PIPADOR REVISION

MRCOG Part 1 Revision Notes

Translation and Protein Synthesis

MOLECULAR BIOLOGY • LECTURE 89

VISUAL EXAMINATION REVISION NOTES

2026 Edition

MRCOG Part 1 Revision Notes

Lecture 89: Translation and Protein Synthesis

Molecular biology • Visual revision edition

COLOUR CODE USED THROUGHOUT THESE NOTES

mRNA / STOP	RIBOSOME	tRNA / 30S	PEPTIDE / PTM	START / 50S

LEARNING OBJECTIVES — tick off as you go

- ☐ Describe the genetic code and its features.
- ☐ Describe ribosomes, tRNAs and the three stages of translation.
- ☐ Explain post-translational modifications and the secretory pathway.
- ☐ Match antibiotics to ribosomal targets, with pregnancy implications.
- ☐ Apply to insulin/C-peptide, vitamin K and warfarin, hCG and misfolding diseases.

1 The Genetic Code

IN ONE LINE: *mRNA is read three bases at a time from AUG to a stop codon. 64 codons, 20 amino acids — redundant but never ambiguous.*

The genetic code (mRNA codons)

1st base ↓ 2nd base →

	U		C		A		G	
U	UUU	Phe	UCU	Ser	UAU	Tyr	UGU	Cys
	UUC	Phe	UCC	Ser	UAC	Tyr	UGC	Cys
	UUA	Leu	UCA	Ser	UAA	STOP	UGA	STOP
	UUG	Leu	UCG	Ser	UAG	STOP	UGG	Trp
C	CUU	Leu	CCU	Pro	CAU	His	CGU	Arg
	CUC	Leu	CCC	Pro	CAC	His	CGC	Arg
	CUA	Leu	CCA	Pro	CAA	Gln	CGA	Arg
	CUG	Leu	CCG	Pro	CAG	Gln	CGG	Arg
A	AUU	Ile	ACU	Thr	AAU	Asn	AGU	Ser
	AUC	Ile	ACC	Thr	AAC	Asn	AGC	Ser
	AUA	Ile	ACA	Thr	AAA	Lys	AGA	Arg
	AUG	Met	ACG	Thr	AAG	Lys	AGG	Arg
G	GUU	Val	GCU	Ala	GAU	Asp	GGU	Gly
	GUC	Val	GCC	Ala	GAC	Asp	GGC	Gly
	GUA	Val	GCA	Ala	GAA	Glu	GGA	Gly
	GUG	Val	GCG	Ala	GAG	Glu	GGG	Gly

Triplet
3 bases = 1 codon; $4^3 = 64$ codons

Degenerate
61 sense codons → 20 amino acids; differences mostly at the 3rd ('WOBBLE') base

Unambiguous
each codon = one amino acid only

Non-overlapping, no commas
read in fixed frames — indels shift the frame

Start
AUG = Met (green)

Stops
UAA ochre, UAG amber, UGA opal (red) — read by RELEASE FACTORS, not tRNAs

Near-universal
mitochondria differ (e.g. UGA = Trp; AGA/AGG = stop)

Figure 1. The codon table.

