



HIGHER SECONDARY MATHEMATICS TEACHERS ASSOCIATION MALAPPURAM (MAM)

MATHEMATICS TEST SERIES - I

JULY/AUG 2021

CLASS : XI	Time : 1 Hr
Max. score : 30	Cool off time : 15 min

(Sets, Relations and functions, Trigonometric functions, Principle of Mathematical Induction & Complex Numbers and Quadratic Equations)

General Instructions to Candidates :

- There is a 'cool-off time' of 15 minutes in addition to the writing time.
- Use the 'cool-off time' to get familiar with questions and to plan your answers.
- Read questions carefully before answering.
- Read the instructions carefully.
- Calculations, figures and graphs should be shown in the answer sheet itself.
- Give equations wherever necessary.
- **You can answer ANY NUMBER of questions fully or partially to get a maximum of 30 marks.**
- Electronic devices except non-programmable calculators are not allowed in the Examination.

വിദ്യാർത്ഥികൾക്കുള്ള പൊതു നിർദ്ദേശങ്ങൾ :

- നിർദ്ദിഷ്ട സമയത്തിനു പുറമെ 15 മിനുറ്റ് "കൂൾ ഓഫ് ടൈം" ഉണ്ടായിരിക്കും.
- ഉത്തരങ്ങൾ എഴുതുന്നതിനു മുൻപ് ചോദ്യങ്ങൾ ശ്രദ്ധാപൂർവ്വം വായിക്കണം.
- എല്ലാ ചോദ്യങ്ങൾക്കും ഉത്തരം എഴുതണം.
- കണക്കു കുട്ടലുകൾ , ചിത്രങ്ങൾ , ഗ്രാഫുകൾ എന്നിവ ഉത്തരപ്പേപ്പറിൽ തന്നെ ഉണ്ടായിരിക്കണം.
- ആവശ്യമുള്ള സ്ഥലത്തു സമവാക്യങ്ങൾ കൊടുക്കണം.
- **പരമാവധി 30 മാർക്ക് കിട്ടത്തക്ക വിധം ഏത് ചോദ്യവും മുഴുവനായോ ഭാഗികമായോ എഴുതാവുന്നതാണ്**
- പ്രോഗ്രാമുകൾ ചെയ്യാനാകാത്ത കാൽക്കുലേറ്ററുകൾ ഒഴികെയുള്ള ഒരു ഇലക്ട്രോണിക് ഉപകരണവും ഉപയോഗിക്കാൻ പാടില്ല.

Each question carries 3 marks

1. If $A = \{x: x \text{ is a letter in the word "MATHEMATICS"}\}$,
 $B = \{y: y \text{ is a letter in the word "STATISTICS"}\}$, then write
(a) A and B in roster form (1)
(b) $A - B$ (1)
(c) $A \cap B$ (1)
2. (a) $A = \{2, 3\}$, $B = \{1, 3, 5\}$, then the number of relations from A to B is
(i) 2 (ii) 64 (iii) 32 (iv) 62 (1)
(b) R is a relation defined on the set $A = \{1, 2, 3, \dots, 14\}$ by
 $R = \{(x, y): 3x - y = 0, x, y \in A\}$.
Write the domain and range of R (2)
3. (a) $\sin(-x) = \dots\dots$ (1)
(i) $\sin x$ (ii) $-\sin x$
(iii) $\cos x$ (iv) $-\cos x$
(b) Prove that $\frac{\tan\left(\frac{\pi}{4}+x\right)}{\tan\left(\frac{\pi}{4}-x\right)} = \left(\frac{1+\tan x}{1-\tan x}\right)^2$ (2)
4. (a) $i^3 = \dots\dots$ (1)
(b) Express $i^9 + i^{19}$ in the form of $a + ib$. (2)

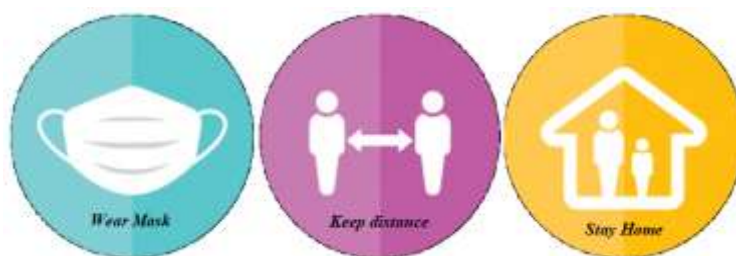
Each question carries 4 marks

5. In a school, there are 20 teachers who teach Mathematics or Physics.
Of these 12 teach Mathematics and 12 teach Physics.
(a) How many teach both the subjects. (2)
(b) How many teach physics only. (2)
6. Consider the modulus function $f(x) = |x|$.
(a) Find the domain and range of the function $f(x) = |x|$. (2)
(b) Draw the graph of the function $f(x) = |x|$. (2)
7. (a) $\cos(x + y) + \cos(x - y) = \dots$ (1)
(b) Prove that $\cos\left(\frac{\pi}{4} + x\right) + \cos\left(\frac{\pi}{4} - x\right) = \sqrt{2} \cos x$ (3)

8. Consider the statement $P(n): 1 + 3 + 3^2 + 3^3 + \dots + 3^{n-1} = \frac{3^n - 1}{2}$
- (a) Show that $P(1)$ is true (1)
- (b) Prove by principle of mathematical induction, that $P(n)$ is true for all $n \in N$ (3)
9. (a) $(a + ib)(a - ib) = \dots\dots$ (1)
- (b) Express $z = \frac{1+2i}{1-3i}$ in the form of $a + ib$ (3)

