1.1: The microscope in cell studies

1. **C**
   The actual cell size is 1 μm, and magnifying it 50,000 times gives 1 μm × 50,000 = 50,000 μm, which equals 50×10^1 mm. Hence, the correct answer is option C.
2. **A**
   Each eyepiece graticule division equals 0.1 mm ÷ 100 = 1.0×10^{-3} mm. Thus, 4 divisions = 4.0×10^{-3} mm = 1.0×10^1 μm.
3. **B**
   Prokaryotic cells typically have diameters ranging from 1×10^3 nm (1 μm) to 5 μm, which fits the range in option B.
4. **A**
   Calibrating the eyepiece graticule with a stage micrometer allows it to be used for accurate measurements of specimen size under a microscope.
5. **A**
   Calibration using a stage micrometer is essential to accurately convert eyepiece graticule units into actual measurements, such as micrometers.
6. **A**
   The electron micrograph shows a eukaryotic cell without a cell wall, indicating it is an animal cell. Plant cells have a cell wall, which is absent in this image.
7. **C**
   The resolution of light microscopes is limited by the wavelength of visible light, which is too large to distinguish the fine structure of cristae. Electron microscopes, with higher resolution, can reveal these details.
8. **D**
   Mitochondria are responsible for energy release through cellular respiration, so they are likely to retain the blue stain, indicating active energy release.
9. **D**
   The magnification is ×24,000, and the real diameter of the virus particle is calculated by dividing the image size by the magnification. The given answer indicates that the virus particle has a diameter of 1.5×10^2 nm.
10. **D**
    Magnification is calculated by multiplying the magnifications of the eyepiece and objective lens. The combination of ×15 eyepiece and ×100 objective gives the greatest magnification (15 × 100 = 1500).
11. **B**
    Light microscopes with a resolution of 0.25 μm (250 nm) can see Mimivirus and Pandoravirus, which are 680 nm and over 1000 nm respectively, but not typical viruses, which are smaller (20–150 nm). Electron microscopes can view all three.
12. **C**
    100 divisions in 10 mm gives each division a value of 0.1 mm. The cell spans 12 divisions, so the actual length of the cell is 12 × 0.1 = 1.2 mm or 360 μm.
13. **C**
    As the wavelength of light increases, the resolving power of a microscope decreases, resulting in lower resolution. Longer wavelengths of colored light provide less clarity, reducing the microscope's ability to distinguish between two close objects.
14. **B**
    The stage micrometer scale shows each small division as 0.1 mm (100 μm). The nucleus measures around 25 divisions, corresponding to 25 μm in actual size.
15. **B**
    Graticule is placed in the eyepiece (1) for rough estimations of object size.
    Micrometer Scale goes on the microscope stage (3) for precise measurements and calibration.
16. **B**
    A light microscope can visualize larger structures like cells and organelles, but struggles with extremely small structures like DNA, paramecium cells are a good choice for light microscopy due to their relatively large size.

17. A

To calculate the actual size of an object in a photomicrograph, the measured size on the photograph (PQ) must be divided by the magnification level of the photograph. This requires understanding the relationship between the actual size, the magnified image size, and the magnification factor.

18. B

The freeze-fracture technique in electron microscopy reveals structures within cell membranes, including protein complexes and nuclear pores. Structure X is likely a nuclear pore.

19. C

To calculate actual sizes from measurements, you need to multiply the reticule units by the known actual length represented by each unit, based on the microscope's calibration. In this case, 96 units x 0.01 mm/unit = 0.96 mm or 960 μm.

20. D

The area of the field of view of the microscope is calculated using the circle area formula. The diameter from the micrometer scale is halved to find the radius. The calculated area, converted from mm^2 to μm^2, (4.91×10^4 μm^2), though it's not an exact match with the calculated value.

21. D

Determining the magnification of the cell image requires looking at the scale bar provided. The scale bar shows 5 μm, and considering the image resolution and size, the magnification can be deduced to be ×4000.

22. D

The magnification is determined by dividing the measured length by the actual length. Given the actual length of the chloroplast is 10 μm and the magnification is ×6300, the measured length is 63,000 μm.

23. C

Measuring the diameter of the lumen we find it to be 50 mm which is 50000 μm. Using the formula for magnification and rearranging it to find the actual diameter we divide 50000/360 and get 139 μm which makes option C the correct answer.

24. C

Option C is the correct answer as the wavelength of light used has no effect on the magnification of the microscope. However, the wavelength is inversely proportional to the resolution of the microscope meaning that an increase in the wavelength causes the resolution to decrease.

25. C

Since the distance between each successful stage micrometer is 40 units that means that one eyepiece graticule measures 0.1/40 × 1000 which is equal to 2.5 μm. Multiplying this by 8 gives 20 μm as the diameter of the white blood cell making option C the correct answer.

26. C

The length from X to Y is measured as 5 cm which is 50 mm and 50000 μm. Dividing this by 25 gives us 2000 which can also be written as 2×10^3 which is the magnification of the image. Hence, option C is the correct answer.

27. C

Option C is the correct answer as magnification is image length / object length. Since the object length is 1 μm converting 2 cm into μm gives 20000 as the magnification.

28. B

Option B is the correct answer as the stage micrometer scale is not used to measure the length of the cells directly rather it is used to calibrate the eyepiece graticule and less of the scale is visible as the magnification changes.

29. B

Option B is the correct answer as in order to calculate magnification a stage micrometer scale, eyepiece graticule and hand lens are required.

30. A

Option A is the correct answer as magnification is equal to image size/actual size. Rearranging this actual size is equal to image size/magnification.

31. C

Magnification is calculated as the image length over the object length. In this case the 2 μm is the object length. In order to measure the magnification, the student will measure the diameter of the cell using the a ruler in millimeters and then multiply it by 1000 to convert it into micrometers. This will then be divided by 2 to get the magnification.

32. B

Statement 1 is correct as resolution is directly proportional to the detail that can be seen. Statement 2 is incorrect as greater magnification does not mean more detail can be seen. Statements 3 and 4 are correct as increasing magnification up to the limit of resolution allows maximum detail to be seen and using a shorter wavelength increases the detail as resolution is inversely proportional to the wavelength of light used. Hence, option B is the correct answer.

33. B

Option B is the correct answer as in order to find the actual length we divide 6 mm by the magnification and find the answer as 6.25×10^{-4} which is closest to the one in option B.

34. B

Option B is the correct answer as in order to find how many times larger the prokaryotic cell is we divide 5000 nm (5 μm) by 300 nm and find the answer rounded off as 17 times.

35. C

Option C is the correct answer as the image length is 3 cm which is 30000000 nm. Dividing this by 3000 gives 10000 as the magnification.

36. D

Option D is the correct answer as the magnification of the object is not dependent on the wavelength of the light used. The resolution of the microscope is inversely proportional to the wavelength of light used. Hence using green light with a lower wavelength would cause the resolution to increase.

37. A

Option A is the correct answer as cell membrane is the smallest amongst the 3 with a diameter in the order of nm. Since red blood cells can squeeze through capillaries they must have a diameter of similar magnitudes that is larger that the thickness of the cell surface membrane. This means they must be in the order of μm.

38. D

Measuring the length of the image we find it to be 5.5 mm. Using the formula Actual Length = Image/Magnification we divide 5.5 by 60000 and convert the result into nanometers by dividing by 10^{-8}. This bring the answer to 9167 nm which is closest to 1100 nm which makes option D the correct answer.

39. C

Option C is the correct answer as first the mm are converted into μm by dividing by 1000. Then the number is divided by 100 since there are 10 stage micrometer units with each having 10 graticule units making a total of 100 units to divide the μm with.

40. B

3 of the stage divisions cover 80 units of the eyepiece graticule. Since each stage division is 0.1 mm 0.3 mm cover 80 units. Dividing 0.3 by 80 we find that one eyepiece graticule is 3.75×10^{-3} mm. Now using the calibrated scale we can see that the nucleus covers approximately 8 units of the scale. Multiplying 8 with 3.75×10^{-3} gives 0.03 mm. Multiplying this by 1000 gives 30 μm making option B the correct answer.

