts high accuracy but low precision compared to Target "A"
- C) Target "A" depicts high accuracy but low precision compared to Target "B"
- D) Target "A" and Target "B" both depict similar precision

5. Engineers are reverse engineering an electric toothbrush. Which one of the four following notebook entries would likely result from the functional analysis of the product?



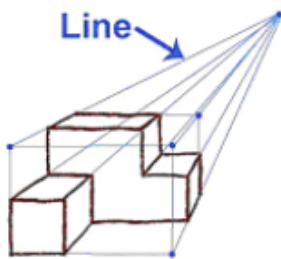
(D)

Part #	Part Name	Qty	Dimensions	Material	Density	Mass or Weight	Texture and Finish	Interaction with Other Parts
1	Toothbrush Replacement Head	1	3.37in. x 0.53 in.	Hard Plastic	0.036 lb/in ³	0.017 lb	smooth	Snap fit into base unit
2	Circular Brush base	1	0.48 in. diam. X 0.10 in. long	Hard Plastic	0.036 lb/in ³	0.004 lb	Smooth	Inserted on axel into Toothbrush Replacement Head

6. Which data set has an arithmetic mean of 38?

- A) 19, 23, 45, 69
- B) 24, 27, 35, 62
- C) 28, 32, 36, 56
- D) 31, 32, 38, 60

7. Use the sketch to answer the question.



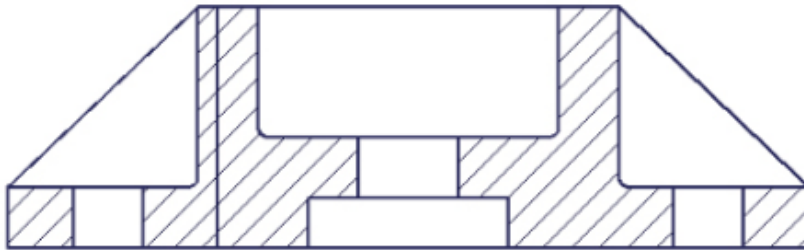
Which type of line does the arrow indicate?

- A) Object line
 - B) Hidden
 - C) Section
 - D) Construction
8. Samantha and Wes are engineers developing a new electrical storage battery. They have determined that the designs they wish to pursue require a technology that does not exist. Knowing this, what should Samantha and Wes do next?
- A) Create a decision matrix to narrow the concepts
 - B) Construct and test a prototype
 - C) Proceed by CAD modeling their design
 - D) Research and develop the needed technology

9. Which of the following is a recommended practice for an engineering notebook?

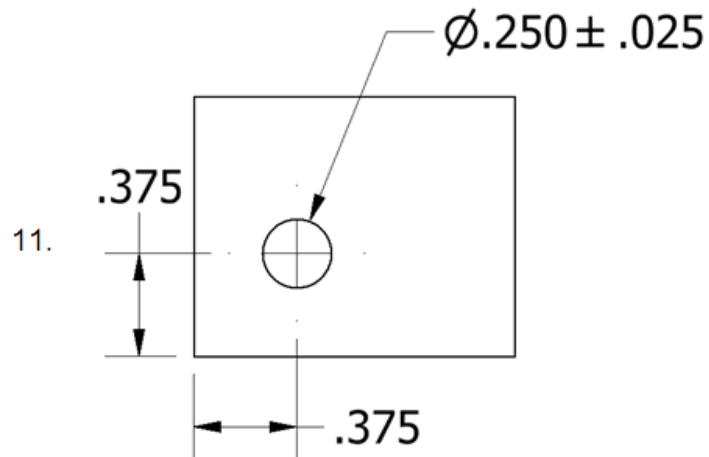
- Ⓐ) Sketches and other documents important to the project that are created outside of the notebook should be labeled, signed, dated, and kept in chronological order in a separate binder.
- Ⓑ) A designer should leave blank space in the engineering notebook near each calculation so that a colleague can check the work and record comments.
- Ⓒ) Each page of an engineering notebook should include a page number, the date, the designer's signature, and a witness' signature.
- Ⓓ) Engineering notebook entries should be made in pencil so that corrections and edits may be made easily and at any time.

10. Use the drawing to answer the question.



Which view does the drawing demonstrate?

