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Master Reference

1. Overview of Applications

The 1 in 60 rule is not limited to en-route track corrections. It also applies wherever an angle, a distance, and a range form a right-angled (or near-right-angled) triangle. The main examinable applications are:

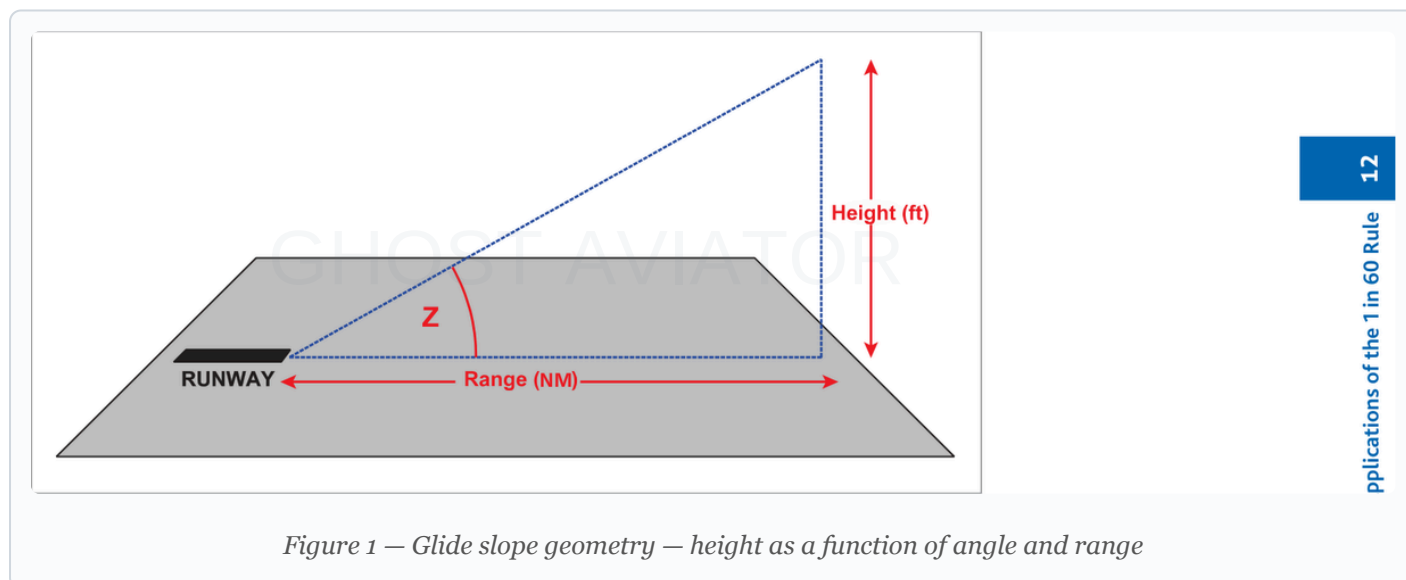
- **Glide slope height** — finding the correct height at a given range
- **Rate of descent (ROD)** — finding the ROD needed to stay on slope at a given speed
- **Speed change on a glide slope** — adjusting ROD when speed changes
- **VOR/DME crosstrack** — finding distance off an airway centre line
- **Range from VOR bearing change** — finding distance to a VOR by timing a bearing change

Key Approximation

1 NM = 6 080 ft, but **1 NM $\approx$ 6 000 ft** is used for all 1-in-60 calculations. This introduces only ~1% error and is accepted for all exam purposes.

2. Height on a Glide Slope

The same track-error geometry applies in the *vertical* plane. The angle is the glide slope angle (Z°), the adjacent side is the range, and the opposite side is the height.



