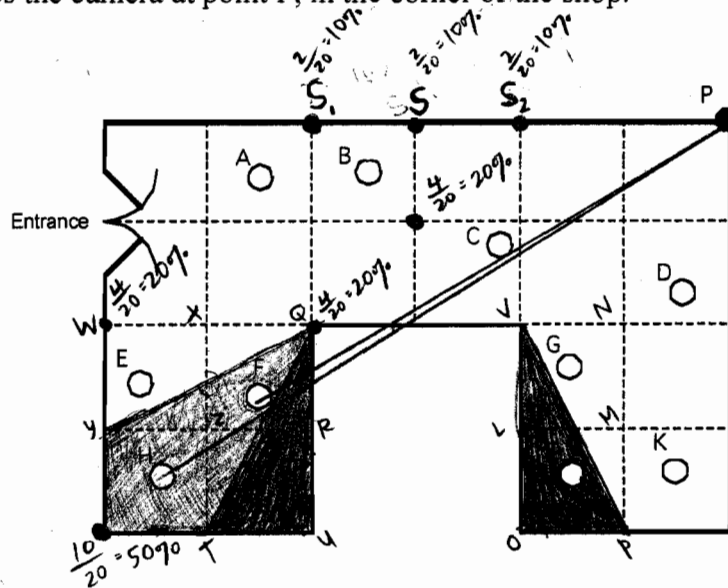A shop owner wants to prevent shoplifting.

He decides to install a security camera on the ceiling of his shop.

The camera can turn right round through 360°.

The shop owner places the camera at point P, in the corner of the shop.

Plan view of the shop

1. The plan shows ten people who are standing in the shop.

   These are labeled A, B, C, D, E, F, G, H, J, K.

   Which people cannot be seen by the camera at P? Tell how you know.

   F, H. If you try to draw a straight line from point P to F and H, which represents the camera's view when it turns in that direction, the line crosses the black border of the store. Which means the camera's view is obstructed by a wall, and hence the camera cannot see straight through to F and H. The camera cannot view the customers at anything but a straight angle, so F and H will remain hidden by the wall and out of sight of the camera.

Please continue your work on the page opposite.

CCR 4

2. The shopkeeper says that "15% of the shop is hidden from the camera"
   Show clearly that he is right.

There are approximately 20 squares total that make up the shop. The shaded area in the diagram at right is the area that is hidden from the camera. Since the line dividing WQRY is at a constant slope, and connects vertices of WQRY, the shaded part of WXZY makes up for the unshaded part of XQRZ. So, there are 3 complete squares that are shaded and hidden from the camera. $\frac{3 \text{ sq.}}{20 \text{ sq.}}$ = 15% of the shop that is hidden from the camera. ✓

3. Show the best place for the camera, so that the it can see as much of the shop as possible.
   Explain how you know that this is the best place

Point S is the best place, since only 10% of the store is concealed from view of the camera there. The darker shaded areas represent the regions of the shop that the camera cannot see from point S. Since the lines dividing XQUT and VNPO are at a constant slope and connect the vertices of XQUT and VNPO, the $\overset{darkly}{\text{shaded}}$ areas in XQRZ and VNML make up for the $\overset{non}{\text{darkly shaded}}$ areas of ZRUT and LMOP. Hence, 2 total squares are shaded darkly and hidden from camera. $\frac{2 \text{ sq.}}{20 \text{ sq.}}$ = 10% of the shop hidden from camera. 2

Only 10% of the shop is hidden if the camera is placed at points S_1 or S_2 as well. 2
But at those two positions you don't get as wide of a view of the whole shop — the camera views one side of the store more than the other, which isn't a good balance if you want to see as much of the shop as possible. With point S, you have an equal view of both sides of the store, which is better for surveying the entire shop. ✓
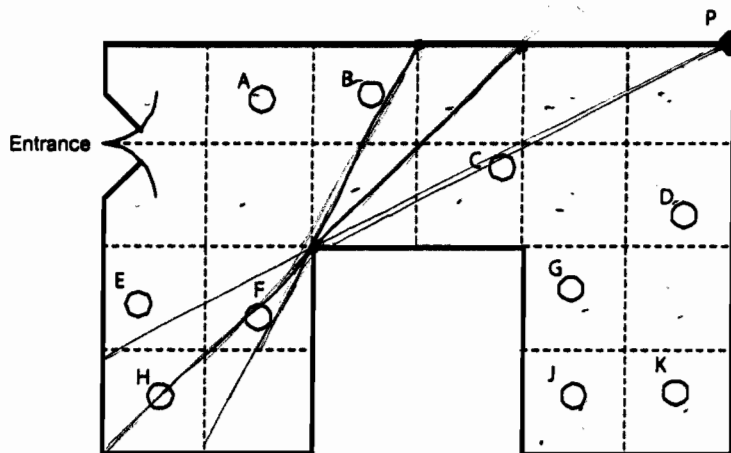
A shop owner wants to prevent shoplifting.