41. D

The image length is 14 cm which is 140000 μm. This divided by 350 gives 400 as the magnification making option D the correct answer.

42. D

Passive immunity is referred to as the injection of antibodies into a person's body. This form of immunity is not triggered by antigens and does not initiate an immune response. Since no immune response is initiated memory cells are also not produced and these antibodies are temporary due to absence of memory cells. Hence, option D is the correct answer.

43. D

The diameters of alveoli and white blood cells are both in the order of μm. The width of cell walls is in nm since the cell walls require an electron microscope for proper observation of their width. Hence, option D is the correct answer.

44. C

Image length can be found by multiplying the actual length with the magnification. Converting this into mm gives 25 mm which makes option C the correct answer.

45. B

From the diagram we can see the nucleolus, chloroplast, ribosomes, mitochondria and plasmodesmata. This makes option B the correct answer.

46. C

Resolution is referred to as the ability of a microscope to view 2 points as separate. Using this definition option C is the correct answer.

47. A

Measuring the length of the virus in the image we find it to be 3.6 cm. Dividing this by 30000 we find 1.2×10^{-4} as the actual length. Converting this into nm gives 1.2×10^{3} nm which is closest to option A making it correct.

48. D

All of the cells mentioned should have diameters up to 10 μm. Using the formula for the actual diameter we can see that only option D is within the range making it the correct answer.

49. A

Calibrating the eye piece graticule, we find that one division is equivalent to 3×10^{-3} mm. Initially measuring the far-left grain we find the actual length to be 0.03 mm and after 4 hours it is 0.06 mm. Subtracting and dividing by 4 gives the answer as 7.5×10^{-3} mm/h or 7.5 μm/h which is closest to option A making it the correct answer.

50. C

In order to calculate the actual size the student should first measure the image in mm using a ruler and then convert that into μm by multiplying by 1000. Then using the formula for magnification he should divide that length by the magnification to find the actual size. Hence, option C explains the correct procedure.

51. C

One stage micrometer division is 0.1 mm. Since the scale covers 12 divisions, 1.2 mm covers the 100 graticule units. Hence, one unit is 0.012 mm. The cells covers 30 units on the scale and multiplying that with 0.012 and converting into μm gives 360 as the answer which makes option C the correct answer.

52. D

Both statements 1 and 2 are incorrect. Only statement 3 is correct since the number of division that the stage micrometers covers of the eyepiece graticule allows the student to find out how much 1 unit is worth. Hence, option D is the correct answer.

53. C

1 cm is 1×10^{4} μm and 1×10^{7} nm. Dividing 1×10^{4} by 1.5×10^{1} gives 6.7×10^{2} and dividing 1×10^{7} by 7.5×10^{2} gives 1.3×10^{4}. Hence, option C is the correct answer.

54. D

In order to measure magnification the first step will be to measure the image length in mm. Then convert that into μm by multiplying with 1000. Then divide that by the actual length to find the magnification. Hence steps 2, 4 and 5 making option D the correct answer.

55. D

The minimum distance can be found using the point where the cells is touching the alveoli wall. This distance on the image is 5 mm. Dividing this by 5000 gives 1×10^{-3} mm as the actual size which is 1 μm. Hence, option D is the correct answer.

56. D

One millimeter contains 1×10^{6} nm. Hence, option D is the correct answer.

57. B

The maximum resolution of a light microscope is 200 nm. Hence, option B is the correct answer.

58. D

The formula for magnification is Image/Actual Length. Using this we can see that option D is the correct answer where $r \times s$ is the length of the image in μm and t is 1/5 where 5 is the actual length.

59. D

Magnification is the product of the eyepiece and the objective lens magnification. Hence, option D is the correct answer as the product is the greatest.

60. C

Magnification is image length/actual length. 2.5 cm is 25000 μm. Hence 25000/7 will give magnification making option C the correct answer.

61. B

Measuring the length of the line in the diagram we find it to be 15 mm which is 15000 μm. In order to find magnification we divide this by 5 and get 3000 as the result. Hence, the answer is B since 2800 is closest to 3000.

62. A

Only the nucleus will be visible in a simple light microscope since the rest of the organelles cannot be seen due to the limit of the resolution of the light microscope. Hence, option A is the correct answer.

63. B

The typical length of a prokaryote is 7.5×10^{2} nm. Hence, option B is the correct answer.

64. C

Measuring the length of the line on the diagram and dividing that by 3 we find the magnification as 0.006. The actual to diagram size is not 1667 : 1. Using the found magnification and measuring the length of the whale which is 0.144 m and dividing that by the magnification we find the actual size as 24 m. Hence statements 1 and 3 are correct making option C the correct answer.

65. D

As the wavelength decreases the resolution increases. However, the magnification remains the same since it is not dependent on wavelength. Hence, option D is the correct answer.

66. C

Images in an electron microscope are always grey in color. Hence, cell 4 is a plant cell and cell 3 is an animal one due to the small nucleus. Cell 2 is the animal cells in the light microscope since the lines are throughout the cells and 1 is the plant cell since the vacuole is the large white area. Hence, option C is the correct answer.

67. C

Since the drawing was done by seeing the image under a microscope at 40 times magnification it means that the diagram is larger than the actual magnified image since that would be in order of μm. Hence, option C is the correct answer.

68. C

The resolution of a light microscope is lower than an electron microscope since it can only separate objects up to 200 nm apart. The magnification is not a correct comparison since even the light microscope can magnify but it cannot resolve the components. Hence, option C is the correct answer.

69. C

Multiplying 0.25 with 50000 gives 12500 μm as the image length. This is equal to 12.5 mm which makes option C the correct answer.

70. D

Only the ruler and measuring cylinder can have a parallax error due to the different viewing angles. The eyepiece graticule cannot have this error due to its fixed position in the lens. Hence, option D is the correct answer.

71. B

Statement 1 is correct as greater resolution allows objects to be seen with more clarity. Statement 2 is incorrect since magnification does not correlate with more detail. Statement 3 is correct as increasing the magnification up to the limit of resolution allows the user to see more details. Statement 4 is correct since the wavelength is inversely proportional to the resolution. Hence, statement 1, 3 and 4 are correct making option B the correct answer.

72. B

Since the entire stage micrometers covers 15 units of the graticule that means that 15 units are equivalent to 2 mm. Using this we can find that 1 unit is equal to 0.13 mm. Multiplying this by 100 gives 13 mm as the answer making option B the correct answer.

73. C

Multiplying 1 μm with 50000 gives 50000 μm as the image length. This is equal to 50 mm which makes option C the correct answer.

74. A

Resolution is the ability to distinguish between 2 objects that are close together whereas magnification is how many times larger the image is compared to the actual size of the object. Hence, option A is the correct answer.

75. D

Statement 1 is incorrect as in order to convert from mm to μm we need to multiply by 1000. Statement 2 is incorrect since calibrating the lens on a different lens will give incorrect readings. Statements 3 and 4 are correct as the eyepiece graticule units are multiplied by the value of the calibrated unit and that is the width. Hence, option D is the correct answer.

76. D

Statement 1 is incorrect since the measurement is done with a magnification meaning that is not the actual length. Statement 2 is correct as this helps the biologists to accurately draw the images with correct proportions so one can use magnification to find actual length. Statement 3 is incorrect as the scale remains the same but the calibration needs to be done again. Hence, only statement 2 is correct making option D the correct answer.

77. A

The total magnification is the product of the magnification of the eyepiece lens and the objective lens. In order to see the greatest number of cells the magnification must be the least. Hence, option A is the correct answer as the product is the least.

78. B

Option A is incorrect as the resolution increases with decreasing distance within the objects. Option C is incorrect as at 600 nm the objects 300 nm apart will not be visible. Option D is incorrect as resolution is inversely proportional to the wavelength of light. Hence, option B is the correct answer.

79. D

Magnification of an object is the Image Size / Actual Size. Hence, option D is the correct formula.

80. A

80 units of the eyepiece graticule cover 0.2 mm. Hence one units is equal to 0.0025 mm. Multiplying this by 4 and then 1000 to get in μm the answer is 10. Hence, option A is the correct answer.

81. C

Grana of chloroplasts and the cristae cannot be seen using a light microscope. Same goes for ribosomes. Hence, option C is the correct answer as the nucleoli will only be clearly visible.

82. D

Magnification refers to as the size of the image in comparison to the actual size of the object. Hence, option D is the correct answer.

83. D

1000 nm is equal to 1 μm and 0.001 mm is equal to 1 μm. Hence, option D is the correct answer.

84. C

Magnifying will not change the distance between the structures. Hence it will remain 200 nm making option C the correct answer.

85. B

The maximum resolution is 250 nm. Hence, typical viruses cannot be seen using a light microscope, but the Mimi virus and the Pandora virus can be seen using both the microscopes. Hence, option B is the correct answer.

86. C

The length of the line is 52 mm which is 52000 μm. Dividing this by 210 gives 248 as the actual size which his closest to 243 making option C the correct answer.

87. C

0.2 mm cover 80 units meaning that one unit is equal to 0.0025. Multiplying this by 100 the diameter is 0.25 mm. Dividing this by 2 we get 0.125 mm as the radius which is 125 μm. Hence, using the formula for area of the circle, option C is the correct answer.

88. D

The length of the line is 35 mm or 35000 μm. Dividing this by 7 we get the magnification which is 5000. Hence, option D is the correct answer.

89. D

In order to find the actual size the student has to multiply the image length in mm by 1000 to convert into μm and then divide that by the magnification to find the actual length. Hence, option D is the correct answer.

90. D

Only the chloroplasts will be visible under the high power of the light microscope. Hence, option D is the correct answer.

91. C

The length of the line is 30 mm which is 30000 μm. Using the magnification given the actual length is 20 μm. Dividing 10000/20 gives 500 which makes option C the correct answer.

92. A

Since an eyepiece graticule is used for measurement it is calibrated. Hence, option A is the correct answer.

93. C

Actual Length is equal to the Image Length divided by the magnification. Hence 6000/600 give 10 μm as the actual length. Hence, option C is the correct answer.

94. C

In option C, Both conversions are incorrect. 5 mm should equal 5.0×10^3 μm and 5.0 10^6 nm, but the table shows 5.0×10^4 μm and 5.0×10^7 nm, which are incorrect by a factor of 10. Hence, C is the correct answer.

95. A
Pancreatic cells are 35000 nm in diameter. Dividing this by 7000 gives 5 as the answer which means that pancreatic cells are five times larger than red blood cells.

96. B
1 mm is 1×10^3 μm and 1×10^6 nm. Using this we can see that 1, 2 and 4 show the correct conversion making option B the correct answer.

97. A
A typical plant cell is about 40 mm in diameter. Hence, option A is the correct answer.

98. C
Resolution is inversely proportional to the wavelength of light. Hence, an increase in wavelength will result in a decrease in the resolution. Magnification is not dependent on the wavelength of light. Hence, option C is the correct answer.

99. B
80 eyepiece divisions cover 0.2 mm. Hence one division is 2.5 μm. Chloroplast at the bottom of the image is 4 units wide making its width 10 μm. Hence, option B is the correct answer.

100. C
Statement 1 is incorrect as the magnifications are multiplied not added.
Statement 2 is correct as resolution decreases as magnification increases.
Statement 3 is correct as resolution is dependent on the wavelength of light.
Statement 4 is incorrect as the stage micrometer is not resolved more clearly than the eyepiece graticule. Hence, statements 2 and 3 are correct making option C the right answer.

101. B
Statement 1 is incorrect as the eyepiece graticule is used for measuring the length. Statements 2 and 3 are correct as the micrometer is used for calibration and it changes as the magnification changes. Hence, option B is the correct answer.

102. D
As the magnification increases the resolution decreases. Hence, option D is the correct answer as it is the greatest magnification.

103. A
An electron microscope has both higher magnification and resolution than a light microscope. Hence, option A is the correct answer.

104. D
Statement 1 is correct as eyepiece graticule help to find the actual length.
Statement 2 is correct since the measurements taken allow cells to be drawn with correct proportions.
Statement 3 is incorrect since the graticule remains the same but needs recalibration. Hence, option D is the correct answer.

1.2: Cells as the basic units of living organisms

1. A
Both P (nucleus) and Q (chloroplast) are bound by a double membrane. The nucleus controls cellular functions, and chloroplasts perform photosynthesis, both having an inner and outer membrane.

2. C
Both mitochondria and typical prokaryotic cells contain 70S ribosomes, which are smaller than the 80S ribosomes found in eukaryotic cytoplasm.

3. C
Lysosomes are only present in animal cells for breaking down organelles. Both prokaryotic and animal cells produce ATP through cellular respiration.

4. C
Centrioles are present in animal cells but absent in plant cells. Plasmodesmata and the tonoplast are specific to plant cells, while the Golgi body is present in both.

5. A
Nucleic acids (DNA and RNA) are found in the nucleus (1), as DNA is the main genetic material, in mitochondria (2) due to mitochondrial DNA, and in ribosomes (3), as ribosomes are involved in mRNA translation during protein synthesis.

6. **C**
A bacterial cell contains a template strand of DNA, used during transcription. Introns and telomeres are found in eukaryotes, and a capsid is a viral structure.

7. **C**
Both eukaryotes and bacteria can respire, making this the common feature, as shown in region C of the Venn diagram. Other features like 80S ribosomes and circular DNA are not shared.

8. **B**
Goblet cells have a large volume occupied by secretory vesicles, which are bound by a single membrane. These vesicles store and release mucus, making up a significant portion of the cell's volume.

9. **A**
The sequence begins with carbohydrate addition to protein (1), then the vesicle separates from the Golgi body (4), fuses with the cell membrane (2), and finally the glycoprotein is released extracellularly (3).

10. **C**
Typical prokaryotes possess DNA (1), 70S ribosomes (3) and RNA (4), but they do not have a capsid (2), which is a viral structure.

11. **B**
Mucin is produced on ribosomes and modified in the Golgi body with carbohydrate chains. It is transported to the cell surface membrane in secretory vesicles, but lysosomes are not involved in this process.

12. **B**
Dicots and bacteria share 70S ribosomes and circular DNA. 80S ribosomes are exclusive to eukaryotes, and centrioles are absent in both.

13. **A**
Microtubules are responsible for the movement of cilia, the attachment of chromosomes during metaphase, and the transport of vesicles within the cell.

14. **D**
Nucleic acids are present in organelles like mitochondria and chloroplasts (which have their own DNA), but not in the Golgi body. Hence, option D correctly identifies the chloroplast and mitochondrion as containing nucleic acids.

15. **A**
Both plant and prokaryotic cells have a cell wall (1), a cell surface membrane (2), and ribosomes (3).

16. **C**
The process begins with the nucleus (3) providing genetic instructions, followed by protein synthesis in the rough endoplasmic reticulum (4), packaging in the Golgi body (2), and finally secretion through the cell surface membrane (1).

17. **A**
Plasmodesmata are channels in plant cell walls, lined by the cell surface membrane, that facilitate transport and communication between adjacent plant cells.

18. **D**
Microtubules are composed of proteins and play a key role in forming the spindle during mitosis, which is essential for chromosome segregation during cell division.

19. **B**
The Golgi body does not contain nucleic acids, while chloroplasts, mitochondria, and ribosomes all contain DNA or RNA for their respective functions.

20. **B**
The nucleus (1) initiates protein synthesis by transcribing DNA into mRNA, which then moves to the cytoplasm for protein synthesis on ribosomes. Mitochondria (2) produce energy (ATP) through cellular respiration and aren't directly involved in glycoprotein synthesis. The endoplasmic reticulum (4) synthesizes proteins, including the protein portion of glycoproteins, while the Golgi apparatus (6) adds carbohydrate chains to form a complete glycoprotein, which is then secreted through the cell membrane.
In short:
- Nucleus: initiates protein synthesis (mRNA)
- Mitochondria: energy production (ATP)
- Endoplasmic reticulum: protein synthesis (protein portion)

Golgi apparatus: post-translational modifications (add carbohydrate chains) and secretion.

