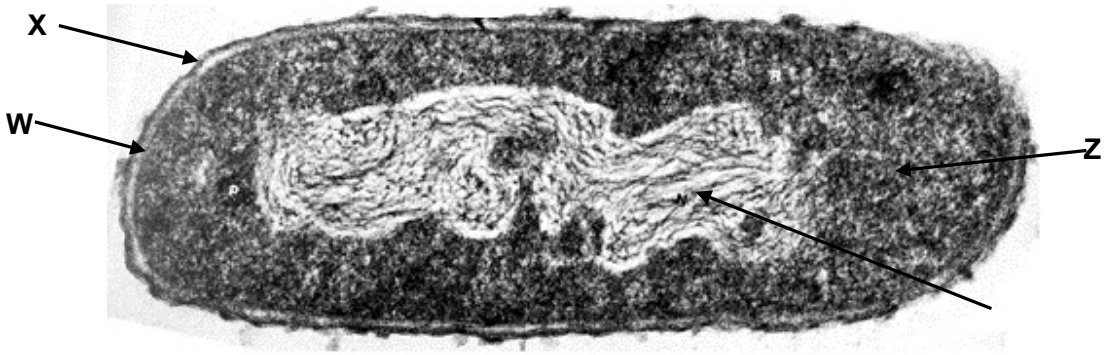
2017 Bacteria and Viruses MCQ

2017 / H2 / ACJC PRELIM / P1 Q6

1 The diagram shows an electron micrograph of a bacterial cell.



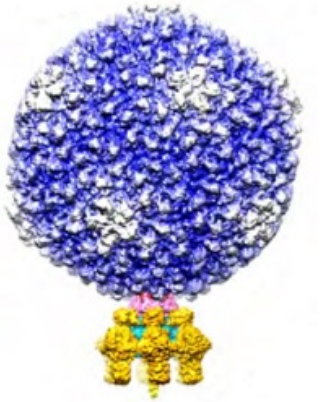
Which of the following correctly identifies the functions of structures W, X, Y and Z?

	W	X	Y	Z
A	Maintains shape of bacterial cell	Protects bacterial cell against desiccation	Contains antibiotic resistance genes which may be beneficial to the bacterial cell	Serves as the site of protein synthesis
B	Controls the passage of substances into and out of the cell	Maintains shape of bacterial cell	Contains genetic information which is essential to the survival of bacterial cell	Serves as the site of translation of mRNA
C	Controls the passage of substances into and out of the cell	Maintains shape of bacterial cell	Contains antibiotic resistance genes which may be beneficial to the bacterial cell	Protects bacterial cell against desiccation
D	Protects bacterial	Protects bacterial	Contains genetic	Maintains shape

	cell against desiccation	cell from the action of phagocytes	information which is essential to the survival of bacterial cell	of bacterial cell

2017 / H2 / ACJC PRELIM / P1 Q7

2 The diagram below shows the enterobacteria phage P22 which is a bacteriophage that infects the bacterium *Salmonella typhimurium*. The genetic material and replication cycle of P22 are similar to the lambda phage.



Which of the following statements can be inferred?

A It is a virulent phage which contains double-stranded RNA and undergoes the lytic cycle.

B It has a spherical envelope that is obtained when the phage buds from the host cell.

C It forms a prophage, which is replicated and passed to the daughter bacterial cells during cell division.

D It has tail fibres which allow the phage to attach to various species of host bacteria.

2017 / H2 / ACJC PRELIM / P1 Q9

3 Many of the most effective antibiotics used in modern medicine are compounds made by fungi that inhibit bacterial protein synthesis. Among the most commonly used drugs are Chloramphenicol, Cycloheximide and Rifampicin. The results of the exposure to eukaryotic and prokaryotic cells to the above three drugs are shown.

Anti-microbial drug	Chloramphenicol	Cycloheximide	Rifampicin
Eukaryotic Animal Cell	Truncated polypeptides were found in mitochondria only	Truncated polypeptides were found in cytosol	No protein synthesized
Prokaryotic Cell	Truncated polypeptides were found in the cytosol	Truncated polypeptides were found in the cytosol	No protein synthesized

Which of the following shows the correct combination of the possible drug mechanisms of the above drugs?