2 The Machinery

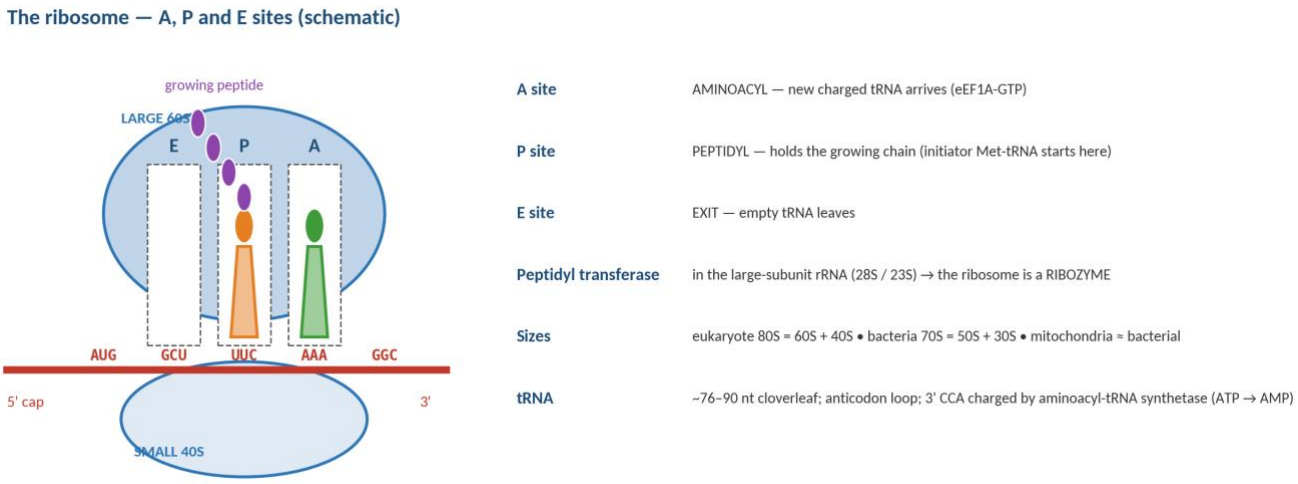


Figure 2. Ribosome sites.

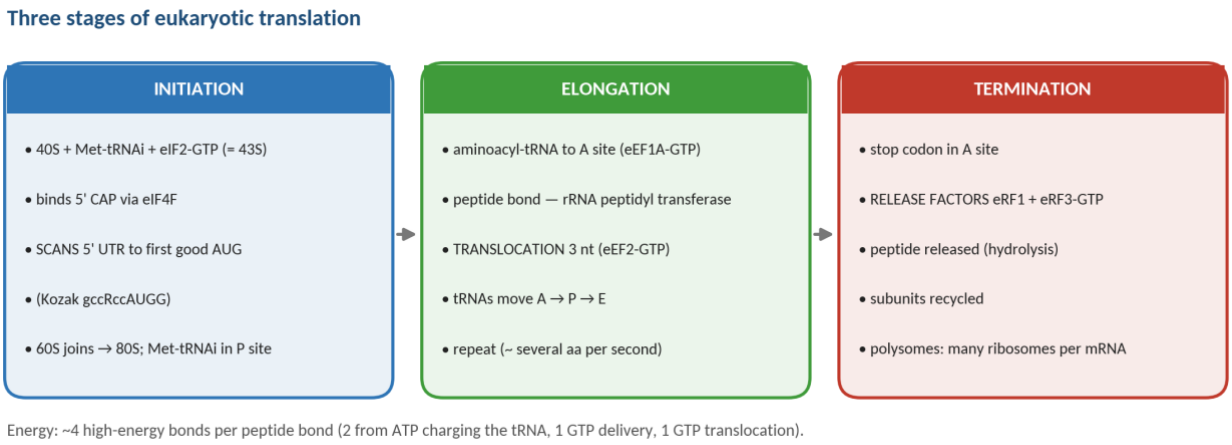


Figure 3. Initiation, elongation, termination.

MNEMONIC / MEMORY HOOK

'APE' — tRNAs move through the ribosome A → P → E (Arrive, Peptide, Exit).

3 After Translation

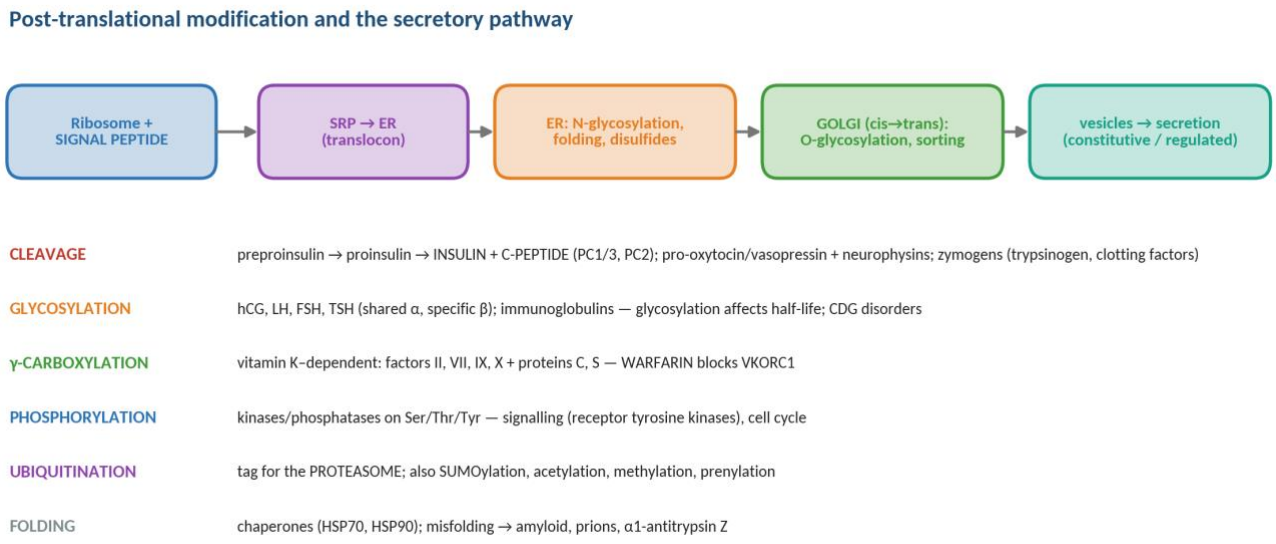


Figure 4. Modifications and the secretory pathway.

