MTH622

Vectors and Classical Mechanics

Formula Sheet

1 Chapters, 724 Formulas

VU Learning HUB

vulearninghub.xyz

$=(,,)=1(,,)+2(,,)+3(,,)$

Curl: curl

Curl: curl = ×

(+)

(+) = +

( )

( ) = +

(+)

(+) = +

..

.. = (+) = (+)

= + = ..

( )

( ) = +

= + = ..

= (2+ 42)

= (2+ 42)^+ (2) ^+ 2+ 8)

= (43 −62)^+ (−62) ^+ (122 −622)

at (2, −1,2)

at (2, −1,2) = 8^+ 24^+ 84

//

// = 2^− 3^+ 6.

.

. = 8^+ 48^+ 84. 2

= (2 + + 23)

= (2 + 322)^+ (2+)^+ (+ 23)

= (4+ 3)^+ (4–)^+ (2–2)

= 2^+ 2^+ 2

/(1,1,1)

/(1,1,1) = 2^+ ^+

= –32–3+ 2

= 3–+ 2

Given vector

Given vector = 22–3+ 2 at (1, –1,1)

= 2+ 3+

.

. = (2+ 3+). (3–+ 2)

(2)(3) –(3)(1) + (1)(2)

(2)(3) –(3)(1) + (1)(2) = 5

×

× = (2+ 3+) × (3–+ 2)

= 6 –(–1)–(4 –3)+ (–2 –9)

= 23+ 23+ 322

= 23 + ( )

= 23 + ( )

= 23 + ( )

= 23 +

= 23 + 20

Determine the constant a so that the vector

Determine the constant a so that the vector = (+ 3)^+ (− 2)^+ (+) is

= (+ 3)

= 1 + 1 + = 2 +

. +

. + = . + .

. +

. + = . + .

. +

. + =

= . + . = . .

u

u= 2u= . u

= 2^− 232 + 2

= 2−622 + 2

. (1, −1,1)

. (1, −1,1) = 2(1)(1) −6(−1)2(1)2 + (1)(−1)2

= 2 −6 + 1 = −3

= 3y2 + 6xy2^−2

= 3(−1)(1)2 + 6(1)(−1)2 −(1)2(−1)

= −3 + 6 −1 = 2

A.

A. = 3y2 + 2xy3^−2 . 6^−^

= (1822 −2xy3+ 22)

= [18(1)2(−1)(1)2 −2(1)(−1)3(1) + (1)2(−1)2(1)]

= −18 + 2 + 1 = −15

A

A= (32 −)3y2 + 2xy3^−2

= (93y2 − 3y23) + (63y3 −2xy4)^+ (34−222)

. A

. A= . ((93y2 − 3y23) + (63y3 −2xy4)^+ (34−222))

= 272y2 −3y23 + 183y2 −8xy3+ 34−24

= 6224^+ 434^+ 8323

= 1224 + 434 + 24322

. [()]

. [()] = ()(.) + . (())

= 3() + '()^= 3() + . '()

= 3() + '()

. [()]

. [()] = 3() + '()

. ()

. () = 3+ (−1)

. ()

. () = 3+ ()

. ()

. () = (3 +)

. ()

. () = (3 +)

×

× = (

×

× =

· (×)

· (×) = 0

× (+ B)

× (+ B) = × + ×B

curl (+B)

curl (+B) = curl + curl B

× ()

× () = (×) +() ×

× ()

× () = 0

.(×)

.(×) = 0

curl (+B)

curl (+B) = curl + curl B

L.H. S

L.H. S= curl (+B)

+

+ = (1 + 1)^+ (2 + 2)^+ (3 + 3)

× (+ B)

× (+ B) =

= x + xB

x ()

x () = (x) + () x

L.H.S

L.H.S=x ()

x ()

x () =

= (x) +

= (x) +() x

x ()

x () = 0

L.H.S

L.H.S=x () = x

.(x)

.(x) = 0

L.H.S

L.H.S=.(x)

Hence .(x)

Hence .(x) =

x

x = (24 + 22)^+ 32^-4

x

x = (2 -2)^+ 3^+ 4

x

x = 3^+ 4

(x)

(x)= (2 -2 + 2) x

(x)

(x) =

(x)

(x)= -(6422 + 235)^-(12223 -425)^+ (424 + 4323)

= 43^+ 223^+ 622

× ()

× () =

× ()

× () = -(6422 + 235)^-(12223 -425)^+ (424 + 4323)