	Chloramphenicol	Cycloheximide	Rifampicin
A	Inhibits the peptidyl transferase activity of the 70S ribosomes	Inhibits elongation by binding the E site of the ribosome hence preventing the release of tRNA	Inhibits the transcription of DNA by blocking the movement of RNA polymerase on DNA
B	Inhibits the peptidyl transferase activity of the 80S ribosomes	Inhibits elongation by binding the E site of the ribosome hence preventing the release of tRNA	Inhibits the transcription of DNA by blocking the movement of RNA polymerase on DNA
C	Inhibits elongation by binding the P site of the ribosome hence preventing the formation of peptidyl tRNA	Inhibits elongation by binding the A site of the ribosome hence preventing the release of tRNA	Inhibits translation by binding to the small ribosomal subunit
D	Inhibits elongation by binding to mRNA and preventing ribosomal translocation	Inhibits elongation by binding the P site of the ribosome hence preventing the release of polypeptide	Inhibits translation by binding to the binding site of large ribosomal subunit

2017 / H2 / ACJC PRELIM / P1 Q12

4 Which of the following correctly matches the state of the *lac* operon to the presence/absence of the molecule(s)?

	State of *lac* operon	Glucose	Lactose	cAMP
1	On	Present	Present	Absent
2	On	Absent	Present	Absent
3	Off	Present	Absent	Absent
4	On	Absent	Present	Present

A 1, 2, 3 and 4

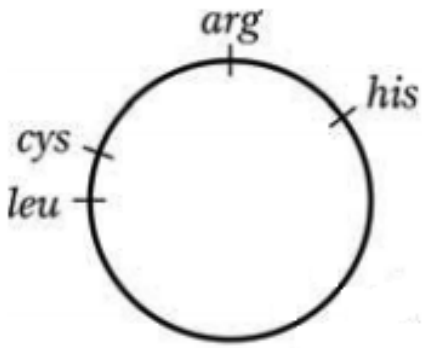
B 1, 3 and 4 only

C 1 and 2 only

D 2 and 3 only

2017 / H2 / ACJC PRELIM / P1 Q19

5 *Salmonella typhi* bacteria is known to be a viable host for a newly discovered temperate phage, but the site of prophage integration is unknown. The following gene map shows the loci of four genes on the *S. typhi* chromosome – *arg*, *his*, *leu* and *cys* – responsible for the biosynthesis of four essential amino acids. Four possible prophage integration sites, W, X, Y, Z are indicated.



The phages are allowed to replicate using a strain of *S. typhi* capable of synthesising all four amino acids (arg^+ his^+ leu^+ cys^+), and the replicated phages are then added to a mutant strain of *S. typhi* of genotype arg^- his^- leu^- cys^-.

After a short incubation, samples of these bacteria are plated on four different media supplemented with different amino acids. The following table shows whether colonies were observed on the various media (+ indicates the presence of an amino acid in the medium while – indicates its absence).

Medium	Supplementation of amino acids in medium				Presence of colonies
	Arg	His	Leu	Cys	
1	–	+	+	+	No
2	+	–	+	+	No
3	+	+	–	+	Yes
4	+	+	+	–	Yes

Which of the following is the most likely prophage integration site?