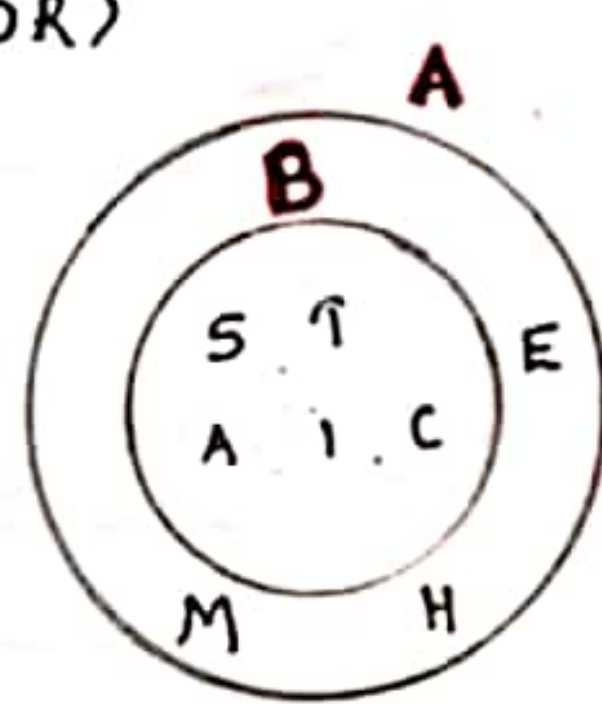
Each question carries 6 marks

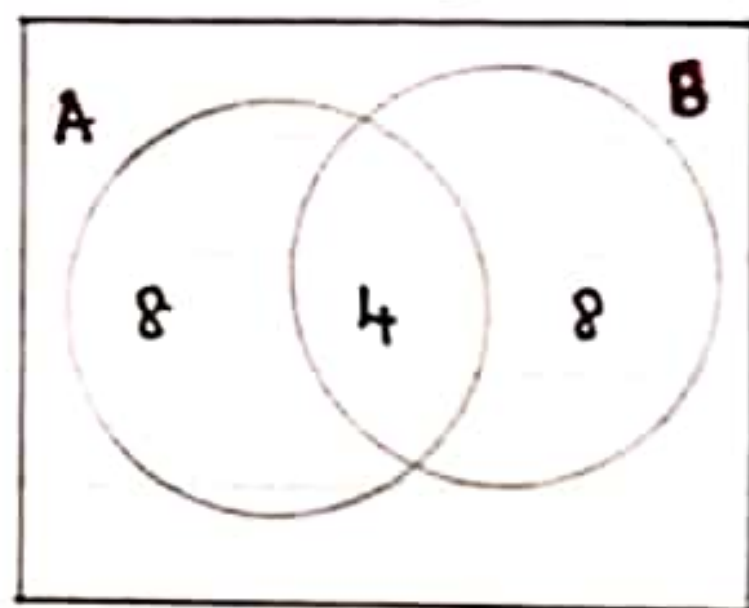
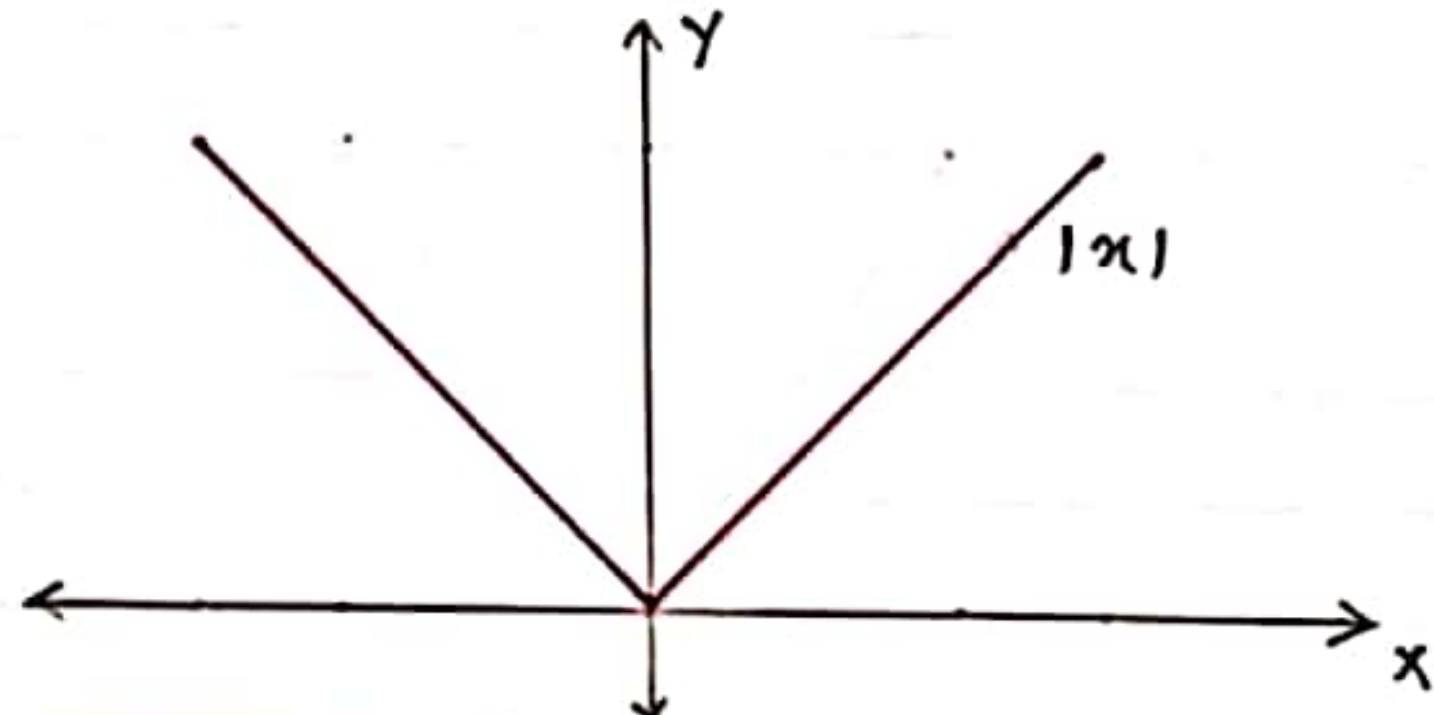
10. If $U = \{1,2,3,4,5,6,7,8,9\}$, $A = \{2,4,6,8\}$, $B = \{2,3,5,7\}$.
- (a) Verify that $(A - B) \cup (B - A) = (A \cup B) - (A \cap B)$ (3)
- (b) Verify that $(A \cap B)' = A' \cup B'$ (3)
11. Let $A = \{1,2,3,4,5,6\}$. Define a relation R on A by
 $R = \{(x, y): y = x + 1\}$
- (a) Depict the relation using an arrow diagram (2)
- (b) Write down the domain, codomain and range of R . (3)
- (c) Is R a function? Why? (1)
12. (a) If $\cos x = -\frac{3}{5}$, x lies in the third quadrant, then find the values of $\sin x$, $\operatorname{cosec} x$, $\tan x$ and $\cot x$ (2)
- (b) Find $\sin 765^\circ$ (1)
- (c) Prove that: $\frac{\cos 7x + \cos 5x}{\sin 7x - \sin 5x} = \cot x$ (3)



