A particle of rest mass $M$ decays into two identical particles of rest mass $m$ each. What is the speed of each of these particles in the rest frame of the original particle?

- i. $c\sqrt{\frac{M^2}{4m^2} - 1}$
- ii. $c\sqrt{1 - \frac{4m^2}{M^2}}$
- iii. $c\sqrt{1 - \frac{m^2}{M^2}}$
- iv. $c\sqrt{\frac{M}{2m} - 1}$

A particle of rest mass $M$ decays into two identical particles of rest mass $m$ each. What is the total energy of one of the decay particles in the rest frame of the other particle?

- A. $\frac{M^2 - 4m^2}{2m}c^2$
- B. $\frac{M^2 - 2m^2}{2m}c^2$
- C. $\frac{M^2 - 2m^2}{2M}c^2$
- D. $\frac{M^2 - 4m^2}{2M}c^2$

A particle of rest mass $M$ decays into two identical particles of rest mass $m$ each. What is the speed of one of these decay particles with respect to the other?

- a. $2c\sqrt{\frac{M}{2m} - 1}$
- b. $c\frac{\sqrt{1-\frac{4m^2}{M^2}}}{1-\frac{2m^2}{M^2}}$
- c. $2c\sqrt{1 - \frac{4m^2}{M^2}}$
- d. $c\frac{\sqrt{1 - \frac{4m^2}{M^2}}}{1 - \frac{2M}{m}}$

A particle of rest mass $M$ decays into two identical particles of rest mass $m$ each. What is the magnitude of the momentum of one of the decay particles in the rest frame of the other particle?

- a. $\frac{M}{2m}\sqrt{M^2 + 2m^2}c$
- b. $\frac{M}{2m}\sqrt{M^2 - 2m^2}c$
- c. $\frac{M}{2m}\sqrt{M^2 + m^2}c$
- d. $\frac{M}{2m}\sqrt{M^2 - m^2}c$

A particle of rest mass $M$ decays into two identical particles of rest mass $m$ each. What is the kinetic energy of one of the decay particles in the rest frame of the other particle?

- A. $\frac{M^2 - 4m^2}{2M}c^2$
- B. $\frac{M^2 - 4m^2}{2m}c^2$
- C. $\frac{M^2 - 2m^2}{2m}c^2$
- D. $\frac{M^2 - 2m^2}{2M}c^2$

For a particle moving at relativistic speeds (speeds close to c) :

- [ ] a. The force is always parallel to the acceleration, bur the ratio of their magnitudes depends on the angle between the velocity and the acceleration.
- [ ] b. The force is parallel to the acceleration only when the velocity is parallel to the acceleration.
- [ ] c. The force is parallel to the acceleration only when the velocity is perpendicular to the acceleration.
- [ ] d. The force is parallel to the acceleration either when the velocity is parallel to the acceleration or when it is perpendicular to the acceleration.

A constant force $F$ acts on a particle of rest mass $m$, initially at rest, for a distance $d$. The speed of the particle after the force acts is $u$. Then we have:

a. $$\frac{1}{\sqrt{1-\frac{u^2}{c^2}}}=\frac{Fd}{mc^2}$$

b. $$\frac{1}{\sqrt{1-\frac{u^2}{c^2}}}=\frac{mc^2}{Fd}+1$$

c. $$\frac{1}{\sqrt{1-\frac{u^2}{c^2}}}=\frac{Fd}{mc^2}+1$$

d. $$\frac{1}{\sqrt{1-\frac{u^2}{c^2}}}=\frac{mc^2}{Fd}$$

A force $\vec{F}$ acts on a particle of rest mass $m$. Then the rate of increase of kinetic energy of the particle is related to its velocity $\vec{u}$ and acceleration $\vec{a}$ by

a. $$m\left(\vec{u}\cdot\vec{a}\right)\left(1-\frac{u^2}{c^2}\right)^{\frac{1}{2}}$$

b. $$\frac{m\left(\vec{u}\cdot\vec{a}\right)}{\left(1-\frac{u^2}{c^2}\right)^{\frac{3}{2}}}$$

c. $$m\left(\vec{u}\cdot\vec{a}\right)\left(1-\frac{u^2}{c^2}\right)^{\frac{3}{2}}$$

d. $$\frac{m\left(\vec{u}\cdot\vec{a}\right)}{\left(1-\frac{u^2}{c^2}\right)^{\frac{1}{2}}}$$

