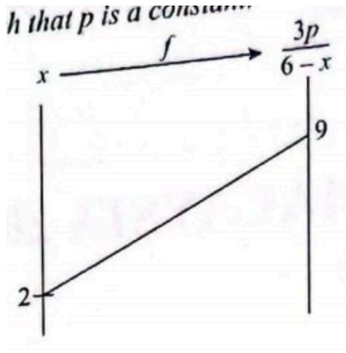
1. Diagram 1 shows the mapping of function f, such that p is a constant.



   (a) State the object which has no image.
   Solution:
   The object which has no image when

$$\begin{aligned} 6 - x &= 0 \\ x &= 6 \end{aligned}$$

   (b) Find the value of p. **Solution:**

$$\begin{aligned} f(2) &= 9 \\ \frac{3p}{6-2} &= 9 \\ \frac{3p}{4} &= 9 \\ 3p &= 36 \\ p &= 12 \end{aligned}$$

2. (a) Express p in terms of k of
   i. $x^{2k+p} = 1$,
   Solution:

$$\begin{aligned} x^{2k+p} &= 1 \\ x^{2k}x^p &= 1 \\ x^p &= x^{-2k} \\ p &= -2k \end{aligned}$$

   ii. $a^p = (\sqrt[k]{a})^6$.
   Solution:

$$\begin{aligned} a^p &= (\sqrt[k]{a})^6 \\ a^p &= a^{\frac{6}{k}} \\ p &= \frac{6}{k} \end{aligned}$$

(b) Given that $3 + \frac{3^y}{3^{2(x+1)}} = 84$, express y in terms of x.

Solution:

$$\begin{aligned}
3 + \frac{3^y}{3^{2(x+1)}} &= 84 \\
\frac{3^y}{3^{2(x+1)}} &= 81 \\
3^{y-2(x+1)} &= 3^4 \\
y - 2(x+1) &= 4 \\
y &= 4 + 2(x+1) \\
y &= 2x + 6
\end{aligned}$$

3. (a) Derive that $\log_a mn = \log_a m + \log_a n$.

Solution:

Let $\log_a m = p$ and $\log_a n = q$, $\log_a mn = r$.

$$\begin{aligned}
a^p &= m \\
a^q &= n \\
a^r &= m \times n \\
a^p \times a^q &= a^r \\
a^{p+q} &= a^r \\
p + q &= r \\
\log_a mn &= \log_a m + \log_a n
\end{aligned}$$

(b) Hence, find the value of u if $\log_u(u+3) + \log_u(u-1) = 2$.

Solution:

$$\begin{aligned}
\log_u(u+3) + \log_u(u-1) &= 2 \\
\log_u[(u+3)(u-1)] &= 2 \\
u^2 + 2u - 3 &= u^2 \\
2u - 3 &= 0 \\
2u &= 3 \\
u &= \frac{3}{2}
\end{aligned}$$

4. (a) Fei buys a block of ice cube. On the journey back home, the ice melts at the rate of 5.5 cm^3 per minute. Determine the rate of change of the side length, in cms^{-1}, of the ice at the instant when the side length is 15 cm.

Solution:

$$\begin{aligned}
\frac{dV}{dt} &= -\frac{5.5}{60} \\
&= -\frac{11}{120} \text{ cm}^3 \text{ s}^{-1} \\
V &= s^3 \\
\frac{dV}{ds} &= 3s^2 \\
\frac{ds}{dt} &= \frac{ds}{dV} \times \frac{dV}{dt} \\
&= \frac{1}{\frac{dV}{ds}} \times \frac{dV}{dt} \\
&= \frac{1}{3s^2} \times -\frac{11}{120} \\
&= -\frac{11}{360s^2} \text{ cm s}^{-1}
\end{aligned}$$

When $s = 15$,

$$\begin{aligned}
\frac{ds}{dt} &= -\frac{11}{360 \times 15^2} \\
&= -\frac{11}{81000} \text{ cm s}^{-1}
\end{aligned}$$

(b) Given that $\frac{d}{dx}\left[\frac{5}{1-x^2}\right] = g(x)$, find $\int [2g(x) + 3]dx$.

Solution:

$$\begin{aligned}
\int [2g(x) + 3]dx &= 2\int g(x)dx + 3\int dx \\
&= 2 \times \frac{5}{1-x^2} + 3x + C \\
&= \frac{10}{1-x^2} + 3x + C
\end{aligned}$$

5. The coordinates of points P and Q are $(2, 3)$ and $(q, 2q)$ respectively. Given that $\overrightarrow{PQ}$ is a unit vector. Using the vectors's triangle law, find the possible values of q.

Solution:

$$\begin{aligned}
\overrightarrow{PQ} &= \overrightarrow{PO} + \overrightarrow{OQ} \\
&= \overrightarrow{OQ} - \overrightarrow{OP} \\
&= q\vec{i} + 2q\vec{j} - 2\vec{i} - 3\vec{j}
\end{aligned}$$

$$
\begin{aligned}
&= (q-2)\vec{i} + (2q-3)\vec{j} \\
\text{Magnitude} &= \sqrt{(q-2)^2 + (2q-3)^2} \\
&= 1 \\
(q-2)^2 + (2q-3)^2 &= 1 \\
q^2 - 4q + 4 + 4q^2 - 12q + 9 &= 1 \\
5q^2 - 16q + 13 &= 1 \\
5q^2 - 16q + 12 &= 0 \\
(5q-6)(q-2) &= 0 \\
q &= \frac{6}{5}, 2
\end{aligned}
$$

6. The variables x and y are related by the equation $y = \dfrac{px}{qx-1}$, such that p and q are constants. If a graph of y against x is drawn, its curve will pass through $\left(\dfrac{1}{2}, -6\right)$ whereas a straight line with the gradient of $\dfrac{1}{8}$ is obtained when a graph of $\dfrac{1}{y}$ against $\dfrac{1}{x}$ is drawn.

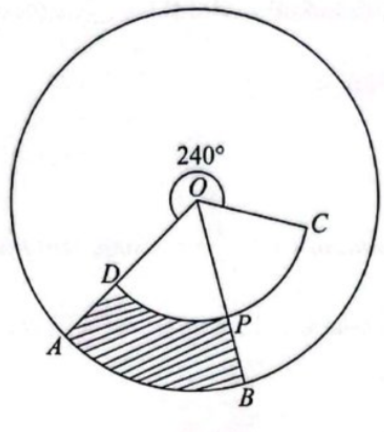
   Find the value of p and of q.

   Solution:

   When $x = \dfrac{1}{2}$, $y = -6$,

$$
\begin{aligned}
-6 &= \frac{p \times \frac{1}{2}}{q \times \frac{1}{2} - 1} \\
-6 &= \frac{\frac{p}{2}}{\frac{q}{2} - 1} \\
-6 &= \frac{p}{q-2} \\
p &= -6q + 12 \\
y &= \frac{px}{qx-1} \\
\frac{1}{y} &= \frac{qx-1}{px} \\
&= -\frac{1}{p}\frac{1}{x} + \frac{q}{p} \\
\frac{1}{8} &= -\frac{1}{p} \\
p &= -8 \\
-8 &= -6q + 12 \\
-6q &= -20 \\
q &= \frac{10}{3}
\end{aligned}
$$

7. Diagram 2 shows sectors AOB and COD inscribed in a circle with centre O.



The radius of the circle and the radius of the sector COD is h cm and k cm respectively. The lengths of arc CP and arc PD are equal. It is given that the perimeter of the minor sector AOB is 15.235 cm and the area of the shaded region is 8.376 cm^2.

[Use $\pi = 3.142$]

(a) State the $\angle COD$, in terms of π,
Solution:

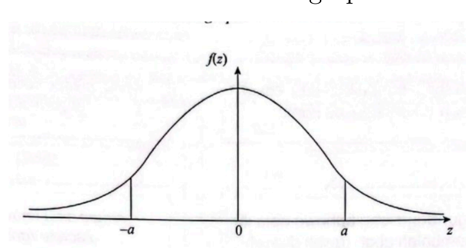
$$\begin{aligned}\angle COD &= 360^\circ - 240^\circ \\ &= 120^\circ\end{aligned}$$

(b) Hence, calculate the value of h and of k to the nearest integer.
Solution:

$$\angle DOP = \angle POC = \frac{120}{2} = 60^\circ = \frac{\pi}{3} \text{ radian}$$

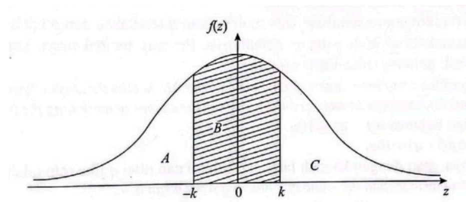
$$\text{Perimeter of sector } AOB = 2\pi h + 2k = 15.235 \text{ cm}$$

8. (a) Diagram 3 shows the standard normal distribution graph.



