WebAssign
CH03-HW02-SP12 (Homework)

Yinglai Wang
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Instructor: Virendra Saxena

Current Score : 34 / 34 **Due :** Thursday, January 26 2012 11:59 PM EST

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1. 8/8 points | Previous Answers MI3 3.5.P.044

(a) In outer space, far from other objects, block 1 of mass 65 kg is at position < 9, 9, 0 > m, and block 2 of mass 1350 kg is at position < 21, 9, 0 > m. What is the (vector) gravitational force acting on block 2 due to block 1? It helps to make a sketch of the situation.

$\vec{F}_{grav}$ = ✔ N

(b) At 4.1 seconds after noon both blocks were at rest at the positions given above. At 4.3 seconds after noon, what is the (vector) momentum of block 2?

$\vec{p}_2$ = ✔ kg · m/s

(c) At 4.3 seconds after noon, what is the (vector) momentum of block 1?

$\vec{p}_1$ = ✔ kg · m/s

At 4.3 seconds after noon, which one of the following statements is true?

- (●) Block 1 is moving faster than block 2.
- ( ) Block 1 and block 2 have the same speed.
- ( ) Block 2 is moving faster than block 1.

✔

- *Read the eBook*
- Section 3.5

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2. 26/26 points | Previous Answers

Done
You have completed this question.
Predicting the motion of a planet

A star of mass 14×10^{30} kg is located at $\langle\ 6 \times 10^{12}, 4 \times 10^{12}, 0\ \rangle$ m. A planet of mass 6×10^{24} kg is located at $\langle\ 3 \times 10^{12}, 9 \times 10^{12}, 0\ \rangle$ m and is moving with a velocity of $\langle\ 0.4 \times 10^4, 1.3 \times 10^4, 0\ \rangle$ m/s.

Your task is to predict the motion of the planet in two steps, each of duration 8.0×10^7 seconds. This is a multipart tutorial question. You must get each question correct before you can go on to the next question. In the first time interval the calculations are broken down into their details. In the second time interval you are asked to work more independently, using what you practiced in the first time interval.

To avoid buildup of small round-off differences, your own answers (after being judged correct within a small tolerance) are used as the basis for later calculations.

We will apply the Momentum Principle to the planet as the chosen system, and assume that the only significant interaction with the surroundings is with the stationary star. Orient the coordinate axes so that the motion is in the xy plane, with z = 0.

Part 1 of 14

What is the relative vector $\vec{r}$ that points from the initial position of the star to the initial position of the planet?

$\vec{r} = \langle$ -3e12 ✓ -3.00e+12 , 5e12 ✓ 5.00e+12 , 0 $\rangle$ m

Part 2 of 14

What is the magnitude of the relative vector from the star to the planet?

$|\vec{r}|$ = 5.831e12 ✓ 5.83e+12 m

Part 3 of 14

What is the unit vector $\hat{r}$ that points from the initial position of the star to the initial position of the planet?

$\hat{r} = \langle$ -0.514 ✓ -0.514 , 0.857 ✓ 0.857 , 0 $\rangle$

Part 4 of 14

What is the magnitude of the gravitational force exerted by the star on the planet?

$|\vec{F}|$ = 1.655e20 ✓ 1.66e+20 N

Part 5 of 14

What is the vector gravitational force exerted by the star on the planet?

$\vec{F} = \langle$ 8.5067e19 ✓ 8.51e+19 , -1.42e20 ✓ -1.42e+20 , 0 $\rangle$ N

Part 6 of 14

What is the impulse due to the gravitational force during the time interval 8.0×10^7 s?

$\vec{F}\Delta t = \langle$ 6.805e27 ✓ 6.81e+27 , -1.136e28 ✓ -1.13e+28 , 0 $\rangle$ N · s

Part 7 of 14

What is the initial momentum of the planet?

$\vec{p}_i = \langle$ 2.4e28 ✓ 2.40e+28 , 7.8e28 ✓ 7.80e+28 , 0 $\rangle$ kg · m/s

Part 8 of 14

What is the momentum of the planet after 8.0×10^7 s?

$\vec{p}_f = \langle$ 3.0805e28 ✓ 3.08e+28 , 6.664e28 ✓ 6.66e+28 , 0 $\rangle$ kg · m/s

Part 9 of 14

What is the velocity of the planet after 8.0×10^7 s?

$\vec{v}_f = \langle$ 5133.33 ✓ 5130 , 11100 ✓ 11100 , 0 $\rangle$ m/s

Part 10 of 14

What is the displacement (change in position) of the planet during the time interval of 8.0×10^7 s? Use the final velocity as an approximation to the average velocity (note that the net force isn't constant).

$\Delta\vec{r} = \langle$ 4.1e11 ✓ 4.10e+11 , 8.88e11 ✓ 8.88e+11 , 0 $\rangle$ m

Part 11 of 14

What is the position of the planet after 8.0×10^7 s?

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$\vec{r}_f = \langle$ 3.41e12 ✓ 3.41e+12 , 9.888e12 ✓ 9.89e+12 , 0 $\rangle$ m

Part 12 of 14

Now the planet has a new position and a new momentum. Starting from these new conditions, predict the position and momentum that the planet will have after a second time interval of 8.0×10^7 s.

At the end of the first time interval and start of the second, what is the new vector gravitational force exerted by the star on the planet?

$\vec{F} = \langle$ 5.4808e19 ✓ 5.48e+19 , -1.2444e20 ✓ -1.25e+20 , 0 $\rangle$ N

Part 13 of 14

What is the new momentum of the planet after the second time interval of 8.0×10^7 s?

$\vec{p}_f = \langle$ 3.52e28 ✓ 3.52e+28 , 5.66e28 ✓ 5.66e+28 , 0 $\rangle$ kg · m/s

Part 14 of 14

What is the new position of the planet after the second time interval of 8.0×10^7 s? Use the final velocity as an approximation to the average velocity (note that the net force isn't constant).

$\vec{r}_f = \langle$ 3.88e12 ✓ 3.88e+12 , 1.06e13 ✓ 1.06e+13 , 0 $\rangle$ m