27. A concave lens always produces an image that is virtual, erect and smaller.

C is the answer.

28. When the incident ray is parallel to the principal axis of a convex lens, the ray refracts through the focal point.

D is the answer.

29. When the incident ray is parallel to the principal axis of a concave lens, the ray refracts as if it came from the focal point.

A is the answer.

30. When the object is placed at $2f$ of a convex lens, the image produced is real, inverted and the same size. Therefore the magnification $\left(\frac{h_i}{h_o}\right)$ is 1.

C is the answer.

MODERN PHYSICS

Lesson 1–Time Dilation

1.
$$t = \frac{t_0}{\sqrt{1-\frac{v^2}{c^2}}}$$
$$= \frac{1.25 \text{ years}}{\sqrt{1-\left(\frac{2.40\times10^8 \text{ m/s}}{3.00\times10^8 \text{ m/s}}\right)^2}}$$
$$= 2.08 \text{ years}$$

2.
$$t = \frac{t_0}{\sqrt{1-\frac{v^2}{c^2}}}$$
$$= \frac{3.00 \text{ years}}{\sqrt{1-\left(\frac{7.50\times10^7 \text{ m/s}}{3.00\times10^8 \text{ m/s}}\right)^2}}$$
$$= 3.10 \text{ years}$$

3.
$$t = \frac{t_0}{\sqrt{1-\frac{v^2}{c^2}}}$$
$$= \frac{1.50 \text{ h}}{\sqrt{1-\left(\frac{44.4 \text{ m/s}}{3.00\times10^8 \text{ m/s}}\right)^2}}$$
$$= 1.50 \text{ h}$$

4.
$$t = \frac{t_0}{\sqrt{1-\frac{v^2}{c^2}}}$$
$$t_0 = t\left(\sqrt{1-\frac{v^2}{c^2}}\right)$$
$$= (50.0 \text{ years})\left(\sqrt{1-\left(\frac{2.80\times10^8 \text{ m/s}}{3.00\times10^8 \text{ m/s}}\right)^2}\right)$$
$$= 18.0 \text{ years}$$

5.
$$t = \frac{t_0}{\sqrt{1-\frac{v^2}{c^2}}}$$
$$t_0 = t\left(\sqrt{1-\frac{v^2}{c^2}}\right)$$
$$= (35.0 \text{ years})\left(\sqrt{1-\left(\frac{2.90\times10^8 \text{ m/s}}{3.00\times10^8 \text{ m/s}}\right)^2}\right)$$
$$= 8.96 \text{ years}$$

6.
$$t = \frac{t_0}{\sqrt{1-\frac{v^2}{c^2}}}$$
$$18.0 \text{ years} = \frac{10.0 \text{ years}}{\sqrt{1-\frac{v^2}{(3.00\times10^8 \text{ m/s})^2}}}$$
$$\sqrt{1-\frac{v^2}{(3.00\times10^8 \text{ m/s})^2}} = \frac{10.0 \text{ years}}{18.0 \text{ years}}$$
$$1-\frac{v^2}{(3.00\times10^8 \text{ m/s})^2} = \left(\frac{10.0}{18.0}\right)^2$$
$$\frac{v^2}{(3.00\times10^8 \text{ m/s})^2} = 1-\left(\frac{10.0}{18.0}\right)^2$$
$$= 0.691$$
$$v = \sqrt{(0.691)(3.00\times10^8 \text{ m/s})^2}$$
$$= 2.49 \times 10^8 \text{ m/s}$$

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