K23-0593
Muhammad Ayesh
Discrete Structures
Assignment #01.

Date: ____________

1. Which of these structures are propositions? What are the truth values of those that are propositions?

(a) Boston is the capital of Massachsetts. YES . TRUE

(b) Miami is the capital of Florida YES FALSE.

(c) 2+3=5 YES ~~FALSE~~ TRUE.

(d) 5+7=10 YES FALSE

(e) x+2=11 NO

(f) Answer this question NO.

2.

Smartphones	RAM	ROM	Resolution.
Smartphone A	256 MB	32GB	8MP
Smartphone B	288 MB	64 GB	4MP
Smartphone C	128 MB	32 GB	5MP

(a) Smartphone B has the most RAM of these three smart

let, A represents "Smartphone A has the most RAM

B represents "Smartphone B has the most RAM

C represents "Smartphone C has the most RAM

The statement can be expressed as: B ∧ ¬A ∧ ¬C.

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TRUE. [Smartphone B indeed has the most RA

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The statement can be expressed as: $B \wedge \neg A \wedge \neg C$.

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TRUE. [Smartphone B indeed has the most RAM

Date: ______

(b) Smartphone C has more ROM or a higher resolution camera than smartphone B.

~~[illegible]~~

R_c represents "Smarphone C has more ROM than Smartphone B" (false)

H_c represents "Smartphone C has higher resolution ~~more~~ ~~ROM~~ camera than smartphone B (TRUE)

$R_C \vee H_c$

$F \vee T$

$\boxed{T}$

(c) smartphone B has more RAM, more ROM, and a higher resolution camera than smartphone A.

Rom B represents "smartphone B has more RAM than smartphone A" (True)

Ram B represents "Smartphone B has more ROM than smartphone A" (True)

HrB represents "Smartphone B has higher resolu[tion] than smarphone A". (false)

$Rom B \wedge Ram B \wedge HRB$

$T \wedge T \wedge F$

$\boxed{F}$ Ans

(d) If smartphone B has more RAM and more ROM than smartphone C, then it also has a higher resolution camera.

RamB represents "Smartphoone B has more RAM than smatphone C" (True)

Rom B represents "Smartphone B has more ROM than smartphone C" (True)

H:B represents "smartphon B has a higher reso than smartphone C". (False).

$(Ram\,B \wedge Rom\,B) \rightarrow HB$.

$(T \wedge T) \rightarrow F$

$T \rightarrow F$

$\boxed{F}$ Ans.

Date:

e) smartphone A has more RAM than smartphone B if and only if smartphone B has more RAM than smartphone A.

Ram A represents "Smartphone A has more RAM than smartphone B."

Ram B represents "Smartphone B has more RAM than smartphone A."

Ram B $\leftrightarrow$ Ram A. Ram A $\leftrightarrow$ Ram B

F $\leftrightarrow$ F F $\leftrightarrow$ T

$\boxed{F}$ Ans F

Date: ____________

3.

	Revenue (billion)	Net Profit (billion)
Acme	138	8
Nadir	87	5
Quixote	111	13

(a) Quixote Media had the largest annual revenue.

~~AR represents but~~ A

QR represents " Quixote media had largest annual revenue ". [False]

NR represents. " Nadir Software had largest annual revenue". [False]

* AR represents " Acme computer had largest annual revenue." [True].

$QR \land (NR \land AR)$

$F \land (F \land T)$

$\boxed{F}$ Ans.

(b) Nadir software had the lowest net profit and Acme computer had the largest annual revenue.

NP represent " Nadir software had the lowest net profit" ~~[False]~~ [True].

AR represent " Acme had the largest annual revenue ~~[False]~~. [True].

$NP \land AR$

$T \land T$

$\boxed{T}$ Ans.

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(c) Acme computer had the largest net profit or Quixote Media had the largest net profit.

AP represents " Acme computer had the largest net profit. [False]

QP represents " Quixote media had the largest net profit". [True]

AP V QP

F V T

$\boxed{T}$ th

(d) If Quixote Media had the smallest net profit, then Acme computer had the largest annual revenue.

QP represents " Quixote media had the smallest net profit". [False]

AR represents " Acme computers had the largest annual revenue". [True]

QP → AR

F → T

$\boxed{T}$ th.

Date:

(e) Nadir software had the smallest net profit if and only if Acme computer had the largest annual revenue.

NP represents "Nadir software had the smallest net profit". [True].

AR represents "Acme computer had the largest annual revenue". [True].

$NP \leftrightarrow AR$

$T \leftrightarrow T$

$\equiv T$

Date: ___________

4. Let p, q, and r be the propositions

p: You have the flu.
q: You miss the final examination.
r: You pass the course.

Express each of these propositions as an English sentence.

(a) $p \rightarrow q$.

If you have flu, then you miss the final examination.