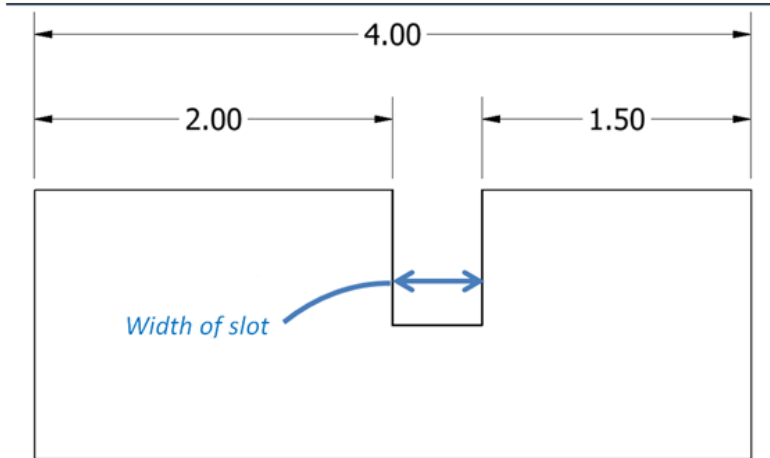
- Ⓐ) Orthographic
- Ⓑ) Auxiliary
- Ⓒ) Isometric
- Ⓓ) Section



The front view of a part is shown above. What is the tolerance on the hole diameter?

- A) 0.275
 - B) 0.025
 - C) 0.375
 - D) 0.050
12. An engineer identified six possible solutions to a problem by comparing them based on cost, complexity, and development time. Which type of analysis tool works BEST to compare and rate possible solutions?
- A) Gantt chart
 - B) Choice table
 - C) Decision matrix
 - D) Design process

13. Use the orthographic projection to answer the question.



All dimensions in inches.

Linear Dimensions

X.X = ± .020

X.XX = ± .010

X.XXX = ± .005

Using the dimensions and the general tolerances shown (assuming the width of the slot is not given), what is the minimum dimension for the width of the slot?

- A) 0.520 in.
- B) 0.470 in.
- C) 0.530 in.
- D) 0.490 in.

14. Use the photograph of a chair to answer the question.



The repeating, equally spaced openings on the seat and backrest of the chair demonstrate which design principle?

- A) Proportion
 - B) Balance
 - C) Rhythm
 - D) Subordination
15. A design team introduced existing technology into clothing that charges small electronic devices using simple body motions. Which term BEST describes this product?
- A) Innovation
 - B) Analysis
 - C) Prototype
 - D) Case study

16. Which term describes the process of analyzing a product's aesthetics, function and structure?

- A) Reverse engineering
- B) Market research
- C) Industrial espionage
- D) Concurrent engineering

17. Use the photograph to answer the question.

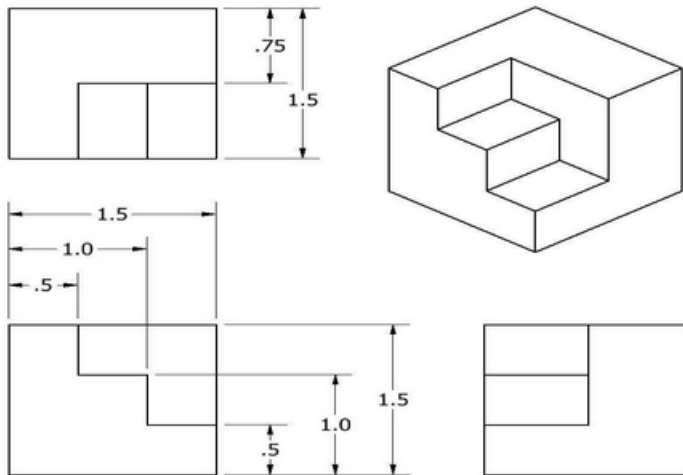


What statement is included in the structural analysis of a paper towel holder?

- A) Center post: to hold paper towel roll centered
- B) Base: symmetrical
- C) Base: chrome finish to match existing appliances
- D) Post top: constructed of ABS plastic

18. An engineering team designing a new product generates and explores several different ideas.
Which of the following is most appropriate for the team to do next?
- Ⓐ) Devise a marketing plan
 - Ⓑ) Develop a working prototype
 - Ⓒ) Design a decision matrix
 - Ⓓ) Create technical drawings
19. Which term BEST describes the guidelines, protocols and rules of conduct that teams develop?
- Ⓐ) Group norms
 - Ⓑ) Team orientation
 - Ⓒ) Rules of practice
 - Ⓓ) Ethical standards

20. Use the data in the image to answer the question.



- A) 6.75 in.²
- B) 2.25 in.²
- C) 9.00 in.²
- D) 13.50 in.²

Calculate the surface area of the object in the image. Round to the nearest hundredth of a square inch.