A Site W

B Site X

C Site Y

D Site Z

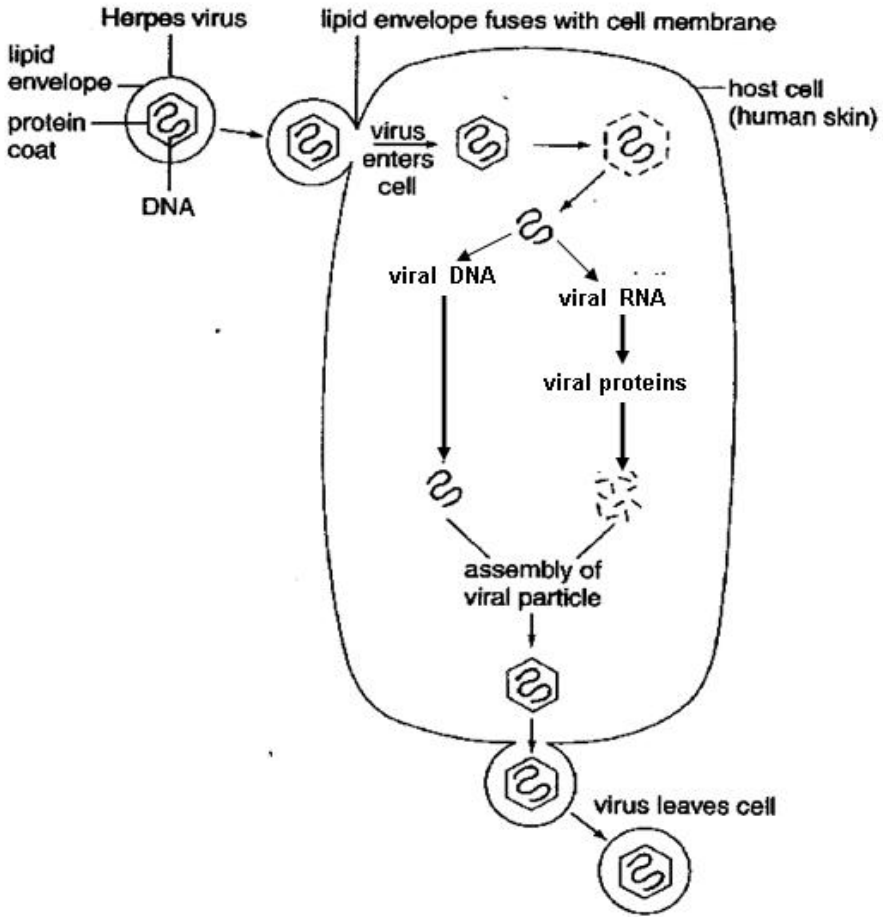
2017 / H2 / AJC PRELIM / P1 Q11

6 Which of the following statement comparing the human immunodeficiency virus (HIV) and lambda phage is **incorrect**?

A The HIV enters by receptor-mediated endocytosis, but the lambda phage infects bacterial cells by injecting its DNA.
B The capsid of the HIV enters the host cell, but the capsid of the lambda virus does not.
C The genome of the HIV must be processed before it is integrated into the host chromosome, but the genome of the lambda virus can be directly integrated.
D New HIV are released from the host cell via budding, but new lambda virus are released via cell lysis.

2017 / H2 / AJC PRELIM / P1 Q12

7 The diagram below shows the reproductive cycle of the herpes virus which causes cold sores on the mouth. With reference to the diagram below, which of the following statements best describes the herpes virus?



A It is not a retrovirus as it does not contain RNA as its genetic material

B Its mode of replication is similar to that of influenza virus.

C Its replication cycle includes a lysogenic phase.

D It carries its own enzymes and ribosomes to make viral proteins.

2017 / H2 / AJC PRELIM / P1 Q13

8 What are the correct characteristics for a prokaryotic genome?

	Promoters	DNA always bound to histone proteins	Plasmids often present	Repeat sequences absent or uncommon
A	✓	×	×	×
B	×	✓	✓	✓
C	×	✓	×	×
D	✓	×	✓	✓

2017 / H2 / AJC PRELIM / P1 Q14

9 A mutant strain of *E. coli* has been isolated in which the *lac* operon is not expressed in the presence of lactose. This mutant strain was mated so that it now contains an F plasmid containing a normal *lac* operon. The mutant and mated strain with regard to their β-galactosidase activities in the presence and absence of lactose was compared. The following results were obtained:

Strain	**Addition of lactose**	**Amount of β-galactosidase (percentage of parent strain)**
Parent	No	0
Parent	Yes	0
Mated	No	0
Mated	Yes	100

With respect to the results shown in table, which part of the bacterial DNA most likely is mutated?

