Academic Year 2025/2026

<u>Reading skills and knowledge acquired during studies</u>

1. **C) Jane Austen – Author of Pride and Prejudice**
   Pride and Prejudice (1813) is a classic novel by Jane Austen, known for its themes of love, class, and societal expectations.

2. **C) Governments took no action to address the crisis.**
   The passage states that governments **did take action**, mentioning **Roosevelt's New Deal**, so this statement is false.

3. **C) The Roman Empire – Ruled by Julius Caesar**
   Julius Caesar was a Roman general and dictator who played a key role in transitioning Rome from a Republic to an Empire.

4. **C) If it rains tomorrow, we will cancel the picnic.**
   This is a **first conditional** sentence, correctly describing a future possibility using "if" + present tense, followed by "will" + verb.

<u>Logical reasoning and problem-solving</u>

5. B   Let **x** be the initial amount of water.

Step 1: Drinks $\frac{1}{5}x$, remaining $\frac{4}{5}x$. Refills, bringing it back to **x**.

Step 2: Drinks $\frac{1}{4}x$, remaining $\frac{3}{4}x$. Refills **half of what he drank**: $\frac{3}{4}x + \frac{1}{8}x = \frac{7}{8}x$

Step 3: Drinks $\frac{1}{3}$ **of remaining water**: $\frac{1}{3} \cdot \frac{7}{8}x = \frac{7}{24}x$

Remaining water: $\frac{7}{8}x - \frac{7}{24}x = \frac{7}{12}x$

Final Equation: $\frac{7}{12}x = 140 \Rightarrow x = 240$

6. A

Exchanged: **$500 × 0.85 = 425 EUR**.

Remaining after spending **€255**: **425 - 255 = 170 EUR**.

Converted back: **170 × 1.10 = $187**.

7. C

Let **5x** and **3x** be the length and width.

Perimeter equation: $2(5x + 3x) = 96$.

Solving $x = 6$, length $= 30$ **cm**.

8. E

- **Graph I:** Finds how many liters are used per hour. $m_1 = \dfrac{60 - 36}{4} = 6 \Rightarrow t_f = \dfrac{60}{6} = 10$

  That means if there are **60 liters** in the fuel tank, it will take **10 hours** for the fuel to run out.

  Graph II: Finds the distance traveled per hour. $m_2 = \dfrac{180}{2} = 90$

  If there are **36 liters** in the car's fuel tank, then it will take **6 hours** for the fuel to run out. Therefore, we have: $d = (10 - 4).90 = 540$

9. D

Apples to Bananas $= \mathbf{3{:}4} \rightarrow \dfrac{\text{Apple}}{\text{Banana}} = \dfrac{3}{4} = \dfrac{9}{12}$ Apples $= \mathbf{9k}$, Bananas $= \mathbf{12k}$.

Bananas to Grapes $= \mathbf{6{:}5} \rightarrow \dfrac{\text{Apple}}{\text{Banana}} = \dfrac{6}{5} = \dfrac{12}{10}$ Bananas $= \mathbf{12k}$, Grapes $= \mathbf{10k}$.

Total equation: $(\mathbf{9k + 12k + 10k = 186})$.

Solving gives **Grapes = 60**.

Biology

10. C
  A. Viruses can be divided into <u>4</u> groups based on their genetic material. (two groups contain DNA & two other groups contain RNA)
  B. HIV is a double-stranded <u>RNA</u> virus causing AIDS.
  C. Bacteriophage is a type of virus which attacks a particular bacterium called E. coli.
  D. Viruses replicate themselves by ~~their own ribosomes and~~ organelles of the host. (Viruses do not contain any organelles)
  E. Viruses ~~always~~ (sometimes) have an envelope surrounding them.

11. E

A. Bacteria always have a cell wall.
B. It is not a must for bacteria to contain capsule. (Some bacteria contain capsules.)
C. Nitrogen-fixation is not possible for every bacterium. (Only some bacteria have this feature.)
D. Naked-DNA can be replicated independently from the main DNA. (Naked DNA=Plasmid)
E. Capsule of bacteria is used for the ~~attachment~~ of bacteria to the surrounding surfaces. (To attach to surfaces, bacteria need "pili")

12. D

1) Plasmid is connected to some protein molecules. (Wrong; It is called "naked" because there is no protein around this molecule.)
2) Plasmid is the DNA that contain the specific code for antibiotic resistance. (Correct)
3) Plasmid is ~~always~~ (sometimes) presented in a bacterium, but the number of this molecule can vary in different bacteria. (Wrong)

13. A

A. They always have a protein coat surrounding their genetic material.
B. They always have a protein around their envelope. (Neither the envelope, nor the protein around that are not necessary.)
C. They are living organisms dependent on their hosts. (Viruses are not alive.)
D. They must have a genetic material, an envelope and a capsid. (The envelope is not a must.)
E. They replicate themselves independently to their host. (They only replicate themselves by their host's organelles.)