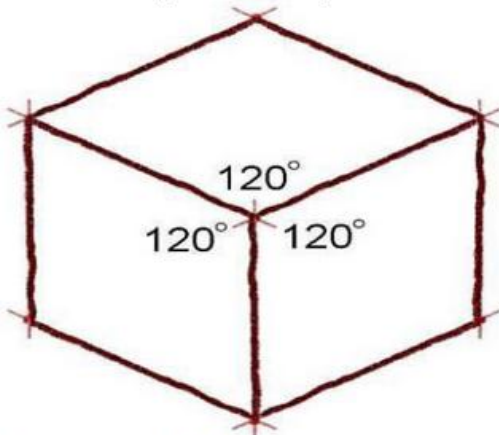
21. Which functional model works best to test the performance and flaws of a design concept?

- A) Prototype
- B) Appearance model
- C) Mock-up
- D) Quarter-scale model

22. Prior to finding a solution, which document does an engineer use to communicate understanding of a problem, the problem constraints, and the solution criteria to the client?

- A) Technical report
- B) Design brief
- C) Project portfolio
- D) Experimental design

23. Use the diagram to help answer the question.



Which type of 3-D sketch is shown in the diagram above?

- A) Orthographic
- B) Two-point perspective
- C) Isometric
- D) Oblique

24. Which information is necessary to locate a hole's position in a part drawing?

- A) Size of the hole
- B) Taper angles
- C) Distance from two reference edges

25. Which step in the design process is indicated by the following statement:

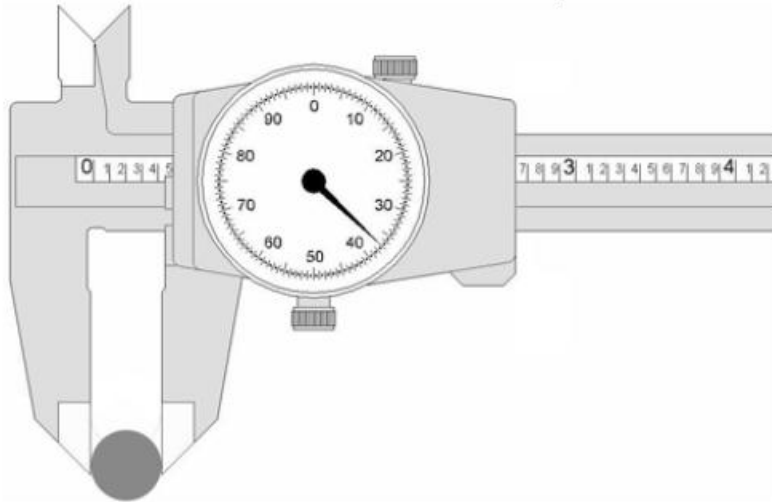
Engineers want to build a system for storing adult mountain bikes, and the system must provide a structure that supports at least one bicycle safely.

- A) Define the problem
- B) Develop a design proposal
- C) Explore possibilities
- D) Select an approach

26. Volume, mass, center of gravity, and density are examples of which of the following?

- A) Product factors
- B) Principles and elements
- C) Standard deviations
- D) Physical properties

27. Read the measurement on the dial caliper.



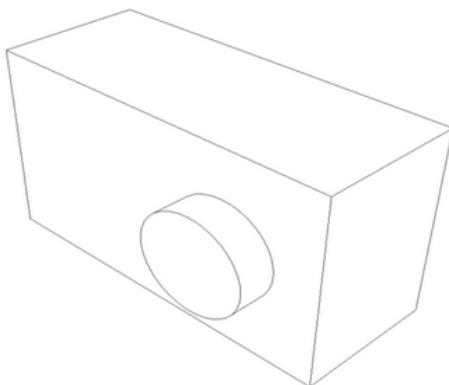
What is the best estimate of the diameter of the metal rod?