Derivation ($Z = 1^\circ$)

Range = 60 ft $\rightarrow$ Height = 1 ft

Range = 6 000 ft (1 NM) $\rightarrow$ Height = 100 ft

General rule: **Height = 100 $\times$ Z $\times$ range (NM)**

Glide slope height

$$H \text{ (ft)} = 100 \times Z^\circ \times \text{Range (NM)}$$

Equivalently: $H = (Z \times \text{range_ft}) / 60$ | where 1 NM = 6 000 ft

Glide slope angle	Height per NM	Common at
2.5°	250 ft/NM	Military fast-jet airfields
3.0°	300 ft/NM	Most civil airports (ILS standard)
3.5°	350 ft/NM	Some civilian airports near terrain
5.5°	550 ft/NM	London City Airport (steep approach)

Worked Examples

Example 1 — 3° slope at 4 NM

$$H = 100 \times 3 \times 4 = \mathbf{1\,200\text{ ft}}$$

Example 2 — 5.5° slope at 3 NM

$$H = 100 \times 5.5 \times 3 = \mathbf{1\,650\text{ ft}}$$

3. Rate of Descent (ROD)

The rate of descent required to maintain a glide slope depends on both the slope angle and the ground speed. Think of it this way: in one minute the aircraft travels $GS/60$ NM, and must descend a height of $100 \times Z \times (GS/60)$ feet.

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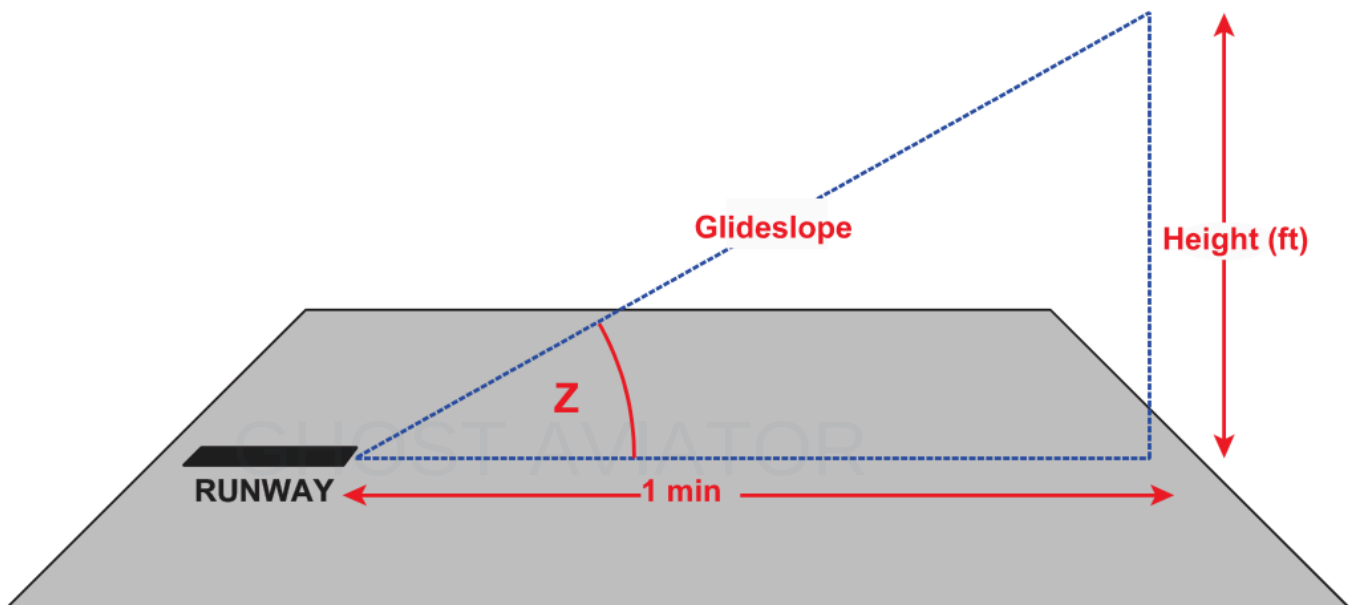


Figure 2 — Rate of descent calculation — range at one minute from touchdown

ROD for a 3° glide slope only

$$\text{ROD (ft/min)} = 5 \times \text{Ground Speed (kt)}$$

For other angles: $\text{ROD} = 5 \times \text{GS} \times (Z / 3)$

✈ Why the $5 \times$ Rule works for 3°

At 3° : height per NM = 300 ft. Distance per minute = $\text{GS}/60$ NM.