21. **B**
The organelles are separated by density, with the heaviest (nucleus) in pellet 1, followed by mitochondria (pellet 2), lysosomes (pellet 3), and ribosomes (pellet 4). Mitochondria produce ATP.

22. B

RER does not have mRNA inside them. Ribosomes are present on the surface of RER. mRNA binds to these ribosomes. mRNA can be inside mitochondria and chloroplast as they both have their own DNA and ribosomes. mRNA is primarily found in the nucleus. It plays a crucial role in carrying genetic information from the nucleus to the ribosomes.

23. C

Palisade mesophyll cells and photosynthetic prokaryotes share some similarities, but palisade mesophyll cells have chloroplasts, while prokaryotes lack membrane-bound organelles like chloroplasts.

24. B

Both viruses and prokaryotes contain polynucleotides (nucleic acids) and polypeptides (proteins), but not all viruses contain polysaccharides. Prokaryotes often have cell walls made of polysaccharides.

25. A

Vesicle formation involves the encapsulation of substances within a lipid bilayer and involves the cell surface membrane, endoplasmic reticulum (ER), and Golgi body. These structures are involved in processes like endocytosis, protein and lipid synthesis, modification, sorting, and packaging for secretion or delivery to other parts of the cell.

26. A

Matching the function with the appearance of cell structures in an animal cell involves understanding of the roles and distinctive features of various organelles. This includes recognizing ribosomes for polypeptide synthesis, the endoplasmic reticulum for lipid synthesis, and the Golgi apparatus for packaging hydrolytic enzymes.

27. D

A tonoplast is the membrane surrounding the central vacuole in plant cells. It's present in root hair cells, endodermal cells, and companion cells, but absent in sieve tube elements, which lack a central vacuole to facilitate sap flow.

28. B

Chloroplasts and mitochondria are organelles that are indeed surrounded by double membranes. They both have an inner and an outer membrane. The nucleus also has a double membrane known as the nuclear envelope, which encloses the genetic material. Vacuoles, typically found in plant cells, are surrounded by a single membrane called the tonoplast. Therefore, vacuoles are not correctly described as being surrounded by a double membrane.

29. D

The endosymbiotic theory suggests that mitochondria evolved from bacteria that were engulfed by a host cell. The evidence supporting this theory includes:

- Folded internal membranes: Similar to the internal membranes found in prokaryotic cells like bacteria, which increase the surface area for biochemical reactions.
- Circular DNA: Mitochondria contain their own DNA, which is circular, not linear like most eukaryotic DNA.
  This is similar to the DNA found in bacteria.
- 70S ribosomes: Mitochondria have 70S ribosomes, which are the size found in bacteria, rather than the 80S ribosomes typically found in the cytoplasm of eukaryotic cells.

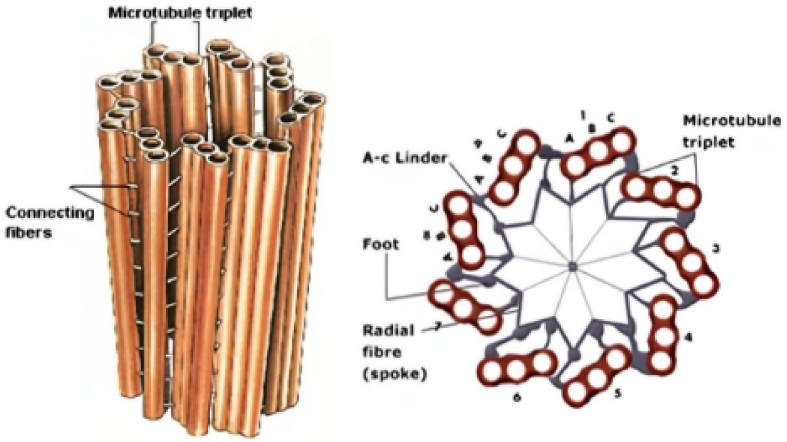
30. C

Cytosine is a nitrogenous base that is found in the nucleic acids of all life forms, including viruses, prokaryotes, and eukaryotes. It is one of the four main bases in DNA and RNA (in DNA, it pairs with guanine, and in RNA, it pairs with guanine through a different molecular mechanism). Ribose and deoxyribose are sugars found in RNA and DNA, respectively, and thymine is a base found only in DNA, not RNA. Some viruses have RNA instead of DNA as their genetic material and would not contain thymine or deoxyribose.

31. A

In plant biology, xylem vessel elements are known to be dead at maturity and therefore do not contain cytoplasm, mitochondria, or a nucleus. On the other hand, companion cells and phloem sieve tube elements are living cells. Companion cells have both mitochondria and a nucleus and are involved in assisting the sieve tube elements by maintaining cellular functions such as protein synthesis and metabolism. Phloem sieve tube elements, while alive, do not contain nuclei in their mature form to allow for the free flow of nutrients.

32. D



Centrioles are primarily composed of proteins, not nucleic acids or phospholipids. These cylindrical structures play a crucial role in cell division, particularly in the formation of the mitotic spindle during cell division. While proteins make up the majority of centrioles, they do not contain nucleic acids (such as DNA or RNA) or phospholipids

33. C

Nucleic acids are found in cytoplasm because ribosomes (located in cytoplasm on REP) contain ribosomal RNA (rRNA) for protein synthesis.
Mitochondria on the other hand contain mitochondrial DNA (mtDNA) encodes proteins for energy production.
But not in lysosomes since they contain enzymes and digest materials, but no nucleic acids.

34. A

Looking at the structure of a mitochondrion it can be appreciated that it doesn't have a cell wall. It only has an outer bilayer envelope. Mitochondria contain ribosomes for protein synthesis. Mitochondria have also retained the circular chromosome mitochondria does not have E.R.

35. B

The correct answer is B (1 and 2 only). Polynucleotides (DNA and RNA) are present in all viruses, prokaryotes, and eukaryotes. Polypeptides (proteins) are also present in all of these organisms. However, polysaccharides are not universally present in all viruses, prokaryotes, and eukaryotes.

36. A

Telomeres are typically found in structures that contain linear chromosomes. Among the listed structures:
The nucleus contains linear chromosomes with telomeres.
Chloroplasts and mitochondria have circular DNA, so they do not contain telomeres.
Bacterial cells typically have circular DNA and do not contain telomeres.
So, only the nucleus typically contains genetic material with telomeres.

37. C

This question tests the student's knowledge of the similarities and differences between chloroplasts and mitochondria. Students need to know that both organelles contain ribosomes and DNA, and are enclosed by double membranes, but the ribosomes are 70S in both organelles, not 80S as stated in statement 1, which is characteristic of eukaryotic cytoplasmic ribosomes. They must also be aware that both organelles can transcribe their DNA and translate mRNA into proteins.

38. C

All viruses consist of nucleic acids which can be DNA or RNA; adenine is a nucleotide present in both DNA and RNA. Thymine is only found in DNA, while ribose is a sugar component of RNA, and deoxyribose is part of DNA. Since adenine is found in all types of nucleic acids

39. B

The structures labeled A, C, and D appear to be common cellular components found in root cells.In root cells, you would expect to find a large number of mitochondria due to the high energy requirements for active transport processes, as well as endoplasmic reticulum and other common organelles, but chloroplasts, which is not usually found in high numbers in root cells as roots are generally not exposed to light, a requirement for chloroplast function.

40. D

Given that the pore size is approximately 2.5 nm and glucose molecules, with a diameter of about 1.5 nm, can pass through, the student must determine which of the other listed entities can also pass through these pores. Bacteria are generally much larger than 2.5 nm and cannot pass through. Haemoglobin, being a protein, is also larger than this pore size. Ribosomes, which are part of the cellular machinery for protein synthesis, are also too large. Fructose, however, is a simple sugar similar in size to glucose and smaller than 2.5 nm, and thus it can pass through the pores.

41. A

Cisternae, membrane-bound sacs, are found in both the endoplasmic reticulum and Golgi apparatus. They are involved in protein and lipid synthesis, folding, modification, and transport. Mitochondria, which focus on energy production, do not contain cisternae.

