50. We orient our $+x$ axis along the initial direction of motion, and specify angles in the "standard" way – so $\theta = -90°$ for the particle B which is assumed to scatter "downward" and $\phi > 0$ for particle A which presumably goes into the first quadrant. We apply the conservation of linear momentum to the x and y axes respectively.

$$\begin{aligned} m_B v_B &= m_B v'_B \cos\theta + m_A v'_A \cos\phi \\ 0 &= m_B v'_B \sin\theta + m_A v'_A \sin\phi \end{aligned}$$

(a) Setting $v_B = v$ and $v'_B = v/2$, the y-momentum equation yields

$$m_A v'_A \sin\phi = m_B \frac{v}{2}$$

and the x-momentum equation yields

$$m_A v'_A \cos\phi = m_B \, v \ .$$

Dividing these two equations, we find $\tan\phi = \frac{1}{2}$ which yields $\phi = 27°$. If we choose to measure this from the final direction of motion for B, then this becomes $90° + 27° = 117°$.

(b) We can *formally* solve for v'_A (using the y-momentum equation and the fact that $\sin\phi = 1/\sqrt{5}$)

$$v'_A = \frac{\sqrt{5}}{2} \frac{m_B}{m_A} v$$

but lacking numerical values for v and the mass ratio, we cannot fully determine the final speed of A. Note: substituting $\cos\phi = 2/\sqrt{5}$, into the x-momentum equation leads to exactly this same relation (that is, no new information is obtained which might help us determine an answer).