NARAYANA EDUCATIONAL INSTITUTIONS

TOPIC: MATHEMATICAL REASONING

1. The statement $p \wedge (q \Leftrightarrow r)$ is a

 1) tautology 2) contradiction 3) contingency 4) none of these

2. If p, q and r statements with truth values false, true and false respectively, then the truth value of $(\sim p \vee \sim q) \vee r$ is

 1) true 2) false 3) false, if r is true 4) false, if q is false

3. $\sim\left[(\sim p) \wedge q\right]$ is logically equivalent to

 1) $\sim(p \vee q)$ 2) $\sim\left[p \wedge (\sim q)\right]$ 3) $p \wedge (-q)$ 4) $p \vee (-q)$

4. The contrapositive of the statements "*if* $2^2 = 5$, then I get first class" is

 1) If I do not get a first class, then $2^2 = 5$
 2) If I do not get a first class, then $2^2 \neq 5$
 3) If I get a first class, then $2^2 = 5$
 4) none of these

5. The contrapositive of $(p \vee q) \to r$ is

 1) $p \to (q \vee r)$
 2) $r \to (p \vee q)$
 3) $\sim r \to \sim (p \vee q)$
 4) $\sim r \to (\sim p \wedge \sim q)$

6. If $x = 5$ and $y = -2$,then $x - 2y = 9$. The contrapositive of this proposition is

 1) If $x - 2y = 9$,then $x \neq 5$ or $y \neq -2$
 2) If $x - 2y = 9$, $x \neq 5$ and $y \neq -2$
 3) $x - 2y = 9$ if and only if $x = 5$ and $y = -2$
 4) none of these

7. Which of the following statements is a tautology?

 1) $(\sim q \wedge p) \wedge q$
 2) $(\sim q \wedge p) \wedge (p \wedge \sim p)$
 3) $(\sim q \wedge p) \wedge (p \wedge \sim p)$
 4) $(p \wedge q) \wedge (\sim (p \wedge q))$

8. Negation of the statement $p \to (q \wedge r)$ is

 1) $\sim p \to \sim (q \vee r)$ 2) $\sim p \to \sim (q \wedge r)$ 3) $(q \wedge r) \to p$ 4) $p \wedge (\sim q \vee \sim r)$

9. The compound statement $p \to (\sim p \vee q)$ is false, then the truth values of p and q are respectively

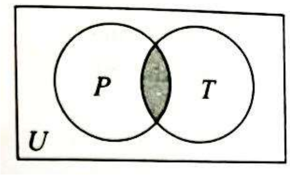
 1) T, T 2) T, F 3) F, T 4) F, F

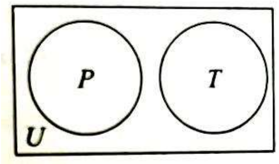
10. Which of the following statements is a tautology

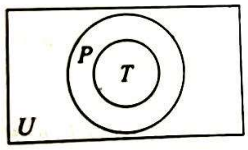
1) $(\sim p \vee q) \sim (p \vee \sim q)$ 2) $(\sim p \vee \sim q) \rightarrow p \vee q$

3) $(p \vee \sim q) \wedge (p \vee q)$ 4) $(\sim p \vee \sim q) \vee (p \vee q)$

11. Which of the Venn diagrams represents the truth of the statement 'No policeman is a thief'

1) 

2) 

3) 

4) None of these

12. Which of the following is logically equivalent to $\sim(\sim p \Rightarrow q)$?

1) $\sim p \wedge q$ 2) $p \wedge q$ 3) $\sim p \wedge \sim q$ 4) $p \wedge \sim q$

13. Which of the following is true?

1) $\sim (p \Leftrightarrow q) \equiv [\sim (p \Rightarrow q) \wedge \sim (q \Rightarrow p)]$ 2) $p \Rightarrow q \equiv \sim p \Rightarrow \sim q$

3) $\sim (p \Rightarrow \sim q) \equiv \sim p \wedge q$ 4) $\sim (\sim p \Rightarrow \sim q) \equiv \sim p \wedge q$

14. If $(p \wedge \sim r) \wedge (\sim p / q)$ is false, then the truth values of p, q and r, respectively

1) T, F and F 2) F, F and T 3) F, T and T 4) T, F and T

15. Which of the following is true for any two statements p and q?

1) $\sim [p \vee (\sim q)] \equiv (\sim p) \wedge q$ 2) $(p \vee q) \vee (\sim p) \wedge q$

3) $(p \wedge q) \wedge (\sim q)$ is a contradiction 4) $\sim [p \wedge (\sim p)]$ is a tautology