He decides to install a security camera on the ceiling of his shop.

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Plan view of the shop

1. The plan shows ten people who are standing in the shop.

   These are labeled A, B, C, D, E, F, G, H, J, K.

   Which people cannot be seen by the camera at P? Tell how you know.

   F and H because a line can be drawn to any other person besides them without coming in contact with a wall, from the camera.

   1

   2

Please continue your work on the page opposite.

CCR 4

T2

Security Camera (continued)

2. The shopkeeper says that "15% of the shop is hidden from the camera"
   Show clearly that he is right.

The shop can be divided up into 20 even squares. If you draw a line a sight from point P to the bottom left of the shop you will cut the 7 square units off. 3/20 = 0.15 = %15

3. Show the best place for the camera, so that the it can see as much of the shop as possible.
   Explain how you know that this is the best place

The top of the shop, at the center so that it has a view of everywhere except the corners closest to it and below it. There will be a total of 2 square units that aren't visible, on on each side

0

(1)

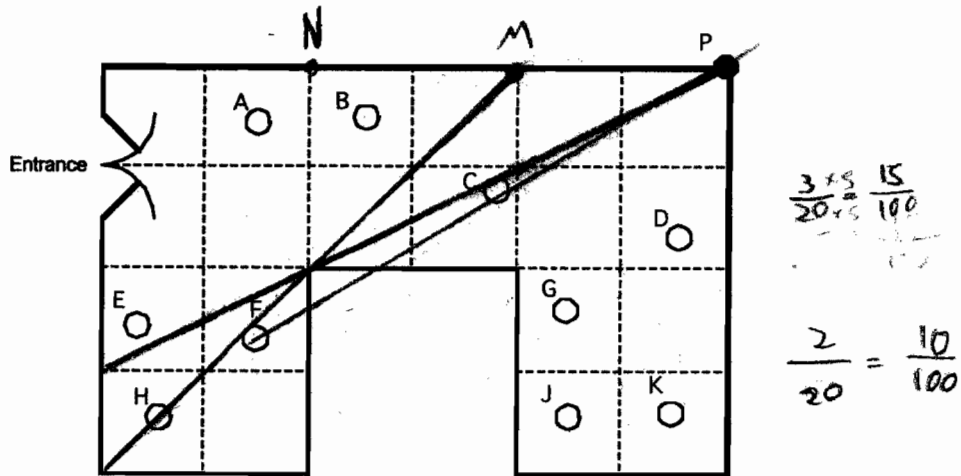CCR 4

⑧

Security Camera

A shop owner wants to prevent shoplifting.

He decides to install a security camera on the ceiling of his shop.

The camera can turn right round through 360°.

The shop owner places the camera at point P, in the corner of the shop.

Plan view of the shop

$$\frac{3 \times 5}{20 \times 5} \frac{15}{100}$$

$$\frac{2}{20} = \frac{10}{100}$$

1. The plan shows ten people who are standing in the shop.

   These are labeled A, B, C, D, E, F, G, H, J, K.

   Which people cannot be seen by the camera at P? Tell how you know.

   H and F can probably not be seen. H and F are hiding around the corner where the camera can't see. ✓

   1

   2

Please continue your work on the page opposite.

Security Camera (continued)

2. The shopkeeper says that "15% of the shop is hidden from the camera"
   Show clearly that he is right.

The shop is separated by a grid. Therefore, you can find the
area of places that the camera cannot see. The area
of the camera's blind spot is 3 and there are 20 squares.
That makes $\frac{3}{20}$, or 15%. ✓

3. Show the best place for the camera, so that the it can see as much of the shop as possible.
   Explain how you know that this is the best place

Putting the camera at point M would enable the
camera to see 90% of the store. Putting it at point
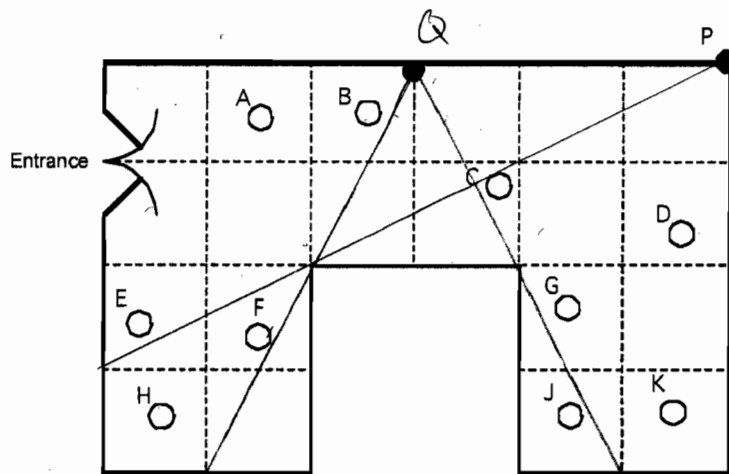N would have the same results.