14. A

1) Bacteria use a structure called "pili" for their sexual activities. (Correct)
2) An example of a double-stranded RNA virus can be the cause of AIDS. (Correct)
3) The envelope of a virus contains ~~4 layers~~ of phospholipid molecules. (Wrong; The envelope in viruses is a one-layer structure, thus it contains 2 layers of phospholipids.)
4) The flagella of a bacteria are used for cellular attachments. (Wrong; They are used for locomotion)

15. B

A. A nucleotide is made of a base, ~~hexose~~ (pentose) sugar and a phosphate group.
B. A nucleotide molecule is defined as a sugar-base plus one to three phosphate group(s). (ATP and ADP are also nucleotides.)
C. ~~C4~~ (C3 & C5) are the place where the phosphodiester bond is presented.
D. ~~C1~~ (C2) is the place where defines the type of the sugar.
E. ATP is the part of a RNA molecule. (It is not the part of a DNA or RNA, but is a nucleotide)

16. D
   A. They are 4 types used in nucleotides. (They are 5 types: A, G, C, T & U)
   B. Adenine & Guanine are Purines and are 1 ringed. (Purines are 2 ringed.)
   C. Uracil comes instead of Adenine in RNAs. (U comes instead of T)
   D. Uracil is a 1 ringed base.
   E. Thymine is replaced by Uracil in RNAs. (T comes in DNA molecules.)

17. C
Each Complete turn of a DNA molecule contains 10 base <u>pairs</u>. Therefore, 20 complete turn contain 20*10*2 bases. If 20% of them are C, then 30% would be A.
30/100 * 400 = <u>120</u>

18. B
   A. Okazaki fragments are parts of the lagging strand.
   B. DNA polymerase starts from the 5'end of the parent strand. (It starts from the lagging strand 5' end)
   C. DNA polymerase is responsible for the complementary base pairing.
   D. DNA Ligase synthesizes phosphodiester bonds between nucleotides.
   E. Both leading & lagging strands were made from their 5' end to their another end. (There is no difference between them in this issue.)

19. E
   A. Thymine is purine base. (T is a Pyrimidine base.)
   B. Cytosine is connected to Guanine with 2̶ <u>(3)</u> hydrogen bonds.
   C. There are 2 one-ringed bases and 3 two-ringed bases in the nature. (A & G are 2-ringed bases and T, C & U are 1-ringed bases)
   D. Thymine is connected to Uracil in RNAs with 2 hydrogen bonds. (T does not connect to U)
   E. There should be always 3 rings in the distance between two opposite back bones.

20. A

1) DNA and RNA has no differences but in the presence of a "H" or "OH" on the second carbon of the pentose. (Wrong; There is another difference which is about U or T in these molecules.)

2) DNA has one more O atom in comparison with RNA. (Wrong; RNA has one more O atom than DNA)

3) Both RNA and DNA can be either single- or double- stranded in the nature. (Correct; We know the example of viruses.)

21. E

1) C5 is the place to connect to the other nucleotide. (Correct)
2) C3 is the place to connect to the other nucleotide. (Correct)
3) C2 is the place where the main difference between RNA and DNA sugar is obvious. (Correct)
4) C1 is in the apex. (Wrong; O is in the apex.)

22. C

The combination of DNA and protein is called "chromatin". (Cambridge AS & A level, page 126)

23. D

Interphase is after the cell division. It makes the cell grow and if another division is considered, it prepares the cell for this situation. It contains G1, S and G2 (3) stages.

24. A

1) S is the stage to replicate organelles. (Wrong; Only centriole is doubled in S, S is the stage for DNA replication.)

2) G1 is the stage to produce DNA polymerase and Ligase. (Correct)

3) G2 is the stage where cell decides whether to divide or not. (Wrong; G1 is the stage to decide whether to divide or not.)

4) S is the stage in which mitosis happens. (Wrong; Mitosis is not in the interphase.)

25. B

A. Nuclear envelope <u>can</u> be seen in this stage. In late prophase it begins to fade.
B. In late phase of this stage, Nucleolus starts to fade.
C. This is a part of <u>nuclear</u> division.
D. It is the <u>first</u> part of mitotic stages.
E. Equator alignment happens in <u>Metaphase</u>.

26. D

In Anaphase and Telophase, we have doubled chromosomes. However, nuclear envelope can be seen in late Telophase.