× ()

× () = (x)

= (+ 2+)^+ (-3-)^+ (4+ + 2)^

= (+ 2+)^+ (-3-)^+ (4+ + 2)^

curl

curl= x = 0

= (-1)^-(4 -)^+ (-2)

= (-1)^+ (-4)^+ (-2)

(-1)^+ (-4)^+ (-2)

(-1)^+ (-4)^+ (-2)= 0

= (+ 2+ 4)^+ (2-3-)^+ (4+ + 2)^

= + 2+ 4

= 4+ + 2

= 4–+ 2 + h(,)

Note that conversely if

Note that conversely if = , then × = 0

= × = × (×)

= ×(2–3)^–(1–3)^+ (1–2)

= (1 + 1)^–(–2 –2)^+ (3 –(–3))

= 2(1^+ 2^+ 3)

× (×)

× (×) = 2

×

× = 2

Evaluate . (×) ×

Evaluate . (×) × = 0.

Let

Let = 1^+ 2^+ 3 and = ^+ ^+ , then

= (2–3)^–(1–3)^+ (1–2)

. ×

. × =

= ^+ ^+ . 3

= . × = .

× ×

× × = . . –2

L.H.S

L.H.S= x(x)

Hence x(x)

Hence x(x) =

= −2+ . (1

()

()= x ()

= x ()^+ ()^+ ()

As we know

As we know = 2 + 2 + 2, therefore

2 + 2 + 2

2 + 2 + 2 = '()

2 + 2 + 2

2 + 2 + 2 = '()

= (1+ 2+ 3)

.

. = (1+ 2+ 3)

= ^+ ^+

and

and = ^+ ^+

= 2^+ 2^+ 3

Also

Also = ^+ ^+

= 2^+ 2^+ 32

= 49(2^+ 2^+ 32)

= ^810+ ^89

= 23^-3^+ 4

Also we calculated,

Also we calculated, = 2^+ 2^+ 32

×

x = 23^-3^+ 4× 2^+ 2^+ 32

= (-35 -24)^-(65 -25)^+ (43 + 24)

= 3(2 + 1)(22)^- 5(3)^+ 10(2 + 1)

= (64 + 62)^- 5(3)^+ (102 + 10)

Also,

Also, = ^+ ^+

= 2^+ 4^+ 32

Total work done

Total work done =

= (64 + 62)^- 5(3)^+ (102 + 10). 2^+ 4^+ 32

= 2(64 + 62)- 4(53) + 32(102 + 10)

= (125 + 123)- (204) + (304 + 302)

= (125 + 104 + 123 + 302)

= 125+ 104

= 2[(2)6 -(1)6] + 2[(2)5 -(1)5] + 3[(2)4 -(1)4] + 10[(2)3 -(1)3]

If

If = (32 + 6)^- 14^+ 202, evaluate

= 32 + 6(0)

-14(0)+ 20(0)2

-14(0)+ 20(0)2 = 32

-14(0)+ 20(0)2

-14(0)+ 20(0)2 = 3 + 6

(0) -14(1)(0) + 20(1)2

(0) -14(1)(0) + 20(1)2= 202

= (32 + 6) - 142 + 203

= 6 - 112 + 203

×

x = 0(i.e. is irrotational).

×

x = x = 0

Conversely, if x

Conversely, if x = 0, then

= (1(,) + 2(,) + 3(,))

= 2(, 1) + 3

= 2(, 1) + 2

= 2(, 1) + |2(,)|1

= 1(, 1, 1) + 2

= 1(, 1, 1) + 1

= 1(, 1, 1) + |1(, 1)|1

= 1(, 1, 1) + 1(, , 1) −1(, 1, 1) + 1(, ,)
−1(, , 1)

= 1^+ 2^+ 3=

.

. = (^−2^+ (−1)). 22^+ 0^+ 6

= 23 + 6(−1)

= [23 + 6(−1)]

= 8 + 16 −12 = 12

×

× =

= [(−2)(6) −(−1)(0)]^−[()(6) −(−1)(22)]^+ [()(0)
−(−2)(22)]

= −63^−(62 + 22 −23)^+ 24

= −63^−(82 −23)^+ 24

= (−63^−82 −23^+ 24)

= ^+ ^

= (2−+)^+ (+ −2)^+ (3−2+ 4)

In the plane

In the plane = 0, = (2−)^+ (+)^and = ^+ ^

Total work done

Total work done=

= ((2−)^+ (+)} .