(b) $\neg q \leftrightarrow r$

You donot miss the final examination if and only if you pass the course.

(c) $q \rightarrow \neg r$.

If You miss the final examination ~~if and only if~~ then you ~~pass~~ fail the course.

(d) $p \vee q \vee r$

You have the flu. or miss the final examina[tion] or you pass the course.

(e) $(p \rightarrow \neg r) \vee (q \rightarrow \neg r)$.

if you have flu then you fail the course, o[r] if you ~~have~~ miss the final exam then you fail the course.

(f) $(p \wedge q) \vee (\neg q \wedge r)$

You have the flu and you miss the final examin[ation]

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Or you didn't miss the final examination and [you] pass the course.

Date:

5. let p, q and r be the propositions.

p: You get an A on the final exam.

q: You do every exercise in this book.

r: You get an A in the class.

Write these propositions using p, q, and r and logical connectives.

(a) You get an A in this class, but you donot do every exercise in this book.

$r \land \neg q$.

(b) You get an A on the final, you do every exercise in this book, and you get an A in the class.

$p \land q \land r$.

(c) To get an A in this class, it is necessary for you to get an A on the final.

$r \rightarrow p$ [Form q is necessary for p]

(d) You get an A on the final, but you don't do every exercise in this book; nevertheless, you get an A in this class

$(p \land \neg q) \land r$

(e) Getting an A on the final and doing every exercise in this book is sufficient for getting an A in this class

$(p \land q) \rightarrow r$ [Form p is sufficient for q]

(d) You will get an A in this ~~final~~ class if and only if you either do every exercise in this book or you get an A on the final

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$r \leftrightarrow (q \lor p)$

Date:

6.

~~(a) P: I will remember~~

(a) P: You send me an email message
q: I will remember to send you the address.

Form :- P only if q.

P→q : If you send me an email message, then I will remember to send you the address.

~~Form :- a~~

(b) P: You were born in the United State.
q: You are a citizen of this country.

Form: a sufficient condition for q, is P

P→q : if you were born in the united state, then you are a citizen of this country.

~~Form :-~~

(c) P: If you keep your textbook
q: It will be a useful reference in your future courses

Form :- if P, q.

P→q: If you keep your textbook, then it will a useful reference in your future courses.

(d) P: The Red wings' goalie plays well.
q: They will win the stanley cup.

Form :- q if P.

P→q : If the Red wings goalie plays well, then they will the stanley cup.

Date:

(e) p: You get the job
q: You had the best credentials.
Form. p implies q.
p→q: If you get the job, then you had the best credentials.

(f) p: There is a storm.
q: The beach erodes.
Form: q whenever p.
p→q: If there is a storm, then the beach storm.

(g) ~~It is~~ p: ~~You have a valid password.~~ You can log on to the server
q: ~~To log on to the server.~~ You have a valid password.
Form:- q is necessary for p.
If you can log onto the server you have a valid password.

h) p: You begin your climb too late.
q: You will reach the summit.
Form: q unless p.
If you will reach the summit, then you begin your climb too late.

Date:

7. (a)

1. It is sunny tomorrow only if will go for a walk ~~tomorrow~~ in the woods. "p only if q"

2. ~~I will~~ To go for a walk ~~tomorrow~~ in the woods it is ~~sufficient~~ necessary ~~to~~ that It is sunny tomorrow

3. I will go for a walk in the woods if it is sunny tomorrow.

4. I will go for a walk in the woods when it is sunny tomorrow.

5. I will go for a walk in the woods unless It is not sunny tomorrow.

(b) ~~S0~~

Converse $q \to p$

If I will ~~tomorrow~~ go for a walk a In the woods, then It is sunny tomorrow.

Inverse $\neg p \to \neg q$

If it is not sunny tomorrow, then I will not go for a walk in the woods.

Date: ______

contrapositive $\neg q \rightarrow \neg p$.

If I ~~will~~ ~~not~~ do not go for a walk in the woods, then it is not sunny tomorrow.

(C)

Inverse of its inverse $p \rightarrow q$.

If ~~will~~ it is sunny tomorrow, then I will go for a walk in the woods.

Inverse of its converse $\neg q \rightarrow \neg p$

If I ~~will~~ donot go for a walk in the woods, then it is not sunny tomorrow.

Inverse of its contrapositive.

If I ~~will~~ go for a walk ~~tomorrow~~ in the woods, then it is sunny tomorrow.

Date:

8.

(a) Jan is rich and happy.

p: Jan is rich

q: Jan is happy

$\neg(p \wedge q) \equiv \neg p \vee \neg q$ ~ DeMorgan's Law

$\neg p \vee \neg q$: Jan is not rich or not happy.

(b) Carlos will bicycle or run tomorrow.

p: Carlos will bicyle tomorrow

q: Carlos will run tomorrow.