A *lac A*

B *lac I*

C Promoter of lac operon

D Operator of lac operon

2017 / H2 / AJC PRELIM / P1 Q15

10 Which comparative statements about prokaryotic and eukaryotic gene expression are correct?

1 DNA methylation is a feature of prokaryotes but not eukaryotes.
2 Eukaryotes and prokaryotes both use ribosomes to translate mRNA.
3 Eukaryotes have introns, most prokaryotes do not.
4 Prokaryotes have genes organized into operons, most eukaryotes do not.

A 1, 2 and 3

B 1, 2 and 4

C 1, 3 and 4

D 2, 3 and 4

2017 / H2 / CJC PRELIM / P1 Q15

11 When a mutant strain of Escherichia coli that has lost the regulatory gene of its tryptophan operon is placed in a medium that contains all nutrients the cell need to grow except tryptophan, which of the following will occur?

A The cells will grow even though there is no tryptophan in the medium.

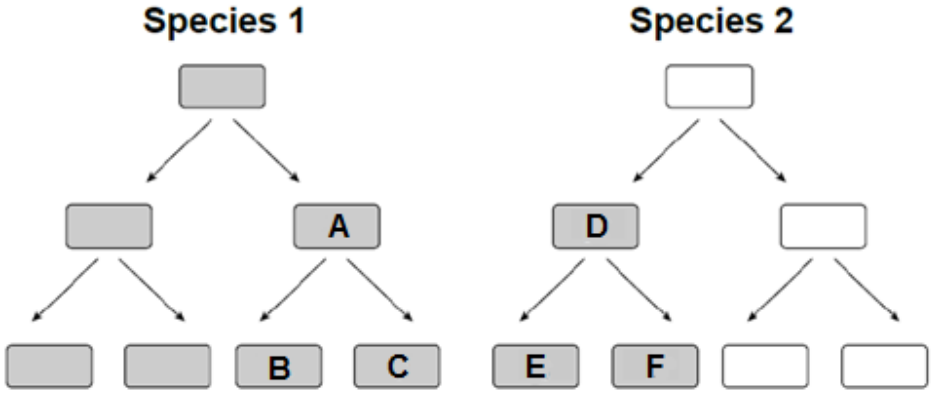
B The cells will grow until excessive tryptophan arrests the expression of the operon.

C The cells will not grow until enough tryptophan has been synthesised to make the repressor active.

D The cells will never grow unless tryptophan is added to the medium.

2017 / H2 / CJC PRELIM / P1 Q16

12 The diagram below shows how two species of bacteria reproduce when placed together in a growth medium. The bacteria that are shaded are resistant to the antibiotic penicillin.



Which one of the following statement(s) is/are likely to be true?

i. Bacteria **B** and **C** are resistant to penicillin as a result of binary fission of Bacterium **A**.

ii. Bacteria **C**, **D** and **F** are resistant to penicillin as a result of random mutation.

iii. Bacterium **D** is resistant to penicillin as a result of conjugation process which transfers the F plasmid carrying penicillin resistance gene from Bacterium **A**.

iv. Bacterium **D** is resistant to penicillin through transduction from Bacterium **A** where there is transfer of the complete F plasmid.

A **iii** only

B **i** and **iii**

C **i** and **iv**

D **ii, iii** and **iv**

2017 / H2 / ACJC PRELIM / P1 Q17

13 Which of the following is true of influenza and HIV viruses?

A Genetic shift causes variation in influenza but not in HIV.

B Both HIV and influenza are virulent upon budding off from their respective host cell.

C Influenza viruses have DNA genomes that are templates for transcription.

D HIV viruses have genomes that are readily inserted into the host genome.

2017 / H2 / DHS PRELIM / P1 Q13

14 *Pithovirus* was recently discovered and classified as a species of giant virus. It is approximately 1.5 μm in length, larger than the smallest known eukaryotic cell and larger than any known giant virus. It carries double stranded DNA and replicates in the cytoplasm of amoeba, a single cell animal. It carries the genes for transcribing DNA to RNA and genes required for protein synthesis.

Which of the following explains why this organism was classified as a virus?