= ((2−)+ (+))

= × = 0.

= x =

= (2 + 3)^+ 2 ^+ 32

= 2 + 3

= 2+ 3 + f( )

= 2+ g( )

= 3 + h( )

= 2+ 3 +

≈sec

≈sec =

(2+ 3 + 6)

(2+ 3 + 6) = 2^+ 3^+ 6

.

. = 18^- 12^+ 3. 2

= 36-36 + 18

.

. = 6(12 -2-3) -36 + 18

= 24 -12+ 4

= 24-62 + 4

= 144 -216 + 96 = 24

.

. = 2^- ^+ 2.

= 8+

(2+)

(2+) = 2^+ ^

22 + (1)2

22 + (1)2 = 2^+ ^

= 2^+ ^

.

. = ^+ 2^– . 2^

2 +

2 + = 6 = 6 –

= + 6 –

= 3 +

= 4 3 +

= 4(18 + 9) = 108

(2)2 + (2)2

(2)2 + (2)2 = 2^+ 2^

= 2^+ 2^

= 2^+ 2^

= 2(^+)

= (^+)

Using 2 + 2

Using 2 + 2 = 16 on S

.

. = ^+ ^– 32. ^+ ^

. ^

. ^= ^+ ^

= +

= −16 −2 + 2

2 ^

2 ≙ 100^+ 100^

= 12 × (4)2 = 192

(2 + 2 −2)

(2 + 2 −2) = 2^+ 2^−2

= 2^+ 2^−2

42 + 42 + 42

42 + 42 + 42 = 2(^+ ^−)

22 + 2 + 2

22 + 2 + 2 = (^+ ^−)

= (^+ ^−)

= (^+ ^−)

(42 + 2−3) and .

(42 + 2−3) and . = −1

2

2 = (42 cos2 + 4 cos sin2 −3)

= (43 cos2 + 5 cos sin2 −32)

= 4 cos2 + 6

= 256 cos2 + 46

= 256 cos2 + 46

= 128(1 + cos 2) + 2048

= 128+ 64 sin 2+ 2048

= 192+ 128= 320

Let

Let = 2 − + 2.

= (2 − + 2)

= 128^−24^+ 384

Using equation 2 + 2y +

Using equation 2 + 2y + = 4 for limit

= 8−82 + 23

3 + 8

3 + 8 = −8

(1^+ 2^+ 3).

(1^+ 2^+ 3). = (1

= (1^+ 2^+ 3).

(1^+ 2^+ 3).

(1^+ 2^+ 3). = (1

.

. = 1^+ 2^+ 3. 1^+ 2^+ 3

.

. = 1 cos + 2 cos + 3 cos

= (4 −4+ 2)

Here we use the given equation 2 + 2

Here we use the given equation 2 + 2 = 4, for limits

portion 3(2 + 2

portion 3(2 + 2 = 4). Then

(2 + 2)

(2 + 2) = 2^+ 2^

= 2^+ 2^

42 + 42

42 + 42 = 2(^+)

22 + 2

22 + 2 = (^+)

= (^+)

.

. = 4^– 22^+ 2.

.

. = . 4^– 2^+

= (4–2+)

= ×

= (B × C).

= C. (× B)

= C. (× B)

= ×

= × .

× (1)

× (1) =

[× (1)].

[× (1)]. = 1

= ^+ ^+ = ^+ ^+ ( )

= ^+

= ^+

= . ^+

[× (1)].

[× (1)]. = −1

[× (1)].

[× (1)]. = −

= cos ^+ cos ^+ cos

.

. = 1^+ 2^+ 3 . (^+ ^+)

= 1+ 2+ 3

= × .

= (2 −)^− 2^− 2). (^+ ^+)

Let

Let = sin = cos , 0 ≤≤2

= + sin 2

×

× = (×) ×

= × .

= × (×).

= . (×) ×

×

× = (×) ×

×

× = 0 identically.

= x .

= x .

= 0 and shows that x = 0.

= x

= x .

= x ().

= x .

= . x

= x .

= . x

.

. = . x

= x

= 2^-(+ 3-2)^+ (2 +)

x .

x . = .

+ 3-2)

+ 3-2)= -2 -2

Let

Let = cos , = sin , = cos , 0 ≤≤2

(2 + 2)

(2 + 2)= (2 -2 +)

x .

x . = -2

x

x = -1

= x .