$\neg(p \vee q) \equiv \neg p \wedge \neg q$. ~ De Morgan's law.

Carlos will not bicycle tomorrow and carlos will not run tomorrow.

(c) The fan is slow or it is very hot.

p: The fan is slow

q: The fan is very hot.

$\neg(p \vee q) \equiv \neg p \wedge \neg q$.

$\neg p \wedge \neg q$: The fan is not slow and the fan is not very hot.

(d) Akram is unfit and Saleem is injured.

p: Akram is unfit

q: Saleem is injured.

$\neg(p \wedge q) \equiv \neg p \vee \neg q$.

Akram is fit ~~and~~ or saleem is not injured.

Date:

9.

(a) Exclusive OR.

(b) Inclusive OR.

(c) Inclusive OR

(d) Inclusive OR.

10.

(a) $(p \wedge (\neg(\neg p \vee q))) \vee (p \wedge q) \equiv p.$

Sol:

$\Rightarrow (p \wedge (\neg(\neg p \vee q))) \vee (p \wedge q)$

∴ DeMorgans law.

$\Rightarrow (p \wedge (\neg(\neg p) \wedge \neg q)) \vee (p \wedge q)$

∴ Double Negation law.

$\Rightarrow (p \wedge (p \wedge \neg q)) \vee (p \wedge q)$

~~∴ Distributive law.~~

$\Rightarrow (p \wedge p \wedge \neg q) \vee (p \wedge q)$

∴ $p \wedge p \equiv p$ Idempotent law.

$\Rightarrow (p \wedge \neg q) \vee (p \wedge q)$

∴ Distributive law

∴ $p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$

$\Rightarrow p \wedge (\neg q \vee q)$

∴ Negation Law ∴ $p \vee \neg p \equiv T$

$p \wedge T$

∴ Identity law ∴ $p \wedge T \equiv p$

$\boxed{p}$

Hence Proved!

Date:

(b) $\neg(p \leftrightarrow q) \equiv (p \leftrightarrow \neg q)$

Sol:

~~write~~ Express both conditions.

L.H.S =

$\neg(p \leftrightarrow q) = \neg\big((p \wedge q) \vee (\neg p \wedge \neg q)\big)$

R.H.S

$\boxed{p \leftrightarrow \neg q \equiv (p \wedge \neg q) \vee (\neg p \wedge \neg \neg q)}$

using Demorgans laws.

$\Rightarrow \neg(p \wedge q) \wedge \neg(\neg p \wedge \neg q)$ ∴ using demorgans law.

$\Rightarrow \neg(p \wedge q) \wedge \neg(\neg p) \vee \neg(\neg q)$

~~Simply~~ ∴ Double Negation law

$\Rightarrow \neg(p \wedge q) \wedge (p \vee q)$

∴ De Morgans law

$\Rightarrow (\neg p \vee \neg q) \wedge (p \vee q)$ $\quad p \wedge (q \vee r) \equiv p \wedge q \vee q \wedge r$

∴ using distributive law.

$\Rightarrow (\neg p \vee \neg q) \wedge p \vee (\neg p \vee \neg q) \wedge q$

∴ using distributive law.

$\Rightarrow \big((\neg p \wedge p) \vee (\neg q \wedge p)\big) \vee \big((\neg p \wedge q) \vee (\neg q \wedge q)\big)$

∴ Negation Laws

$\Rightarrow F \vee (\neg q \wedge p) \vee ((\neg p \wedge q) \vee F)$

~~∴ Distributive law~~

~~$((F \vee \neg q) \wedge (F \vee p)) \vee ((\neg p \vee F) \wedge (q \vee F))$.~~

~~∴ Identity law ∴ Domination law.~~

~~$(\neg q \wedge p) \vee (\neg p \wedge q)$~~

∴ Identity law

$\Rightarrow \boxed{(\neg q \wedge p) \vee (\neg p \wedge q)}$

Hence Proved.

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Date:

(c) $\neg P \leftrightarrow q \equiv P \leftrightarrow \neg q$.

$\neg P \leftrightarrow q \equiv (\neg P \wedge q) \vee (P \wedge \neg q)$ $P \leftrightarrow \neg q \equiv (P \wedge \neg q) \vee (\neg P \wedge q)$

∴ using commutative law.

$\boxed{(P \wedge \neg q) \vee (\neg P \wedge q)}$

Hence Proved!

(d) $(P \wedge q) \rightarrow (P \rightarrow q) \equiv T$

$\because P \rightarrow q \equiv \neg P \vee q$

$\neg(P \wedge q) \vee (\neg P \rightarrow q)$

∴ De Morgan's law and $P \rightarrow q \equiv \neg P \vee q$.

$(\neg P \vee \neg q) \vee (\neg P \vee q)$

$P \vee (q \vee r)$

∴ ~~Distributive~~ law.