$\text{ROD} = 300 \times (\text{GS}/60) = \underline{5 \times \text{GS}}$. The factor of 5 comes directly from $300/60$.

Worked Examples

3° slope, GS 120 kt:

$$\text{ROD} = 5 \times 120 = \underline{600 \text{ ft/min}}$$

4° slope, GS 100 kt:

$$3^\circ \text{ ROD} = 5 \times 100 = 500 \text{ ft/min}$$

$$\text{Scale to } 4^\circ: 500 \times (4/3) = \underline{667 \text{ ft/min}} \text{ (use 670 in practice)}$$

4. Change of Speed on a Glide Slope

Changing speed on a glide slope requires a corresponding change in ROD to stay on the slope.

➔ Speed Change Rules

- Decrease speed → Decrease ROD
- Increase speed → Increase ROD

Change in ROD for a 3° slope only

$$\Delta \text{ROD (ft/min)} = 5 \times \Delta \text{Ground Speed (kt)}$$

For other angles: scale by (Z / 3)

Worked Examples

Example 1 — London Heathrow (3°), GS 140 kt

$$\text{ROD} = 5 \times 140 = \underline{700 \text{ ft/min}}$$

Example 2 — London City (5.5°), GS 120 kt

$$3^\circ \text{ ROD} = 5 \times 120 = 600 \text{ ft/min}$$

$$\text{Scale to } 5.5^\circ: 600 \times (5.5/3) = \underline{1100 \text{ ft/min}}$$

Example 3 — London Heathrow (3°), reduce GS from 140 → 120 kt

$\Delta\text{Speed} = 20 \text{ kt} \rightarrow \Delta\text{ROD} = 5 \times 20 = 100 \text{ ft/min}$

Decrease ROD: $700 - 100 = \mathbf{600 \text{ ft/min}}$

Example 4 — London City (5.5°), reduce GS from 120 → 110 kt

3° change: $5 \times 10 = 50 \text{ ft/min}$

Scale to 5.5°: $50 \times (5.5/3) = \mathbf{92 \text{ ft/min}}$ decrease

5. VOR/DME Crosstrack Problems

The 1 in 60 formula applies directly to find how far an aircraft is off an airway centre line when the RMI QDM differs from the published airway QDM.