O&G example	Why it matters
hCG	Heavily glycosylated dimer: α shared with LH, FSH, TSH; β gives specificity. β-hCG resembles LH → rescues the corpus luteum; high hCG can stimulate the thyroid (gestational thyrotoxicosis, hyperemesis, molar pregnancy). Hyperglycosylated hCG dominates early pregnancy and GTN
Oxytocin / vasopressin	Made as larger precursors with neurophysins, cleaved during transport to the posterior pituitary
Insulin	Cleavage releases C-peptide (figure 6) — useful in hypoglycaemia work-up
Clotting factors	Vitamin K–dependent γ-carboxylation in the liver — warfarin target; neonatal vitamin K

4 Drugs That Act on Translation

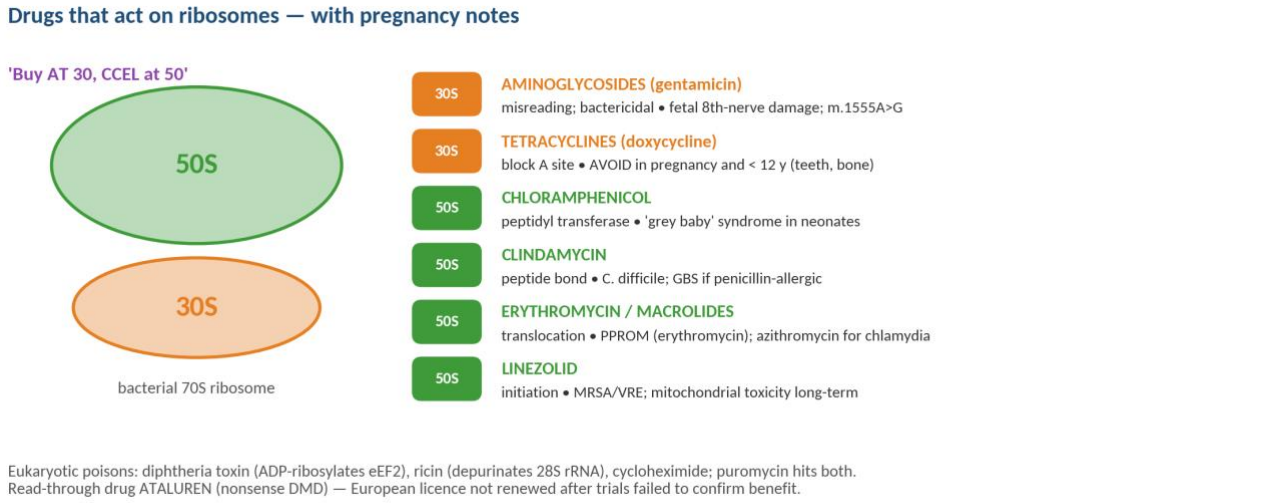


Figure 5. Ribosomal antibiotics.

MNEMONIC / MEMORY HOOK

'Buy AT 30, CCEL at 50' — Aminoglycosides, Tetracyclines on 30S; Chloramphenicol, Clindamycin, Erythromycin (macrolides), Linezolid on 50S.

- Human **mitochondrial ribosomes** resemble bacterial ones — hence aminoglycoside ototoxicity (worse with m.1555A>G) and linezolid mitochondrial toxicity.