42. C

The vacuole is primarily involved in the storage of water, ions, and sometimes pigments and sugars, especially in plant cells. The nucleolus is involved in the production of ribosomes, specifically ribosomal RNA (rRNA). Ribosomes are the cellular structures where protein synthesis occurs. Lastly, lysosomes are organelles that contain digestive enzymes and are involved in breaking down cellular waste, not in cell recognition.

43. B

Both prokaryotes and eukaryotes possess cell membranes and ribosomes, essential for protein synthesis and forming the cell's boundary. Prokaryotes lack a nucleus and organelles like mitochondria, found in eukaryotes.

44. D

Not all viruses contain thymine; RNA viruses contain uracil instead. Adenine and cytosine are present in both DNA and RNA, making them common in all viruses.

45. C

80S ribosomes are characteristic of eukaryotic cells, found in the cytoplasm and associated with the endoplasmic reticulum, and are also present in eukaryotic organelles like mitochondria and chloroplasts.

46. A

Prokaryotic organisms are defined by the presence of cytoplasmic DNA, which is not enclosed within a nucleus, distinguishing them from eukaryotic cells. Both prokaryotes and eukaryotes may have cell walls and ribosomes, but only eukaryotic cells contain a nucleus.

47. A

Matching each organelle with its correct function is a fundamental concept in cell biology. Microtubules are involved in making cilia and the spindle apparatus, the rough endoplasmic reticulum is involved in separating some processes from the cytoplasm, the Golgi body makes lysosomes, and centrioles are involved in assembling the spindle during nuclear division.

48. D

The nucleolus is responsible for the synthesis of ribosomal RNA (rRNA), a crucial component of ribosomes, the cellular machinery for protein synthesis.

49. C

Prokaryotic cells and mitochondria share similarities such as circular DNA and ribosomes, but differ in structures like a nucleus and cell wall, a key distinction in cellular biology.

50. B

Cristae are membrane folds found only in mitochondria. Endoplasmic reticulum and Golgi bodies, which lack cristae, are involved in protein and lipid processing, not energy production.

51. B

mRNA is found in the nucleus where it is transcribed and in the cytoplasm where it is translated into proteins. It is not associated with structures like chloroplasts or ribosomes.

52. A

Viruses are composed of genetic material (DNA or RNA) enclosed in a protein coat. This composition is a fundamental aspect of virology.

53. C

1 represents the centrioles which are explained correctly by statement Y. 2 describes the ribosomes which are explained correctly by statement W and 3 represents the smooth endoplasmic reticulum which is represented by statement V. Hence, option C is the correct answer.

54. B

Option B is the correct answer as both chloroplasts and mitochondria contain 70S ribosomes and circular DNA.

55. D

Option A is incorrect as the capsid is made of protein only. Option B is incorrect as some viruses contain RNA as well. Option C is incorrect as viruses have a capsid made of protein not phospholipids. Hence, option D is the correct answer as all viruses have a non-cellular structure meaning that they do not have a cell membrane or organelles that normal cells have.

56. B

Option B is the correct answer as most prokaryotic cells are between the nm and the μm range.

57. D

Option D is the correct answer as mRNA passes to the ribosome through the nucleus which has a porous double membrane that is represented by X. Mitotic spindles are produces by centrioles which are non-membrane bounded cylindrical structures represented by Y. The hydrolytic enzymes are manufactured by the golgi body which are flattened membrane bound sacs represented by Z.

58. A

Option A is the correct answer as typical prokaryotic cells contain 70S ribosomes in the cytoplasm while eukaryotic cells contain these ribosomes in the chloroplasts or the mitochondria.

59. D

Option D is the correct answer as only the chloroplast is visible at 400 times magnification as the endoplasmic reticulum, centrioles are ribosomes are too small to be clearly visible.

60. A

Option A is the correct answer as the capsid of a virus is made of protein. Viruses can contain DNA as well and their outer membrane is not made of phospholipids and they do not have ribosomes.

61. A

Option A is the correct answer as a cell wall surrounds the root hair cells while more than one microvillus are present on the surface of a cell that help to increase the surface area.

62. B

Option B is the correct answer as prokaryotes, mitochondria and chloroplasts have 70S ribosomes which are smaller than 80S ribosomes and they all contain circular DNA. Prokaryotes however do not contain a double membrane.

63. D

Option D is the correct answer as chloroplasts and mitochondria contain their own ribosomes made of rRNA which means that they also contain tRNA and their own DNA. Cytoplasm similarly contains rRNA, tRNA and mRNA as well and the ribosomes are made of rRNA and tRNA and mRNA is passed to them.

64. B

Statements 1 and 2 are correct as viruses contain either DNA or RNA but not both and they use the host cell's machinery to manufacture their proteins. Statement 3 is incorrect as viruses have an outer protein coat. Hence, option B is the correct answer.

65. B

Option B is the correct answer as the chloroplast and the mitochondria alongside the nucleus all contain ribosomal RNA. Smooth endoplasmic reticulum does not contain rRNA.

66. D

Option D is the correct answer as 1 is the nucleus which is a double membrane bounded organelle with pores. 2 is the centriole that organizes the spindles during cell division and has a cylindrical structure. 3 is the ribosome which are small spherical structures not associated with any membrane.

67. B

Option B is the correct answer as the mitochondria provide the energy for the formation of the lysosomes while the endoplasmic reticulum and Golgi body provide the membranes and the hydrolytic enzymes in it respectively.

68. D

Option D is the correct answer as the organism must be prokaryote since prokaryotes contain DNA that is circular lying naked in the cytoplasm.

69. D

Option D is the correct answer as transcription obviously occurs in the nucleus but also occurs in the chloroplast and the mitochondria since they contain separate chromosomes from the nucleus.

70. C

Option C is the correct answer since viruses can contain either DNA or RNA but not both at the same time.

71. C

Option C is the correct answer as a typical prokaryote has a size in small orders of micrometers.

72. A

Option A is the correct answer as Plasmodium is a eukaryote meaning that it has Golgi body, ribosomes and mitochondria as well.

73. A

Option A is the correct answer as cytoplasm contains nucleic acid in the form of tRNAs. Chloroplasts contain nucleic acid as they contain genetic material and ribosomes contain rRNA. Golgi body does not contain any nucleic acid.

74. B

Option A is incorrect as deoxyribose is not a present in ATP. Options C and D are incorrect as ATP contains pentose sugar not ribose or hexose sugars. Hence, option B is the correct answer as ATP is produced in the mitochondria and chloroplasts.

75. D

Option D is the correct answer as the mitochondrion, chloroplast and the nucleus all have double membranes.

76. C

Option C is the correct answer the mRNA from the nucleus goes to the ribosomes where translation occurs and then it moves to the rough endoplasmic reticulum from where the protein is transported to the Golgi body for post-translational modifications. Options B and D are incorrect as the smooth ER manufactures lipids not proteins. Option A is incorrect as from the Golgi body the protein is secreted form the cell packaged in a vesicle.

77. D

Option D is the correct answer as statements 1 and 2 are incorrect since the mitochondria do not have a cell wall or linear DNA. They contain 70S ribosomes so it is possible that tetracyline affects the ribosomes preventing them from carrying out translation.

78. D

Option D is the correct answer as mitochondria have their own DNA and ribosomes contain nucleic acid in the form of mRNA.

79. A

Option A is the correct answer as centrioles as the microtubules are bunched together.

80. D

Option D is the correct answer as prokaryotes and chloroplasts both have 70S ribosomes that are the site for translation and protein synthesis. Prokaryotes and mitochondria both have circular DNA that contains necessary information for proper functioning. The inner mitochondrial membrane is relatively impermeable except to specific substances. Prokaryotes do not have an inner folded membrane like mitochondria.

81. B

Option B is the correct answer as all viruses are non-cellular meaning that they are not made up of cells. Like all viruses they also have a protein coat and either DNA or RNA but not both at the same time.

82. C

Magnification is image/object length. Since the magnification and the object length are know we multiply them to find the image length which comes out to be 50000 μm. Dividing this by 1000 converts it into mm which is 50 mm making option C the correct answer.