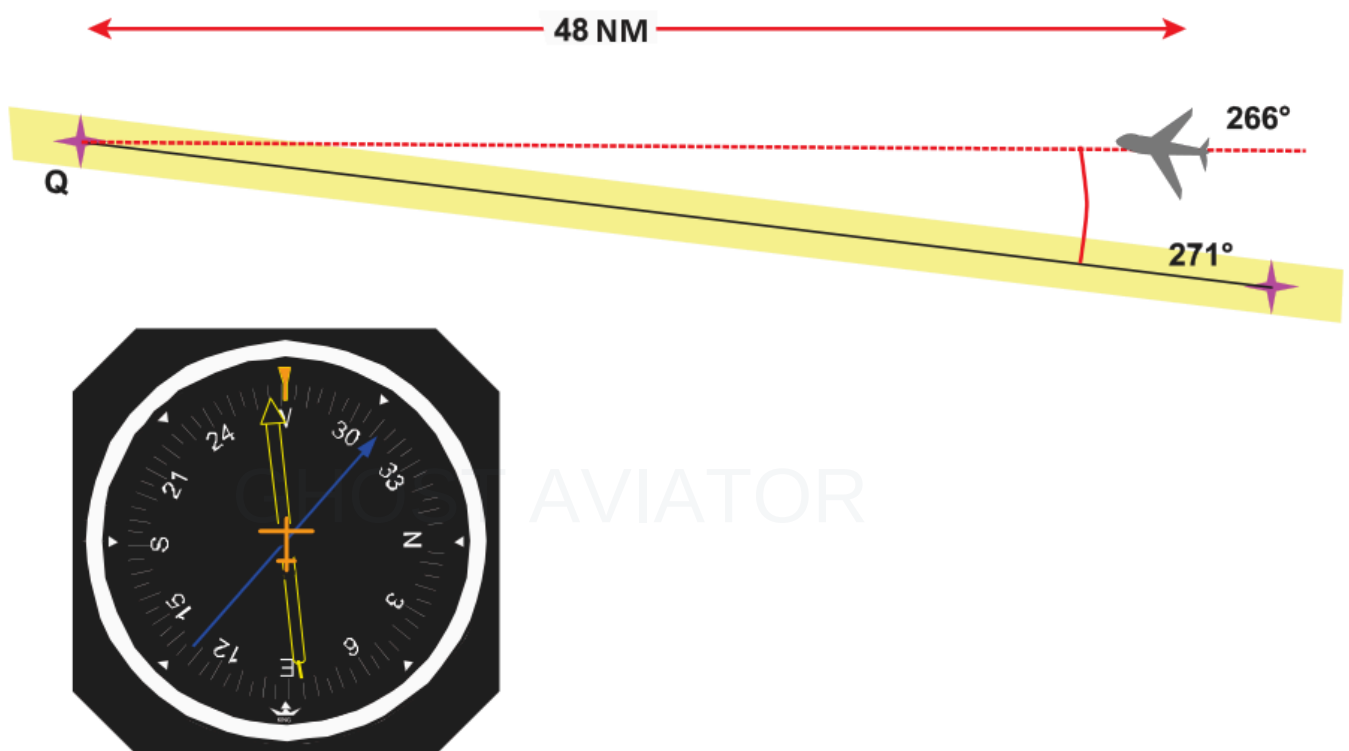


Figure 3 — VOR/DME crosstrack distance problem

Distance off centre line

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$$\text{Distance off (NM)} = (\text{Angle off}^\circ \times \text{DME range}) / 60$$

$$\text{Angle off} = |\text{RMI QDM} - \text{Airway centre line QDM}|$$

Worked Example

Airway QDM = 271°(M). RMI reads QDM 266°(M), DME 48 NM.

$$\text{Angle off} = |271 - 266| = 5^\circ$$

$$\text{Distance off} = (5 \times 48) / 60 = \textbf{4 NM right}$$
 of centre line

Note: RMI < airway QDM → aircraft is **RIGHT** of centre line

✂ Which side of centre line?

The QDM is the bearing *to* the VOR. If your QDM is *higher* than the airway QDM, the VOR is displaced to the right of your nose → you are **left** of centre line.

If your QDM is *lower* than the airway QDM, the VOR is displaced left → you are **right** of centre line.

i Airway Width

Most airways extend **5 NM each side** of the centre line (10 NM total). If your distance off is 5 NM or more, you are at or beyond the airway boundary and in potential conflict with ATC clearances.

6. Finding Range from Change of VOR Bearing

If you record the change in QDM (or QDR) from a VOR over a known time and ground speed, you can calculate your range from the VOR using the 1 in 60 rule.