A It is only able to replicate within amoeba.

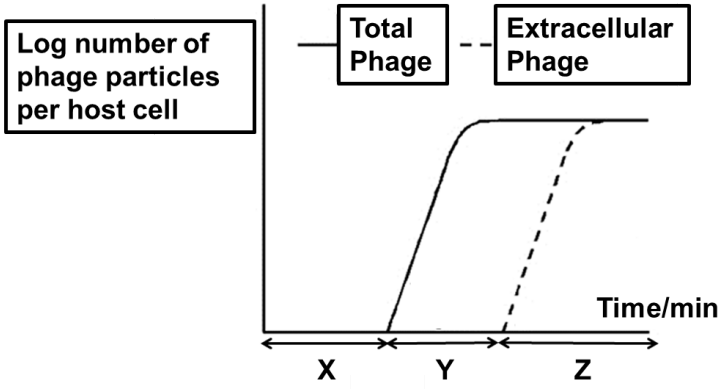
B It is too large to be known as a eukaryotic cell.

C It carries double stranded DNA, similar to bacteriophages.

D Similar to HIV and influenza virus, it carries enzymes that transcribes its genome.

2017 / H2 / DHS PRELIM / P1 Q14

15 The figure below shows a growth cycle of a T4 phage.



Which of the following statements about **X**, **Y** and **Z** of the growth cycle is correct?

A **Y** is the period where there is just active viral DNA replication and protein production.

B **X** is the eclipse period where the phage just infected the host cell.

C **X** corresponds to the period where the phage exists as a prophage.

D Period **Z** will correspond to the death of host cells.

2017 / H2 / DHS PRELIM / P1 Q15

16 When trypsin converts chymotrypsinogen to chymotrypsin, some molecules of chymotrypsin bind to a repressor, which in turn binds to the operator and prevents further transcription of trypsin gene. This is most similar to which of the following operons?

A trp operon during lack of tryptophan

B trp operon during abundance of tryptophan

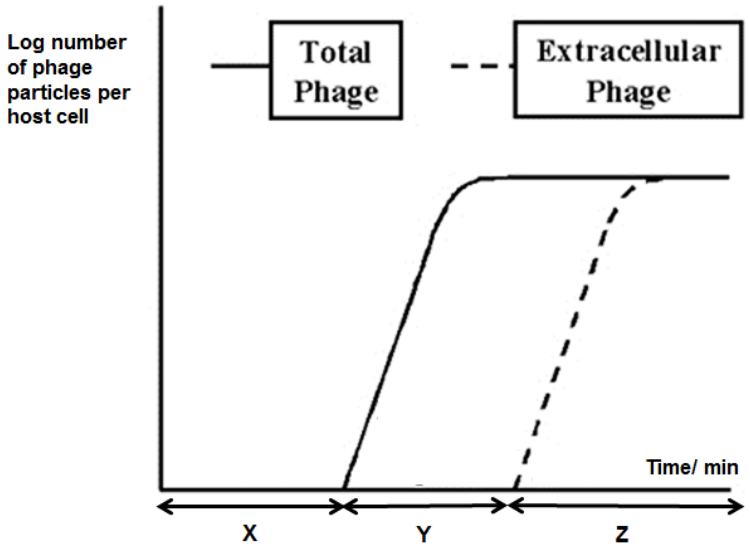
C lac operon during lack of lactose

D lac operon during abundance of lactose

2017 / H2 / MJC PRELIM / P1 Q16

QUESTION 17

The figure below shows a growth cycle of bacteriophages.



Which of the following is **true** about X, Y and Z of the growth cycle for T4 bacteriophage and lambda phage?

	T4 bacteriophage	**Lambda phage**
A.	Period X is when the phage injects its viral RNA into host cell.	Period X is when the phage infects host cell and integrates its viral DNA into the host chromosome
B.	Period Z is when phage lysozymes digest the host's cell wall.	Cell lysis occurs in Period Z.
C.	Period X is when hydrolysis of host cell occur.	Period X is where the prophage replicates.
D.	Period Y is when host cell's DNA is hydrolysed into fragments	Period Y is when there is phage assembly.