83. B

Option B is the correct answer as the mitochondria and chloroplasts contain their separate DNA while the nucleolus contains the cell's DNA. Centrioles on the other hand do not contain any DNA.

84. A

Option A is the correct answer as eukaryotic cells contain either contain mitochondria or chloroplasts which contain circular DNA and 70S ribosomes. 80S ribosomes are present outside of these structures.

85. C

1 refers to the nucleolus which is described by statement X as it has pores that allow mRNA to pass through. 2 refers to the ribosomes which are represented by W are they are non-membrane bound spherical structures. 3 refers to the smooth endoplasmic reticulum which is represented by V. Hence, option C is the correct answer.

86. B

Option B is the correct answer as 70S are ribosomes are present in the chloroplasts in plants and in bacteria as well. Option A is incorrect as plant cells do not contain centrioles. Options C and D are incorrect as bacterial cells do not contain lysosomes and cell walls made of cellulose.

87. A

Option A is the correct answer as semi-conservative replication of DNA takes place in mitochondria, chloroplasts and nuclei as well.

88. B

Option B is the correct answer as typical prokaryotic cells have a diameter between 1×10^3 nm to 5 μm.

89. C

Option C is the correct answer as chloroplasts and mitochondria contain ribosomes since they have their own DNA separate from the nucleus. The cytoplasm also contains free ribosomes in the endoplasmic reticulum. Golgi body do not have ribosomes.

90. D

Viruses can contain DNA or RNA but not both at the same time. They can also contain proteins in addition to that. They do not contain any carbohydrates, lipids or phospholipids since they do not have a cell membrane.

91. A

All 3 structures are found in both prokaryotic cells and plant cells. The cell wall of prokaryotes is usually made of chitin. Both contain circular DNA with plant cells having it in chloroplasts. And cytoplasm is the medium is which all the organelles are suspended. Hence, option A is the correct answer.

92. D

1 describes the nuclear pore which is correctly explained by statement X. 2 describes the smooth endoplasmic reticulum which is correctly explained by statement V. 3 describes the golgi body which is correctly explained by statement Z. Hence, option D is the correct answer.

93. C

The largest is the width of the chloroplast followed by the mitochondrion and then followed by the ribosome and finally the cell surface membrane. Hence, option C is the correct answer.

94. C

The image shows the centriole which means that statement 1 is incorrect but statements 2 and 3 are correct since microtubules which make it up are proteins and centrioles replicate in the interphase of the cell cycle. Hence, option C is the correct answer.

95. D

Eukaryotic DNA is linear and has histone proteins associated with it. Hence, option D is the correct answer.

96. D

The nuclear envelope is continuous with the rough endoplasmic reticulum. Hence, option D is the correct answer.

97. A

Statement 1 is correct. Statement 2 is correct as well since protein synthesis is an active process. Statement 3 is incorrect as ATP does not contain deoxyribose. Statement 4 is incorrect as ATP is not used in facilitated diffusion. Statement 5 is correct as ATP is used for loading sucrose into companion cells. Hence, option A is the correct answer.

98. D

1 describes the nucleus which is explained by statement X. 2 describes the centrioles which is explained by statement Y. 3 represents the smooth endoplasmic reticulum which is explained by statement V. Hence, option D is the correct answer.

99. B

Ribosomes makes proteins and lysozymes are manufactured by the Golgi body. Hence, option B is the correct answer.

100. D

1 describes the mitochondrion, 2 a bacterium and 3 a chloroplast. Hence, option D is the correct answer.

101. C

1 describes the centrioles explained by statement Y.
2 describes the ribosomes explained by statement W.
3 describes the Golgi body explained by statement Z. Hence, option C is the correct answer.

102. B

The picture shows a plant cell since chloroplasts are visible. The nucleus is not exclusive to only plant cells, so option A is incorrect. Hence, option B is the correct answer.

103. A

Both the 70s ribosomes and the circular DNA are found within the mitochondria and the linear DNA within the nucleus and 80s ribosomes in the rough ER. Hence, option A is the correct answer.

104. B

Centromeres are present in only eukaryotic cells as well as telomeres. Hence, option B is the correct answer.

105. D

Since those structures that release energy remain blue suggests that ATP takes up the stain since structures than use ATP dissolve the stain quickly. Hence, mitochondrion is the organelle that stays blue since it manufactures ATP making option D the correct answer.

106. C

The molecule will have to pass through the inner and outer membranes of the mitochondrion and then the cell surface membrane. Since each membrane has 2 phospholipid layers 2×3 means the molecule will pass through 6 layers. Hence, option C is the correct answer.

107. B

Chloroplasts, mitochondrion, and prokaryotic cells all contain 70S ribosomes. Cytoplasm of a eukaryotic cell contains 80S ribosomes. Hence, option B is the correct answer.

108. C

Mitochondria, ribosomes and nucleus contain RNA. Hence, option C is the correct answer.

109. A

Both prokaryotic cells and plant cells contain cells walls. Hence, option A is the correct answer as histones, telomeres and tonoplasts are found in the plant cell only.

110. D

The manufacture of glycoproteins is carried out by the Golgi body which modifies existing proteins. Since bacteria do not contain Golgi bodies, they cannot produce glycoproteins. Hence, option D is the correct answer.

111. C

2 and 4 must be circular DNA since that is common between prokaryotic cells, mitochondria, and chloroplasts. Hence, option C is the correct answer.

112. C

Both animal and plant cells contain lysosome, nucleolus and vacuole. Hence, option C is the correct answer.

113. A

Eukaryotes can contain DNA, 70S ribosomes in mitochondria and RNA in the form of mRNA and tRNA. Hence, option A is the correct answer.

114. A

mRNA, tRNA, and rRNA are present in prokaryotic cells and in eukaryotic cells. Hence, option A is the correct answer.

115. C

Of all the structures listed only the plasmodesmata contains cytoplasm. Hence, option C is the correct answer.

116. B

The sequence shown is listed during the production of a protein where mRNA passes from the nucleus to the 139 where the proteins is manufactured. From there it is modified at the Golgi Body and then packaged in a vesicle. Hence, since antibody is a protein option B is the correct answer.

117. C

1 is the nucleus represent by statement X. 2 is the ribosomes represented by statement W and 3 is the Golgi Body represented by statement Z. Hence, option C is the correct answer.

118. A

Only the chloroplasts and the mitochondria contain 70S ribosomes since they manufacture their own proteins. Hence, option A is the correct answer.

119. C

Only the nucleoli are visible since all the other structures are too small. Hence, option C is the correct answer.

120. B

Viruses can either have DNA or RNA and they are enclosed by a protein coat. Hence, option B is the correct answer.

121. D

P represents the cell wall, Q the vacuole, R the chloroplast and S the nucleolus. Hence, option D is the correct answer.

122. A

Microtubules are involved in the movement of cilia, vesicles and attachment of centromeres. Hence, option A is the correct answer.

123. B

The order from largest to smallest is Nucleus, Chloroplasts, Mitochondria and Ribosomes. Hence, option B is the correct answer.

124. A

All of the organelles listed have rRNA in them making option A the correct answer.

125. B

Lysosomes contain digestive enzymes which help in the destruction of bacteria. Hence, stopping this stops the bacterial destruction making option B the correct answer.

126. C

Options A and D are incorrect since the lysosomes have a single membrane. Option B is incorrect since lysosomes are not present only in phagocytes. Hence, option C is the correct answer as lysosomes are vesicles enclosed by a single membrane and contain hydrolytic enzymes that can act inside or outside the cell.

127. C

The Golgi Body is required for the packaging of proteins into vesicles and the mitochondria for the provision of ATP for the movement of the vesicle. Hence 1 and 3 are required making option C the correct answer.

128. D

Statement 1 is incorrect since chloroplasts also produce ATP. Statement 2 is correct as ATP can be converted into ADP via hydrolysis. Statement 3 is also incorrect since ATP contains Adenosine not deoxyribose. Hence, option D is the correct answer.

129. D

The organism is a prokaryote since it contains circular DNA. Hence, options A, B and C are incorrect since the organism is not a eukaryote making option D the correct answer.

