

**B12169**

**ADMISSION TEST FOR THE DEGREE COURSE IN MEDICINE AND SURGERY**

**Academic Year 2019/2020**

General Knowledge and Logical Reasoning

- 1** People who are vegetarian or vegan tend to live longer than meat eaters. If we want to live longer, we should give up eating meat.

Which one of the following best expresses a flaw in the above argument?

- A** It ignores the possibility that other variables help vegetarians live longer.
- B** It assumes that a long life is always desirable.
- C** It ignores the convenience of cooking with meat.
- D** It suggests that we only eat for survival rather than for pleasure.
- E** It assumes that a vegetarian or vegan diet provides an optimal balance of nutrients.

- 2** The UK government continues to spend more than it raises through taxation. The shortfall is made up through borrowing in the form of bonds paid for by tax revenues in the future. But, since it is unfair to saddle future generations with our debts, we must streamline public finances and only fund institutions and programmes that promise a financial return. In light of this, government should drastically reduce spending on the arts. Every year about £450 million of taxpayers' money is given to artists and art programmes to encourage creativity. Many of these applicants and beneficiaries probably can't find anyone to buy their modern sculptures or installations. Arts funding represents an indulgence we can no longer afford in the age of austerity.

Which one of the following, if true, most weakens the above argument?

- A** Creative industries, including museums, galleries and film, add £84 billion to the UK economy.
- B** UK taxpayers are currently paying back bonds and securities issued by governments in the past.
- C** The UK government could increase income taxes on people with annual incomes over £250 000.
- D** The UK government currently funds parks and public ceremonies, which offer no financial return.
- E** The public enjoy art and it makes a positive impact on the population's wellbeing.

- 3** Internet abuse directed at female journalists has received a great deal of attention recently. There is a common assumption that the targets of such vile behaviour are overwhelmingly women abused because they are women. However, there was little reaction to recent reports that male public figures get more online abuse than their female counterparts. Male politicians fare especially badly, receiving more than six times as much abuse as female politicians. The only occupational category in which women get more online abuse than men is journalism: abusive messages account for over five per cent of those sent to female journalists and TV presenters and fewer than two per cent of those sent to male journalists.

Which one of the following is a conclusion that can be drawn from the above passage?

- A** The issue of online abuse tends to receive more public attention when it is directed at women.
- B** The kind of abuse that women face is worse than the abuse directed at men.
- C** Journalists are not public figures in the same way that politicians or celebrities are.
- D** The online abuse that women attract is due to who they are, not to what they say or write.
- E** Male politicians themselves are generally more abusive and aggressive than their female counterparts.

- 4** There is increasing evidence that sitting for long periods can be associated with a number of health problems. It can lead to obesity and diabetes, and cardiovascular diseases are twice as likely to affect people with sedentary jobs as those who stand while working. People with sedentary jobs should thus do everything they can to minimise these risks. Although daily exercise alleviates the problem, it is not sufficient. Researchers believe that this is because periods of intense exercise after work cannot counteract the damage caused by sitting without interruption all day. Those with sedentary jobs should interrupt sitting whenever possible, doing light exercise at hourly intervals, both inside and outside the workplace.

Which one of the following best expresses the main conclusion of the above argument?

- A** People with sedentary jobs should interrupt their sitting with regular light exercise, both at work and outside work.
- B** The health risks associated with extended periods of sitting can be completely offset by major changes in lifestyle.
- C** People with sedentary jobs are exposed to a number of health problems due to the nature of their work.
- D** People with standing jobs are generally healthier than people with sitting jobs.
- E** Not doing regular exercise is the major factor exacerbating the health problems associated with long hours of sitting.

- 5** There are two reasons to argue: one is to score a victory at all costs, the other to reach some agreement even if that means a respectful agreement to differ. Politicians instinctively argue to win, to the extent that anything an opponent says must be interpreted as wrong or stupid or both. But this is the opposite of good, honest debate. The right way to respond to an opponent's argument, even when your aim is to oppose it, is to acknowledge its best and strongest points, because that is how you would wish your arguments to be received and interpreted by your opponents. Only on that basis can a fair outcome be achieved, whoever wins.

Which one of the following applies the same general principle as the above argument?

- A** You should not jump queues, for the simple reason that you would not want other people to push in front of you.
- B** Professional footballers should not set out to win at all costs, for the same reason that businesses should not put profit above everything else.
- C** Nobody should look for ways to avoid their full tax liability because, if some people do it, everyone will want to do the same.
- D** You should never throw food away if it is still fit for consumption, for the same reason that you should not buy more than you know you can eat.
- E** Politicians should show respect to each other because argumentative behaviour gives politics a bad name.