SERIES TEST - 11

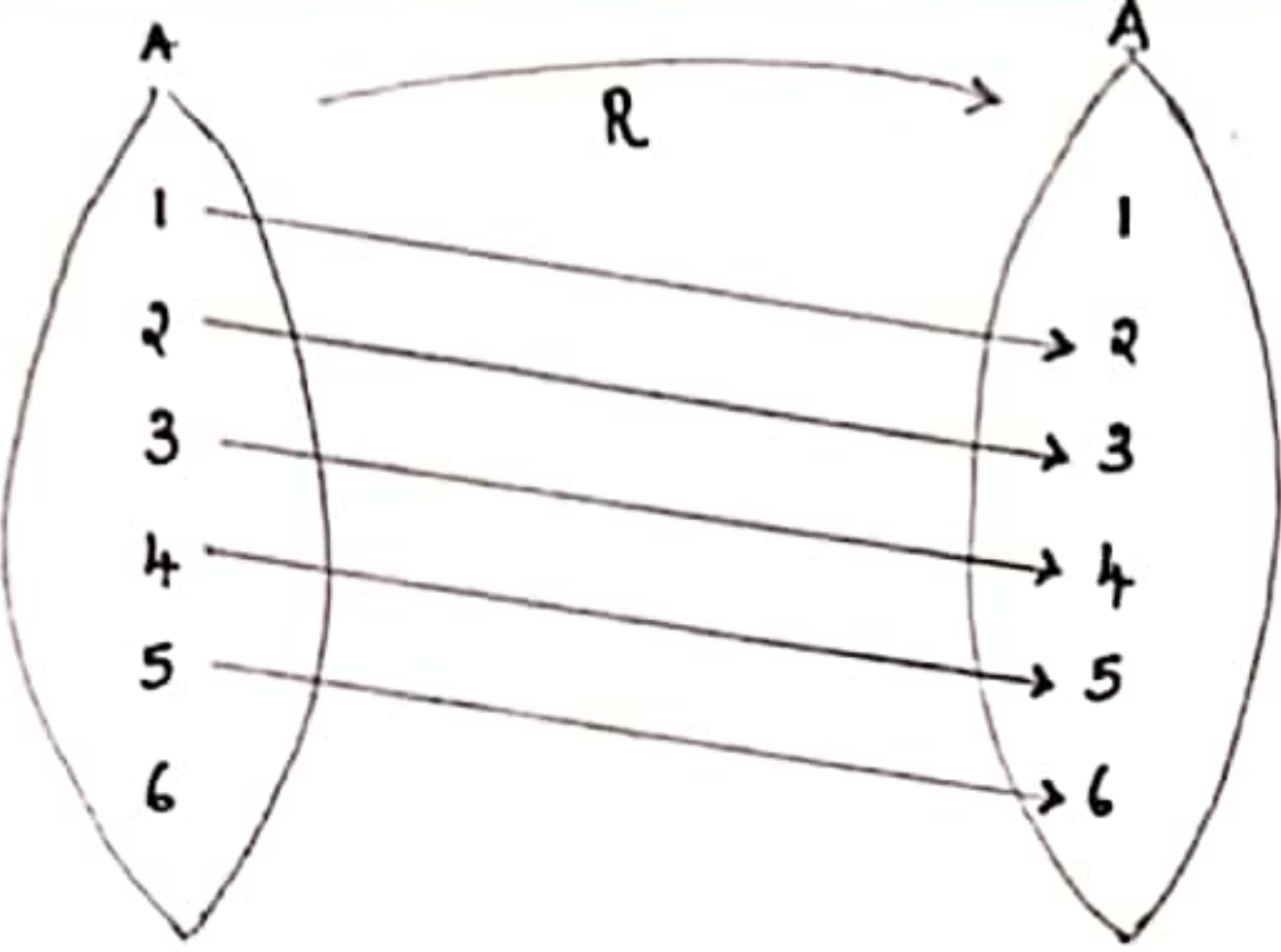
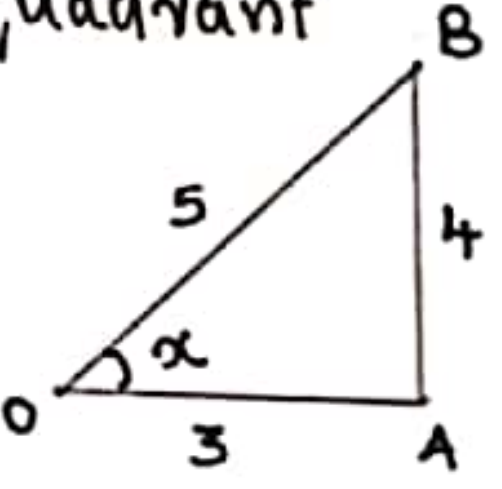
[SETS . RELATIONS & FUNCTIONS . TRIGONOMETRIC FUNCTIONS . PMT
COMPLEX NUMBERS & QUADRATIC EQUATIONS]