- A) 0.347
- B) 0.437
- C) 0.0437
- D) 1.437

28. Parallel, tangent, and coincident are examples of which of the following?

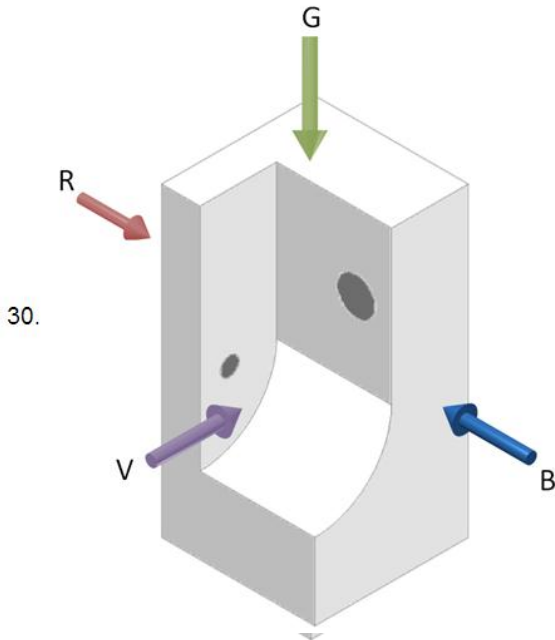
- A) Dimensions
- B) Numeric constraints
- C) Geometric constraints
- D) Assembly constraints

29. Use the pictorial to answer the question.



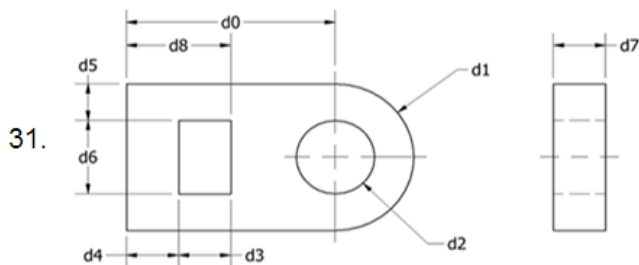
What is the minimum number of views necessary to fully describe the part shown?

- A) 1
- B) 3
- C) 6
- D) 2



Use the randomly oriented pictorial view of the object to answer the question. Which line of sight (indicated by arrows) is the BEST choice to use in order to create the **front** view orthographic projection?

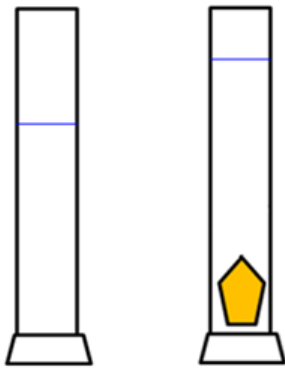
- A) G - green
- B) B - blue
- C) R - red
- D) V - violet



What is the parametric equation for dimension d_2 if the diameter of the hole is always to be $1/3$ of d_0 ?

- A) $d_2 = d_0/3$
- B) $d_2 = d_1/d_2$
- C) $d_5 = d_0 - d_1$
- D) $d_2 = d_1/3$

32.



An irregularly shaped object has a mass of 150 grams. You have a graduated cylinder that contains 100 mL of water and when the object is placed into the cylinder the volume of water increases to 140 mL. What is the density of the material of the object?

- A) .625 g/mL
- B) 3.75 g/mL
- C) 3.00 g/mL
- D) 1.07 g/mL

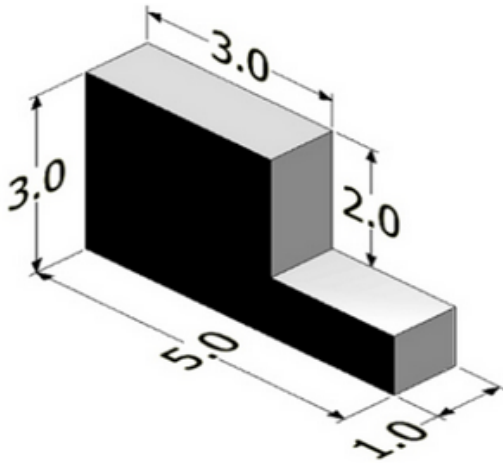
33. How many degrees of freedom does any unconstrained object have in 3-D modeling?

