

Physics 200-05
Mini Test Solutions

The class average (out of 1 max for each question) is listed at the beginning of the question.

1. [.4] Given two matrices,

$$A = \begin{pmatrix} 2 & 0 \\ 1 & 1 \end{pmatrix} \quad (1)$$

$$B = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \quad (2)$$

- a) What is AB?

$$AB = \begin{pmatrix} 2 & 0 \\ 1 & -1 \end{pmatrix}$$

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- b) What is the determinant of B?
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2. [.66] Given the complex numbers

$$x = 1 + 2i \quad (3)$$

$$y = 3i \quad (4)$$

What is xy

 $-6 + 3i$

3. [.23] A particle of mass 1Kg and velocity 1 m/s travelling in the x direction collides with another particle of mass 2 kg and speed 0 m/s. What is the final velocity of the two particles assuming that the collision is elastic and the velocities after the collision are all purely in the x direction?

1Kg mass at $-1/3$ m/s, 2Kg mass at $2/3$ m/s

4. [.15] What is the the taylor series expansion to second order in x of the function

$$f(x) = \sqrt{1-x} \quad (5)$$

around the point $x=0$?

$$1 - x/2 - x^2/8 + O(x^3)$$

5. [.4] What is the solution of the differential equation

$$\frac{dy(x)}{dx} = 5y(x) \quad (6)$$

assuming that the value of $y(0)=1$.

$$y(x) = e^{5x}$$

6) [.13] What is the kinetic energy, the potential energy, and the total energy of a particle of mass m in circular orbit around a star of mass M , at a distance R away from the central star? (the mass m may be assumed to be very much smaller than M .)

Balance of angular acceleration vs gravitational force

$$\frac{mv^2}{R} = \frac{GMm}{R^2}$$

Thus

$$KE = \frac{1}{2}mv^2 = \frac{GMm}{2R}$$

$$PE = -\frac{GMm}{R}$$

$$Total = -\frac{GMm}{2R}$$

The above assumes that M is stationary, and that the smaller particle orbits around that stationary location of M .