130. A

Both chloroplasts and mitochondria contain 70S ribosomes are circular DNA. Hence, option A is the correct answer.

131. A

The first place where the amino acids will become concentrated will be the rough endoplasmic reticulum represented by option A since the ribosomes here are the site for protein synthesis which requires amino acids. Hence, option A is the correct answer.

132. C

Cisternae can be found in the Golgi Body and the endoplasmic reticulum and not the mitochondria or the chloroplast. Hence, option C is the correct answer.

133. B

Statements 1 and 2 are correct since both mitochondria and chloroplasts produce ATP. Statement 3 is incorrect since ATP is an energy molecule and is not a part of DNA. Hence, option B is the correct answer.

134. B

Since the question asks for the functions we need to look for options which state the functions. Lysosomes digest unwanted structures, mitochondria produce ATP, smooth endoplasmic reticulum produces lipids and Golgi Body modifies existing proteins into glycoproteins and other forms. Hence, option B is the correct answer.

135. A

Option A is the correct answer since the 80S ribosomes are found in eukaryotic cells. However eukaryotic cells also contain mitochondrion which in turn contain 70S ribosomes that are also present in prokaryotes. Hence, option A is the correct answer.

136. D

Bacterial cell walls are made of peptidoglycan whereas plant cell walls are made of monomers of Beta glucose. Hence, option D is the correct answer.

137. B

The rough endoplasmic reticulum marked by X is responsible for the production of proteins and their transport to the Golgi Body for modifications and packaging into vesicles. Hence, option B is the correct answer.

138. A

Nucleic acid can be found in the cytoplasm in the form of tRNA in the rough ER in the form of rRNA and mRNA and in the mitochondria as the circular DNA. Hence, option A is the correct answer

139. D

2 and 4 represent 70S ribosomes that are found in prokaryotes, mitochondria and chloroplasts. Hence, option D is the correct answer.

140. A

Cell wall, cell surface membrane and ribosomes are common between both plant cells and prokaryotic cells. Hence, option A is the correct answer.

141. B

Goblet cells contain the highest proportion of cell structures enclosed by a single membrane since it addition to having all the conventional cell structures they also have the ability to secrete mucus. Hence, option B is the correct answer.

142. B

Root cells can contain plasmodesmata, Golgi body and mitochondria but not glycogen since plants cannot store glucose in the form of glycogen. Hence, option B is the correct answer.

143. C

Radioactive nucleotides will be concentrated in the nucleus and the mitochondria since each of these organelles use the nucleotides to make mRNA for protein synthesis. Hence, option C is the correct answer.

144. B

Chloroplasts and the mitochondria produce ATP not the nucleus. Hence, option B is the correct answer.

145. B

The largest pellet will be of the nucleus followed by the mitochondria then the lysosome and finally the ribosomes. Hence, option B is the correct answer.

146. A

The Golgi body makes glycolipids. Ribosomes make proteins. Rough endoplasmic reticulum transports proteins and smooth endoplasmic reticulum makes lipids. Hence, option A is the correct answer.

147. B

The cell with the most extensive Golgi bodies is the one that secretes a lot of protein. From the options we can see that this is the goblet cell that secretes mucus. Hence, option B is the correct answer.

148. D

Viruses cannot have carbohydrates, phospholipids or lipids. They can have either DNA or RNA but not both. And they have proteins. Hence, option D is the correct answer.

149. C

Option A is incorrect as the Rough ER does not produce amino acids. Option B is incorrect as ribosomes are not produced by the Rough ER. Option D is incorrect as triglycerides and phospholipids are made by the Smooth ER. Hence, option C is the correct answer.

150. B

Cell wall and cell membrane are present in all prokaryotic cells. Endoplasmic reticulum is present is no prokaryotes. Flagellum is present in some but not all. Hence, option B is the correct answer.

151. B

In the diagram the nucleus and mitochondria are visible. Hence, ATP and RNA will be produced in large quantities. Hence, option B is the correct answer.

152. A

Option A is the correct answer since viruses contain DNA or RNA surrounded by a protein coat. Option B is incorrect since plant cell walls contain only cellulose. Option C is incorrect as centrioles are not found in plant cells. Option D is incorrect as prokaryotic cells contain 70S ribosomes.

153. B

Plant cell wall is made of cellulose and they have both 70S and 80S ribosomes. Their diameter ranges from 5-40 μm. Hence, option B is the correct answer.

154. C

Extensive endoplasmic reticulum and Golgi bodies suggests that the cell secretes proteins. From the cells given we can see that lymphocytes is the correct choice since they produce antibodies. Hence, option C is the correct answer.

155. C

Since cytosine is a nucleotide, the radioactivity will be detected in the nucleus first since nucleotides are used in the replication of DNA or the production of mRNA. Hence, option C is the correct answer.

156. A

Lysosomes contain hydrolytic digestive enzymes that break down unwanted structures. Their presence in mature plant cells can be explained using option A which states their presence in the vacuoles. Hence, option A is correct since it describes the function of lysosomes.

157. C

Prokaryotes, mitochondria and chloroplasts contain circular DNA which is represented by 2 and 4 respectively. Hence, option C is the correct answer since 1, 3 and 5 can be any of prokaryotes, chloroplasts or mitochondria since circular DNA is common between all 3 of them.

158. C

Lysosomes are enclosed in a single membrane and contain hydrolytic enzymes. Hence, option C is the correct answer.

159. D

Eukaryotic DNA is linear and has histone proteins associated with it. Hence, option D is the correct answer.

160. A

Both chloroplasts and mitochondria contain their own DNA with 70S ribosomes and mRNA since they manufacture their own proteins. Hence, option A is the correct answer.

161. C

Eukaryotic cells contain membrane bound organelles which is identifiable by the chloroplasts that is W. Hence, option C is the correct answer. X is the cell wall and Y is the cell membrane which are present in prokaryotes as well.

162. B

70S ribosomes and circular DNA are found in both prokaryotes and eukaryotes. 80S ribosomes are found in only eukaryotic cells. Hence, option B is the correct answer.

163. A

Cytoplasm, cell surface membrane and ribosomes are found in both animal cells (eukaryotic) and prokaryotic cells. Hence, option A is the correct answer.

164. C

The smooth endoplasmic reticulum manufactures and transports lipids. It is represented by option C which is the correct answer.

165. B

70S ribosomes are found in chloroplasts. Hence, option B is the correct answer.

166. D

Chloroplast and mitochondrion both manufacture ATP. Hence, option D is correct since it represents the overlap between the 2 organelles.

167. B

Prokaryotes are around 1 μm in size. Hence, option B is the correct answer.

168. C

The nucleus produces mRNA for a protein. This mRNA goes to the ribosomes in the rough endoplasmic reticulum. From there the protein is transported to the Golgi body which transports it in a vesicle. Hence, option C is the correct answer.

169. B

Option A is incorrect since eukaryotes contain circular DNA as well. Option C is incorrect since prokaryotes do not contain endoplasmic reticulum. Option D is incorrect since ribosomes in prokaryotes are 70S while eukaryotes contain both 70S and 80S ribosomes. Hence, option B is the correct answer as prokaryotes contain circular DNA only and eukaryotes contain DNA associated with histone proteins.

170. B

According to the endosymbiont theory mitochondria was once prokaryotes that took shelter in a cell leading to the mitochondria today. Hence, mitochondria will be centrifuged alongside the bacteria. Hence, option B is the correct answer.

171. A

Chloroplast, mitochondrion, nucleus and cytoplasm all contain ribosomes. Hence, option A is the correct answer.

172. C

Prokaryotes contain the cell wall and the cell membrane as well which are represented by X and Y respectively. However, they do not contain nucleus which is represented by W. Hence, option C is the correct answer.

173. C

Photosynthetic prokaryotes contain cell surface membrane and ribosomes. Hence, option C is the correct answer.

174. B

In animal cells centriole is present while it is absent in plant cells. The rest of the structures are common between animal and plant cells. Hence, option B is the correct answer.

175. D

Statement 1 is incorrect as they contain 70S ribosomes. Statements 2 and 3 are correct as both produce ATP and contain circular DNA molecules. Hence, option D is the correct answer.

