No. Date Assignment 1 serv ((veglage) = presignal Age () , 40 Q1. (a) 7p (b) p1 79 (c) p → 9 = (d) 7p → 79 (e) p→q (f) q∧¬p (g) q→p Q2. (a) p q p@q p1q (p@q) -> (p1q) F T T T T T T F . Thunt F ton or Fig. T T F Evereir = religion (a) T F F F T or har ha $\neg p \leftrightarrow q \quad (p \leftrightarrow q) \oplus (\neg p \leftrightarrow q)$ 9 p↔9 T F (r) or A r. Tary = (re-p) x (re-q) T F F The slaver To come and some T F Timble town I born; what site (8) F 1-y F as y This y y For bout his other deines work it Then we can find y, y ly + y free, both me nouse Q3. (a) Counter example: P(x): 0<x<4 Q(x): 0<x<2 domain: real number x $\forall x (P(x) \rightarrow Q(x))$ is $\forall F$, $\forall x P(x) \rightarrow \forall x Q(x) = F \rightarrow F = T$ (b) Prove it. First, if $\forall \times P(x) \land \forall \exists \times Q(x) = T$, $\forall \times P(x) = T$, $\exists \times Q(x) = T$ Suppose yo s.t. Q(yo)=T Then for $\forall x$, $P(x) \land Q(y_0) = T \land T = T$, that is $\forall x \exists y (P(x) \land Q(y)) = T$. Second, if $\forall x \exists y (P(x) \land Q(y)) = T$, that is, for any x_0 , there exist yo, such that $P(x_0) \wedge Q(y_0) = T$, which means $P(x_0) = T$, $Q(y_0) = T$. So $\forall x P(x) = T$, $\exists y Q(y) = T$, $\forall x P(x) \land \exists x Q(x)$. Proved.

No.	
Date ·	
Q4. (1)	$(\neg p \land (p \rightarrow q)) \rightarrow \neg q = \neg (\neg p \land (p \rightarrow q)) \lor \neg q$ (useful)
	$= p \vee \neg (p \rightarrow q) \vee \neg q \qquad (De Morgan)$
	= $p V - (-p Vq) V - q$ (useful)
	= pv(pn 7q) V7q (De Morgan)
	= (pvpv-1q) 1 (pv-1qv-1q) (distributive)
	= $(p \vee 7q) \wedge (p \vee 7q)$ (idempotent)
	= PV79 not a tautology.
(2)	$(p \vee q) \rightarrow r = \neg (p \vee q) \vee r$ (useful)
	= (7p17q)VY (De Morgan)
	= $(\neg p \lor r) \land (\neg q \lor r)$ (distributive)
()	$p \rightarrow r) \Lambda (q \rightarrow r) = (\neg p \lor r) \Lambda (\neg q \lor r)$
•	lence the two are equivalent.
	It's false. Proved by contradiction.
	If there exist xo, such that for $\forall y$, if $y \neq 0$, $xy = 1$
	Then we can find y, y, (y, # x), both are nonzero.
	satisfied x. y = 1, x. y = 1, so y = y = x,
	contradict to y, = y2.
	t's true. m=1, n=2 satisfies n²+m²=5, which proved existence.
G) L	is true. The proved existence.
25. 📦 (1)	P(x): x finished homework. I have you
•	Q(x): x can answer this question.
Talmon	domain: all students
	Premise 1: ¬P(you) → ¬Q(you)=T Premise 2: P(you)=T
Tel . W	From those we can not not !! P(you) = T
111111	From these we can not get the conclusion Q(you)=T.
	to velipe T. James I. School ecour
	Proyed.