16. The contrapositive of $(p \vee q) r$ is

1) $\sim r \sim p \wedge \sim q$ 2) $r(p \vee q)$ 3) $\sim r(p \vee q)$ 4) $p(q \vee r)$

17. Which of the following is the inverse of the proposition "If a number is a prime then it is odd"?

a) If a number is not a prime then it is odd

b) If a number is a prime then it is odd

c) If a number is not odd then it is a prime

d) If a number is not odd then it is not a prime

18. In the truth table for the statement $(p \to q) \leftrightarrow (\sim p \vee q)$., the last column has the truth value in the following order

1)TTTT 2) FTFT 3) TTFF 4) FFFF

19. Which of the following is false?

1) $(p \Rightarrow q) \Leftrightarrow (\sim q \Rightarrow \sim p)$ is a contradiction 2) $p \vee (\sim p)$ is a tautology

3) $\sim(\sim p) \Leftrightarrow p$ is a tautology 4) $p \wedge (\sim p)$ is a contradiction

20. Which one of the following statements is not a false statement?

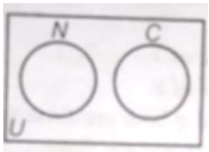
1) p: Each radius of a circle is a chord of the circle

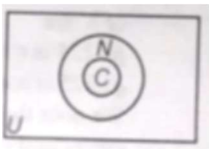
2) q: Circle is a particular case of an ellipse

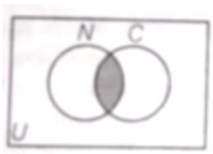
3) $r: \sqrt{13}$ is a rational number

4) s: The centre of a circle bisects each chord of the circle

21. Which ven diagram represents the truth of the statement ‘No child is naughty where, U is the universal set of human beings C is the set of children and N is set of naughty persons?

1) 

2) 

3) 

4)None of these

22. The Boolean expression p and $(p \wedge \sim q) \vee q \vee (\sim p \wedge q)$ is equivalent to

1) $p \vee q$ 2)P 3)q 4) $\sim p$

23. Which of the following is a statement?

1) $\sim(p \vee q) \equiv p \vee \sim q$ 2) $(p \Rightarrow q) \equiv \sim q \Rightarrow \sim p$

3) $\sim(p \Rightarrow q) \equiv p \wedge \sim q$ 4) $\sim(p \vee q) \equiv \sim p \wedge \sim q$

24. The contrapositive of the statement “If i become a teacher then i will open a school” is

1) If I will not open a school, then I will not become a teacher

2) If I will open a school, then I will not become a teacher

3) If I will not open a school, then I will become a teacher

4)None of these

25. The contrapositive of statement of “If $x^2 = 25$,then $(x = 5 \, or \, x = -5)$ is

1) If $x^2 \neq 25$, then $x \neq 5$ and $x \neq 5$ 2) If $x \neq 5$ or $x \neq -5$, then $x^2 = 25$

3) $x \neq 5$ and $x \neq -5$ then $x^2 \neq 25$ 4) If $x \neq 5$ and $x \neq -5$, then $x^2 = 25$

26. $\sim[\sim p \wedge (p \Leftrightarrow q)] =$

1) $q \wedge p$ 2) $p \vee q$ 3) $\sim p$ 4) $\sim q$

27. The converse of $(p \wedge (\sim q)) \Rightarrow r$ is

1) $\sim r \Rightarrow (\sim p \vee q)$ 2) $r \Rightarrow (\sim p \wedge \sim q)$ 3) $(\sim p \vee q) \Rightarrow \sim r$ 4) All

28. The negation of $x \in A \cap B \Rightarrow (x \in A\, and\, x \in B)$ is

1) $x \in A \cup B \Rightarrow (x \in A\, or\, x \in B)$ 2) $x \in A \cap B\, or\, (x \in A\, and\, x \in B)$

3) $x \in A \cap B\, and\, (x \notin A\, or\, x \notin B)$ 4) $x \notin A \cap B\, and\, (x \in A\, and\, x \in B)$

29. Consider the logical statements p and Q make a truth table for $\sim P \wedge Q$

1)

P	Q	$\sim P$	$\sim P \wedge Q$
T	T	F	F
T	F	F	F
F	T	T	F
F	F	T	F

2)

P	Q	$\sim P$	$\sim P \wedge Q$
T	F	F	F
T	F	F	F
F	F	T	F
F	F	T	F

3)

P	Q	$\sim P$	$\sim P \wedge Q$
T	T	F	F
T	T	F	F
F	T	F	F
T	T	T	F

4)

P	Q	$\sim P$	$\sim P \wedge Q$
T	T	F	F
F	F	F	F
T	T	T	F
F	F	T	F

30. Which of the following statement is a contradiction

1) $(\sim p) \wedge (p \wedge \sim q)$ 2) $p \wedge \sim q$ 3) $\sim p \wedge q$ 4) $p \wedge q$

1.

p	q	r	$\boxed{q \Leftrightarrow r}$		$\boxed{p \wedge (q \Leftrightarrow r)}$
T	F	F	T		T
T	F	T	F		F
T	T	F	F		F
T	T	T	T		T
F	F	F	T		F
F	F	T	F		F
F	T	F	F		F
F	T	T	T		F

2.