Sub Q	ANSWERS	Score	Obt. Score
1.	<p>a) $A = \{M, A, I, H, E, I, C, S\}$ (OR) $B = \{S, I, A, I, C\}$</p> <p>b) $A - B = \{M, H, E\}$ $A \cap B = \{S, I, A, I, C\}$</p> 	<p>$\frac{1}{2}$ $\frac{1}{2}$ 1 1</p>	3
2.	<p>a) (ii) or 64 $[2^{2 \times 3} = 2^6 = 64]$</p> <p>b) $R = \{(x, y) : 3x - y = 0, x, y \in A\}$ $= \{(x, y) : y = 3x, x, y \in A\}$ $\therefore R = \{(1, 3), (2, 6), (3, 9), (4, 12)\}$</p> <p>Domain of $R = \{1, 2, 3, 4\}$ Range of $R = \{3, 6, 9, 12\}$</p>	<p>1 1 $\frac{1}{2}$ $\frac{1}{2}$</p>	3
3.	<p>a) (ii) or $-\sin x$</p> <p>b) $\frac{\tan(\pi/4 + x)}{\tan(\pi/4 - x)} = \frac{\frac{\tan \pi/4 + \tan x}{1 - \tan \pi/4 \tan x}}{\frac{\tan \pi/4 - \tan x}{1 + \tan \pi/4 \tan x}} = \frac{\frac{1 + \tan x}{1 - \tan x}}{\frac{1 - \tan x}{1 + \tan x}}$</p> <p>$= \frac{(1 + \tan x)}{(1 - \tan x)} \times \frac{(1 + \tan x)}{(1 - \tan x)}$</p> <p>$= \left(\frac{1 + \tan x}{1 - \tan x} \right)^2$</p>	<p>1 1 $\frac{1}{2}$ $\frac{1}{2}$</p>	3