- A) 4
- B) 6
- C) 2
- D) 3

34. Which element will enhance the visual appearance of a 3-D sketch?

- A) Dimensions
- B) Center lines
- C) Hidden lines
- D) Tonal shading

35. Use the multi-view drawing to answer the question.



The multi-view drawing details an aluminum part and shows dimensions in centimeters. A rubber coating will be applied to the outside surface of the part such that 1 liter covers 2000 square centimeters.

How many full parts can be covered with 5 liters of rubber coating?

- A) 263 parts
- B) 217 parts
- C) 52 parts
- D) 909 parts

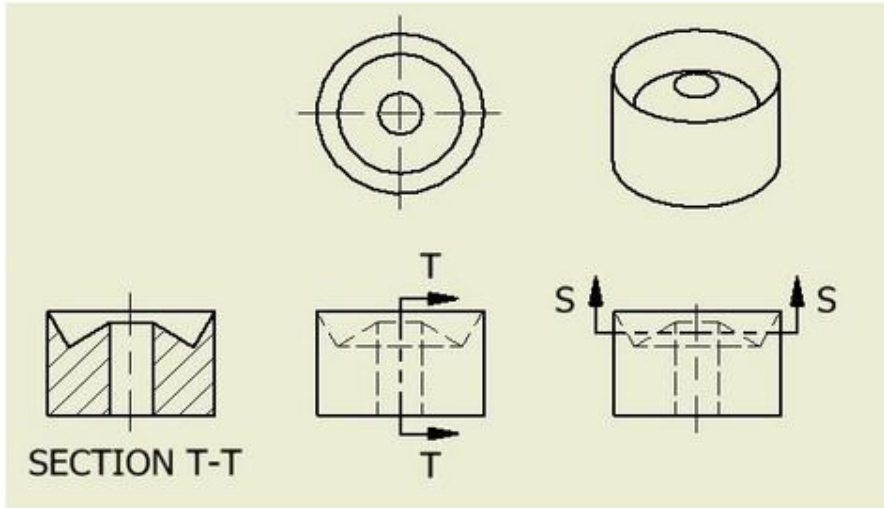
36. Which phrase does NOT apply to brainstorming?

- Ⓐ A free-for-all exchange of ideas
- Ⓑ Criticism is allowed
- Ⓒ Piling on is welcome
- Ⓓ Quantity over quality

37. Which of the descriptions listed below best describes the step in the reverse engineering process called functional analysis?

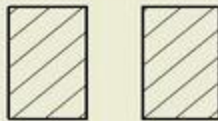
- Ⓐ The product is analyzed based on the choice of materials, mass, durability, strength, transparency, frictional properties, flexibility, and resistance to fatigue.
- Ⓑ The product's purpose is identified, observations are made to determine how the product works and the system's inputs and outputs are listed.
- Ⓒ The product is analyzed as it is carefully disassembled in non-destructive operations. All parts should remain intact and undamaged.
- Ⓓ The product is analyzed based on various principles and elements of design such as texture, color, balance, rhythm, proportion, and unity.

38.



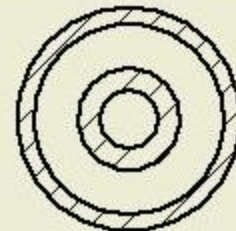
Which option is the correct section view S-S?

A)



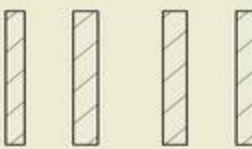
SECTION S-S

B)



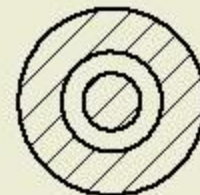
SECTION S-S

C)



SECTION S-S

D)



SECTION S-S

39.



Identify the following hole note that would be needed for identifying an appropriate hole for the fastener shown, assuming the head of the fastener will be flush with the surface.

- A) \square $\phi.25$ THRU $\phi.375$ ∇ .25
- B) \sphericalangle $\phi.25$ THRU $\phi.375$ X 82°
- C) 1/4-20 UNC - 2B ∇ .75
- D) $\phi.25$ ∇ .20

40. A small rural community has recently seen a large influx of population and is now in need of redesigning and developing their sewage treatment facilities. Which of the following engineering disciplines would be best suited for the job?