$Let\ S : (\sim p \vee \sim q) \vee r$
$\Rightarrow S : (\sim F \vee \sim T) \vee F$
$S : (T \vee F) \vee F = T$

Hence, (3) is the correct answer

3. $\sim [(\sim p) \wedge q] \equiv \sim (\sim p) \vee \sim q \equiv p \vee (\sim q)$

4. Let p and q be two propositions given by $p : 2^2 = 5, q : I$ get 1^{st} class

The given statement is $p \to q$.

The contrapositive of this statement is $\sim q \to \sim p$

i.e., If I do not get first class, then $2^2 \neq 5$.

5. We know that the contrapositive of $p \to q$ is $\sim q \to \sim p$. Therefore, contrapositive of $(p \vee q) \to r$ is $\sim r \to \sim (p \vee q)$.

6. Let p, q and r be three propositions given by $p : x = 5, q : y = -2\ and\ r : x - 2y = 9$

Then, the given statement is $(p \wedge q) \to r$

Its contrapositive is $\sim r \rightarrow \sim(p \wedge q)$

i.e., $\sim r \rightarrow \sim p \vee \sim q$

i.e., If $x-2y \neq 9$, then $x \neq 5 \, or \, y \neq -2$.

7. We have

$(\sim q \wedge p) \wedge q \cong (\sim q \wedge q) \wedge p \cong c \wedge p \cong c$

So, statement in option (1) is a contradiction.

$(\sim q \wedge p) \wedge (p \wedge \sim p) \cong (\sim q \wedge p) \wedge c \cong c$, which is a contradiction

$(\sim q \wedge p) \vee \cong (p \vee \sim p) \cong (\sim q \wedge p) \wedge t \cong t$, which is a tautology.

$(p \wedge q) \wedge (\sim (p \wedge q)) \cong c$ is a contradiction.

8. We know that $\sim\left(p \vee q\right) \cong p \wedge -q$

$\sim\left(p \rightarrow (q \wedge r)\right) \cong p \wedge (\sim (q \wedge r))$

$\sim\left(p \rightarrow (q \wedge r)\right) \cong p \wedge (\sim q \vee \sim r)$ (by demorgan's laws)

9. We know that $p \rightarrow q$ is false only when p is true and q is false. Therefore,

$p \rightarrow \left(\sim p \vee q\right)$ is false only when p is true and $\left(\sim p \vee q\right)$ is false

Now ,$\sim p \vee q$ is false if q is false, because $\sim p$ is false

Hence, $p \rightarrow \left(\sim p \vee q\right)$ is false only when p is true and q is false

10. The truth table of $\sim\left(p \vee \sim q\right) \vee (p \vee q)$ is as shown below

p	q	$\sim p$	$\sim q$	$p \vee q$	$\sim p \vee \sim q$	$(\sim p \vee \sim q) \vee (p \vee q)$
T	T	F	F	T	F	T
T	F	F	T	T	T	T
F	T	T	F	T	T	T
F	F	T	T	F	F	T

11. No policeman is a thief means $P \cap T = \phi$

That is, there is no common elements (area) between P and T SO

12. Since $\sim\left(p \Rightarrow q\right) = p \wedge \sim q$

$\sim\left(\sim p \Rightarrow q\right) = \sim p \wedge \sim q$

13. $\sim\left(p \Rightarrow q\right) p \wedge \sim q$

$\sim\left(\sim p \Rightarrow \sim q\right) \equiv p \wedge \sim(\sim q) \equiv p \wedge q$

Thus $\sim(\sim p \Rightarrow \sim q) \sim p \wedge q$

14.

p	q	r	$\sim p$	$\sim r$	$p \wedge \sim r$	$\sim p \vee q$	$(p \wedge \sim r) \Rightarrow (\sim p \vee q)$
T	T	T	F	F	F	T	T
T	T	F	F	T	T	T	T
T	F	T	F	F	F	F	T
T	F	F	F	T	T	F	F
F	T	T	T	F	F	T	T
F	T	F	T	T	F	T	T
F	F	T	T	F	F	T	T
F	F	F	T	T	F	T	T

p	q	$\sim p$	$\sim q$	$p \vee \sim q$	$\sim(p \vee \sim q)$	$\sim p \wedge q$
T	T	F	F	T	F	F
T	F	F	T	T	F	F
F	T	T	F	F	T	T
F	F	T	T	T	F	F

15.