5 Clinical Correlates

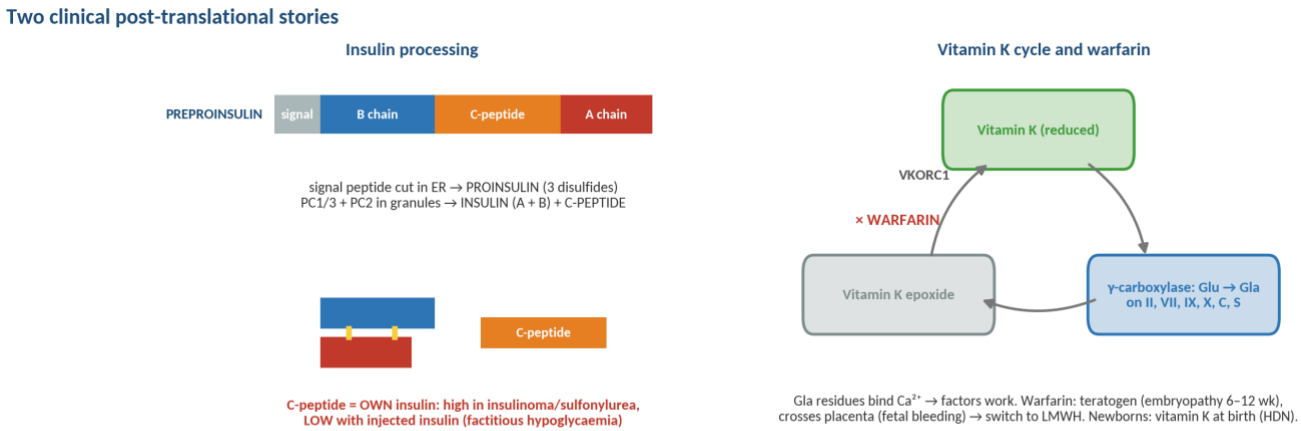


Figure 6. Insulin and vitamin K.

Condition	Protein problem
Misfolding / aggregation	Alzheimer's (β-amyloid, tau), Parkinson's (α-synuclein), Huntington's, prion disease (CJD, vCJD), α1-antitrypsin Z (liver accumulation + lung deficiency)
Nonsense mutations	Premature stop → truncated protein or mRNA decay; read-through drugs (ataluren) disappointing
Congenital disorders of glycosylation	Multisystem, often AR; transferrin isoelectric focusing screens
Bacterial toxins	Diphtheria toxin halts elongation (eEF2); ricin (castor bean) inactivates 28S rRNA

★ PEARL

Stops (UAA, UAG, UGA) are read by release factors, not tRNAs. Peptidyl transferase is rRNA — a ribozyme. Low C-peptide + high insulin = injected insulin; warfarin blocks VKORC1 and is teratogenic (6–12 weeks).

6 MRCOG Exam Pearls — Last-Minute Page

Numbers to know

64 Codons	**61 / 3** Sense / stop	**20** Amino acids (+ synthetases)	**80S / 70S** Eukaryote / bacteria
60S + 40S Eukaryotic subunits	**50S + 30S** Bacterial subunits	**~4** High-energy bonds per peptide bond	**II, VII, IX, X, C, S** Vitamin K–dependent

HIGH-YIELD CHECKLIST

- ☐ Code: triplet, degenerate (wobble), unambiguous, non-overlapping, near-universal.
- ☐ AUG = Met start; UAA, UAG, UGA stops (release factors).
- ☐ 80S (60S + 40S) vs 70S (50S + 30S); mitochondria bacterial-like.
- ☐ A, P, E sites; peptidyl transferase = rRNA ribozyme.
- ☐ Initiation (cap scanning, Kozak), elongation (eEF1A, eEF2), termination (eRF1/3).
- ☐ Signal peptide → SRP → ER → Golgi → secretion.
- ☐ PTMs: cleavage (insulin), glycosylation (hCG), γ-carboxylation (vit K), phosphorylation, ubiquitin.
- ☐ Buy AT 30, CCEL at 50; tetracyclines avoid in pregnancy; chloramphenicol grey baby.
- ☐ C-peptide distinguishes own vs injected insulin.
- ☐ Misfolding: amyloid, prions, α1-antitrypsin Z.

Self-assessment — cover the right-hand column

Question	Answer
Why is the code 'degenerate'?	Most amino acids have more than one codon
What reads stop codons?	Release factors
Which ribosomal site holds the growing chain?	P (peptidyl) site
Which molecule catalyses peptide bonds?	rRNA (ribozyme)
Subunit targeted by gentamicin?	30S
Subunit targeted by clindamycin?	50S
Antibiotic causing 'grey baby' syndrome?	Chloramphenicol
What does warfarin inhibit?	Vitamin K epoxide reductase (VKORC1)
Hypoglycaemia, high insulin, low C-peptide?	Exogenous (injected) insulin
Which hCG subunit gives specificity?	β subunit

7 References

- Alberts B et al. Molecular Biology of the Cell. 7th ed. 2022.
- BNF — antibacterials in pregnancy (current).
- RCOG Green-top Guideline No. 37b — anticoagulation in pregnancy (warfarin embryopathy).