∴ ~~commutative law~~. ∴ Associative law. ~~$(P \vee q) \vee r$~~ $P \vee (q \vee r)$

$(\neg P \vee \neg q \vee \neg P) \vee q$

∴ Idempotent law $P \vee P \equiv P$

$(\neg P \vee \neg q) \vee q$

∴ Associative law.

$\neg P \vee (\neg q \vee q)$

∴ Negation law.

$\neg P \vee T$

∴ Domination law

$P \vee T \equiv T$

$\boxed{T}$ Ans.

(e) $\neg(p \vee \neg(p \wedge q)) \equiv F$

Sol:

$\neg(p \vee \neg(p \wedge q))$

$\therefore$ De Morgan's Law.

$\neg p \wedge \neg(\neg(p \wedge q))$

$\cancel{\neg p \wedge}$ $\therefore$ Double Negation law..

$\neg p \wedge (p \wedge q)$

$\therefore$ Associative law.

$(\neg p \wedge p) \wedge q$

$\cancel{F \wedge q}$ $\therefore$ Negation Law.

$F \wedge q$

$\therefore$ Domination law.

$\boxed{F}$ ~~Ans~~

Hence Proved!

Date:

11. Using truth table, show that these compound propositions are logically equivalent or not.

(a) $(p \to r) \wedge (q \to r)$ and $(p \vee q) \to r$

p	q	r	$p \to r$	$q \to r$	$(p \to r) \wedge (q \to r)$	$p \vee q$	$(p \vee q) \to r$
T	T	T	T	T	T	T	T
T	T	F	F	F	F	T	F
T	F	T	T	T	T	T	T
T	F	F	F	T	F	T	F
F	T	T	T	T	T	T	T
F	T	F	T	F	F	T	F
F	F	T	T	T	T	F	T
F	F	F	T	T	T	F	T

Logically equivalent

(b) $(p \to q) \vee (p \to r)$ and $p \to (q \vee r)$

p	q	r	$p \to q$	$p \to r$	$(p \to q) \vee (p \to r)$	$q \vee r$	$p \to (q \vee r)$
T	T	T	T	T	T	T	T
T	T	F	T	F	T	T	T
T	F	T	F	T	T	T	T
T	F	F	F	F	F	F	F
F	T	T	T	T	T	T	T
F	T	F	T	T	T	T	T
F	F	T	T	T	T	T	T
F	F	F	T	T	T	F	T

Logically equivalent.

Date:

(c) $(p \to q) \to (r \to s)$ and $(p \to r) \to (q \to s)$

p	q	r	s	$p \to q$	$r \to s$	$(p \to q) \to (r \to s)$	$p \to r$	$q \to s$	$(p \to r) \to (q \to s)$
T	T	T	T	T	T	T	T	T	T
T	T	T	F	T	F	F	T	F	F
T	T	F	T	T	T	T	F	T	T
T	T	F	F	T	T	T	F	F	T
T	F	T	T	F	T	T	T	T	T
T	F	T	F	F	F	T	T	T	T
T	F	F	T	F	T	T	F	T	T
T	F	F	F	F	T	T	F	T	T
F	T	T	T	T	T	T	T	T	T
F	T	T	F	T	F	F	T	F	F
F	T	F	T	T	T	T	T	T	T
F	T	F	F	T	T	T	T	F	F
F	F	T	T	T	T	T	T	T	T
F	F	T	F	T	F	F	T	T	T
F	F	F	T	T	T	T	T	T	T
F	F	F	F	T	T	T	T	T	T

NOT Logically equivalent.

Let $P(m, n)$ be the statement "m divides n" where the domain for both variables consists of all positive integers.
(By "m divides n" we mean that $n = km$ for some integer k.)
Determine the truth values of each of these statements.

(a) $P(4, 5)$

Statement: 4 divides 5.
Explanation: 5 cannot be expressed as $4 \times k$ for any integer k
Truth value: False.

(b) $P(2, 4)$

Statement: 2 divides 4
Explanation: 4 can be expressed as $2 \times k$ for $k = 2$
Truth value: True.

(c) $\forall m \forall n \; P(m, n)$

Statement: For all positive integers m and n, m divides n.
Explanation: This statement is false because not every integer m divides every integer n. For example 2 does not 3.
Truth value: False.

(d) $\exists m \forall n \; P(m, n)$

Statement: There exists a positive integer 'm' such that ~~divides~~ for all the positive Integers n, m divides n.
Explanation: for m to divide every n, must be 1.
The only integer that divides all positive integers is 1.
Truth value: ~~False~~. True.

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Date:

13. Determine the truth value of each of these statements if the domain of each variable consists of all ~~variables~~. real numbers

(a) $\exists x\ (x^2 = 2)$

sol:

Statement :- There exist real no x for which $x^2 = 2$.

