11. Shell reaches maximum height when $v\sin\frac{\pi}{3} = gt \Rightarrow t = \frac{v\sqrt{3}}{2g}$

maximum height $= \frac{3v^2}{8g}$, horizontal velocity of shell is $v\cos\frac{\pi}{3} = \frac{v}{2}$

by conservation of momentum horizontally when Superman catches shell, $3mV = 2m.3v + m.\frac{v}{2}$

so velocity of both Superman and the shell after catching shell is $\frac{13}{3}v$

by conservation of momentum vertically when Superman releases shell , $2mu = m\frac{3v}{2}$

so Supermans vertical velocity becomes $\frac{3v}{4}$

consider now the downward motion of the shell, taking downwards as positive we have

$u = \frac{3v}{2},\ a = g,\ s = \frac{3v^2}{8g}$ so time taken to reach ground is given by $\frac{3v^2}{8g} = \frac{3v}{2}T + \frac{1}{2}gT^2$

$\Rightarrow T^2 + \frac{3v}{g}T - \frac{3v^2}{4g^2} = 0 \Rightarrow T = \frac{1}{2}\left[-\frac{3v}{g} + \sqrt{\frac{9v^2}{g^2} + \frac{12v^2}{16g^2}}\right] = -\frac{3v}{4g} + \frac{v}{4g}\sqrt{39}$ (-ve answer inadmissible)

Superman now has velocity $\begin{pmatrix} \frac{13v}{3} \\ \frac{3v}{4} \end{pmatrix}$ so his angle to the horizontal is $\arctan\left(\frac{9}{52}\right) = 10^{\circ}$

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