1. **B** - Archaea possess membranes with ether-linked lipids and lack peptidoglycan in their cell walls, distinguishing them from Bacteria.
2. **D** - Glycogen is highly branched, providing many terminal ends for simultaneous hydrolysis and therefore the fastest release of α-glucose units.
3. **B** - A dihybrid test cross (PpTt × pptt) yields four phenotypes in 1 : 1 : 1 : 1 ratio if genes assort independently
4. **A** - Mitochondria possess circular, naked DNA like bacterial genomes—key evidence for endosymbiotic origin.
5. **B** - The pathway states that SCF “activates tyrosine kinase (TK)”. Receptors with intrinsic or associated tyrosine-kinase activity are receptor tyrosine kinases.
6. **A** - DNA polymerase I removes RNA primers and fills gaps with DNA; its loss halts primer replacement on the lagging strand.
7. **B** - Statement 1 is true because glycolysis proceeds in a straight sequence of reactions from hexose phosphate to pyruvate. Statement 2 is true because acetyl-CoA enters the Krebs cycle, which regenerates its starting compound in a loop. Statement 3 is false because the Calvin-Benson cycle is also cyclic, regenerating ribulose bisphosphate.
8. **A** - A larger radius (or diameter) of the inhibition zone reflects greater diffusion and antimicrobial activity; this metric is standardised for comparing antibiotics.
9. **A** - Thick lignified secondary walls prevent vessel collapse, maintaining the tensioned water column required for transpiration pull.
10. **A** - Net Primary Productivity equals Gross Primary Productivity minus energy lost in respiration (NPP = GPP – R).
11. **A** - hCG from the embryo maintains the corpus luteum, ensuring continued progesterone secretion during early pregnancy.
12. **D** - In situ conservation protects species within their natural habitats, allowing ecological interactions to continue.
13. **B** - Bond 1 is a hydrogen bond and bond 3 is a disulfide covalent bond—both contribute to tertiary folding. Bond 2 is a peptide bond that defines the primary structure, not the tertiary structure.
14. **C** - The photosystems and electron-transport components are embedded in the thylakoid membrane where light-dependent reactions occur.
15. **B** - Pre-existing resistant variants survive antibiotic exposure and reproduce, increasing allele frequency—core mechanism of natural selection.

16. **D** - The presence of vitamin C lowers Vmax at every ATP concentration, consistent with non-competitive inhibition that reduces maximum enzyme activity.

17. **A** - Ca^{2+} binds to troponin, shifting tropomyosin and exposing myosin-binding sites on actin, enabling cross-bridge formation.

18. **C** - Sons inherit Y from father and one X from mother. With carrier mother (½ chance X^c), 50 % of sons are colour-blind.

19. **A** - Total water potential equals the sum of solute potential (always negative or zero) and pressure potential (positive or zero): $\Psi w = \Psi s + \Psi p$.

20. **C** - Carbon 6 of glucose carries a $–CH_2OH$ group; its presence completes the hexose formula $C_6H_{12}O_6$ and confers high solubility.

21. **B** - Memory B cells secrete high-affinity IgG during a secondary immune response; these antibodies bind to the immobilised antigen in the T region, producing the positive line.

22. **A** - FAD is reduced in the Krebs cycle within the matrix; the resulting $FADH_2$ donates electrons to the electron-transport chain located on the inner mitochondrial membrane.

23. **D** - Rock store: 1×10^{13} Tg; biotic store: 2.1×10^3 Tg. $1 \times 10^{13} \div 2.1 \times 10^3 \approx 4.8 \times 10^9 \approx 5 \times 10^9$.

24. **B** - Pre-mRNA splicing removes introns and joins exons in the nucleus before export to the cytoplasm.

25. **A** - Arrow A spans the difference between the peak of the uncatalysed pathway and the peak of the catalysed pathway, showing how much the enzyme lowers the activation energy barrier.

26. **C** - After a meal, pancreatic β-cells secrete insulin → body cells absorb glucose → liver converts excess to glycogen, lowering blood glucose.

27. **A** - Ventricular pressure exceeds atrial pressure (AV valve closes) but remains lower than aortic pressure (semilunar valve has not yet opened) – the isovolumetric-contraction phase.

28. **A** - The sugar–phosphate backbone of DNA is composed of alternating deoxyribose sugars and phosphate groups joined by phosphodiester bonds.

29. **A** - CO_2 contributes most because of both high concentration and long atmospheric lifetime, despite lower GWP than some gases.

30. **B** - Chlorophylls absorb poorly in the green region (~520 nm), so electron transport, photophosphorylation and NADPH generation fall. The Calvin cycle depends on this ATP and NADPH and therefore slows significantly.

31. **A** - Spermatogenesis yields four equal sperm; oogenesis yields one ovum plus polar bodies due to unequal cytokinesis.

32. **D** - Telomerase extends telomeres in rapidly dividing germ-line stem cells; inhibition limits their replication first.

33. **B** - Competition, predation and other biotic factors restrict the fundamental niche to the realised niche where the species can persist competitively.

34. **D** - Cross $I^Ai \times I^Bi$can produce genotypes I^AI^B (AB), I^Ai (A), I^Bi (B) and ii (O); all four phenotypes possible

35. **B** - Stabilising selection favours intermediate phenotypes, reducing extremes and thereby decreasing variation around the mean.

36. **B -** An IgG Fab fragment contains one light chain and the N-terminal portion of one heavy chain; the two chains are held together primarily by inter-chain disulfide bridges.

37. **A -** Cold triggers vasoconstriction to reduce heat loss and shivering thermogenesis in muscles to generate heat.

38. **A** - Viruses are acellular particles without metabolic enzymes; they depend entirely on host cells for replication, unlike bacteria or protists.

39. **C** - Modern cladograms rely heavily on molecular (DNA or amino-acid) sequence comparisons to infer evolutionary relationships.

40. **B -** Mature eukaryotic mRNA bears a **5′ methyl-guanosine cap**, absent in prokaryotic mRNA.