= x .

×

x = −1

+

+ =

+

+ =

+

+ =

= (+ 2) + 2

+

+ = (33 + 4)

+

+ = 22+ 2

= + 2, and

+

+ =

+

+ = (^+). (^+) = .

= ^+ ^and = ^+ .^

Also, if

Also, if = ^+ ,^then

= (x).

+

+ = . = .

+

+ = . = . x = x .

= x = (^+) x = ^_^

+

+ = . = .

+

+ = . = . x = x .

= x = (^+) x = ^_^

. ()

. () = (). () + (.) = 2+ ()()

+

+ = 0

+

+ =

+

+ = 0

+

+ = 0

+

+ =

+

+ =

sin)+ cos (0)

sin)+ cos (0) = |-sin = cos |0

(-1)(0) + 0

(-1)(0) + 0= 0

+

+ =

= ˙+ ˙+ ˙

= ˙+ ˙+ ˙

= ¨+ ¨+ ¨

a

a = +

= + +

= −+ +

= (−)+ ()+ ()

= + +

/

/ = −+ +

= −+ +

= −+ +

= + + (−+ +)

= ÷ ˙

So, ˙

So, ÷ −sin ÷ cos ˙ or ÷ (−sin + cos)˙

v

v = +

.

= x = = x = –

= – + (+)

= (–)+ (() + ())

= (–)+

a.

a. = 150 × 106)

the center of the galaxy is

the center of the galaxy is = 2.8 × 104 . its orbital speed is = 220 /)

= 4(3.14)2(6.4 × 106)2

= 3.4 × 10–3

= = 150 × 106

= 4(3.14)2(150 × 106)2

= 6 × 104

= = 2.8 × 104

= 4(3.14)2(150 × 106)2

= 1.5 × 10−12

= 1 + 2 + … . . +=

= (33 + 2)^+ (4 + 8)^−5

= (92 + 2)^+ (43 + 8)^−5

= (18+ 2)^+ 122^

= (362 + 8)^+ (163 + 32)^−20

= (72+ 8)^+ 482^

= 42^+ (16−4)^−12

0

0 = + 4−9, find

= 42^+ (16−4)^−12

= 2^+ (4−1)^−3

+ 4−9

+ 4−9=

3

3 = −120000 ft Ib/sec 2

= 85 = 85 × 9.81

−

− = 85 × 0.45

= − 85 × 0.45

= 85 × 9.81 – 85 × 0.45

= 2^- ^-. 8^+ 2^- 5

= 16 –2 + 5 = 19

= 3.38 × 1010–1

= 3.38 × 1010

curl

curl = × = 0

= (2 –23)^+ (3 + 2–23)^+ (63 –322)

i.e. ×

i.e. × = 0

= (–322 + 322)^–(–62 + –62)^+ (2–22 –2+ 22)

As we obtain ×

As we obtain × = 0

= + = 1

2 2 + ()

2 2 + () =

= () + ()

= 2+2 (2)

(2 –1) + (2 –1)

(2 –1) + (2 –1) = ().

(+)

(+) = ().

= 2^–2^+ 2^

= 2^−2^+ 2^

= (2)^−(2−2)^+ (2 + 2)^

¨+

¨+ = 0

= 10, / = 0 = 0

= cos 3/2+ sin 3/2

= 10 cos 3/2+ Bsin 3/2

= −103/2 sin 3/2 + 3/2 Bcos 3/2

= 10 cos 3/2

= −103/2 sin 3/2

()

() = A cos(2/T)

Thus,

Thus, = 10 cos 3/2

Period

Period = T = 22

¨+

¨+ = 0

¨+

¨+ = − ˙

¨+ ˙+

¨+ ˙+ = 0

.

= −2 3

and 0

and 0 = (1) −2 3

= 102 3

= 10−2 3

= ^ + ^ + ^

= cos ^ + sin ^ + ^

= cos ^ + sin ^

= −sin ^ + cos ^

/

/ = cos ^ + sin ^

= cos ^ + sin ^

= cos ^ + sin ^

/

/ = −sin ^ + cos ^

= −sin ^ + cos ^

1. 2

1. 2 = (cos ^ + sin). (−sin ^ + cos)