	Date · ·
(2) P(x): x submitted homework.	(5847F (B) 10)
Q(x): x get 100 in the final exam	
domain: all student in this class	
Premise 1: $\forall x \ P(x) \rightarrow \forall x \ Q(x)$ B	remise 2: 3x 7P(x)
Conclusion: Ix 7Q(x)	
∃x 7P(x), so ∀x P(x)= F, F→ ∀x	Q(x) = T, we don't know
$\forall x Q(x) = T \text{ or } F$, so we can n	
(9409=
Q6. $(\neg Y \lor (p \land \neg q)) \rightarrow (Y \land p \land \neg q)$	or = (98-9) r (d)
= $7(7YV(P\Lambda79))V(Y\Lambda P\Lambda79)$ (use	ful) privipe ():- 1 ==
= (rn-(pn-1q)) v(rnpn-1q) (De)	Morgan) gr-V (pr-q)=
= (YA(7p & VQ)) V (YAPA7Q) (De)	Morgan) qrvipvqr) =
$= (\gamma \Lambda - p) \vee (\gamma \Lambda q) \vee (\gamma \Lambda p \Lambda - q) \qquad (dist$	ributive) (prypy ar =
= Y 1 (Y V P) 1 (Y V 79) 1 (Y V Q) 1 (Y V P V Q) 1	T1 (YV7P) 1 (YV7PV7Q) 1.T
1 (YV7pVq) ATAT (dist	ributive)
abso (abso	rption, domination)
From $Y=T$, we get $YVS=T$.	4.08-(des) 14-(84-0) (D)
71011. 7 = 1.	6-14-(d+1)) (b+d) = =
(CAA ** X)	14-19411) 14 (61 1-16 =
(aver	11((1/1/r)r)/(pr/19)=
107 -03	- 1 1 (95 A 1) V (pr A 9) =
WE MAD	
- The Mark of Mark of Market of Mark	y ar 74) A (\$2.50 x 2.74) =
Control CAL COLORS A LABORATOR	FMTYT) A (FYTYA) =
Carried at the control	TATATA
Walter (St.)	= =
variable (Charles	~ gery) (p g) sanst).
S	· '

Q7. (a) 7 (p@q)	Assumption of the late of a second way
=7 ((p17q)V(7p1q))	(definition)
=7(p179)17(7p19)	(De Morgan)
= (pvq) 1 (pv 7q)	(De Morgan)
= (7p/p)V(p++7q)V(q+p)V(q17q) (distributive)
= F V (7P17q)V(P1q)VF	(negation)
= (7p17q) V(p1q)	(identity)
= p ↔ q	(definition)
(b) $\neg (p \rightarrow q) \rightarrow \neg q$	(6. (17 V (1.176)) - 2. (2.17 v)
= 7 (7(p + q)) V7q	(useful)
= (p→q) V¬q	(double negation)
= (7p vq) v7q	(useful)
= \$7pV(qV7q)	(associative)
TE TPVT TO A SPECY OF A SPEC	(negation) Algrey Ale
= T (104 dinas)	(domination)
Hence, $\neg(p\rightarrow q)\rightarrow \neg q$ is a ta	utology.
Hence, $\neg(p\rightarrow q)\rightarrow \neg q$ is a ta (c) $(p\rightarrow q)\rightarrow ((y\rightarrow p)\rightarrow (y\rightarrow q))$	•
(c) $(p \rightarrow q) \rightarrow ((r \rightarrow p) \rightarrow (r \rightarrow q))$	Ton vet who get yyse T.
	T = 277 Dep av T = 7 mill
(c) (p→q)→((r→p)→(r→q)) = ¬(p→q) v ((r→p)→(r→q)) = ¬(¬p vq) v ((¬vvp)→(¬r+v	(useful) (useful)
(c) '(p→q)→((r→p)→(r→q)) = ¬(p→q) V ((r→p)→(r→q)) = ¬(¬pVq) V ((¬rVp)→(¬r→v = (p∧¬q) V (¬(¬rVp) V (¬rVq	(useful) (q)) (useful))) (useful)
(c) $(p \rightarrow q) \rightarrow ((r \rightarrow p) \rightarrow (r \rightarrow q))$ = $\neg (p \rightarrow q) \lor ((r \rightarrow p) \rightarrow (r \rightarrow q))$ = $\neg (\neg p \lor q) \lor ((\neg r \lor p) \rightarrow (\neg r \rightarrow v))$ = $(p \land \neg q) \lor (\neg (\neg r \lor p) \lor (\neg r \lor q))$ = $(p \land \neg q) \lor ((r \land \neg p) \lor \neg r \lor q)$	(useful) (useful) (useful) (useful) (De Morgan)
(c) $(p \rightarrow q) \rightarrow ((r \rightarrow p) \rightarrow (r \rightarrow q))$ = $\neg (p \rightarrow q) \lor ((r \rightarrow p) \rightarrow (r \rightarrow q))$ = $\neg (\neg p \lor q) \lor ((\neg v \lor p) \rightarrow (\neg v \rightarrow v))$ = $(p \land \neg q) \lor (\neg (\neg v \lor p) \lor (\neg v \lor vq))$ = $(p \land \neg q) \lor ((v \land \neg p) \lor \neg v \lor vq) \land (\neg q)$	(useful) (q)) (useful))) (useful) (De Morgan) V(r17p) V7r Vq) (distribution