On Diagram 3, shade the region(s) to represent $P(|Z| \geq a)$.

(b) Diagram 4 shows the standard normal distribution graph which is divided into three equal parts.

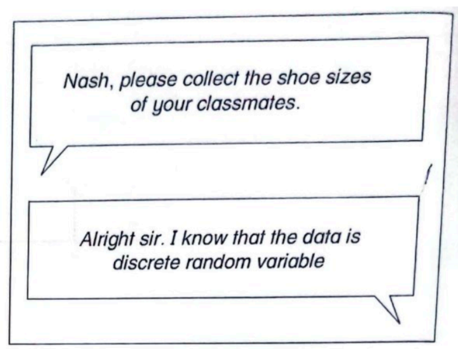


State

i. the value of k,

ii. the mode for part A.

9. (a) Diagram 5 shows the conversation between Nash and Cikgu Wong.



Is Nash's statement true? Give your justification.

(b) In a shooting competition, Dev fires n shots and p is the chance that his shots hit the target whereas q is the otherwise chance. The chance of his shots hit the target at most one is 11 times of the chance of not hitting the target.

i. Show that $n(1 - q) = 10q$.

ii. Hence, or otherwise, find the value of p and of q if the mean is 6.

10. (a) A school bookstore is having a stock clearance promotion which involves 8 different pens and 10 different notebooks. Ani will spend RM24 in the promotion. Table 1 shows the prices for a unit of each item.

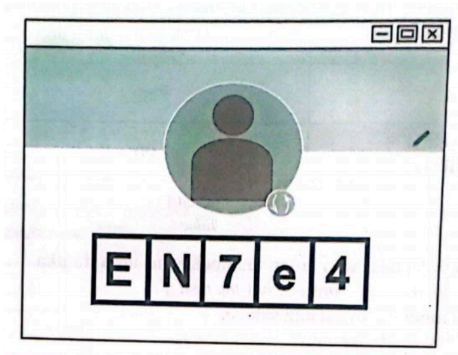
Item	Pen	Notebook
Price (RM)	2.00	4.00

Find the number of different ways Anvi can buy the item if

i. she wants to buy notebooks only,

ii. the number of notebooks is at most equal to the number of pens.

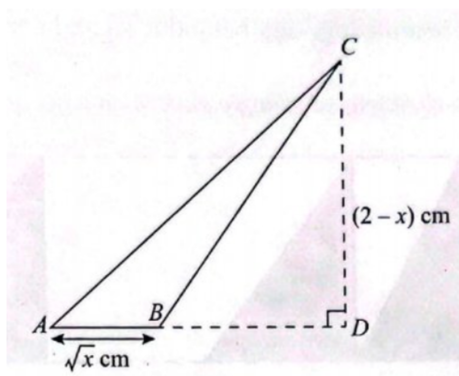
(b) Diagram 6 shows an example of five-character password formed by using letters and digits on a computer screen.



Find the number of different passwords if

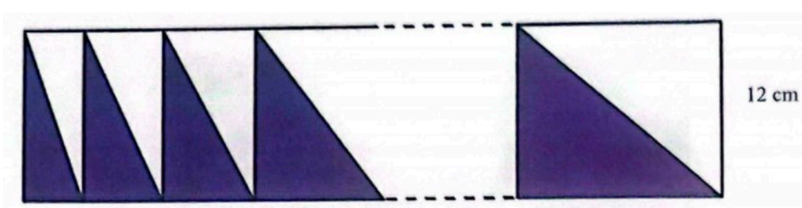
(i) the first three characters are A8a without repetition, (ii) the first character must be a non-vowel capital letter and followed by at least two prime numbers placed adjacently.

11. Diagram 7 shows triangle ABC.



It is given that $BC = (2 + x)$cm, $AD^2 = 1 + \sqrt{2}$ and ABD is a straight line. Show that $x = \dfrac{1 + 5\sqrt{2}}{49}$ cm.