= −sin cos + sin cos = 0

2. 3

2. 3 = (−sin ^ + cos). ^ = 0

3. 1

3. 1 = .^(cos ^+ sin) = 0

= cos ^+ sin ^

= −sin ^+ cos ^

= −sin ^+ cos ^= (−sin ^+ cos) = ·

= −cos ^−sin ^= −(cos ^+ sin) = − ·

= 1 + + 2

= 1 +

1

1 = 1 +

1 + 1

1 + 1 = 2 + 2

2 + 1

2 + 1 = 1

= −3(2 + 2)

= −3= −(2 + 2)

= −(2 + 2)

=(2 + 2)3/2 and

5 (2 + 2)5/2

5 (2 + 2)5/2 = 1

= 2 −1 = 2 −1

= //1

1

1 = 5−3+ 7

2

2 = 2+ 3+

Impulse

Impulse = 200(2+ 3+ −(5−3+ 7))

= 200(−3+ 6−6)

Impulse magnitude

Impulse magnitude = 2009 + 36 + 36

= 1800mgm/sec

= x

= x = x

(x)

(x) = 0

= (2 + 2)

= (2 + 2)

= (2 + 2)

2x 2

2x 2= 2

= x

= x

11 + 22

11 + 22 = 11 + 22

6 × 5 + 4 × (−3)

6 × 5 + 4 × (−3) = 6 × 1.5 + 4 × 2

9

9 = 4 × 2

Velocity of A before collision

Velocity of A before collision= 1 = (−1 + 4) −1

Velocity of A after collision

Velocity of A after collision= 1 = (−2 + 2) −1

11 + 22

11 + 22 = 11 + 22

6 × 5 + 4 × (−3)

6 × 5 + 4 × (−3) = 6 × 1.5 + 4 × 2

9

9 = 4 × 2

Velocity of before collision

Velocity of before collision = 1 = (−1 + 4)ms−1

Velocity of after collision

Velocity of after collision = 1 = (−2 + 2)ms−1

11 + 22

11 + 22 = 11 + 22

= 8(−2 + 2) + 2(3)

−8 + 32+ 16−16+ 2(−0.8 + 1.4) −2(3)

−8 + 32+ 16−16+ 2(−0.8 + 1.4) −2(3) = 0

8+ 16+ 2(−0.8− 1.6)

8+ 16+ 2(−0.8− 1.6) = 0

8+ 16−2(+0.8+ 1.6)

8+ 16−2(+0.8+ 1.6) = 0

8+ 16

8+ 16= 2(0.8+ 1.6)

2

2 = 0.8+ 1.6

= x = x ()

= x ()

= x (x)

= [x (x)

= ^+ ^+ ^

.

. = + +

= ^+ ^+ ^1^+ 2^+ 3^

= ^+ ^+ ^1^+ 2^+ 3^

11

11 = ()(2 + 2)

22

22 = ()(2 + 2)

33

33 = ()(2 + 2)

31

31 = −()

= ^+ ^+ ^

= + + + (+) + (+) + (+)

= × (1)

= ×

0

0 = × () = × (0)

= || sin = || sin = sin = |× |

= |× |2

|× |

|× | = |

= (–)^+ (–)^+ (–)^

|× |2

|× |2 = (–)2 + (–)2 + (–)2

= 211 + 222 + 233 + 212 + 223 + 231

||

|| =

= ()211 + ()222 + ()233 + 2()12 +
2()23 + 2()31

= [211 + 222 + 233 + 212 + 223 + 231]

1

1 = 211 + 222 + 233 + 212 + 223 + 231

112 + 222 + 332 + 212+ 223+ 231

112 + 222 + 332 + 212+ 223+ 231= 1

= + x

= '+

(x)2

(x)2 = (x). (x)

= . x (x)

2 [. x (x)]

2 [. x (x)] = 1

x (x),

x (x), = x

=

= 23

= 2

= 2= (-

=

= 2

= = 23

= 23

= 43

= 4(cos)3

= 44cos3

= 44cos cos2

= 44cos (1 −sin2)

= 44cos (1 −sin2)

= 44(cos

= 44× 2

11

11 = ()(2 + 2)

= (2 + 2)

= (2 + 2)

= (2 + 2)

= [2

12

12 = −

= −

$= -$

$= ()(2 + 2)$

$= (2 + 2)$

$= (2 + 2)$

$= (2 + 2)$

$= [2$

12

$12 = -$

$= -$

$= -$

$= ()(2 + 2)$

$= (2 + 2)$

2 + 2

$2 + 2 = 2(\sin 2 \cos 2 + \sin 2 \sin 2)$

$= 2 \sin 2 (\cos 2 + \sin 2)$

$= 4 \sin 3$

'2 + '2 + '2

$'2 + '2 + '2 = 1$

11

$11 = (2'2 + 2'2)''''$

11

$11 = 3'2' + 3\ '2'$

,

$' = '2$

,

' = 4 sin3

= −"(""