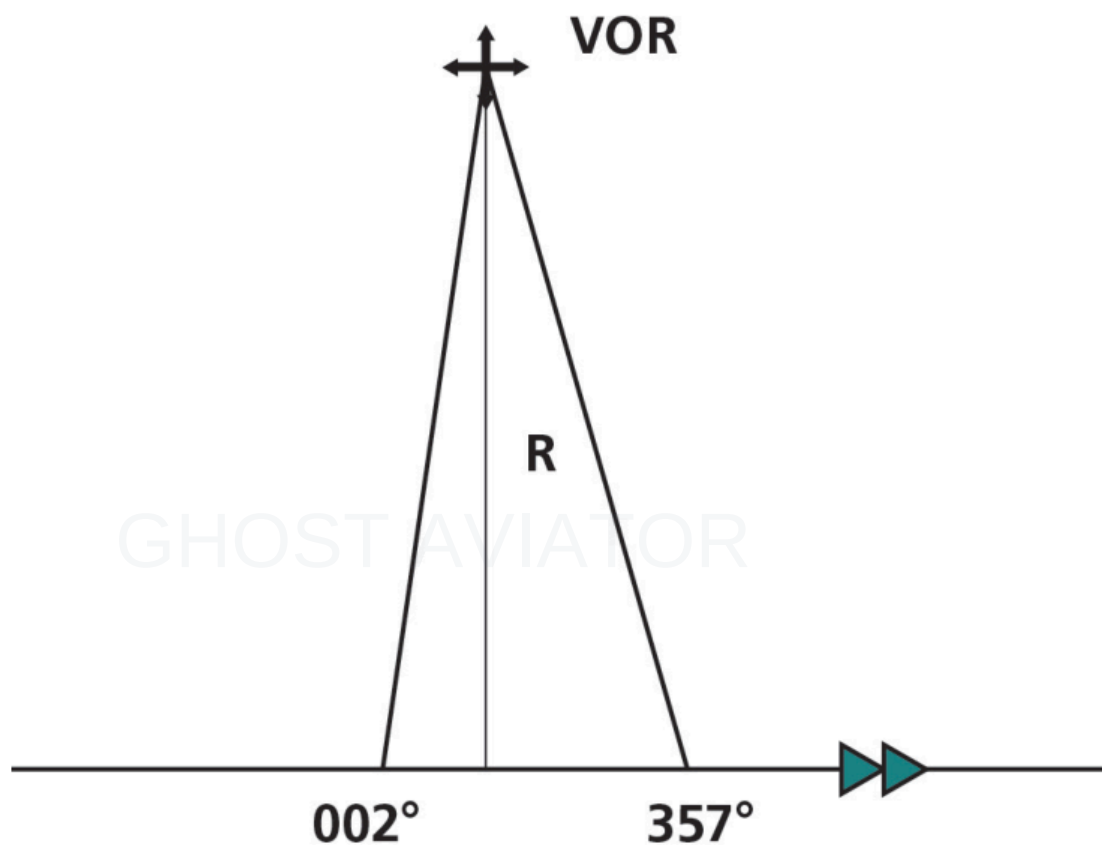


Figure 4 — Finding range from change of VOR bearing

Worked Example

Tracking 090°(M) at 180 kt GS. At 1100 hrs QDM = 002°. At 1105 hrs QDM = 357°.

Bearing change: $002^\circ \rightarrow 357^\circ = 5^\circ$ (VOR moved left, so aircraft passed from right side to left side)

Distance flown: $5 \text{ min} \times 180/60 = 15 \text{ NM}$

Using 1 in 60: $5^\circ \times \text{Range} = 15 \times 60 \rightarrow \text{Range} = (15 \times 60) / 5 = \mathbf{180 \text{ NM}}$

Range from bearing change

$$R = (\text{Distance flown} \times 60) / \text{Bearing change } (^\circ)$$

Range is the *perpendicular* distance — closest point of approach to the VOR

Practical Notes

- The bearing change angle must be small enough for the 1 in 60 approximation to hold ($< \sim 20^\circ$)
- The midpoint of the time interval should ideally be when the aircraft is abeam the VOR (QDM = 000° or 360°)
- This technique works equally with QDM or QDR, as long as you use the *change* consistently

Chapter 12 Quick Revision

- Glide slope height: **$H = 100 \times Z \times \text{range(NM)}$**
- ROD (3° only): **$\text{ROD} = 5 \times \text{GS}$** | other angles: multiply by $Z/3$
- Speed change ROD (3° only): **$\Delta\text{ROD} = 5 \times \Delta\text{GS}$** | scale for other angles
- VOR/DME crosstrack: **$\text{DO} = (\text{angle off} \times \text{DME}) / 60$**
- VOR range: **$R = (\text{distance flown} \times 60) / \text{bearing change}$**
- Airway width: 5 NM each side of centre line in most countries

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Practice Questions & Detailed Answers

8 questions (14 sub-parts) • Glide slope, ROD, VOR/DME, bearing change range

Q1. An aircraft is flying due South. At 1000 hrs, point P bears $267^\circ(\text{T})$ from the aircraft. At 1006 hrs, point P bears $275^\circ(\text{T})$. Ground speed is 120 kt. Estimate the range from point P.