2017 / H2 / MJC PRELIM / P1 Q17

QUESTION 18
Human immunodeficiency virus (HIV) is a retrovirus. After infecting a host cell, viral DNA is produced which is incorporated into the DNA of the host cell. The modified host genome now codes for the production of new HIV particles.

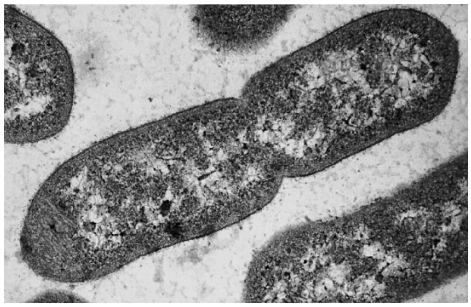
Which could be used as a potential treatment to slow down the spread of HIV?

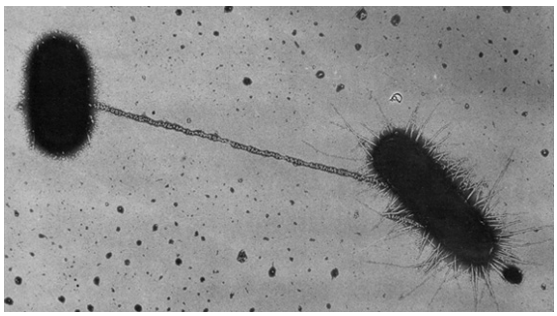
1 Inhibitors of restriction endonucleases
2 Inhibitors of reverse transcriptase
3 Reverse transcriptase
4 (–) single-stranded RNA of HIV

A. 2 only **B.** 1 and 2 **C.** 1 and 3 **D.** 2 and 4

2017 / H2 / MJC PRELIM / P1 Q18

QUESTION 19
The photomicrographs below show two different processes occurring in bacteria.





Which of the following statements are **false**?

1 Both requires a protein appendage to take place.
2 In both process, semi-conservative replication of DNA occurs.
3 In both processes, replication of the bacterial chromosomal DNA occurs.
4 Both involved the transfer of a single-stranded DNA to another bacterial cell.

A. 1 and 2 **B.** 3 and 4 **C.** 1, 2 and 3 **D.** 1, 3 and 4

2017 / H2 / NJC PRELIM / P1 Q10

20 What increases the possibility of antigenic shift in influenza virus?

A infection of multiple individuals with the same strain of influenza virus

B lack of proofreading ability in viral RNA polymerase

C presence of herd immunity

D simultaneous infection of one individual with two different strains of influenza virus

2017 / H2 / NJC PRELIM / P1 Q11

21 Which event is most likely due to bacterial conjugation?

A A gene encoding resistance to gentamicin in the *Escherichia coli* chromosome appears in the genome of a bacteriophage that has infected *Escherichia coli*.

B A strain of *Corynebacterium diphtheriae* produces a toxin encoded by a prophage.

C A strain of *Pseudomonas aeruginosa* produces β-lactamase encoded by a plasmid similar to a plasmid of another Gram-negative bacterium.

D An encapsulated strain of *Streptococcus pneumoniae* acquires the gene for capsule formation from an extract of DNA from another encapsulated strain.

2017 / H2 / NJC PRELIM / P1 Q12

22 Which rows correctly compare generalised and specialised transduction?

	generalised transduction	specialised transduction
1	Any donor gene can be transferred by the phage.	Only certain donor genes can be transferred by the phage.
2	The transducing phage contains a hybrid chromosome in its capsid.	The transducing phage contains only bacterial chromosome in its capsid.
3	Phage genome is transcribed.	Phage genome is not transcribed.
4	The donor cell lyses, releasing the phages.	The donor cell lyses, releasing the phages.

A 1 and 3

B 1 and 4

C 2 and 3

D 2 and 4

2017 / H2 / NJC PRELIM / P1 Q13

23 Which statement correctly describes the control of transcription of the genes involved in the breakdown of lactose in *Escherichia coli*?

A A repressor protein binds to the operator and the genes are switched on.

