SUMMARY OF 60:1 RULES AND FORMULAS
CLIMBS AND DESCENTS

The 60:1 Rule:	1° = 1 NM at 60 NM	1° = 100 FT at 1 NM

Climb and Descent Gradients: Required gradient (FT/NM) = **altitude to lose (or gain) / distance to travel**	Pitch change = **gradient / 100**	**(1° pitch change = 100 FT/NM)**

VVI:

VVI = **Gradient (or pitch X 100) X TAS in minutes**

VVI for a 3° glideslope = $\left(\frac{\text{GndSpd X 10}}{2}\right)$	VVI for a 2.5° glideslope = $\left(\frac{\text{GndSpd X 10}}{2}\right)$ **– 100**

Determine TAS and NM/MIN: TAS = **IMN X 600**	TAS = **IAS +** $\frac{\text{FL}}{2}$	TAS = **IAS +** $\left(\frac{5\text{kt}}{1000'}\right)$ *Note: works well for the 200-300 knot range*
NM/MIN = **IMN X 10**	TAS = 2% of IAS per 1000'	NM/MIN = $\left(\frac{\text{TAS}}{60}\right)$

Steps to Determine Required Pitch and VVI (Winded Application). Mathematical steps:

Required gradient: **Gradient = Alt to lose / Dist to travel**

Required VVI with wind: **VVI = gradient X groundspeed (NM/MIN)**	**NOTE***: For practical applications, each 60 KTS of wind will change pitch 1°.*
Required pitch change: **Pitch change = required VVI / TAS (in NM/MIN)**	

TURNS

Turn Radius (TR)	**Turn Diameter (TD) = 2 X TR**
Distance to turn 90° using 30° of bank: TR = **NM/MIN - 2** or	TR = **(IMN X 10) - 2**
TR = $\frac{\text{(NM/MIN)}^2}{10}$ or	TR = **IMN^2 X 10**
Distance to turn 90° using SRTs and 1/2 SRTs: SRT = .5**% of TAS (or groundspeed)**	1/2 SRT = **1% of TAS (or groundspeed)**
Bank for Rate Turns: Bank for SRT = $\left(\frac{\text{TAS}}{10}\right)$ **+ 7**	Bank for 1/2 SRT = $\left(\frac{\text{TAS}}{20}\right)$ **+ 7**

Lead Point for Radial to an Arc or 90° Intercept of an Arc:

Lead point in DME = **Desired Arc ± TR**

Lead Point for Arc to Radial or 90° Intercept of a Radial: Lead point (in degrees) = $\left(\frac{60}{\text{Arc}}\right)$ **X TR (in NM)** or	$\left(\frac{60}{\text{DME}}\right)$ **X TR (in NM)**

For Turns Less or More Than 90°, Use The Following: (These cover most situations):

Degrees to Turn	Fraction of 90° Turn	Degrees to Turn	Fraction of 90° Turn
180°	2	90°	1
150°	1 5/6	60°	1/2
135°	1 2/3	45°	1/3
120°	1 1/2	30°	1/6

Bank Angle Required to Maintain an Arc:

Required bank angle = $\left(\frac{30}{\text{Arc}}\right)$ **X TR (Use IMN squared for TR to obtain best results)**

or Required Bank angle = $\left(\frac{\text{Radial Lead Point}}{2}\right)$

HOLDING

Teardrop Holding Calculations:

Offset in degrees = **TD X 60 / outbound distance** or	**TR X 120 / outbound distance**
Timing: **< 14,000 = 1+00**	**> 14,000 = 1+30**

Outbound Correction for Inbound:

1+00 Correction = $\left(\frac{3600}{\text{inbound time}}\right)$ **= outbound time**

1+30 Correction = $\left(\frac{8100}{\text{inbound time}}\right)$ **= outbound time**

Double Drift:

Into wind turn = **30° bank - 1° for every deg of drift** Inbound to fix = **course heading + drift**	Other Turn = **30° bank** Outbound leg = **outbound heading + (drift X 2)** **Hold double drift for same amount of time as the 180° turn**
Drift calculation: Drift = **Crosswind Component / NM/MIN of TAS**	**180° turn = 1% TAS / 2** *Ex. 240 TAS = 2.4 / 2 = 1.2 Min = 1+12*
Triple drift: Into Wind Turn = **30° bank** Inbound to fix = **Course heading + drift**	Other Turn = **30° bank** Outbound leg = **outbound heading + (drift X 3)** **Hold triple drift for same amount of time as the 180° turn**
Drift Calculation: Drift = **Crosswind component / NM/MIN of TAS**	**180° turn = 1% TAS / 2** *Ex. 240 TAS = 2.4 / 2 = 1.2 Min = 1+12*

APPROACH

Teardrop Penetration Calculation:

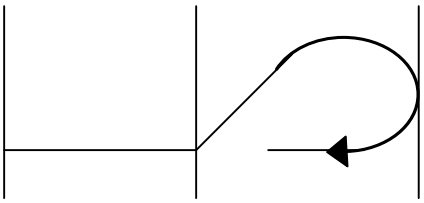
Determine **outbound distance** for 30° bank turn: Outbound distance = $\left(\frac{\text{TD X 60}}{\text{Degrees between radials}}\right)$	$\left(\frac{\text{TR X 120}}{\text{Degrees between radials}}\right)$

Determine **bank angle** required for teardrop penetration (When 30° bank will not work):

TR X 60 / Distance between Radials in NM

Procedure Turn Calculations:

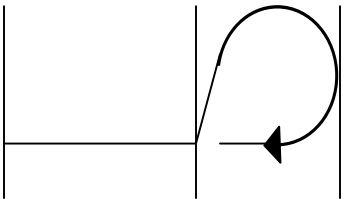
45/180 Maneuver distance = **(3 X TR) + 2**



(3 X TR) + 2

|-----Remain within distance----------|

80/260 Maneuver distance = **3 X TR**



3 X TR

|---Remain within distance----|

VDP Calculation:

VDP (in NM) From the ***end of the runway*** = **HAT / Gradient (normally 300)**

VDP (in timing) From the ***FAF*** = **(FAF to End of runway Distance) (NM) - HAT / Gradient (normally 300) = FAF to VDP Dist**

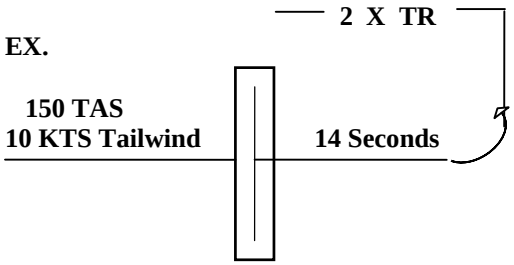
Timing to MAP (From timing box) / NM from FAF to MAP = Seconds per Mile or **60 / (TAS / 60) = Seconds per Mile**

(Seconds per Mile) X FAF to VDP Dist (NM) = Time (in Seconds)

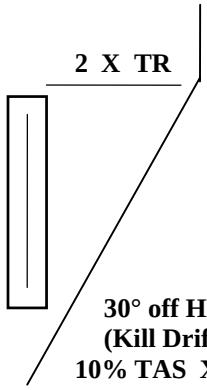
CIRCLE

Perpendicular to Runway
Timing passing runway =
10% TAS (corrected for winds)
(TAS + headwind - tailwind component)
(Yes, subtract tailwind to counteract it "pushing you across the ground")

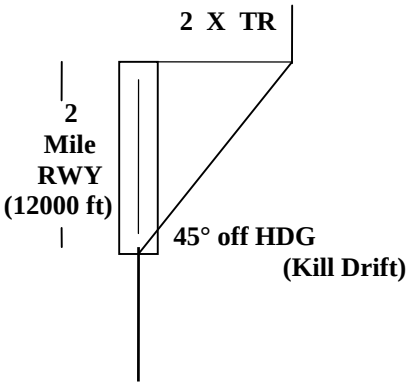
EX.



Displacement using 30° rule
Turn 30° off RWY HDG
(Kill Drift)
and time for 10% TAS X 4



Displacement using 45° rule
Turn 45° off RWY HDG
(Kill Drift)
Displace using Runway



NOTE: If 2 X TR = 2 MI than displace down a 2 MI RWY as as depicted.