Answer: 90 NM

Bearing change: $275^\circ - 267^\circ = 8^\circ$

Distance flown in 6 min at 120 kt: $120 \times 6/60 = 12 \text{ NM}$

Range: $R = (12 \times 60) / 8 = \text{90 NM}$

Instructor's Note: Source key: 90 NM. Verified.

Q2. You are approaching Innsbruck, Austria on a glide slope of 3.5° . What height (QFE) should you be at 2 NM range?

Answer: 700 ft

$H = 100 \times Z \times \text{range} = 100 \times 3.5 \times 2 = \text{700 ft}$

Instructor's Note: Source key: 700 ft. Verified.

Q3. You are approaching Rota, Spain, on a glide slope of 2.6° . At what height should you be at 4 NM range?

Answer: 1 040 ft

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$$H = 100 \times 2.6 \times 4 = \underline{1\,040\text{ ft}}$$

Instructor's Note: Source key: 1040 ft. Verified.

Q4. You are approaching Paris/Charles de Gaulle on a 3° glide slope. What height (QFE) at 2 NM range?

Answer: 600 ft

$$H = 100 \times 3 \times 2 = \underline{600\text{ ft}}$$

Instructor's Note: Source key: 600 ft. Verified.

Q5. Using the glide slope scenarios in Q2–Q4, what rates of descent (ROD) are required to maintain the slope at the given ground speeds?

- (a) Q2 scenario (3.5°), GS 120 kt
- (b) Q3 scenario (2.6°), GS 180 kt
- (c) Q4 scenario (3°), GS 150 kt

Answer: (a) 700 ft/min | (b) 780 ft/min | (c) 750 ft/min

(a) Innsbruck — 3.5° , GS 120 kt:

$$3^\circ \text{ ROD} = 5 \times 120 = 600 \text{ ft/min}$$

$$\text{Scale to } 3.5^\circ: 600 \times (3.5/3) = \underline{700 \text{ ft/min}}$$

(b) Rota — 2.6° , GS 180 kt:

$$3^\circ \text{ ROD} = 5 \times 180 = 900 \text{ ft/min}$$

$$\text{Scale to } 2.6^\circ: 900 \times (2.6/3) = \underline{780 \text{ ft/min}}$$

(c) Paris CDG — 3° , GS 150 kt:

$$\text{ROD} = 5 \times 150 = \underline{750 \text{ ft/min}} \text{ (standard } 3^\circ \text{ rule applies directly)}$$

Instructor's Note: Source key: (a)700, (b)780, (c)750. All verified.

Q6. On approach to London Heathrow runway 27, glide slope 3° , you reduce speed from 150 kt to 120 kt GS. What change in ROD is required to maintain the glide slope?

Answer: Decrease ROD by 150 ft/min

Speed change: $\Delta GS = 150 - 120 = 30 \text{ kt}$

ROD change (3°): $\Delta ROD = 5 \times 30 = 150 \text{ ft/min}$

Decrease speed → **Decrease ROD by 150 ft/min**

Instructor's Note: Source key: decrease ROD by 150 ft/min. Verified.

Q7. You are flying into Gioia Del Colle, Italy, on a glide slope of 2.5° . Due to a hydraulic failure you cannot select flaps; approach speed 220 kt TAS with a 10 kt headwind component.

(a) What ROD is required to maintain the glide slope?

You regain partial hydraulics and select mid-flap, reducing approach speed to 190 kt TAS.

(b) What change in ROD is required?