A particle moving in one dimension is described by the Lagrangian

$$L=\frac{1}{2}m\dot{x}^2+A\omega x^2\cos\left(\omega t\right)+2Ax\dot{x}\sin\left(\omega t\right)-\frac{1}{2}m\omega^2x^2$$

The equation of motion for this particle is

a. $m\ddot{x}-2A\dot{x}\sin\left(\omega t\right)=-m\omega^2x+2A\omega x\cos\left(\omega t\right)$

b. $m\ddot{x}=-m\omega^2x$

c. $m\ddot{x}+2A\dot{x}\sin\left(\omega t\right)=-m\omega^2x+2A\omega x\cos\left(\omega t\right)$

d. $m\ddot{x}+2A\dot{x}\sin\left(\omega t\right)+2A\omega x\cos\left(\omega t\right)=-m\omega^2x$

A particle moving in one dimension is described by the Lagrangian

$$L=\frac{1}{2}m\dot{x}^2+2Ax^3t+3Ax^2\dot{x}t^2$$

The equation of motion for this particle is

a. $m\ddot{x}=6Ax^2t+6Ax\dot{x}t^2$

b. $m\ddot{x}+6Ax\dot{x}t^2=6Ax^2t$

c. $m\ddot{x}=0$

d. $m\ddot{x}-6Ax\dot{x}t^2=6Ax^2t$

A particle moving in two dimensions is described by the Lagrangian

$$L=\frac{1}{2}m\left(\dot{r}^2+r^2\dot{\theta}^2\right)+Ar^2\cos\left(\theta\right)\dot{\theta}+2Ar\sin\left(\theta\right)\dot{r}$$

The equation of motion for this particle is

- [ ] a.
$$\ddot{r}-r\dot{\theta}^2=4\frac{A}{m}\sin\left(\theta\right)\dot{r}$$
$$r\ddot{\theta}+2\dot{r}\dot{\theta}=2\frac{A}{m}\cos\left(\theta\right)\dot{r}-\frac{A}{m}r\sin\left(\theta\right)\dot{\theta}$$

- [ ] b.
$$\ddot{r}-r\dot{\theta}^2=0$$
$$r\ddot{\theta}+2\dot{r}\dot{\theta}=0$$

- [ ] c.
$$\ddot{r}-r\dot{\theta}^2=2\frac{A}{m}r\cos\left(\theta\right)\dot{\theta}+2\frac{A}{m}\sin\left(\theta\right)\dot{r}$$
$$r\ddot{\theta}+2\dot{r}\dot{\theta}=2\frac{A}{m}\cos\left(\theta\right)\dot{r}-\frac{A}{m}r\sin\left(\theta\right)\dot{\theta}$$

- [ ] d.
$$\ddot{r}-r\dot{\theta}^2=2\frac{A}{m}r\cos\left(\theta\right)\dot{\theta}$$
$$r\ddot{\theta}+2\dot{r}\dot{\theta}=2\frac{A}{m}\cos\left(\theta\right)\dot{r}$$

A particle moving in one dimension is described by the Lagrangian

$$L=\frac{1}{2}m\dot{x}^2+A\omega x^2\cos\left(\omega t\right)+Ax\dot{x}\sin\left(\omega t\right)-\frac{1}{2}m\omega^2x^2$$

The equation of motion for this particle is

a. $m\ddot{x}=-m\omega^2x$

b. $m\ddot{x}-A\dot{x}\sin\left(\omega t\right)=-m\omega^2x+A\omega x\cos\left(\omega t\right)$

c. $m\ddot{x}=-m\omega^2x+A\omega x\cos\left(\omega t\right)$

d. $m\ddot{x}+A\dot{x}\sin\left(\omega t\right)+A\omega x\cos\left(\omega t\right)=-m\omega^2x$