12. Diagram 8 shows a purple coloured right angled triangle pattern on a net of a rectangular roll of paper.



It is given that the length of the base of the first triangle is a cm and the length of each subsequent base increases by d cm.

(a) Derive that the length of the base of the n^{th} triangle is $T_n = a + (n - 1)d$.

(b) On the net, the 31st purple coloured triangle is the last triangle with an area of 72 cm^2 and it is given that $a = 30$ d.

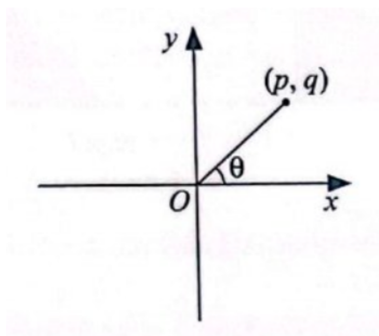
i. Find the value of d, in cm.

ii. Zul wants to send a number of rolls of the paper to his friend through a courier company. Table 2 shows an information related to parcel delivery charges.

Mass	0 – 2.5 kg	Every subsequent 500 g
Rate (RM)	9.00	1.20

If Zul has RM15 and the mass of the paper per cm^2 is 4×10^{-5} kg, calculate the maximum number of rolls of the paper that can be sent.

13. (a) Diagram 9 shows angle θ on a Cartesian plane.



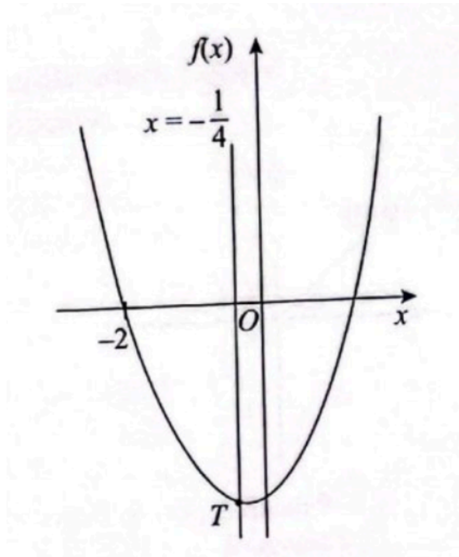
i. On Diagram 9, label the position of $-\theta$.

ii. State the value of $\tan(-\theta)$ in terms of p and q.

(b) Solve the equation $2\cos x = \sqrt{3}\cot x$ for $0° \leqslant x \leqslant 360°$.

(c) It is given that $\tan m = p$, such that m is a reflex angle. Express $\cos\left(\frac{\pi}{3} - m\right)$ in terms of p.

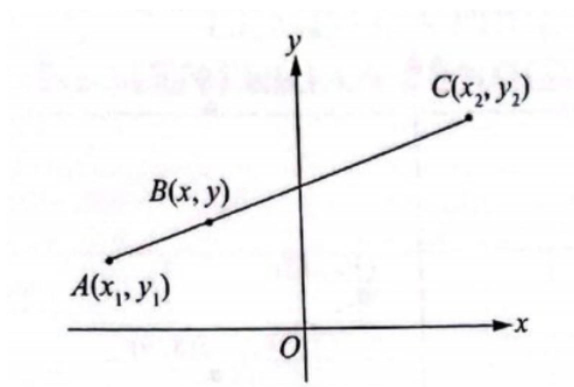
14. Diagram 10 shows a curve of a quadratic function $f(x) = 2x^2 + hx - 2k + 5$, such that h and k are constants. The curve has a minimum point at T.



(a) Determine the range of values of x of $f(x) > 0$.

(b) Prove that $k > \dfrac{40 - h^2}{16}$. item Using the method of completing the square, find the minimum value of function $f(x)$ in terms of k.

15. (a) Diagram 11 shows a line segment AC.



It is given that point B divides the line segment AC in the ratio of $m : n$. Show that $y = \dfrac{ny_1 + my_2}{m+n}$.

(b) It is given that $P(x, y)$ moves such that its distance from $R\left(\frac{3}{2}, -\frac{1}{2}\right)$ is 2.5 times its distance from the y-axis. Find the equation of locus of P.