B A repressor protein binds to the operator and the genes are switched off.

C A transcription factor binds to the promoter and the genes are switched on.

D A transcription factor binds to the promoter and the genes are switched off.

2017 / H2 / ACJC PRELIM / P1 Q14

24 A region of eukaryotic DNA consists of over fifty tandem repeats of the same sequence of twelve bases.

Where is this repetitive region **least** likely to be found?

A an exon

B an intron

C centromere

D promoter

2017 / H2 / NYJC PRELIM / P1 Q12

25 Which of the following statements concerning lac operon is true?

1 Transcription of lac operon takes place all the time.

2 There is one single mRNA transcribed from the lac operon.

3 There is one start and one stop codon in the mRNA of lac operon.

4 The repressor molecule binds to the operator to turn off lac operon.

A 4 only

B 1 and 3

C 2 and 4

D 2, 3 and 4

2017 / H2 / NYJC PRELIM / P1 Q13

26 Some events that take place during generalised transduction are listed below.

1 Bacterial host DNA is fragmented.
2 Bacterial DNA may be packaged in a phage capsid.
3 Recombination between donor bacterial DNA and recipient bacterial DNA.
4 Phage infects a bacterial cell.
5 Phage DNA and proteins are made.

Which sequence of events is correct?

A 4 1 3 5 2

B 4 1 5 2 3

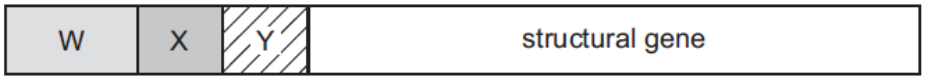
C 4 5 2 3 1

D 4 5 1 3 2

2017 / H2 / NYJC PRELIM / P1 Q11

27 The diagram represents a length of DNA from a prokaryote that includes a structural gene.

Parts of the length of DNA are labelled **W**, **X** and **Y**. They have different functions in the control of transcription of the structural gene.



What identifies the functions of parts **W**, **X** and **Y**?

	W	**X**	**Y**
A	operator	regulator	promoter
B	promoter	regulator	operator
C	regulator	promoter	operator
D	promoter	operator	promoter

2017 / H2 / NYJC PRELIM / P1 Q9

28 The table shows the mode of action of two antibacterial drugs that can affect the synthesis of proteins.

antibacterial drug	rifampicin	streptomycin
mode of action	binds to the RNA polymerase	causes errors in translation

If bacteria are treated with both drugs, what will be the immediate effects?

1 Transcription will stop, but faulty proteins may continue to be synthesised.

2 If translation has started, proteins may be faulty.

3 Translation will be inhibited.

A 1, 2 and 3 **B** 1 and 2 only **C** 1 and 3 only **D** 2 and 3 only

2017 / H2 / RI PRELIM / P1 Q11

29. Which of the following statement(s) regarding viruses is/are incorrect?

I When viruses go through antigenic drift, two different viruses may have infected a single host cell and recombined into a new virus.

II The DNA-dependent RNA polymerases that are required for the replication of influenza viral genome in the host cell are of viral origin.

III Cytotoxic T cells can kill virus-infected target cells by releasing perforins that create pores in the infected cell and lysozymes that activate enzymes that trigger apoptosis of the cell respectively.

IV The enzyme integrase is involved in the integration of viral DNA into the host cell genome in both the lambda phage and human immunodeficiency virus life cycles.

V For the influenza virus to enter the host cell, haemagglutinin on the host cell membrane binds to a sialic acid receptor of the virus.

A **IV** only

B **I**, **II** and **IV** only

C **I**, **II, III** and **V** only

D All of the above

2017 / H2 / RI PRELIM / P1 Q12

30. Which of the following statement(s) is/are true?

I A mutation that inactivates the regulatory gene of a repressible operon in *E.coli* would result in the continuous transcription of the structural genes that are controlled by that regulator.

II During generalised transduction, the prophage may be improperly excised to include the adjacent segment of bacterial DNA during an induction event.

III A mutation in the regulatory gene that resulted in the permanent repression of the *lac* operon could be due to the inability of the mutant repressor to bind to the inducer.