(c) $(p \rightarrow q) \rightarrow ((r \rightarrow p) \rightarrow (r \rightarrow q))$ = $\neg (p \rightarrow q) \lor ((r \rightarrow p) \rightarrow (r \rightarrow q))$ = $\neg (\neg p \lor q) \lor ((\neg v \lor p) \rightarrow (\neg v \rightarrow v))$ = $(p \land \neg q) \lor (\neg (\neg v \lor p) \lor (\neg v \lor vq))$ = $(p \land \neg q) \lor ((v \land \neg p) \lor \neg v \lor vq) \land (\neg q)$ = $(p \lor (v \land \neg p) \lor \neg v \lor vq) \land (\neg q)$ = $(p \lor v \lor \neg v \lor vq) \land (p \lor \neg p \lor \neg v \lor vq)$	(useful) (q)) (useful) (useful) (useful) (De Morgan) ((r)\(\tau\rap\) V \(\tau\rap\) (distribution (distribution)
(c) $(p \rightarrow q) \rightarrow ((r \rightarrow p) \rightarrow (r \rightarrow q))$ = $\neg (p \rightarrow q) \lor ((r \rightarrow p) \rightarrow (r \rightarrow q))$ = $\neg (\neg p \lor q) \lor ((\neg v \lor p) \rightarrow (\neg v \rightarrow v))$ = $(p \land \neg q) \lor (\neg (\neg v \lor p) \lor (\neg v \lor vq))$ = $(p \land \neg q) \lor ((v \land \neg p) \lor \neg v \lor vq) \land (\neg q)$	(useful) (q)) (useful))) (useful) (useful) (De Morgan) V(rn-p) V TY VQ) (distribution () N (79 V9 V (rn-p) V TY) (distribution

					No.
					Date · ·
Q8.	(a) 3x (c)	K) A D(x) A I	F(x))	2001 1 201	5 M K (80) (10
	(b) Yx (C(x)	D(x) AF	(x))	CASE O W	11(x): X (AM)
	(C) 3 × (C)) ^ F(x) ^ ·	7D(x))	iweir:	W has to
					Wilson W
					10. 12140
					- ALC: 1
29.	O p n q	premise	She to p	-	E aliche)
	© p	from O,	$p \wedge 9 = T$ then	p=T	le girei
	3 p → 7(9/1)	r) premise	3 Sireta . 3	1,00	- (0) (27 2)
	@ 7(9Ar)	from G	3,	'srshi's	(6) 310-10-
	-				a hliene
	Ø 78	from @	6	in the	(c) 16 × line
	Ø s→v	premise	e da ric attanca	tal 20 0	g(x): x hac
	8 75	from G	00 1 1000	ride a	h(8) X (ata
	8 75				
0 6	8 75	14	11x4 - 418	4-181 - 4	W ARK I
o. a	8 75Nuppose fo	x): x is	in this class,	g(x): x (enjoys whale watch
o. a	Suppose for h(x): x can	x): X is	in this class, ocean polluti	g(x): x (enjoys whale watch
o. a)	8 75 Suppose for h(x): x can We have	x): X is res about premise	in this class, ocean polluti	g(×): X (on. , ∀x (g)	enjoys whale watch $(x) \rightarrow h(x)$, we wa
	8 75 Suppose for h(x): x can We have, y to get 3	x)1 x is res about premise x (f(x) 1	in this class, ocean polluti Ix (f&) 1 g&) h&)	g(≈): x (on. , ∀≈ (g(enjoys whale watch $(x) \rightarrow h(x)$, we wa
	8 75 Suppose for h(x): x can we have, y to get 3 0 3 x (f(x)1	x): x is ves about premise x (f(x) 1 g(x))	in this class, ocean polluti ===================================	g(×): × (on. , ∀× (g)	enjoys whale watch $(x) \rightarrow h(x)$, we wa
	Suppose for h(x): x can we have to get 3 D 3 x (f(x) 1) F(x) 1 9 (x)	x)1 x is res about premise x (f(x) A g(x))	in this class, ocean polluti ===================================	g(×): X (on. , ∀x (g)	enjoys whale watch $(x) \rightarrow h(x)$, we wa
	 Suppose for h(x): x can we have. y to get I If I x (f(x) A f(y) A g(y) g(y) 	x): x is res about premise x (f(x) A g(x))	in this class, ocean polluti ∃x (f(x) ∧ g(x)) h(x)) premise using existne from ②, f(y)	g(×): X (on. , ∀x (g)	enjoys whale watch $(x) \rightarrow h(x)$, we wa