sub Q	ANSWERS	Score	Net Score
4.	<p>a) $i^3 = i^2 \cdot i = -1 \times i = -i$</p> <p>b) $i^9 = i^8 \cdot i = (i^2)^4 \cdot i = (-1)^4 \cdot i = i$ $i^{19} = i^{18} \cdot i = (i^2)^9 \cdot i = (-1)^9 \cdot i = -i$ $\therefore i^9 + i^{19} = i + (-i) = 0$</p> <p>(OR)</p> <p>$i^9 = i^{8+1} = i^8 \cdot i = 1 \cdot i = i$ $i^{19} = i^{16+3} = i^{16} \cdot i^3 = 1 \cdot (-i) = -i$ $i^9 + i^{19} = i + (-i) = 0$</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 5px; margin: 5px;"> $i^{4k} = 1$ </div> <div style="border: 1px solid black; padding: 5px; margin: 5px;"> $i^2 = -1$ </div> </div>	1 1 1	3
5.	<p>Let A = Set of Maths teachers B = Set of Physics teachers</p> <p>\therefore Given $n(A) = 12$ $n(B) = 12$ $n(A \cup B) = 20$</p> <p>a) Both Maths & Physics = $n(A \cap B)$ $n(A \cap B) = n(A) + n(B) - n(A \cup B)$ $= 12 + 12 - 20$ $= 4$</p> <p>b) Physics only = $n(B - A)$ $n(B - A) = n(B) - n(A \cap B)$ $= 12 - 4$ $= 8$</p> <div style="text-align: center;"> <p>OR</p>  <p>$n(A \cap B) = 4$ $n(B - A) = 8$</p> </div>	1 $\frac{1}{2}$ $\frac{1}{2}$ 1 $\frac{1}{2}$ $\frac{1}{2}$	4
6.	<p>Given $f(x) = x$</p> <p>a) Domain of $f = \mathbb{R}$ Range of $f = [0, \infty)$</p> <p>b)</p> 	1 1	4
		2	

Sub Q	ANSWERS	Score	Total Score
7.	<p>a) $\cos(x+y) + \cos(x-y) = 2 \cos x \cos y$</p> <p>b) $\cos(\pi/4 + x) + \cos(\pi/4 - x) = 2 \cos \pi/4 \cdot \cos x$ $= 2 \times \frac{1}{\sqrt{2}} \cdot \cos x$ $= \frac{(\sqrt{2})^2}{\sqrt{2}} \times \cos x = \sqrt{2} \cos x$</p> <p style="text-align: center;">OR</p> <p>$\cos(\pi/4 + x) + \cos(\pi/4 - x) = (\cos \pi/4 \cos x - \sin \pi/4 \sin x) +$ $(\cos \pi/4 \cos x + \sin \pi/4 \sin x)$ $= \frac{1}{\sqrt{2}} \cos x + \frac{1}{\sqrt{2}} \cos x$ $= (\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}) \cos x$ $= \frac{2}{\sqrt{2}} \cos x = \sqrt{2} \cos x$</p>	<p>1</p> <p>1 1 $\frac{1}{2} + \frac{1}{2}$</p> <p>1 1 $\frac{1}{2}$ $\frac{1}{2}$</p>	4
8.	<p>$P(n) : 1 + 3 + 3^2 + \dots + 3^{n-1} = \frac{3^n - 1}{2}$</p> <p>a) LHS of $P(1) = 1$, RHS of $P(1) = \frac{3^1 - 1}{2} = \frac{2}{2} = 1$ LHS = RHS $\therefore P(1)$ is true</p> <p>b) Let $P(k)$ is true i.e. $1 + 3 + 3^2 + \dots + 3^{k-1} = \frac{3^k - 1}{2}$ — (1) To prove $P(k+1)$ is true i.e. to prove, $1 + 3 + 3^2 + \dots + 3^{k-1} + 3^k = \frac{3^{k+1} - 1}{2}$ LHS $\Rightarrow 1 + 3 + 3^2 + \dots + 3^{k-1} + 3^k$ $= \left(\frac{3^k - 1}{2} \right) + 3^k$ by (1) $= \frac{3^k - 1 + 2 \cdot 3^k}{2}$ $= \frac{3^k(1+2) - 1}{2} = \frac{3^k \cdot 3 - 1}{2} = \frac{3^{k+1} - 1}{2} = \text{RHS}$</p>	<p>$\frac{1}{2}$ $\frac{1}{2}$</p> <p>$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2} + \frac{1}{2}$</p>	4