27. B

A. Centrosomes are replicated in the S phase of animal cells. (based on the figure about mitosis)
B. In <u>Prophase</u> sister chromatids are not visible, yet.
C. In Prophase chromosomes can be seen but it may be more condensed later, so chromatids can be seen in Metaphase.
D. In late Telophase, Nucleolus can be seen again. (Exactly as the early prophase.)
E. In Anaphase centrioles are in poles of the animal cell. (They get in there by metaphase.)

28. C

A. Centriole is ~~always~~ needed in this process. (Not all plant cells have or need centrioles.)
B. ~~Just~~ after Telophase ~~is~~ the turn of cell surface membrane to appear. (In plant cells, just after Telophase, a new cell <u>wall</u> appears first.)
C. In Anaphase, there would not be any sign of nuclear envelope.
D. In Anaphase, homologous chromosomes ~~would~~ be separated. (Sister chromatids would separate.)
E. In Interphase, cell's ~~nucleus divides~~. (Nuclear division is the next and separate step)

29. D

The image is showing the separation of chromatids, without any sign of nuclear envelope. Thus, it is showing "Anaphase"; We can see that two parts containing four chromosomes are going to be presented. Therefore, the original cell had also 4 chromosomes. It is not possible to say that it was 2n or n by this image, but we only have one choice correct in here.

30. D

A. Flagella is an ~~extra~~-cellular structure. (It is extra in prokaryotes, not in eukaryotes.)
B. ~~Pili~~ is used for antibiotic resistance. (Plasmid is important in antibiotic resistance.)
C. Ribosome is the only organelle ~~surrounded by membrane~~, in all types of cells. (Ribosome does not have membrane.)
D. Mitochondria have similar ribosomes with E. coli.
E. Cell wall main ingredient is ~~Murin~~. (Murin is the main material in bacteria. However, cellulose is the main one in plant cells.)

31. C

HIV is a double-stranded RNA virus. Therefore, first of all the sequence has a complementary strand. Moreover, it uses Uracil instead of Thymine in front of Adenines. Thus the sequence would be: **<u>UGCCGUUUGCCGU</u>**

32. C

A, T, C and G are all in same numbers. Therefore, if the whole genome contains 300 bases, 75 is the number of each.

A is connected to T with 2 hydrogen bonds (75*2=150) and C is connected to G with 3 hydrogen bonds (75*3=225). Thus, whole hydrogen bonds would be 375.
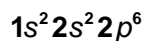
Chemistry

33. A

The ion $^{2x+2}_{x}A^{2+}$ has x protons. A neutral atom has x electrons, but since it's 2+, it lost 2 electrons. So, the number of electrons is x - 2.

34. A

The atom has 8 protons (oxygen). The O^{2-} ion has 10 electrons. The electron configuration is:

$1s^2 2s^2 2p^6$

35. A

Ionization energy increases across a period and decreases down a group in the periodic table. Noble gases have the highest ionization energy in their periods.

Among the given elements, Neon (Ne, Z = 10) is a noble gas and has the highest first ionization energy.

36. A

To find the element with the same number of neutrons as $^{79}_{35}Br^-$:

- Neutrons in $^{79}_{35}Br^- = $ Mass number - Protons $= 79 - 35 = 44$.

- Now, check which option also has 44 neutrons:

  - $^{78}_{34}Se \rightarrow 78-34 = 44$ ✅ (Correct answer)

  - $^{81}_{35}Br^{2+} \rightarrow 81-35 = 46$ ❌

  - $^{81}_{35}Br^- \rightarrow 81-35 = 46$ ❌
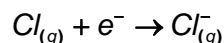
  - $^{82}_{34}Kr \rightarrow 82-34 = 48$ ❌

  - $^{101}_{44}Ru^+ \rightarrow 101-44 = 57$ ❌

37. A

First electron affinity is the energy change when one electron is added to a neutral atom in the gas phase.

The correct equation for chlorine's first electron affinity is:

$$Cl_{(g)} + e^- \rightarrow Cl^-_{(g)}$$

38. B

Fe^{3+} has an electron configuration of [Ar] $3d^5$, meaning it has five unpaired d-electrons.

39. D

Na (Sodium) has the largest second ionization energy because removing a second electron requires disrupting its stable noble gas configuration (Ne) after losing the first electron.

40. A

 First ionization energy decreases down a group and increases across a period.

Order: Be > Li > Na

41. B

Neon has a higher nuclear charge and **a full octet**, making it harder to remove an electron compared to fluorine.

42. C

Argon (Ar) and Potassium (K) can have the same mass number (isobars), meaning they have the same total number of nucleons (protons + neutrons).

