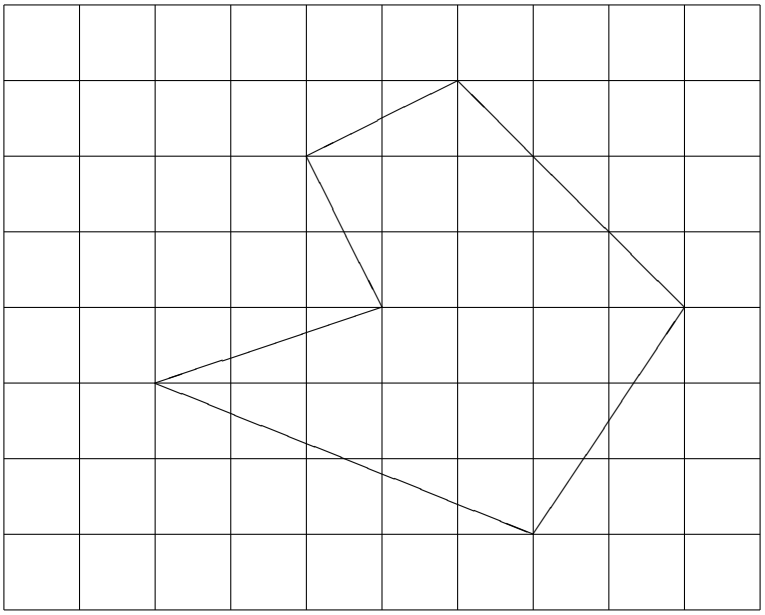
Do two of the problems (1-5) below. They are 10 points each. Show all your work. Explain your solution. Put your answers on the answer sheet.

1. Find the area and perimeter of the polygon below. Each square is 1 cm by 1 cm.



2. Prove Pythagoras's formula.

3. A row boat is tied to a pier using a 10 foot rope. The rope is tied to a cleat on the boat which is 1 foot above the water line. The other end is attached to a pylon on the pier at a point 7 feet above the water. Find the largest horizontal distance that the boat can be from the pier.

4. A map of Lake Mendota is traced onto a 1 foot by 1 foot plywood square. The square weighs 30 ounces. The picture of the lake is then cut out and weighed. Assume that one acre of Lake's surface corresponds to 10 square inches on the map. If the the cut out weighs 20 ounces, how many acres is Lake Mendota?

5. A disk with diameter 8 inches is cut into half along its diameter. Each half disk is used to make the slanted side of a cone. What is the volume of these two cones?

Put all your answers on the answer sheet. Each of these problems is one point and there is no penalty for guessing.

6. If a planar shape is formed by intersecting a vertical or horizontal plane with a solid torus (i.e. a bagel or donut), then it is

(a) two disks

(b) an annulus

(c) a circle

(d) it could be any of the above

(e) none of above

7. If you round off 6252.084321 to the nearest 100 then you get:

(a) 6252

(b) 6252.08

(c) 6200

(d) 6300

(e) none of above

8. The area of triangle A is 20 and its height is 5. If triangle B is similar to triangle A but its height is 10, then what is the area of B?

(a) 20

(b) 25

(c) 40

(d) 80

(e) none of above

9. Two triangles $C$ and $D$ are similar. The lengths of the sides of triangle $C$ are 2,3, and 4. The lengths of the sides of triangle $D$ are 1,2, and ?

(a) 3

(b) 1.5

(c) there is no such triangle $D$.

(d) it is impossible to say because not enough information is given.

(e) none of above

10. A soccer field is 120 feet by 90 feet. What is the area of this soccer field in square yards?

(a) 10800

(b) 1200

(c) 3600

(d) 210

(e) none of above

11. A hexagonal prism has

(a) 8 faces, 18 edges, and 12 vertices.

(b) 6 faces, 12 edges, and 8 vertices.

(c) 8 faces, 12 edges, and 6 vertices.

(d) 6 faces, 18 edges, and 14 vertices.

(e) none of above

12. The **surface area** of a box which is 2 feet high, 3 feet wide, and 4 feet long is

(a) 12 square feet

(b) 24 square feet

(c) 36 square feet

(d) 52 square feet

(e) none of above

13. Jupiter has many moons. Three of them are Europa, Ganymede, and Callisto.

| moon | distance from Jupiter in 1000 km | radius in km |
|---|---|---|
| *Europa* | 670 | 1560 |
| *Ganymede* | 1070 | 2631 |
| *Callisto* | 1882 | 2410 |

For an observer on the surface of Jupiter which of the three moons would appear to be largest?

(a) Europa

(b) Ganymede

(c) Callisto

(d) All three would be exactly the same size.

(e) none of above

14. Which of the following does **not** imply that two triangles are congruent:

(a) ASA

(b) SSS

(c) SAS

(d) AAA

(e) none of above

15. 1 meter equals _____ inches (answer rounded to nearest inch).

(a) 100

(b) 39

(c) 36

(d) 12

(e) none of above

16. For a polygon on the integer lattice (its vertices have integer coordinates), its area will be $\frac{1}{2}B + I - 1$ where $B$ is the number of lattice points on its perimeter and $I$ is the number of lattice points in its interior. This is known as _____'s formula.

(a) Archimedes

(b) Cavalieri

(c) Euler

(d) Pick

(e) none of above

17. A convex polyhedron satisfies the formula

$$v + f = e + 2$$

where $v$ is the number of vertices, $e$ is the number of edges, and $f$ is the number of faces. This is known as _____'s formula.

(a) Archimedes

(b) Cavalieri

(c) Euler

(d) Pick

(e) none of above

18. The area of a triangle is $\sqrt{s(s-a)(s-b)(s-c)}$ where $a, b, c$ are the lengths of its sides and $s$ is half of its perimeter. This is called _____'s formula.

(a) Archimedes

(b) Euclid

(c) Heron

(d) Pythagoras

(e) none of above

19. The ancient Greek mathematician, _____, found that the volume of a sphere is $4/3\pi r^3$ by looking at the hourglass (the enclosing cylinder minus the two inside cones).

(a) Archimedes

(b) Euclid

(c) Heron

(d) Pythagoras

(e) none of above

20. Which of the following is **not** an isometry of the plane?

(a) rotation

(b) reflection

(c) shear

(d) translation

(e) none of above

21. (True or False) Similar triangles are not congruent.

22. (True or False) Doubling the perimeter of a square doubles its area.

23. (True or False) If two rectangles have the same area, then they are congruent.

24. (True or False) The surface area of a cube is always larger than its volume.

25. (True or False) If two quadrilaterals have the same four angles, then they are similar.

Name_____

Circle the correct answer.

| | | | |
|---|---|---|---|
| 6. a b c d e | 11. a b c d e | 16. a b c d e | 21. True False |
| 7. a b c d e | 12. a b c d e | 17. a b c d e | 22. True False |
| 8. a b c d e | 13. a b c d e | 18. a b c d e | 23. True False |
| 9. a b c d e | 14. a b c d e | 19. a b c d e | 24. True False |
| 10. a b c d e | 15. a b c d e | 20. a b c d e | 25. True False |

Below and on the back of this sheet, put the answers to 2 of the problems 1-5. Show all your work. Explain your solution. You may use additional paper if necessary.