	 Suppose for h(x): x can we have to get ∃ ∃x (f(x) ∧ f(y) ∧ g(y) g(y) ∀x (g(x) → 	x): x is res about premise x (f(x) A g(x)) h(x))	in this class, ocean polluti $\exists x (f(x) \land g(x))$ $h(x))$ premise using existne from \textcircled{o} , $f(y)$ premise	g(x): X (on. , Vx (g) ess 1g(y) = T	enjoys whale watch $(x) \rightarrow h(x)$, we wa
	 Suppose for h(x): x can we have. y to get I If I x (f(x) A f(y) A g(y) g(y) 	x): x is res about premise x (f(x) A g(x)) h(x))	in this class, ocean polluti $\exists x (f(x) \land g(x))$ h(x)) premise using existne from \textcircled{o} , f(y) premise using arbita	g(x): X (on. , Vx (g) ess 1g(y) = T	enjoys whale watch $(x) \rightarrow h(x)$, we wa
	 Suppose for h(x): x can we have to get ∃ ∃x (f(x) ∧ f(y) ∧ g(y) g(y) ∀x (g(x) → 	x): x is res about premise x (f(x) A g(x)) h(x))	in this class, ocean polluti Ix (fox) A gox) h(x)) premise using existne from ②, f(y) premise using arbita from③©	g(x): X (on. , Vx (g) ess 1g(y) = T	enjoys whale watch $(x) \rightarrow h(x)$, we wa
	 Suppose for h(x): x can we have. y to get ∃ ∃x (f(x) ∧ f(y) ∧ g(y) g(y) y(x) → h(y) 	x): x is res about premise x (f(x) A g(x)) h(x))	in this class, ocean polluti $\exists x (f(x) \land g(x))$ h(x)) premise using existne from \textcircled{o} , f(y) premise using arbita	g(x): X (on. , Vx (g) ess 1g(y) = T	enjoys whale watch $(x) \rightarrow h(x)$, we watch then $g(y) = T$

(b) f(x): x in this class, g(x): x owns a p	
11 VIII VIII VIII VIII VIII VIII VIII V	ersonal computer,
h(x): x can use a word processing prov	gram A (8) 1 (4) (6)
We have the following premises. Yx (t	$f(x) \rightarrow g(x)$, $\forall x (g(x) \rightarrow h(x))$,
f(zeke). We want to get h(zeke).	WIGHTON DIN
$\mathbb{O} \ \forall x (f(x) \rightarrow g(x)) $ premise	(3) (x) (x) (x)
Θ f(Zeke) \rightarrow g(Zeke) using existness	
B g(Zeke) from OB	
	(3) p= 7(qnv) p.em
\bigcirc g(Zeke) \rightarrow h(Zeke) using existness	was lavor of
1 h(Zeke) Tom @6	(s) q from
(c) f(x): x lives in this room (x is one of A	ABCDE)
q(x): x has taken a course in dedisc	rete math.
h(x): x can take a course in algori	thms.
We have $\forall x (f(x) \rightarrow g(x)), \forall x (g(x) \rightarrow b)$	n(x)), we want to
We have $\forall x (f(x) \rightarrow g(x))$, $\forall x (g(x) \rightarrow h(x))$.	n(x)), we want to
get $\forall x (f(x) \rightarrow h(x))$. O $\forall x (f(x) \rightarrow g(x))$ premise	n(x)), we want to
get $\forall x (f(x) \rightarrow h(x))$. $\emptyset \ \forall x (f(x) \rightarrow g(x))$ premise $\emptyset \ f(x) \rightarrow g(x)$ from \emptyset , y is a	n(x)), we want to in x = (x) = szugane (x) un arbitrary student
get $\forall x (f(x) \rightarrow h(x))$. ① $\forall x (f(x) \rightarrow g(x))$ premise ② $f(y) \rightarrow g(y)$ from \mathcal{O} , y is a	n(x)), we want to i x (x)t szugger (s) un arbitrary student
get $\forall x (f(x) \rightarrow h(x))$. ① $\forall x (f(x) \rightarrow g(x))$ premise ② $f(y) \rightarrow g(y)$ from \mathcal{O} , y is a ③ $\forall x (g(x) \rightarrow h(x))$ premise ① $f(y) \rightarrow g(y)$ from $g(y)$	n(x)), we want to i x : (x)t szuggus (s) unda szxoz x : (x)t un arbitrary student ((x)t) x E top at