- A) Chemical Engineer
- B) Electrical Engineer
- C) Mechanical Engineer
- D) Civil Engineer

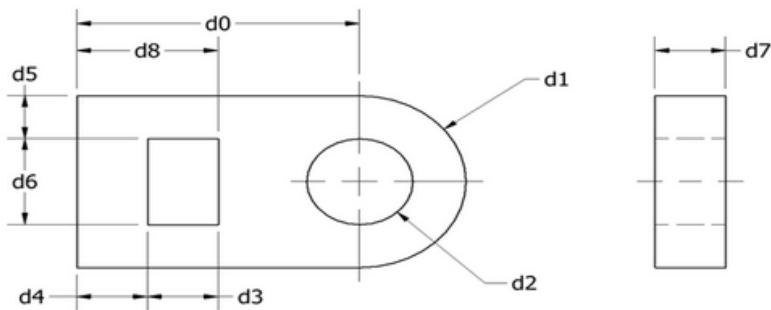
41.



Which of the following view types would be needed to provide essential information for the development of a working drawing and the manufacturing of the product shown?

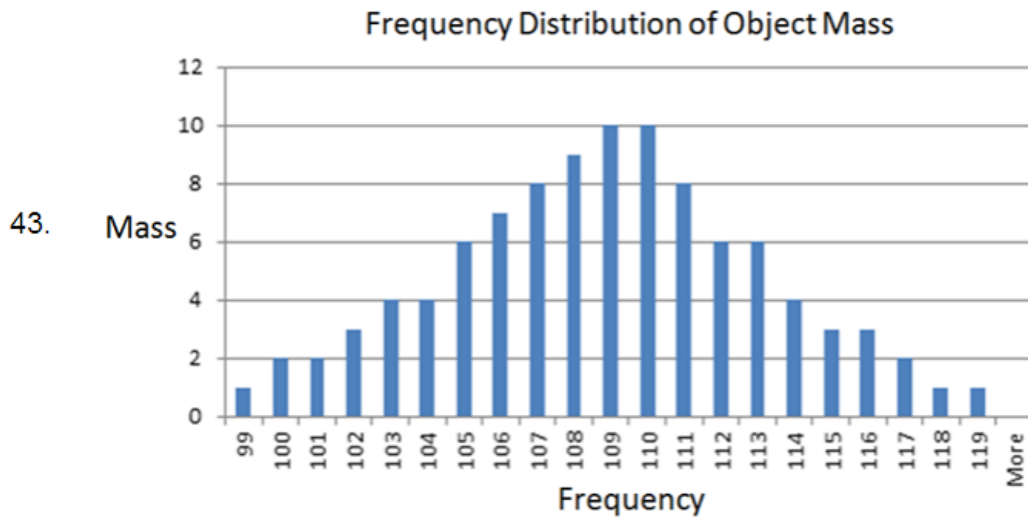
- A) Perspective
- B) Section
- C) Auxiliary
- D) Oblique

42.



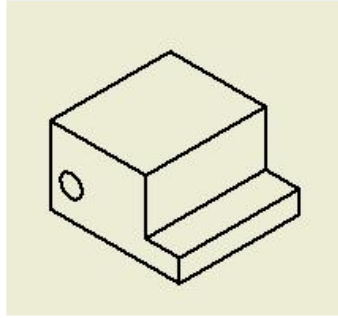
What would be the parametric equation for dimension d7 if the depth of the part is always to be 1/4 of d0?

- A) $d7 = d1 - 0.25(d5 + d6)$
- B) $d7 = d0 - d1$
- C) $d7 = d0 \cdot 0.25$
- D) $d7 = d0 - d2 \cdot 0.25$



The histogram presents the mass (to the nearest gram) of one hundred objects. The mean of the data is 108.8 g. Which of the following is most likely the standard deviation of the data? Note that you do not have to calculate the standard deviation in order to estimate its value.

44. A foam material has a density of 175 g/L. What is its density in units of lb/ft^3 ?
- A) 2.25 lb/ft^3
 - B) 10.9 lb/ft^3
 - C) 2.81 lb/ft^3



45.

All the features of an object are visible in the view depicted. The round hole goes all the way through the object. How many dimensions are necessary to fully describe the object in this illustration?

- A) 8
- B) 6
- C) 7
- D) 9

46. Which of the four following pictures BEST shows the design principle of random rhythm?

Ⓐ



Ⓑ



Ⓒ



Ⓓ