(c) What is your new ROD?

Answer: (a) 875 ft/min | (b) Decrease by 125 ft/min | (c) 750 ft/min

(a) Initial ROD:

$GS = TAS - \text{headwind} = 220 - 10 = 210 \text{ kt}$

$3^\circ \text{ ROD} = 5 \times 210 = 1050 \text{ ft/min}$

Scale to 2.5° : $1050 \times (2.5/3) = 875 \text{ ft/min}$

(b) ROD change on speed reduction:

Key point: use TAS change for ΔROD (GS change = TAS change if headwind component unchanged)

$\Delta TAS = 220 - 190 = 30 \text{ kt}$ $3^\circ \Delta ROD = 5 \times 30 = 150 \text{ ft/min}$

Scale to 2.5°: $150 \times (2.5/3) = 125 \text{ ft/min}$

Decrease speed → **Decrease ROD by 125 ft/min**

(c) New ROD:

$875 - 125 = \text{750 ft/min}$

Instructor's Note: Source key: (a)875, (b)decrease 125, (c)750. All verified. Note: GS used for initial ROD, TAS change used for delta ROD — source uses same values because headwind is constant.

Q8. You are flying an airway with centre line QDM of $137^\circ(\text{M})$ toward VOR/DME 'A'. Your RMI reads $141^\circ(\text{M})$ / DME 90 NM.

- (a) Are you left or right of centre line?
- (b) What is your distance off the airway centre line?
- (c) Are you in trouble with ATC? (Airways normally extend 5 NM from centre line.)

Answer: (a) Left of centre line | (b) 6 NM | (c) Yes

(a) Side of centre line:

Airway QDM = $137^\circ(\text{M})$. Your QDM = $141^\circ(\text{M})$ — *higher* than centre line QDM.

Higher QDM means VOR is displaced further clockwise from your nose → you are displaced anti-clockwise → **LEFT of centre line**

(b) Distance off:

Angle off = $141^\circ - 137^\circ = 4^\circ$

DO = $(4 \times 90) / 60 = \text{6 NM}$

(c) ATC concern:

6 NM > 5 NM airway half-width → **Yes, you are outside the airway.**

You have exceeded the protected airspace boundary and are potentially in conflict with adjacent airways or uncontrolled airspace.

Instructor's Note: Source key: (a)left, (b)6NM, (c)yes. Verified.

Master Reference — Chapter 12

All Formulae

Application	Formula	Notes
Glide slope height	$H \text{ (ft)} = 100 \times Z \times \text{range (NM)}$	1 NM = 6 000 ft approx.
ROD (3° only)	$ROD = 5 \times GS \text{ (kt)}$	ft/min
ROD (any angle)	$ROD = 5 \times GS \times (Z/3)$	ft/min
ΔROD (3° only)	$\Delta ROD = 5 \times \Delta GS$	ft/min; direction matches speed change
ΔROD (any angle)	$\Delta ROD = 5 \times \Delta GS \times (Z/3)$	Use TAS change if headwind constant
VOR crosstrack	$DO \text{ (NM)} = (\text{angle off} \times DME) / 60$	Angle off = RMI QDM – airway QDM
VOR range	$R \text{ (NM)} = (\text{distance flown} \times 60) / \Delta \text{bearing}$	Range at closest point of approach

Speed vs ROD Rules

Action	ROD change
Decrease speed on glide slope	Decrease ROD
Increase speed on glide slope	Increase ROD

Answer Key — No ✕ Flags

Q	Answer(s)
1	90 NM
2	700 ft
3	1 040 ft
4	600 ft
5	(a) 700 ft/min (b) 780 ft/min (c) 750 ft/min
6	Decrease ROD by 150 ft/min
7	(a) 875 ft/min (b) decrease 125 ft/min (c) 750 ft/min
8	(a) Left (b) 6 NM (c) Yes — outside airway

DGCA CPL/ATPL General Navigation Study Notes

Chapter 12 — Other Applications of the 1 in 60 Rule

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