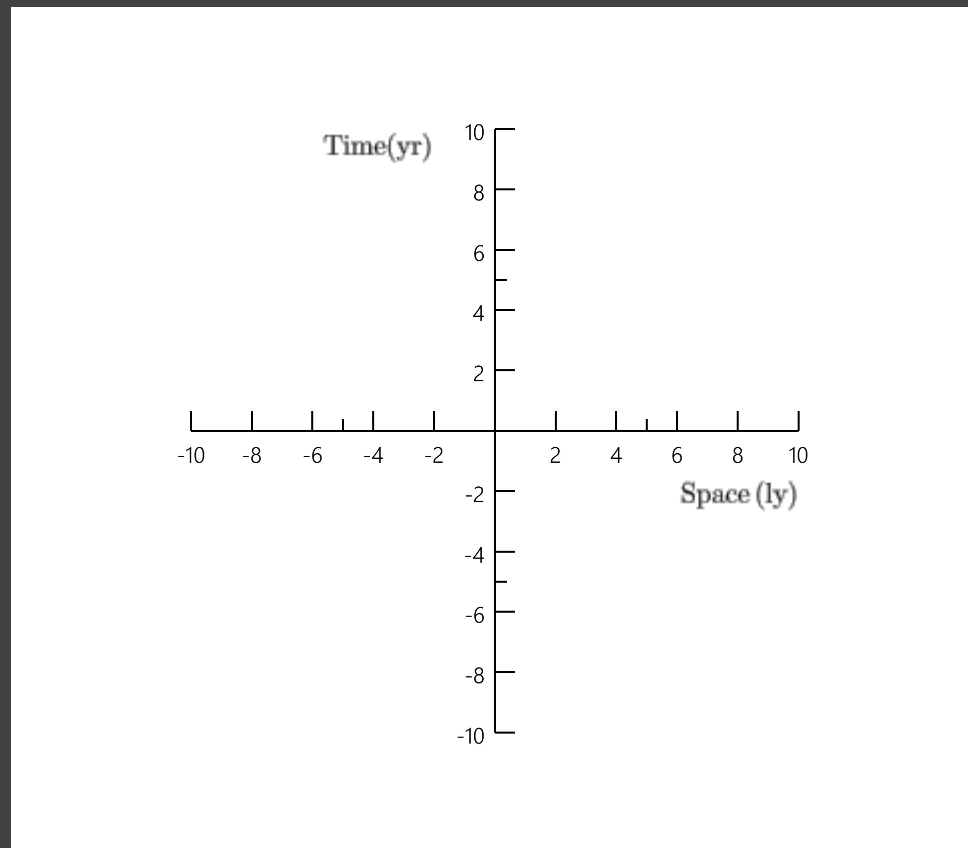
No elements selected



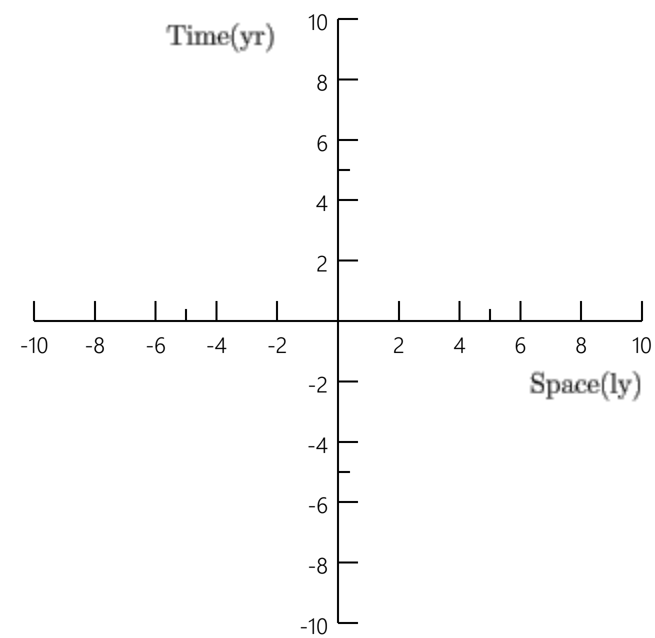
Select the elements from the list and add them to the canvas setting the appropriate attributes. Press TAB to get to the main menu.

rt C

Draw a worldline for Angela, who is traveling away from you at a speed of 100,000 $\mathrm{km/s}$.

ANSWER:

No elements selected



Select the elements from the list and add them to the canvas setting the appropriate attributes. Press **TAB** to get to the main menu.

Problem S3.53

nsider a spacetime diagram on which the vertical time axis is marked in seconds and the horizontal space axis is marked in light-seconds. Assume a worldline with a pe of 27° (from the horizontal).

rt A

At what speed would an object have to be traveling to have this worldline?

Express your answer to two significant figures and include the appropriate units.

ANSWER:

$v = 5.9 \times 10^{8} \ \frac{\mathrm{m}}{\mathrm{s}}$

Correct

rt B

Can any object have this worldline?

ANSWER:

- no
- yes

Correct

rt C

What is the least possible slope of the worldline?

Express your answer in degrees to two significant figures.

ANSWER:

ϕ_{minimal} = 45 °

Correct

Problem S3.58

e Andromeda Galaxy is about 2.5 million light-years away. Suppose you had a spaceship that could constantly accelerate at a = 1.6 g.

long as the ship is gone from Earth for many years, the amount of time that passes on the spaceship during the trip is approximately:

$$_{\mathrm{ip}} = \frac{2c}{a}\ln\left(\frac{a \times D}{c^2}\right)$$

ere D is the distance to the destination and $\ln$ stands for the natural logarithm (which you can calculate with the "ln" key on most scientific calculators). If D is in ters, $g =$ 9.8 $\mathrm{m/s^2}$, and $c = 3 \times 10^8\ \mathrm{m/s}$, the answer will be in units of seconds.

rt A

Could you go to the Andromeda Galaxy and come back within your lifetime?

ANSWER:

- no
- yes

Correct

rt B

How long would that trip last for you?

Express your answer in years to two significant figures.

ANSWER:

t_{personal} = 37 yr

Answer Requested

rt C

How many time would pass on Earth?

Express your answer in years to two significant figures.

ANSWER:

t_{Earth} = 5.0×10^6 yr

Answer Requested

Problem S3.59

r a relatively weak gravitational field, such as that of a planet or an ordinary star, the following formula tells us the fractional amount of gravitational time dilation at a tance r from the center of an object of mass M_{object}:

$$\frac{1}{c^2} \times \frac{GM_{\text{object}}}{r}$$

$= 6.67 \times 10^{-11}\ \text{m}^3/(\text{kg} \times \text{s}^2)$; $c = 3 \times 10^8\ \text{m/s}$.) For example, while 1 hour passes in deep space far from the object, the amount of time that passes at a tance r is 1 hour minus 1 hour multiplied by the factor above. (This formula does *not* apply to strong gravitational fields, like those near black holes.)

rt A

Calculate the amount of time that passes on Earth's surface while 3.0 hour passes in deep space.

Express your answer in seconds to three significant figures.

ANSWER: