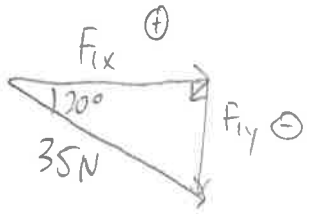
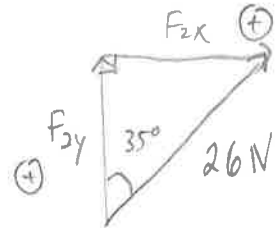
Vector Addition Practice

1. a) F_1



F_2

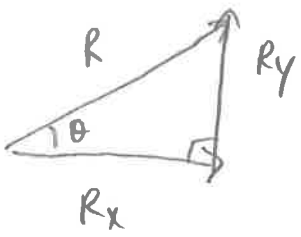


$F_{1x} = (35N)\cos 20°$
$F_{1x} = -(35N)\sin 20°$

$F_{2x} = (26N)\sin 35°$
$F_{2y} = (26N)\cos 35°$

$R_x = F_{1x} + F_{2x}$
$= (35N)\cos 20° + (26N)\sin 35° = 47.8022\ N$

$R_y = F_{1y} + F_{2y}$
$= -(35N)\sin 20° + (26N)\cos 35° = 9.327248\ N$



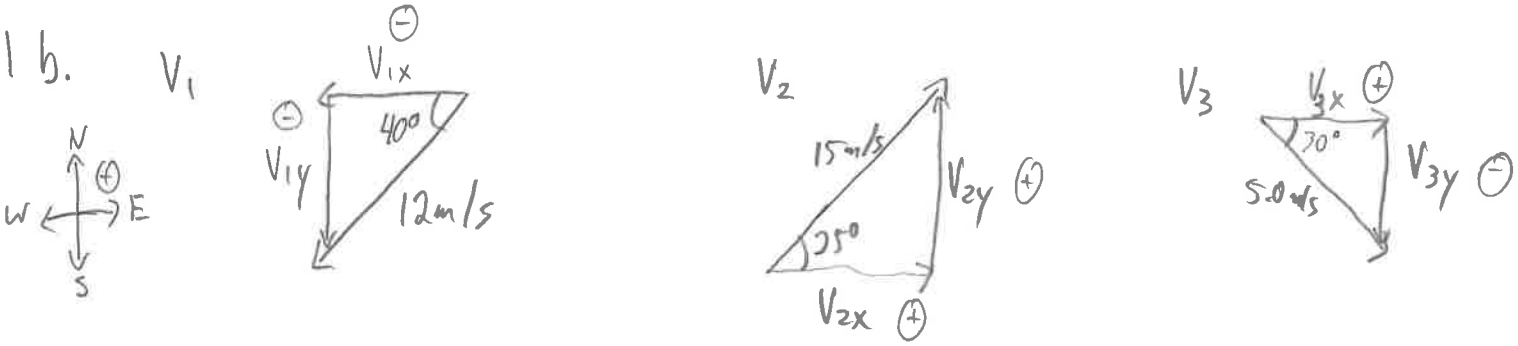
$R = \sqrt{R_x^2 + R_y^2}$
$= \sqrt{(46.8022N)^2 + (9.327248N)^2}$
$= 48.7036\ N$
$= 49\ N$

$\tan\theta = \frac{R_y}{R_x}$

$\theta = \tan^{-1}\left(\frac{9.327248N}{47.8022N}\right) = 11.0409°$

$R = 49N,\ 11°\ N\ of\ E$

1b.



$$R_x = V_{1x} + V_{2x} + V_{3x}$$

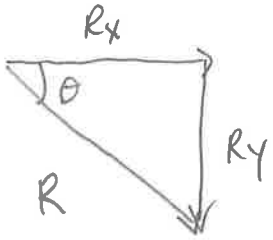
$$= -(12\,m/s)(\cos 40°) + (15\,m/s)(\cos 25°) + (5.0\,m/s)(\cos 30°)$$

$$= 8.7322\ldots\ m/s$$

$$R_y = V_{1y} + V_{2y} + V_{3y}$$

$$= -(12\,m/s)(\sin 40°) + (15\,m/s)(\sin 25°) - (5.0\,m/s)(\sin 30°)$$

$$= -3.8741\ m/s$$



$$R = \sqrt{R_x^2 + R_y^2}$$

$$= \sqrt{(8.7322\,m/s)^2 + (-3.8741\,m/s)^2}$$

$$= 9.5530\ m/s$$

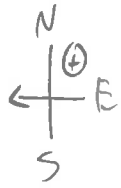
$$\tan\theta = \frac{R_y}{R_x}$$

$$\theta = \tan^{-1}\left(\frac{3.8741\,m/s}{8.7322\,m/s}\right)$$

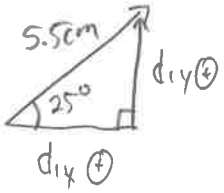
$$= 23.9247°$$

R = 9.6 m/s, 24° S of E

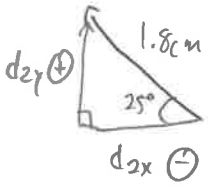
d.c



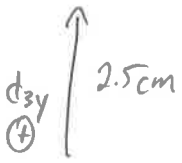
d_1



d_2



d_3



$$R_x = d_{1x} + d_{2x} - d_{3x}$$

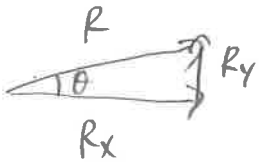
NO d_{3x} =

$$= (5.5\text{cm})(\cos 25^\circ) - (1.8\text{cm})(\cos 25^\circ) - (0\text{cm})$$

$$= 3.3533 \text{ cm}$$

$$R_y = (5.5\text{cm})(\sin 25^\circ) + (1.8\text{cm})(\sin 25^\circ) - 2.5\text{cm}$$

$$= 0.5851 \text{ cm}$$



$$R = \sqrt{R_x^2 + R_y^2}$$

$$= \sqrt{(3.3533\text{cm})^2 + (0.5851\text{cm})^2}$$

$$= 3.4039 \text{ cm}$$

$$\tan\theta = \frac{R_y}{R_x}$$

$$\theta = \tan^{-1}\left(\frac{0.5851 \text{ cm}}{3.3533 \text{ cm}}\right)$$

$$= 9.897^\circ$$

$R = 3.4$ cm, 9.9° N of E

2.

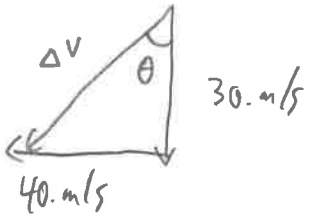
V_i → 40. m/s

V_F ↓ 30. m/s

$t = 5.0\,s$

$a = \frac{\Delta V}{t}$

$\Delta V = V_F - V_i$



$\Delta V = \sqrt{(30.\,m/s)^2 + (40.\,m/s)^2}$

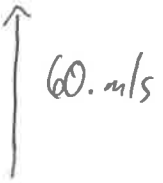
$= 50\ m/s$

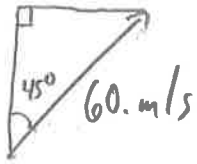
$\tan\theta = \frac{V_i}{V_F}$

$\theta = \tan^{-1}\left(\frac{40\,m/s}{30\,m/s}\right) = 53.130°$

$a = \frac{\Delta V}{t} = \frac{50\,m/s}{5.0\,s} = 10\ m/s^2$

$= \boxed{10\ m/s^2,\ 53°\ W\ of\ S}$

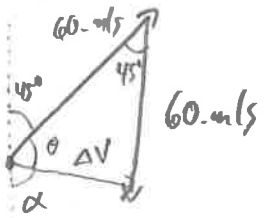
3. V_i 

V_F 

$t = 3.0\,s$

$a = \frac{\Delta V}{t}$

$\Delta V = V_F - V_i$



$\Delta V = \sqrt{V_F^2 + V_i^2 - 2V_F V_i \cos 45°}$

$= \sqrt{(60.\,m/s)^2 + (60.\,m/s)^2 - 2(60.\,m/s)(60.\,m/s)\cos 45°}$

$= 45.92201\ m/s$

$\alpha = 180° - 45° - \theta$

$\frac{\sin 45°}{45.92201} = \frac{\sin\theta}{60}$

$\theta = \sin^{-1}\left(\frac{60 \cdot \sin 45°}{45.92201}\right)$

$= 67.5$

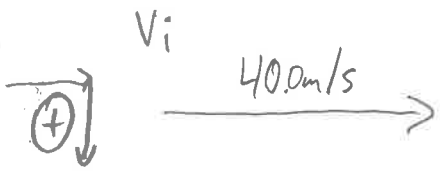
$\alpha = 180° - 45° - 67.5° = 67.5°$ E of S

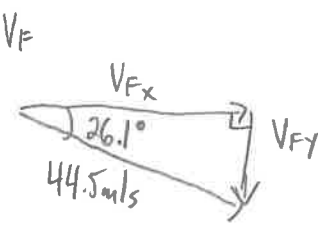
$a = \frac{\Delta V}{t} = \frac{45.92201\ m/s}{3.0\,s}$

$= 15.307\ m/s^2$

$\boxed{a = 15\ m/s^2,\ 68°\ E\ of\ S}$

4.





$t = 2.0\ s$

$a = \frac{\Delta V}{t}$

$\Delta V_x = V_{Fx} - V_{ix}$

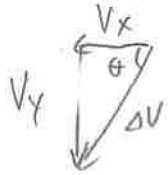
$= (44.5\ m/s)(\cos 26.1°) - (40.0\ m/s)$

$= -0.037772\ m/s$

$\Delta V_y = V_{Fy} - V_{ix}$

$= (44.5\ m/s)(\sin 26.1\ m/s)$

$= 19.5772\ m/s$



$\Delta V = \sqrt{V_x^2 + V_y^2}$

$= \sqrt{(-0.037772 m/s)^2 + (19.5772 m/s)^2}$

$= 19.5772\ m/s$

$\tan\theta = \frac{V_y}{V_x}$

$\theta = \tan^{-1}\left(\frac{19.5772 m/s}{0.037772 m/s}\right)$

$= 89.889°$ below the horizontal $\Rightarrow$ Down

$= 90°$

$a = \frac{\Delta V}{t} = \frac{19.5772 m/s}{2.0\ s} = 9.7886\ m/s^2$

$a = 9.8\ m/s^2$ down

5. V_i 60. m/s → ; V_F 50. m/s ← ; ⊕ ←

$t = 0.30\,s$

$\Delta V = V_F - V_i$

$= 50.\,m/s - (-60.\,m/s)$

$= 110\ m/s$ back

$a = \frac{\Delta V}{t}$

$a = \frac{110\,m/s \text{ back}}{0.3\,s}$

$= 366.\overline{6}\ m/s^2$

$= 367\ m/s^2$ back

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6. N, E, S

V_i 100 km/h at 45°; V_F 50. km/h →

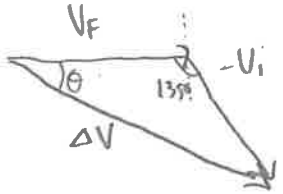
$a = \frac{\Delta V}{t}$ $t = 4.0\,s$

$\Delta V = V_F - V_i$

$\Delta V = \sqrt{V_F^2 + V_i^2 - 2V_F V_i \cos 135^\circ}$

$= \sqrt{(50.\,km/h)^2 + (100.\,km/h)^2 - 2(50.\,km/h)(100.\,km/h)\cos 135^\circ}$

$= 139.896\ km/h = 38.86\ m/s$



$\frac{\sin\theta}{100} = \frac{\sin 135^\circ}{139.896}$

$\theta = \sin^{-1}\left(\frac{100 \cdot \sin 135^\circ}{139.896}\right) = 30.361^\circ$ S of E

$a = \frac{38.86\,m/s}{4.0\,s} = 9.715\ m/s^2$

$a = 9.7\,m/s,\ 30.^\circ$ S of E