Explanation :- The solution are $x=\sqrt{2}$ and $x=-\sqrt{2}$ they both are real nos.

Truth value :- True.

(b) $\exists x\ (x^2 = -1)$

statement: There Exist a real no x for which $x^2 = -1$

Explanation: ~~x~~ x^2 will always give a positive real no hence, there is no such value of which gives the -1.

Truth value : False.

~~(c) : $\forall x\ (x^2+2 \geq 1)$~~

~~Statement : For all real numbers 'x', $x^2+2 \geq 1$~~

~~Explanation: Not all value of x will be greater than 1.~~

~~Example $x=2$ $x^2+2 \geq 1 \Rightarrow 4+6 \geq 1$ ← This is wrong.~~

~~Truth value : False.~~

(d) $\exists x\ (x^2 = x)$.

statement: There exis real no x for which $x^2 = x$

Explanation :- If $x=1$ then the equation $1=1$ which is true.

Truth value : True.

Date:

(c) $\forall x \; (x^2 + 2 \geq 1)$

Sol:-

Statement: For all ~~a~~ real no's x $x^2 + 2 \geq 1$

Explanation: ~~If~~ x. For all real number x, $x^2 \geq 0$ add '2' on both side $x^2 + 2 \geq 2$, hence for all real no's x $x^2 + 2 \geq 1$

Truth value: True.

Date:

14. Let $F(x,y)$ be the statement "x can fool y" where the domain consist of all people in the world. Use quantifiers to express each of these statements.

(a) Everybody can fool Bob.

$\forall x F(x, Bob)$. For all people x, x can fool Bob.

(b) Alice can fool every body.

$\forall y F(Alice, y)$ For all people y, Alice can fool y.

(c) Everybody can fool somebody.

~~$\forall x \forall y$~~ $\forall x \exists y F(x,y)$. For every person x, ther exist a person y such that x can fool y.

(d) There is no one who can fool everybody.

$\neg \exists x \forall y \ F(x,y)$ There does not exist a person x such that x can fool everybody.

(e) Everyone can be fooled by somebody.

$\forall y \exists x \ F(x,y)$ For every person y, there exists a person x such that x can fool y.

Date:

15.

(a) $\exists x\,(P(x) \wedge Q(x))$

(b) $\exists x\,(P(x) \wedge \neg Q(x)$

(c) $\forall x\,(P(x) \vee Q(x))$

(d) $\forall x\,(\neg P(x) \wedge \neg Q(x))$

16.

(a) $\exists x \exists y\ Q(x, y)$

There exist ~~a~~ student x and there exist a student y such that x has sent email to y.

(b) $\exists x \forall y\ P(x, y)$

There exist a student x such that x has sent a email to ~~all~~ every student y.

(c) $\forall x \exists y\ P(x, y)$

For all students x, there exist a student y such that every student x has sent an email to y.

(d) $\exists y \forall x\ Q(x, y)$

There exist a ~~y~~ student y, ~~such~~ such that y has recieved an email from all students x.

Date:

(e) $\forall y \exists x P(x,y)$.

For all students y, there exists a students x such that all students y has recieved an email from x.

(f) $\forall x \forall y \ P(x,y)$

For all students x, and y such that all students x have sent email to all students y.

17.

(a) $\exists x \exists y \quad P(x,y)$

There is a student in the class who has taken atleast one computer science course.

(b) $\exists x \forall y \ P(x,y)$.

There is a student in the class who has taken all the computer science course.

(c) $\forall x \exists y \ P(x,y)$

All the students in the class has taken atleast one CS course.

(d) $\exists y \forall x \ P(x,y)$

There is a CS course that every student in the class has taken.

Date:

(e) $\forall y \exists x \quad P(x, y)$

~~All CS Co~~

~~for~~ Every CS course is ~~has~~ taken by atleast one student in the class.

(f) $\forall x \forall y \quad P(x, y)$

Every student in the class has taken ~~one~~ all the CS courses.

18-

(a) Addition.

(b) Simplification.

(c) Modus Ponens.

(d) Modus Tollens.

(e) Hypothecal Syllogism.

~~(f)~~

19-

p: Today is Tuesday.

q: I have a test in Mathe

r: I have a test in Econ

Date:

19.

(a) p: Today is tuesday.
q: I have a test in Mathematics.
r: I have a test in Economics.
s: My economics professor is sick.

Premises:

$p \to (q \vee r)$

$s \to \neg r$

$p \wedge s$

Conclusion: q.

1.	$p \wedge s$	Premise
2.	p	Simplification on 1.
3.	$p \to (q \vee r)$	Premise.
4.	$q \vee r$	Modus ponens on 2 & 3
5.	s	Simplification 1
6.	$s \to \neg r$	Premise
7.	$\neg r$	modus ponens on 5 & 6
8.	$r \vee q$	Commutative on 4
9.	$\boxed{q}$	Disjunctive on 7 & 8

~~Premises~~

(b) p: Ali is a lawyer.
q: He is ambitious.
r: Ali is an early riser.
s: He likes chocolates.

