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① Let identity element be I,

$$x * I = I * x = x$$

$$\Rightarrow x = x + I + 1$$

$$\boxed{I = -1}$$

Inverse of x is x^{-1}

Now,

$$x * x^{-1} = I$$

$$x + x^{-1} + 1 = -1$$

$$x + x^{-1} = -2$$

$$x^{-1} = -2 - x$$

$$\boxed{x^{-1} = -(2 + x)}$$

② $7 \cancel{(6)}{}^{5} C_2$

⑥ No. of ways of selecting (2 consonant out of 7)
and (2 vowels out of 4)

$$= \;^{7}C_2 \times \;^{4}C_2$$

$$= \frac{7!}{5! \times 2!} \times \frac{4!}{2! \times 2!} = 126$$

Each grp contain 4 letter
no. of ways of arranging 4 letters
among themselves = 4!
$$= 4 \times 3 \times 2 \times 1 = 24$$

So, Required no of ways = $24 \times 126 = 3024$

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(7) Set p: I am late
q: I have money
r: I will take a cab to work

$$[(p \wedge q) \rightarrow r]$$

④ $x=0, y=0, z=1$
minterm $= x'y'z = |1*|^*| = 1$
maxterm $= \cancel{x'y'z'}$ $x'+y'+z =$
$= 1+1+1 = 3$

⑧ ~~(to be done)~~

⑤ For one relative vipin has 4 servants.
For one relative he can send matters in 4 ways,
So for 7 relatives —
$\boxed{4^7 \text{ ways.}}$

⑩ converse $=$ when $|AB|^2 + |BC|^2 = |AC|^2$
So ABC is right Led triangle.
Contrapositive $\Rightarrow$ when $|AB|^2 + |BC|^2 \neq |AC|^2$
Then ABC is not a right Led triangle.

Inverse $\Rightarrow$ When ABC is not a right angled tringle then
$|AB|^2 + |BC|^2 \neq |AC|^2$.

⑬ Let the universe consists of all living thing.
Let $P(x): x$ is a plant
$A(x): x$ is an animal
$H(x): x$ has a heart
$g:$ John's cat
Then the inference pattern is
$(\forall x)(P(x) \lor A(x))$
$\sim P(g)$
$(\forall x)(A(x) \rightarrow H(x))$
$H(g)$

Argument

[1]	(1)	$(\forall x)(P(x) \lor A(x))$	Rule P
[2]	(2)	$\neg P(g)$	Rule P
[1]	(3)	$P(g) \lor A(g)$	Rule US (1)
[1,2]	(4)	$A(g)$	Rule T (2),(3)
[5]	(5)	$(\forall x)(A(x) \to H(x))$	Rule P
[5]	(6)	$A(g) \to H(g)$	Rule US (5)
[1,2,5]	(7)	$H(g)$	Rule T (4),(6)

(4) $\Sigma m(0,1,3,0,9,13) + \Sigma d(2,8,7,10,15)$

(5) $^7P_4 = \dfrac{\lfloor 7}{\lfloor 7-4} = 7 \times 6 \times 5 \times 4 = 840$

(3) order of grp = no of distinct element
$\Rightarrow$ order $= 3^4 = 81$

(2) $[Z_9, +_9]$ $[\{0,2,4,6\}, +_9]$

i) Closure: Let $a, b \in H \Rightarrow a + b \in H$
   $0, 2 \in H \Rightarrow 0 + 8 \Rightarrow 2 \in H$
   Pt is closure.

ii) Identity: 0
   $\Rightarrow$ It is a nonempty subset of the
   grp. hence it is a subgroup.

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(12) $\Sigma m(0,1,3,8,9,13) + \Sigma d(2,5,7,10,15)$

	$C \cdot D$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\cdot\bar{B}$	1	1	3	d 2
$\bar{A}B$	4	d 5	d 7	6
AB	12	1 13	d 15	14
$A\bar{B}$	1 8	1 9	11	d 10

$\Rightarrow \bar{A}\cdot\bar{B} + \bar{C}D + \bar{B}\bar{D}$

(9)   M(x,y): x is the mother of y
      P(k,x): k is parent of x
      M(G,x): G is mother x

$\Rightarrow [M(x,y) \wedge [P(\neg k, x) \wedge M(G,x)]]$

$\Rightarrow$ Every person y has two maternal grand parents k and G.

(10) (a) True ~~False~~.
      (b) False.

(11) (a)   -| a   b   c   d

      g   b   c   d   1

      5   c   d

      c   d   a   b

      d   a   b   c

$$c @ b = c @ (d @ c) = (c @ d) @ c$$

$$d @ a = (c @ a) @ a = d @ a = d @ (c @ c)$$
$$= (d @ c) @ c$$
$$= b @ c$$

$$a @ c = a @ (b @ a) = (a @ b) @ a$$
$$= c @ a$$
$$= d$$