get $\forall x (f(x) \rightarrow h(x))$. ① $\forall x (f(x) \rightarrow g(x))$ premise ② $f(y) \rightarrow g(y)$ from ①, y is a ③ $\forall x (g(x) \rightarrow h(x))$ premise ④ $g(y) \rightarrow h(y)$ from ③	n(x)), we want to i x : (x)t szuggus (s) soda szxoz x : (x)d un arbitrary student (x)f) x E top at (x)f (x)f (x)t x E s
get $\forall x (f(x) \rightarrow h(x))$. ① $\forall x (f(x) \rightarrow g(x))$ premise ② $f(y) \rightarrow g(y)$ from \mathbb{O} , y is a ③ $\forall x (g(x) \rightarrow h(x))$ premise ④ $g(y) \rightarrow h(y)$ from \mathbb{O}	n(x)), we want to i x : (x)t szuggus (s) soda szxoz x : (x)d un arbitrary student (x)f) x E top at (x)f (x)f (x)t x E s
get $\forall x (f(x) \rightarrow h(x))$. ① $\forall x (f(x) \rightarrow g(x))$ premise ② $f(y) \rightarrow g(y)$ from ①, y is a ③ $\forall x (g(x) \rightarrow h(x))$ premise ① $f(y) \rightarrow g(y)$ from ③	n(x)), we want to i x : (x)t szuggus (s) soda szxoz x : (x)d un arbitrary student (x)f) x E top at (x)f (x)f (x)t x E s
get $\forall x (f(x) \rightarrow h(x))$. ① $\forall x (f(x) \rightarrow g(x))$ premise ② $f(y) \rightarrow g(y)$ from ①, y is a ③ $\forall x (g(x) \rightarrow h(x))$ premise ④ $g(y) \rightarrow h(y)$ from ③ ③ $f(x) \rightarrow h(y)$ from ② ⑥ $\forall x (f(x) \rightarrow h(x))$ using arbitrari	n(x)), we want to i x : (x)t szuggus (s) soda szxoz x : (x)d un arbitrary student (x)f) x E top at (x)f (x)f (x)t x E s
get $\forall x (f(x) \rightarrow h(x))$. ① $\forall x (f(x) \rightarrow g(x))$ premise ③ $f(y) \rightarrow g(y)$ from ①, y is a ③ $\forall x (g(x) \rightarrow h(x))$ premise ④ $g(y) \rightarrow h(y)$ from ③ ⑤ $f(x) \rightarrow h(y)$ from ② ⑥ $\forall x (f(x) \rightarrow h(x))$ using arbitrari	n(x)), we want to i x : (x)t szuggus (s) soda szxoz x : (x)d un arbitrary student (x)f) x E top at (x)f (x)f (x)t x E s
get $\forall x (f(x) \rightarrow h(x))$. ① $\forall x (f(x) \rightarrow g(x))$ premise ② $f(y) \rightarrow g(y)$ from ①, y is a ③ $\forall x (g(x) \rightarrow h(x))$ premise ④ $g(y) \rightarrow h(y)$ from ② ⑤ $f(x) \rightarrow h(y)$ from ② ⑥ $\forall x (f(x) \rightarrow h(x))$ using arbitrari	n(x)), we want to if x (x)t saugape (18) and a rever x ((x)t) an arbitrary student ((x)t) x = 0 ((x)t)

	No.
	Date
Q11. (a) $\exists n \in \mathbb{N} ((n^3 + 6n + 5 \text{ is odd}) \land (n \text{ is not even}))$	GIB. Suppose
The original statement is true.	1.086
IT n^3+6n+5 is odd, then n^3+5 is odd, be	cause on is even
From n ³ +5 is odd, we get n ³ is even, th	en n is even.
Hence, $\forall n \in \mathbb{N} \ (n^3 + 6n + 5 \text{ is odd} \Rightarrow n \text{ is even})$	No. on
bor. when hore payoff is horber otherwise o.	
Q12. If a^2+b^2 is even, then a^2+b^2+2ab is even, which n	neans (a+b)2
on is even, so atb is even	
or than bo + Va.	silve
Q13. Disprove. $a=2$, $b=\frac{1}{2}$ are both rational, but a^{b}	140
Q14. Prove by contradiction. Suppose $\sqrt[3]{2}$ is irrational, it can be written as so $\frac{n^3}{m^3} = 2$, $n^3 = 2m^3$ is even, so n is even	ท
Suppose $n=2k$, $n^3=8k^3=2m^3$, $m^3=4k^3$ is ex	ven, so m is even
Contradict to gcd(m,n)=1.	
Q15. Prove by contradiction.	
By the theorem, $\sqrt{2}$ and $\sqrt{3}$ are not rational.	
C ==== 5+13 is vational, 12+13 = x.	
$\frac{1}{2}$ = $\frac{1}{2}$ then $\frac{1}{2}$	7 '-
is votional. \(\frac{1}{2}\) is vational, but by the	oyem, 16 is
irrational, which cause a contradiction.	