~~conclusion~~ Premises:

$p \to q$

$r \to \neg s$

$q \to r$

Conclusion: $p \to \neg s$.

1.	$p \to q$	Premise
2.	$q \to r$	Premise
3.	$p \to r$	Hypothetical Syllogism on 1 & 2
4.	$r \to \neg s$	Premise
5.	$\boxed{p \to \neg s}$	Hypothetical Syllogism on 3 & 4

Date:

20(a) $(A \cap B) \cap \bar{C}$

$A \cap B = \{1, 2, 4, 5\} \cap \{2, 3, 5, 6\}$

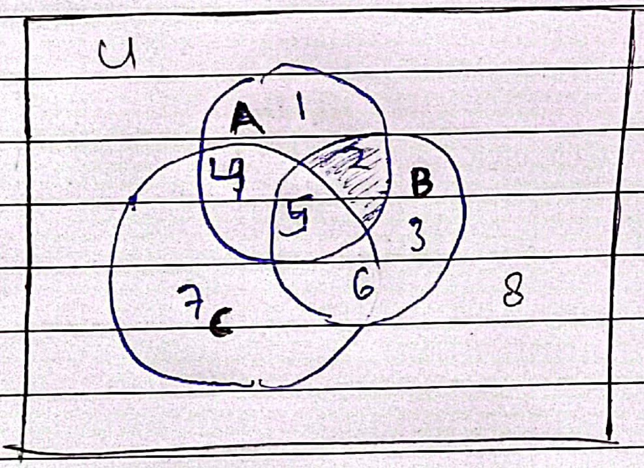
$A \cap B = \{2\}$

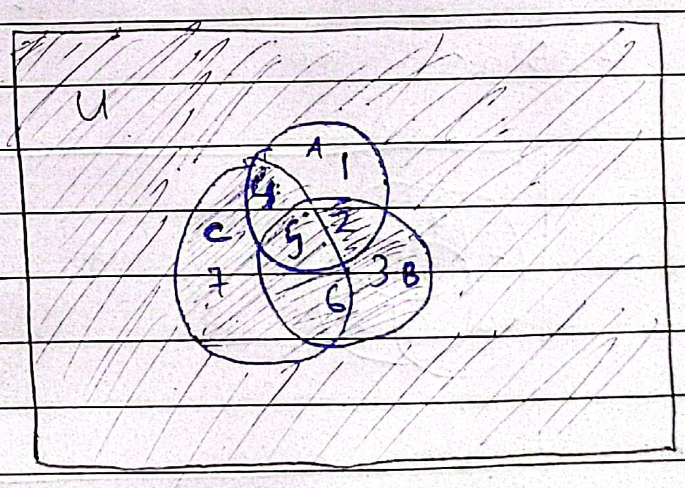
$\bar{C} = U - C = \{1, 2, 3, 4, 5, 6, 7, 8\} - \{4, 5, 6, 7, 8\}$

$\bar{C} = \{1, 2, 3\}$

$(A \cap B) \cap \bar{C} = \{2\} \cap \{1, 2, 3\}$

$(A \cap B) \cap \bar{C} = \{2\}.$





(b) $\bar{A} \cup (B \cup C)$

Sol:

$B \cup C = \{2, 3, 5, 6\} \cup \{4, 5, 6, 7\}$

$B \cup C = \{2, 3, 4, 5, 6, 7\}$

$\bar{A} = U - A = \{1, 2, 3, 4, 5, 6, 7, 8\} - \{1, 2, 4, 5\}.$

$\bar{A} = \{3, 6, 7, 8\}$

$\bar{A} \cup (B \cup C) = \{2, 3, 4, 5, 6, 7, 8\}$

MIGHTY PAPER PRODUCT

~~$(A - B) \cap C = \{1, 2\} \cap \{4, 5, 6, 7\}$~~

~~$= \{\ \}$~~

(c) $(A - B) \cap C$

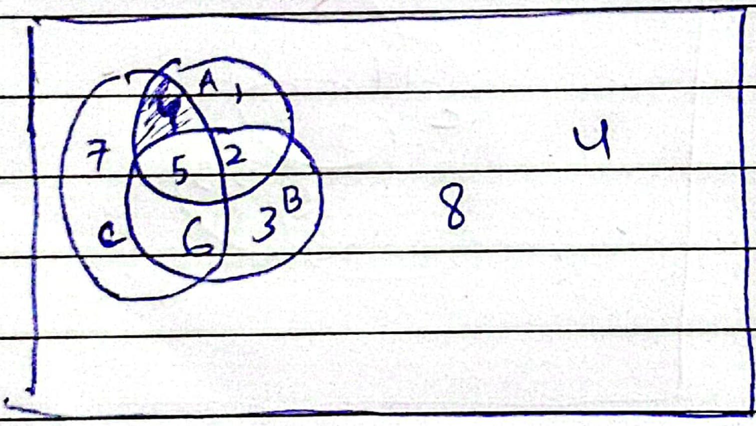
Sol:

$A - B = \{1, \cancel{2}, 4, \cancel{5}\} - \{2, 3, 5, 6\}$

$A - B = \{1, 4\}$

$(A - B) \cap C = \{1, 4\} \cap \{4, 5, 6, 7\}$

$(A - B) \cap C = \{4\}$



Date:

(d) $(A \cap B) \cup \bar{C}$

Sol:

$(A \cap B) \cup C$

$\bar{B} = U - B = \{1,2,3,4,5,6,7,8\} - \{2,3,5,6\}$

$\bar{B} = \{1,4,7,8\}$

$A \cap \bar{B} = \{1,2,4,5\} \cap \{1,4,7,8\}$

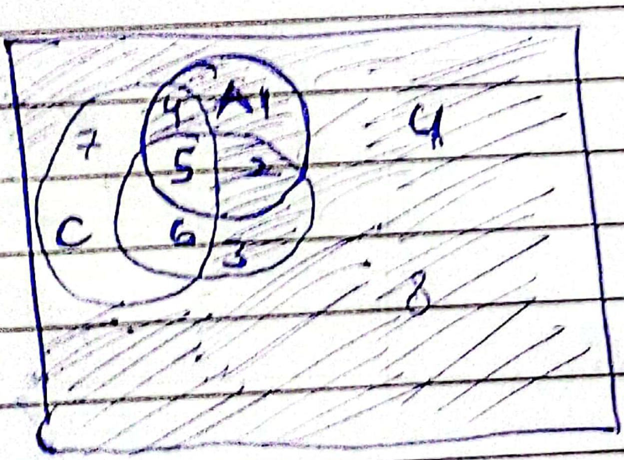
$A \cap \bar{B} = \{1,4\}$

$(A \cap \bar{B}) \cup \bar{C}$

$\bar{C} = U - C = \{1,2,3,4,5,6,7,8\} - \{4,5,6,7\}$

$\bar{C} = \{1,2,3,8\}$

$(A \cap \bar{B}) \cup \bar{C} = \{1,2,3,4,8\}$



Date:

(d) $(A \cap B) \cup \bar{C}$

sol:

$(A \cap \bar{B}) \cup C$.

$\bar{B} = U - B = \{1, 2, 3, 4, 5, 6, 7, 8\} - \{2, 3, 5, 6\}$

$\bar{B} = \{1, 4, 7, 8\}$

$A \cap \bar{B} = \{1, 2, 4, 5\} \cap \{1, 4, 7, 8\}$

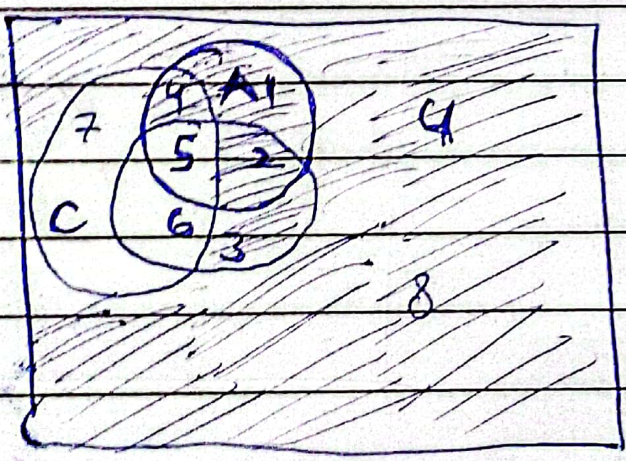
$A \cap \bar{B} = \{1, 4\}$

~~$(A \cap \bar{B}) \cup \bar{C}$~~

$\bar{C} = U - C = \{1, 2, 3, 4, 5, 6, 7, 8\} - \{4, 5, 6, 7\}$

$\bar{C} = \{1, 2, 3, 8\}$

$(A \cap \bar{B}) \cup \bar{C} = \{1, 2, 3, 4, 8\}$



2.

(a) $(A-(A\cap B))\cap(B-(A\cap B))=\emptyset$

Solution:-

$(A\cap(\overline{A\cap B}))\cap(B-(A\cap B))$.

$\because$ Associative law.

$(A\cap B)\cap((\overline{A\cap B})\cap(\bar{A}\cap B))$

$\because A\cap A=A$ $\because$ Idempotent law.

$(A\cap B)\cap(\bar{A}\cap B)$

$\because A\cap\bar{A}=\emptyset$ complement law.

$\boxed{\emptyset}$ Hence proved!!!