176. B

Option A is incorrect as cell wall code is not within the chloroplast. Option C is incorrect as prokaryotes do not have an inner folded membrane. Option D is incorrect as prokaryotes and mitochondria have circular DNA not linear. Hence, option B is the correct answer as the 70S ribosomes in prokaryotes and chloroplasts are used for polypeptide synthesis.

177. B

Plant and prokaryotic cells both have the cell membrane, cytoplasm and ribosomes represented by 1,2 and 6 respectively. Hence, option B is the correct answer.

178. C

Most eukaryotic cells can be found within 10 to 100 μm. Hence, option C is the correct answer.

179. B

In eukaryotic cells ribosomes can be found in the cytoplasm and on the outside of the rough endoplasmic reticulum. Hence, option B is the correct answer.

180. A

Both chloroplasts and typical prokaryotic cells contain 70S ribosomes and circular DNA. 80S ribosomes are found in neither of them. Hence, option A is the correct answer.

181. A

Of all the organelles listed the cell surface membrane is the smallest requiring measurement in nanometers. Hence, option A is the correct answer.

182. C

Once the mitochondrion vesicle fuses with the lysosome the hydrolytic enzymes inside the lysosomes catalyze the breakdown of the damaged mitochondrion. Hence, option C is the correct answer.

183. B

Ribosomes in the rough endoplasmic reticulum are responsible for manufacturing the hydrolytic enzymes within the lysosome. These enzymes are then packaged in a vesicle by the Golgi body and finally ATP form the mitochondria helps in the movement of vesicles. Hence, option B is the correct answer.

184. B

Both chloroplasts and typical prokaryotic cells contain 70S ribosomes and circular DNA. 80S ribosomes are found in neither of them. Hence, option B is the correct answer.

185. D

Statement 1 is incorrect since hydrolytic reaction use a molecule of water. Statement 2 is correct as glycosidic bonds can be broken via hydrolysis. Statement 3 is correct since sucrose is made of glucose and fructose. Hence, option D is the correct answer.

186. B

Option B is the correct answer as it shows the ribosomes which are the site for protein synthesis.

187. B

Mitochondria contain 70S ribosomes making option B the correct answer.

188. B

The amino acids will travel in the cytoplasm (1) to the ribosomes on the rough endoplasmic reticulum (4) from where they will go to the Golgi body (3) and will finally exit the cell via a vesicle (2). Hence, option B is the correct answer.

189. C

Root hairs increase the surface area and contain a vacuole. Microvilli cannot be resolved with a light microscope and more than one are present on a cell. Hence, option C is the correct answer

190. B

Chloroplasts and typical prokaryotic cells contain 70S ribosomes. Hence, option B is the correct answer.

191. C

Options A and D are incorrect since lysosomes are single membrane bounded organelles. Option B is incorrect since lysosomes are not found only in phagocytes. Hence, option C is the correct answer.

192. B

Glycoproteins are modified forms of proteins meaning that they will be manufactured in the Golgi body (2). Proteins will be manufactured by the ribosomes on the rough endoplasmic reticulum (3). Steroids are a form a lipid which will be manufactured by the smooth endoplasmic reticulum (4). Hence, option B is the correct answer.

193. B

mRNA produced in the nucleus travels to the ribosome on the rough endoplasmic reticulum. The protein from the ribosomes travels to the Golgi body where it is modified and packaged into a vesicle. Hence, option B is the correct answer.

194. C

Prokaryotic cell walls is made of peptidoglycan and they contain 70S ribosomes only. Their size ranges from 1-5 μm. Hence, option C is the correct answer.

195. B

Since the total number of rRNA molecules is 38000 and each type has 19000 molecules we can deduce that there are 19000 ribosomes in the cell since each ribosomes contain one of each subunit. Hence, option B is the correct answer.

196. C

Option A is incorrect since the structure is Golgi body, but the function is of the centrioles. Option B is incorrect since the structure is a centriole, but the function is of a lysosome. Option D is incorrect since ribosomes are not membrane bounded. Hence, option C is the correct answer as the structure is smooth endoplasmic reticulum that makes lipids.

197. D

Animal cells and bacterium both contain cell membrane, ribosomes and DNA. Hence, option D is the correct answer.

198. B

The diameter of the nucleus is 26 mm which is 26000 μm. Dividing this by 5700 gives 4.56 as the actual diameter which is closest to option B making it the correct answer.

199. D

The nucleus and the mitochondria in plant cells are double membrane bounded structures. Hence, option D is the correct answer.

200. B

1 is the sap vacuole. 2 is the lysosome. 3 is the mitochondria. 4 is the endoplasmic reticulum and 5 is the ribosomes. 1, 3, 4 and 5 are found in plant cells while 2, 3, 4 and 5 are found in animal cells. Hence, option B is the correct answer.

201. B

Since the inability to manufacture enzymes results in lipid buildup, we can assume that the enzyme is used for lipid breakdown. This means that the structure is a lysosome since lysosomes contain such enzymes that break down structures. Hence, option B is the correct answer.

202. D

Option D is the correct answer since it shows the Golgi body which is the site where proteins are modified and packaged into vesicles.

203. C

X is the vacuole which contains mineral ions, Y is the chloroplast which contains starch and Z is the nucleus which contains DNA and RNA. Hence, option C is the correct answer.

204. A

Options B, C and D are incorrect since prokaryotes do not contain linear DNA or 80S ribosomes. Hence, option A is the correct answer since mitochondria, chloroplasts and prokaryotes all contain circular DNA and 70S ribosomes.

205. C

The amino acid first goes to the ribosome from where it goes to the endoplasmic reticulum and goes to the Golgi body where it is manufactured in a exocytotic vesicle. Hence, option C is the correct sequence.

206. A

2 and 4 must be a feature common between chloroplast, mitochondria and prokaryotes. This is 70S ribosomes. Hence, option A is the correct answer.

207. D

Ribosomes are composed of 2 subunits of rRNA which do not require a membrane. Hence, option D is the correct answer.

208. C

Nucleoli is the largest followed by lysosome then the centriole and lastly the ribosomes. Hence, option C is the correct answer.

209. B

Since glucose would be used for modification of proteins the first place where it would be concentrated will be the Golgi body since that is where proteins are modified. Hence, option B is the correct answer.

1.3: Multiple topics

1. **C**
   Hydrolysis, transcription, and translation occur in both eukaryotes and prokaryotes.
2. **D**
   Ribosomes are around 30 nm. Lysosomes are around 680 nm. Mitochondria are around 1000 nm in size. Hence, option D is the correct answer.
3. **B**
   The Mimi virus and the Pandora virus can be seen using a light and electron microscope since they are both larger than the maximum resolution. Hence, option B is the correct answer.
4. **A**
   Pellet 1 would be the nucleus. 2 would be the mitochondria. 3 would be the lysosome and 4 would be the ribosomes. Hence, pellet 3 contains lysosomes which digested old organelles. Hence, option A is the correct answer.
5. **A**
   The microscope has a resolution of 250 nm. Since both the viruses are larger than this both of them can be seen using the light microscope. Hence, option A is the correct answer.
6. **D**
   All of the above are larger than the pore size meaning that none of them can pass through the pore. Hence, option D is the correct answer.
7. **A**
   Both prokaryotes and eukaryotes contain all the 3 types of RNA. Hence, option A is the correct answer.
8. **D**
   μm is the appropriate unit for measurement of diameter of both lysosomes and red blood cells. Hence, option D is the correct answer.
9. **D**
   The least dense are the ribosomes followed by the mitochondria then the chloroplasts and finally the nuclei. Hence, option D is the correct answer.
10. **C**
    Pancreatic cells are 35000 nm. Dividing this by 7000 gives 5 meaning that red blood cells are 5 times smaller than pancreatic cells. Hence, option C is the correct answer.
11. **B**
    Option A is incorrect since DNA replication has no correlation with lysosomes. Option C is incorrect since facilitated diffusion uses carrier proteins and channels meaning it does not require ATP form mitochondria. Option D is incorrect since smooth ER produces lipids not ribosomes. Hence, option B is the correct answer since Golgi body packages proteins into vesicles.