Sub Qn.	ANSWERS	Score	Total Score
9.	<p>a) $(a+ib)(a-ib) = a^2 - (ib)^2 = a^2 - i^2 b^2 = a^2 + b^2$</p> <p>b) $z = \frac{1+2i}{1-3i}$</p> $= \frac{(1+2i)(1+3i)}{(1-3i)(1+3i)}$ $= \frac{1+3i+2i+6i^2}{1^2+3^2}$ $= \frac{1+5i-6}{10}$ $= \frac{-5+5i}{10} = -\frac{1}{2} + \frac{1}{2}i$	<p>1</p> <p>1</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}+\frac{1}{2}$</p>	4
10.	<p>$A = \{2, 4, 6, 8\}$ $B = \{2, 3, 5, 7\}$</p> <p>a)</p> $A-B = \{4, 6, 8\}$ $B-A = \{3, 5, 7\}$ $(A-B) \cup (B-A) = \{3, 4, 5, 6, 7, 8\} \text{ --- } ①$ $A \cup B = \{2, 3, 4, 5, 6, 7, 8\}$ $A \cap B = \{2\}$ $(A \cup B) - (A \cap B) = \{3, 4, 5, 6, 7, 8\} \text{ --- } ②$ From ① & ② $(A-B) \cup (B-A) = (A \cup B) - (A \cap B)$ <p>b)</p> $A \cap B = \{2\}$ $(A \cap B)' = U - (A \cap B) = \{1, 3, 4, 5, 6, 7, 8, 9\} \text{ --- } ①$ $A' = U - A = \{1, 3, 5, 7, 9\}$ $B' = U - B = \{1, 4, 6, 8, 9\}$ $A' \cup B' = \{1, 3, 4, 5, 6, 7, 8, 9\} \text{ --- } ②$ From ① & ② $(A \cap B)' = A' \cup B'$	<p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p> <p>$\frac{1}{2}$</p>	6

Sub Q	ANSWERS	Score	Total Score
11. a)		2	6
b)	<p>Domain of $R = \{1, 2, 3, 4, 5\}$ Co domain of $R = \{1, 2, 3, 4, 5, 6\}$ Range of $R = \{2, 3, 4, 5, 6\}$</p>	1 1 1	
c)	<p>No, 'R' is not a function. Since 6 has no image. [Every element of A should have unique image in A is violated]</p>	1	
12. a)	<p>Given $\cos x = -\frac{3}{5}$, x in IIIrd quadrant</p> <p>From $\triangle OAB$</p>  <p>$\sin x = -\frac{4}{5}$ [x in IIIrd qua: $\sin x$ is -ve]</p> <p>$\operatorname{cosec} x = \frac{1}{\sin x} = \frac{1}{-4/5} = -\frac{5}{4}$ [$\operatorname{cosec} x$ -ve]</p> <p>$\tan x = \frac{\sin x}{\cos x} = \frac{-4/5}{-3/5} = \frac{4}{3}$ [$\tan x$ +ve]</p> <p>$\cot x = \frac{1}{\tan x} = \frac{1}{4/3} = \frac{3}{4}$ [$\cot x$ +ve]</p>	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	

$$\begin{aligned}
 \text{b)} \quad \sin 765^\circ &= \sin (2 \times 360^\circ + 45^\circ) \\
 &= \sin 45^\circ \\
 &= \frac{1}{\sqrt{2}}
 \end{aligned}$$

$$\text{c)} \quad \frac{\cos 7x + \cos 5x}{\sin 7x - \sin 5x} = \frac{2 \cos \left[\frac{7x+5x}{2} \right] \cos \left[\frac{7x-5x}{2} \right]}{2 \cos \left[\frac{7x+5x}{2} \right] \sin \left[\frac{7x-5x}{2} \right]}$$

$$= \frac{\cos 6x \cdot \cos x}{\cos 6x \cdot \sin x}$$

$$= \cot x$$

1

6

1+1

$\frac{1}{2}$

$\frac{1}{2}$