2

CCR 4   (10)

A shop owner wants to prevent shoplifting.

He decides to install a security camera on the ceiling of his shop.

The camera can turn right round through 360°.

The shop owner places the camera at point P, in the corner of the shop.

Plan view of the shop

1. The plan shows ten people who are standing in the shop.

   These are labeled A, B, C, D, E, F, G, H, J, K.

   Which people cannot be seen by the camera at P? Tell how you know.

   F and H because they are shielded from
   the camera by a wall.   ✓   1

                                             2

Please continue your work on the page opposite.

Security Camera (continued)

2. The shopkeeper says that "15% of the shop is hidden from the camera"
   Show clearly that he is right.

If you draw a line from P as ↑ you see that
2 squares and 2 partial squares are not
visible. The partial squares add up to 1 full
square, so 3 full squares are not visible.
There are 20 squares total, so $\frac{3}{20}$ = 0.15 = 15%.

shown on the previous page

✓

1

1

1

3. Show the best place for the camera, so that the it can see as much of the shop as possible.
   Explain how you know that this is the best place

Point Q as shown because if you draw 2
lines from Q as shown, there a 2 sets of
partial squares not visible. Both sets add
up to 1 full square, so there are a total of
only 2 squares not visible, which is only 10%.
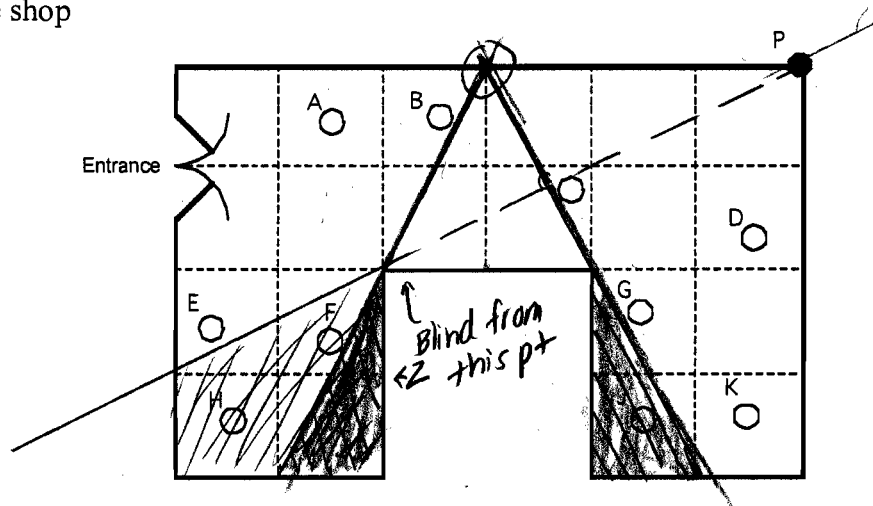
1

0

2

CCR 4

⑨

A shop owner wants to prevent shoplifting.

He decides to install a security camera on the ceiling of his shop.

The camera can turn right round through 360°.

The shop owner places the camera at point P, in the corner of the shop.

Plan view of the shop

1. The plan shows ten people who are standing in the shop.

   These are labeled A, B, C, D, E, F, G, H, J, K.

   Which people cannot be seen by the camera at P? Tell how you know.

   F and H, because when the line of vision hits the corner of the intersecting walls, everything in the shaded portion (as shown) is unseen by the camera, as cameras cannot see through walls.

   not red

Please continue your work on the page opposite.

Page 6   CCR 4

Security Camera (continued)

2. The shopkeeper says that "15% of the shop is hidden from the camera"
   Show clearly that he is right.

The entire store's area is about 20 squares. The shaded portion (as shown)
reflects the hidden part of the store (explained in #1), and is 3
squares exactly. $3/20 = 15/100$, or 15%, thus 15% is hidden
from the camera.

| 1 |
| 1 |
| 1 |

3. Show the best place for the camera, so that the it can see as much of the shop as possible.
   Explain how you know that this is the best place

The best place is the circled point on the top line. When the
line of vision hits the intersection of the line (wall), the shaded (in red)
parts after it are hidden. The shaded portions add up to 2
squares, less than the amounts from pt P or any other pt.
  └ hidden

| 1 |
| 0 |
| 2 |

CCR 4

9