(b) $(A-B)\cup(A\cap B)=A$

Sol:-

$(A\cap\bar{B})\cup(A\cap B)=\cancel{A}$

$\because$ Distributive law.

$A\cap(\bar{B}\cup B)$

$\because$ complementation law.

$A\cap U$

$\because$ Identity laws.

$\boxed{A}$ Hence Proved!!!

Date:

(c) $(A - B) - C = (A - C) - B$

Sol:

$(A \cap \bar{B}) - C$

$(A \cap \bar{B}) \cap \bar{C}$

∴ Associative

$(A \cap \bar{C}) \cap \bar{B}$

$(A - C) \cap \bar{B}$

$\boxed{(A - C) - B.}$ Hence Proved!

(d) $\overline{\bar{B} \cup (\bar{B} - A)} = B$

Sol:

$\overline{\bar{B} \cup (\bar{B} - A)}$

∴ De Morgan's

$\bar{\bar{B}} \cap \overline{\bar{B} - A}$

∴ Complementation law

$B \cap \overline{\bar{B} - A}$

∴ ~~De~~ Morgans

$\cancel{B \cup \overline{\bar{B} - A}}$

$B \cap (\overline{\bar{B} \cap \bar{A}})$

∴ DeMorgans

$B \cap (\bar{\bar{B}} \cup \bar{A})$

∴ complementation

$\boxed{B \cap (B \cup A)}$

∴ ~~Absorbtion~~ Absorbtion

$\boxed{B}$ Hence Proved!!!

Date:

20

$n(A) = 100$

$n(w) = 20$

$n(b) = 15$

$n(w \cap b) = 10.$

$n(w \cup b) = n(w) + n(b) - n(w \cap b)$

$n(w \cup b) = 20 + 15 - 10 = 25$

Number of apples that can be sold = $100 - n(W \cup B) = 100 - 25$

$= \boxed{75}$

Ans

The no of apples that can be sold is 75.

(b)

$n(U) = 1000$

$n(CS) = 350$

$n(SE) = 450$

$n(CS \cap SE) = 100$

$n(CS \cup SE) = n(CS) + n(SE) - n(CS \cap SE)$

$= 350 + 450 - 100$

$= 700$ like either.

$n(U) - n(CS \cup SE) = 1000 - 700$

$= 300$ like neither.

Date.

$n(M) = 78$

$n(I) = 32$

$n(T) = 57$

~~$n(M \cup I) = 13$~~ $\quad n(M \cap I) = 13$

~~$n(I \cup T) = 21$~~ $\quad n(I \cap T) = 21$

~~$n(T \cup M) = 16$~~ $\quad n(T \cap M) = 16$

~~$n(I \cup M \cup T) = 5$~~ $\quad n(M \cap I \cap T) = 5$

~~$n(I \cap M \cap T) = 5$~~

$$n(M \cup I \cup T) = n(M) + n(I) + n(T) - n(M \cap I) - n(I \cap T) - n(T \cap M) - n(T \cap M \cap I)$$

$$= 78 + 32 + 57 + 57 - 13 - 21 - 16 - 5$$

$$= 112$$

but 14 like none of 3 ~~flee~~ flavors

$$n(U) = 112 + 14$$

$$= \cancel{118}\ \boxed{126}$$ Ans

(d)

Date: ________

(d) $A \times (B \cap C) = (A \times B) \cap (A \times C)$

Left hand side:

$A \times (B \cap C)$ represents all ordered pairs (a, b) whe

- $a \in A$
- $b \in B \cap C$ (i.e b belongs to both B and C).

In set-builder notation, this can be written as:

$$A \times (B \cap C) = \{(a, b) \mid a \in A \text{ and } b \in B \cap C\}$$

Since $b \in B \cap C$ means that $b \in B$ and $b \in C$.

$$A \times (B \cap C) = \{(a, b) \mid a \in A \text{ and } b \in B \text{ and } b \in C$$

Right hand side

$(A \times B) \cap (A \times C)$

- $A \times B$ represents all ordered pairs (a, b) where $a \in A$ $b \in B$ i.e

$$A \times B = \{(a, b) \mid a \in A \text{ and } b \in B\}$$

- $A \times C$ represents all ordered pairs (a, c) wher $a \in A$ an $b \in C$.

$$A \times C = \{(a, b) \mid a \in A \text{ and } b \in C\}.$$

Thus the intersection $(A \times B) \cap (A \times C)$ consists of all ordered pairs (a, b) that are in both $A \times B$ and $A \times C$. In other words, the are the ordered pairs wher

- $a \in A$
- $b \in$ n

Date: ____________

Thus in set builder notation, we can express this as:

$(A \times B) \cap (A \times C) = \{(a, b) \mid a \in A \text{ and } b \in B \text{ and } b \in C$

Hence both sides are equal