**Physics 30 - Lesson 2**

**Two Dimensional Momentum**

/48

**Practice problems**

1.

4.0 + 6.0

**After**

3.0 m/s [E]

**Before**

6.0 kg

4.0 kg

2.8 m/s [S]





18

11.20



2.

+16 m/s

**Before**

80 kg

100 kg

–25 m/s

100 kg

28o

**After**



80 kg

9.5 m/s





80 kg

446.0

61.20

3. **(component method)**

+50.0 m/s

25 kg

30o



**Before**

**After**

14 kg

30o



11 kg

77.8 m/s





508.86

427.9



3. **(vector addition method)**



14 kg

30o



11 kg

77.8 m/s



+50.0 m/s

25 kg

30o



**Before**

**After**



1250

855.8

+

=

855.8

1250

30o





**Assignment**

1)



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= 1.4 x 103 kg(37.0 km/h)

= 51800 kg km/h

= 2.0 x 103 kg(35.0 km/h)

= 70000 kg km/h



The initial momentum of the nucleus is zero, therefore the final momentum vectors of all the particles will also add up to zero.

before

after

= 9.0 x 10-21 kg m/s

= 4.8 x 10-21 kg m/s



2)

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= 9.0 x 10-21 kg m/s

= 4.8 x 10-21 kg m/s





A.



B.



C.



**Component method**

p’0.5x = 0.75cos30

p’0.5x = 0.650 east

p’0.5y = 0.75sin30

p’0.5y = 0.375 south

p’0.5 = 0.50 kg(1.50 m/s)

p’0.5 = 0.75 kg m/s

0.50 kg

30o

**After**



p’0.3

p’x = px

p’0.3x + p’0.5x = px

p’0.3x = px – p’0.5x

p’0.3x = 1.0 east – 0.650 east

p’0.3x = 0.350 east

p’y = py

p’0.5y + p’0.3y = 0

p’0.3y = – p’0.5y

p’0.3y = – 0.375 south

p’0.3y = 0.375 north

0.30 kg

3)

/6

2.0 m/s

**Before**

0.50 kg

px = 0.50 kg(2.0 m/s east)

px = 1.0 kg m/s east

py = 0

0.30 kg



**Vector addition method**

3)

/6

 





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

30o

0.75

1.0

p0.3’

4)

/6

200 m/s

**Before**

3000 kg

px = 3000 kg(200 m/s east)

px = 6.0 x 105 kg m/s east

py = 0

p’25y =25 kg(2000 m/s north)

p’25y = 50000 kg•m/s north

**After**



p’2975

p’x = px

p’29750x + p’25x = px

p’2975x = px – p’25x

p’2975x = 6.0 x 105 east – 0

p’2975x = 6.0 x 105 east

p’y = py

p’2975y + p’25y = 0

p’2975y = – p’25y

p’2975y = – 50000 north

p’2975y = 50000 south



**Component method**

p’0.10x = 0.550cos56

p’0.10x = 0.308 east

p’0.10y = 0.550sin56

p’0.10y = 0.456 north

p’0.10 = 0.10 kg(5.50 m/s)

p’0.10 = 0.550 kg m/s

0.250 kg

56o

**After**



p’0.25

p’x = px

p’0.25x + p’0.10x = px

p’0.25x = px – p’0.10x

p’0.25x = 1.75 east – 0.308 east

p’0.25x = 1.442 east

p’y = py

p’0.25y + p’0.10y = 0

p’0.25y = – p’0.10y

p’0.25y = – 0.456 north

p’0.25y = 0.456 south

0.100 kg

5)

/6

7.00 m/s

**Before**

0.250 kg

px = 0.250 kg(7.00 m/s east)

px = 1.75 kg•m/s east

py = 0

0.100 kg



**Vector addition method**

5)

/6

 









56o

0.550

1.75

p’0.25

**Component method**

p’6x = 75cos40

p’6x = 57.45 east

p’6y = 75sin40

p’6y = 48.21 south

p’6 = 6.0 kg(12.5 m/s)

p’6 = 75 kg m/s

6.0 kg

40o

**After**

20.0 m/s

**Before**

10.0 kg

px = 10.0 kg(20.0 m/s west)

px = 200 kg m/s west

py = 0

6)

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

p’4

p’x = px

p’4x + p’6x = px

p’4x = px – p’6x

p’4x = 200 west – 57.45 east

p’4x = 257.45 west

p’y = py

p’4y + p’6y = 0

p’4y = – p’6y

p’4y = – 48.21 south

p’4y = 48.21 north



**Vector addition method**

6)

/6

 









40o

75

200

p4’

140o

Since the balls have the same mass, we can ignore it and just use the velocities

7)

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v1’ = 3.0 m/s

v2’ = 4.0 m/s

90o

v1

 

8)

/6

**Vector addition method**

 





105o

p’

1.0

1.2

30o

45o





**Component method**

8)

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45o

p1x =1.2cos45o

p1x =0.8485 east

p1y =1.2sin45o

p1y =0.8485 north

p1 =0.30 kg(4.0 m/s)

p1 = 1.2 kg m/s

30o

p2y =1.0cos30o

p2y =0.866 north

p2x =1.0sin30o

p2x =0.50 west

p2 =0.20 kg(5.0 m/s)

p2 = 1.0 kg m/s

(y–direction)

py’=py

py’ = p1y + p2y

py’ = 0.8485 north + 0.866 north

py’ = 1.7145 north

(x–direction)

px’=px

px’ = p1x + p2x

px’ = 0.8485 east + 0.50 west

px’ = 0.3485 east





0.3485

1.7145

p’