43. B

An element that forms a -3 ion typically belongs to Group 15 (Nitrogen family), gaining 3 electrons to complete its octet.

Examining the configurations, B) $1s^2 2s^2 2p^6 3s^2 3p^3$ corresponds to phosphorus (P, Z = 15), which forms P^{3-}.

44. C

The largest ion with a noble gas configuration will be the one with the fewest protons (least attraction pulling electrons inward) and have most charges.

45. D

For isoelectronic species (same number of electrons), radius decreases as nuclear charge increases because a stronger positive charge pulls electrons closer.

Order of increasing nuclear charge:

- Ca^{2+} (20 protons, smallest radius)

- K^+ (19 protons)

- Ar (18 protons, largest radius)

Thus, the correct order from smallest to largest radius is:
$Ca^{2+} < K^+ < Ar$

46. A

The number of neutrons is found by:

Neutrons = Mass number – Atomic number = $(2x + 6) - x = x + 6$

47. C

The maximum oxidation number in oxides increases across Period 3 from +1 (Na) to +6 (S) as elements have more valence electrons available for bonding.

Physics and Mathematics

48. A

To push the box at a constant speed, the child would need to apply a force equal to the frictional force. Therefore,

$$F = f_k = \mu mg$$

The rate of work $(\frac{W}{t})$ is power. Power is given by:

$$P = Fv \Rightarrow \mu mgv$$

49. C

The string pulling all three masses (total 6m) must have the largest tension. String A is only pulling the block of mass 3m and string B is pulling a total mass of 5m.

50. A

Since P is at an upward angle, the normal force is decreased as P supports some of the weight. Since a component of P balances the frictional force, P itself must be larger than f.

51. A

The force of friction = 0.2×10 kg $\times 9.8$ m/s2 = 19.6 N, which is greater than the applied force, which means the object is accelerating to the left, or slowing down

52. D

Newton's second law applied to m_1: T = m_1a, or a = T/m_1, substitute this into Newton's second law for the hanging mass: m_2g – T = m_2a

53. B

Halfway up, the object has gained **half of its potential energy**, meaning it has lost **half of its initial kinetic energy**:

$$E_2 = \frac{E_k}{2}$$

Using the kinetic energy formula:

$$\frac{1}{2}mv_2^2 = \frac{1}{2}m\frac{v^2}{2}$$

Taking the square root:

$$v_2 = \frac{v}{\sqrt{2}}$$

54. A

To find the speed of the pendulum at its lowest point, we use **energy conservation**:

1. **At the highest point** (initial position):

   o   The pendulum has **only potential energy**: PE=mgh

- o Height **h** (vertical displacement) can be found using geometry:

$$L - L\cos 60° = L(1 - \frac{1}{2}) = \frac{L}{2}$$

- o So, initial potential energy: $PE = mg\frac{L}{2}$

2. **At the lowest point**:

- o All potential energy converts into **kinetic energy**: $KE = \frac{1}{2}mv^2$

- o By conservation of energy: $mg\frac{L}{2} = \frac{1}{2}mv^2$

3. **Solve for v**:

$$gL = v^2 \Rightarrow v = \sqrt{gL}$$

55. E

We simplify the given expression:

$$\sqrt{50} = 5\sqrt{2}, \quad \sqrt{18} = 3\sqrt{2}, \quad \sqrt{2} = \sqrt{2}$$

$$5\sqrt{2} - 3\sqrt{2} + \sqrt{2} = 3\sqrt{2} = \sqrt{18}$$

56. D

Rewriting $\frac{1}{9}$ as $(1/3)^2$:

$$(\frac{1}{3})^{x-2} < (\frac{1}{3})^2$$

Since 1/3 is a fraction $\left(0 < \frac{1}{3} < 1\right)$ the exponent rule states that smaller exponents result in larger values. Thus, for the inequality to hold:

$$x - 2 > 2 \Rightarrow x > 4$$

57. E

consists of the **sum of three positive expressions** (since exponential functions and constants are always positive).

Since the sum of positive terms **can never be zero**, the equation has **no real solutions.**

58. B

Square Both Sides:

Since both sides are absolute values (always non-negative), we can square them:

$$x^2 + 4x + 4 > x^2 - 2x + 1 \Rightarrow 4x + 4 > -2x + 1 \Rightarrow x > -\frac{1}{2}$$

59. A

$$5^{x+1} - 5^x = 5^x (5-1) = 4.5^x$$

60. B

$$\left(\left(\sqrt{2} \right)^{\sqrt{2}} \right)^{\sqrt{2}} = \left(\sqrt{2} \right)^{\sqrt{2} \cdot \sqrt{2}} = \left(\sqrt{2} \right)^2 = 2$$