16. Contra positive of $p \Rightarrow q \, is \sim q \Rightarrow \sim p$

Contra positive of $(p \vee q) \Rightarrow r$ is

$-r \Rightarrow \sim(p \wedge q), i.e \sim r \Rightarrow (\sim p \vee \sim q)$

So $(\sim q \wedge p) \equiv (q \Rightarrow p)$

17. If p:A number is a prime

Q: It is odd

We have $p \Rightarrow q$

The inverse of q is $\sim p \Rightarrow \sim q$

Ie, if a number is not a prime then it is not odd

18.

p	q	$p \to q$	$\sim p$	$\sim p \vee q$	$(p \to q) \leftrightarrow (\sim p \vee q)$
T	T	T	F	T	T
T	F	F	F	F	T
F	T	T	T	T	T
F	F	T	T	T	T

19. (a) $p \Rightarrow q$ is logically equivalent to $\sim p \Rightarrow \sim q$,therefore, $(p \Rightarrow q) \Leftrightarrow (\sim q \Rightarrow \sim p)$ is a tautology but not a Contradiction so

20. We know that, equation of an ellipse is given by $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

If we take a=b, then we get $x^2 + y^2 = a^2$ which satisfies all the conditions of circle.

Circle is the particular case of an ellipse Hence,(b) is the correct answer

21. No child is naughty means $C \cap N = \phi$

i.e, there is no common elements between C and N .

Hence,(a) is the correct answer

22.

$$
\begin{aligned}
&[(p \wedge \sim q) \vee q] \vee (\sim p \wedge q) = (p \vee q) \wedge (\sim q \vee q) \vee (\sim p \wedge q) \\
&= (p \vee q) \wedge t \vee (\sim p \wedge q) \\
&= p \vee q \wedge t \\
&= p \vee q
\end{aligned}
$$

23. Since, $\begin{aligned} &p \Rightarrow q = \sim p \wedge q \\ &\sim (p \Rightarrow q) = p \wedge \sim q \end{aligned}$

24. Let $p : I$ become a teacher, $q : I$ will open a school

Contrapositive of $p \rightarrow q$ is $\sim q \rightarrow \sim p$

If I will not open a school, then I will not become a teacher

25. Hence $P : x^2 = 25; q : x = 5 \ or \ x = -5$

The given statement of the form $P \Rightarrow (q \vee r)$

THE CONTRA POSITIVE OF $p \Rightarrow (q \vee r) \equiv \sim (q \vee r) \Rightarrow p$

ii)if $x \neq 5$ and $x \neq -5$ then $x^2 \neq 25$

26.

$$
\begin{aligned}
\sim [\sim p \wedge (p (=) q)] &= p \vee \sim (p (=) q) \\
&= p \vee \sim [(p (=) q) \wedge (q \rightarrow p)] \\
&= [p \vee \sim [(p \wedge \sim q)] \vee (q \wedge \sim p)] \\
&= p \vee (q \wedge \sim p)] \\
&= (p \vee q) \wedge (p \vee \sim p) \\
&= (p \vee q)
\end{aligned}
$$

$$(p\wedge\sim q)\Rightarrow r = r\Rightarrow(p\wedge(\sim q)$$

$$=\sim r\vee(p\wedge\sim q)$$

27. The converse of $=(p\wedge\sim q)\vee(\sim r)$

$$=[\sim(\sim p\vee q)]\vee(\sim r)$$

$$=(\sim(p\vee q)\Rightarrow\sim r$$

$x\in A\cap B;\ Q: x\in A\ \ AND\ \ x\in B$

28. Let $\sim[p\rightarrow q]=\sim(\sim p\vee q)=p\wedge\sim q$

$ie.\ x\in A\cap B\ \ and\ \ (x\in A\ \ or\ \ x\in B)$

29.

P	Q	$\sim P$	$\sim P\wedge Q$
T	T	F	F
T	F	F	F
F	T	T	F
F	F	T	F

30.

P	Q	$\sim P$	$\sim q$	$p\wedge\sim q$	$(\sim p)\wedge(p\wedge\sim q)$
T	T	F	F	F	F
F	T	T	F	F	F
T	F	F	T	T	F
F	F	T	T	F	F

MATHS-A KEY									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
3	3	4	2	3	1	3	4	2	4
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
2	3	4	1	1	2	4	1	1	2
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
1	1	3	1	3	2	3	3	1	1