= 2(1 + 1) + 3(1 + 0) + 4(1 + 0)

= 4 + 3 + 4 = 11

= 2(0 + 1) + 3(1 + 0) + 4(1 + 1)

= 2 + 3 + 8 = 1

= 2(0 + 1) + 3(1 + 1) + 4(1 + 0)

= 2 + 6 + 4 = 12

(1 + 2)

(1 + 2)= 11 + 22

= 11 + 22

= 120(5) + 0

(1 + 2)1

(1 + 2)1 = 2

−1

−1 = 1+ 2−2

= 3

= 2= 2(−)

= 2 (−

= 2−

= 2= 2

2

2 = (x)2

= +

= [x (+

= [x + x

= (x)2 +

= 0 + '

= + 2 (1)

= 0 + ()2

4 2+ 2

4 2+ 2 = (1

4 2 + 2)

4 2 + 2) = (1

= { 4

= + 2

33

33 = 11 + 22

= +

= ()2 =

= (2

= (2

= 2

= 2

= +

= 1+ 2

1

1= 2

2

2= ' + 2

(11–)1 + 122 + 133

(11–)1 + 122 + 133 = 0

211 + (22–)2 + 233

211 + (22–)2 + 233 = 0

311 + 322 + (33 –)3

311 + 322 + (33 –)3 = 0 (3)

= = 0 whereas ≠0

(11 –)1 + 122 + 133

(11 –)1 + 122 + 133 = 0

211 + (22 –)2 + 233

211 + (22 –)2 + 233 = 0

311 + 322 + (33 –)3

311 + 322 + (33 –)3 = 0

(11 –)1 + 122

(11 –)1 + 122 = 0

211 + (22 –)2

211 + (22 –)2 = 0

(11 –) cos + 12 sin

(11 –) cos + 12 sin = 0

21 cos + (22 –) sin

21 cos + (22 –) sin = 0

–3 + 2 + +

–3 + 2 + + = 0 (4)

cos2 + cos2 + cos2

cos2 + cos2 + cos2 = 1

= 1^+ 2^(2)

= 3^+ 4^(3)

= 5^+ 6^(4)

= 1^+ 2^

= (–12 –23)^+ (–11 –33)^+ (–21 –32)^

= 1^+ 2^+ 3^

= + 2x

= + 2x + ˙x + x (x)

()

()= = ()+ 0

= ^ + ^ + ^ 0

= 0 + (^ + ^) + ^

= 0 + + x

= 0 + + 2x + ˙x + x (x)

= 2 ^ − 2 ^ + (2 + 4) ^

= (2 + 1) ^ − 6 ^ + 43 ^

= 2 ^ − 6 ^ + 122 ^

(

(= 1) = 2 ^ − 6 ^ + 12 ^

= + x

= 2 ^ − 6 ^ + 12 ^ + /

(

(= 1) = 2 ^ − 6 ^ + 12 ^ + /

= 34 ^ − 2 ^ + 2 ^

= 2 ^ + 24 ^

(

(= 1) = 2 ^ + 24 ^

= + 2x + ˙x + x (x)

(

(= 1) = 2 ^ − ^ + 6 ^

.

= 2^-2^+ 2^

(

(= 1) = 2^-2^+ 2^

= 2^-6^+ 122,^therefore

2x

2x = 2 /

/

/ = 32^+ 4^-10^

x (x)

x (x) = /

= -14^+ 212^+ 40^

= (2^+ 24}+ (4^-4^-8}+ 2(24^-12^-10}+
(-14^+ 212^+ 40}

= 40^+ 184^+ 36^

= cos ^+ sin ^--^

x

x = /

x

x = (-3-+ 5 cos)^-(2--5 sin)^+ (-2 cos + 3 sin
)^

= cos ^+ sin ^--^+ (-3-+ 5 cos)^-(2--5 sin)^

= (cos + 5 cos -3-)^+ (5 sin + sin -2-)^+ (---2 cos
+ 3 sin)^

= (6 cos -3-)^+ (6 sin -2-)^+ (---2 cos + 3 sin)^

= (-sin ^+ cos ^+ -}

= 2(2^-3^+ 5^) × (cos ^+ sin ^--^)