IV The F factor on the F plasmid, codes for proteins necessary for the formation of sex pili and subsequent cytoplasmic mating bridge, allowing for conjugation to occur between bacteria.

A **III** only

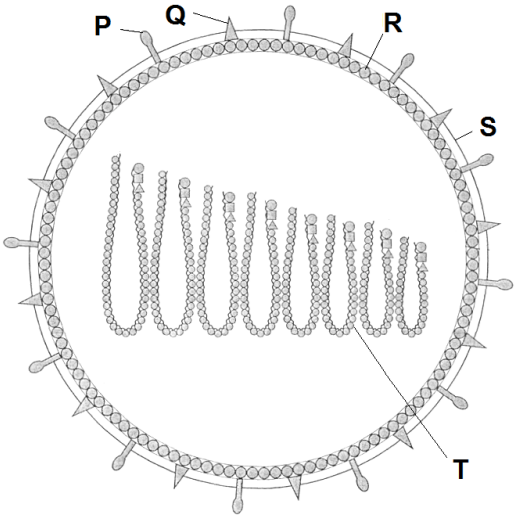
B **I** and **II** only

C **I**, **III** and **IV** only

D All of the above

2017 / H2 / RVHS PRELIM / P1 Q16

31 The diagram shows the structure of an influenza virus.



Which of the following statements concerning the lettered components are correct?

1 Mutations that disrupt the function of **R** will result in the inability of the virus to initiate infection in the host cell.

2 **P** and **Q** are unlikely targets for vaccination because they undergo mutation constantly.

3 New influenza viruses acquire **S** from host cell during budding.

4 The host cell enzymes are not required to form the complementary RNA from **T**.

A 1 and 2 only

B 3 and 4 only

C 1, 2 and 3

D 2, 3 and 4

2017 / H2 / RVHS PRELIM / P1 Q17

32 Which statements about viruses are true?

1 They encode genes for synthesising their own ATP.

2 They are single-cell organisms.

3 They can have genomes made of DNA.

4 They package ribosomes into their virion.

5 They can have a single-stranded or double-stranded RNA genomes.

6 They can have a membrane-like envelope.

A 5 and 6 only

B 3, 5 and 6

C 1, 3, 5 and 6

D All of the above

2017 / H2 / RVHS PRELIM / P1 Q18

33 Which of the following statements about the *lac* operon are correct?

1 *lac Z*, *lac Y* and *lac A* are structural genes that will be expressed when the operator is switched on.

2 In the absence of alloactose, the repressor protein will be unable to bind to the operator.

3 When glucose and lactose are available and the repressor becomes inactive as allolactose binds to it.

4 *lac Y* codes for a protein that increases uptake of lactose from environment.

5 Catabolite activator protein binds to promoter to increase rate of transcription.

A 1 and 2

B 1 and 3

C 1, 2 and 5

D 3, 4 and 5

2017 / H2 / VJC PRELIM / P1 Q15

2017 Bacteria and Viruses MCQ ANS

15 Which of the following statements are true of HIV and influenza virus?

1 Genetic material with the same sense

2 Uncoating occurs after fusion of envelope with host membrane

3 Viral particles contain specific enzymes that are not found in the host cells

4 Replication of viral genetic material takes place in the nucleus immediately upon infection

5 Changes in the genome are due to the lack of proofreading mechanism only

A 1 and 4 only
B 2 and 3 only
C 1, 4 and 5 only
D 2, 3 and 5 only

Question	Answer	Question	Answer
1	**B**	21	**C**
2	**C**	22	**B**
3	**A**	23	**B**
4	**B**	24	**D**
5	**A**	25	**C**
6	**A**	26	**B**
7	**A**	27	**C**
8	**B**	28	**B**
9	**C**	29	**C**
10	**D**	30	**C**
11	**A**	31	**B**
12	**B**	32	**B**
13	**A**	33	**D**

14	**A**	34	**B**
15	**D**		
16	**B**		
17	**B**		
18	**D**		
19	**D**		
20	**D**		