= (4^-6^+ 10^) × (cos ^+ sin ^--^)

= (6--10 sin)^+ (4-+ 10 cos)^+ (4 sin + 6 cos)^

= 2^-3^+ 5^'=

×

× = 0 × (sin ^-cos ^+ -^) = 0

× (×)

× (×) = (2^-3^+ 5^) × [(2^-3^+ 5^) × (sin ^-cos ^+ -^)]

= (2^-3^+ 5^) × [(-3-+ 5 cos)^-(2--5 sin)^+ (-2 cos + 3 sin)]

= (6 cos -9 sin -25 sin + 10-)^+ (4 cos -6 sin -15-+ 25 cos)^+ (4-

= (6 cos -34 sin + 10-)^+ (29 cos -6 sin -15-)^

= (6 cos -45 sin + 16-)^+ (40 cos -6 sin -11-)^

= cos ^+ sin ^--^

= (-sin ^+ cos ^+ -^)

= cos ^+ sin ^+ ^

= -2× - '× -× (×)

= '= (-sin ^+ cos ^+ ^)'

= (-sin ^+ cos ^+ ^)''+(-cos ^-sin ^)2 (4)

= -^+

×

x = ^x (−sin ^+ cos ^+ }·

×

x = ^x (cos ^+ sin ^+ }

× (x)

x (x) = 2^x (cos ^−sin }

= (−sin ^+ cos ^+ }:= ·

¨−(cos ^+ sin }2

¨−(cos ^+ sin }2 = −+ + (2+ 2)(cos ^+ sin }

.^

.^ = .^(−sin ^+ cos ^+ } =

(sin ^+ cos }.

(sin ^+ cos }. = (sin ^+ cos }. (−sin ^+ cos ^+ }

(2 + 2)¨

(2 + 2)¨= −

= −x (x)

//

// = /−x (x)/ = 2cos

^

^= ^cos + ^sin

^

^= ^sin + ^cos

= −x (x)

becomes x (x)

becomes x (x) = 2^x (^x)

-2^x (^x)

-2^x (^x) = -2[(.^)^-(.^)]

.^

.^= (^sin + ^cos). ^

-x (x)

-x (x) = -2sin (^sin + ^cos) + 2^

= (-2sin2 + 2)^-2sin cos ^

= (-2(1 -cos2) + 2)^-2sin cos ^

= /-(2cos2)^+ 2sin cos }/

= (2cos2)2 + (2sin cos)2

= 42 cos4 + 42 cos2 sin2

= 42 cos4 + 42 cos2 (1 -cos2)

= 42 cos4 + 42 cos2 -42 cos4

= 42 cos2

= = 3^+ ^-2^

= + x

= 0+ x

= (0,0,0) + (5^-4^-10} x (3^+ 1^-2}

= (0^+ 0^+ 0} + /

= (0^+ 0^+ 0} + ((8 + 10)^-(-10 + 30)^+ (5 + 12)}

= (0^+ 0^+ 0} + (18^-20^+ 17}

= 18^-20^+ 17^

+ × (

+ × (=)

+ ×)

+ ×) =

(1 ‘+ 23 + 32)

(1 ‘+ 23 + 32) = 1

(2 ‘+ 31 + 13)

(2 ‘+ 31 + 13) = 2

(3 ‘+ 12 + 21)

(3 ‘+ 12 + 21) = 3

11^+ 22^+ 33^+ (23 – 32)^+ (

11^+ 22^+ 33^+ (23 – 32)^+ (21 – 13)^+
(12 – 21)^=

11 + 23 – 32

11 + 23 – 32 = 1

22 + 31 – 13

22 + 31 – 13 = 2

33 + 12 – 21

33 + 12 – 21 = 3

11 + 32I3 – 23I2

11 + 32I3 – 23I2 = 1

22 + 13I1 – 31I3

22 + 13I1 – 31I3 = 2

33 + 21I2 – 12I1

33 + 21I2 – 12I1 = 3

= 0 + + 2x + ‘x + x (x)

= – ‘x –2x –x (x) –0

0

0 = x (x)

= - ẋ -2x -x (x) -x (x)

= 7.27 x 10-5rad/sec

= -2x -x (x)

= -x (x) (6)

¨+ 2ˆx

¨+ 2ˆx = -2ˆx (ˆx)

Good Luck!

Keep practicing!