- 6** A recent study on runners in Denmark has provided new evidence that we should do all things in moderation. The research tracked health outcomes for 800 runners divided into three categories: 500 who regularly jogged slowly for modest distances; 250 who achieved moderate exercise levels through running; and 50 endurance runners who had exercised strenuously for many years. Ten years into the study, the researchers found that two of the endurance runners had died. This death rate was much higher than for the groups who took light and moderate exercise. Cardiologists explain that, while light to moderate exercise is extremely beneficial, decades of very strenuous exercise can actually damage the heart.

Which one of the following expresses the flaw in the above argument?

- A** It draws a general conclusion on the basis of too small a number of runners.
- B** It assumes that runners will accurately report the distances that they cover.
- C** It draws a conclusion about the effects of running over too short a period.
- D** It assumes that research on Danish runners can be generalised to other runners.
- E** It ignores the overwhelming evidence about the benefits of exercise.

- 7 A study of the language in a million reviews of 6,500 US restaurants and their menus found that the length of words in menus and reviews directly correlate with the prices of food offered. Upmarket places filled their menus with terms such as 'tonnarelli' and 'bastilla'. While cheaper places had 'decaf' and 'sides', the finer restaurants used 'decaffeinated' and 'accompaniments'. The study also found that reviews of expensive establishments used longer words and expressions like 'delightful' and 'extraordinary', while when describing cheaper places people would use shorter words, like 'nice' and 'cool'.

Which one of the following, if true, most strengthens the above argument?

- A Detailed price analysis has shown that every additional letter in restaurant menus adds 20 cents to the cost of a main course.
- B The most expensive food in cheap restaurants can be described in the same terms as the cheapest food in the fancy restaurants.
- C Some of the longest words in the reviews of a cheap restaurant can be of the same length as the shortest words.
- D A review of the ten most expensive restaurants suggests that the most expensive dishes do not always receive the most positive reviews.
- E Upmarket restaurants do not always receive reviews containing longer words.

- 8 Anyone who has played poker can appreciate how difficult it is to detect a liar. Technology doesn't help very much, and few experts have confidence in the polygraph (the 'lie-detector' machine). When it was first invented in the twentieth century, the polygraph was quickly popularised by newspapers and novels. However, what it detects is fear, not lying. The physiological responses that it measures (usually heart rate, skin conductivity, and rate of respiration) don't necessarily accompany dishonesty.

Which one of the following can be drawn as a conclusion from the above passage?

- A Polygraphs cannot tell if a person is lying.
- B Heart rate is affected by lying.
- C All people tell lies.
- D People who lie often show fear.
- E The polygraph was popularised in fiction and newspapers.

- 9** Doing things which are motivated simply by a concern for others is one clear way in which mankind distinguishes itself from animals. Morally, then, we should help others less fortunate than ourselves. People in rich countries, for example, can provide aid for people in poorer countries who face hardships and injustice, often caused or compounded by the actions and decisions of rich countries themselves. This duty supersedes any temporary financial problems richer countries face, or any cynical calculation of why it might be in the richer countries' interests to help. Rich countries should always help poorer countries.

Which one of the following is an assumption underlying the above argument?

- A** Having a feature which distinguishes humans from animals confers an obligation to use it.
  - B** Rich countries cannot afford to help poorer countries in times of an economic turndown.
  - C** Poor countries cannot improve their situations except with the help of richer countries.
  - D** Rich countries will only help poorer countries if they see it as being in their self-interest.
  - E** The feature which distinguishes humans from animals confers a moral obligation only to other humans.
- 10** Crash tests have shown that bigger cars are more robust and are thus more likely to protect their passengers in an accident. It is also widely known that bigger cars usually have much bigger engines than smaller ones. This means that the size of the engine positively affects the safety of a car.

Which one of the following expresses the flaw in the above argument?

- A** Even though car size is strongly associated with engine size and safety rating, this does not imply that engine size contributes to making cars safer.
- B** It does not take into account that engine size is only one factor in the safety level of a car.
- C** It ignores that a bigger engine means a higher maximum speed and better acceleration, which are safety risks.
- D** The criteria used in crash tests are highly artificial and are therefore unlikely to be of any use in real situations.
- E** It fails to recognise that engine size influences the safety rating only indirectly.

- 11** I live in London, but my brother lives in New York, where the local time is 5 hours behind British time. My sister lives in Hong Kong, where the local time is 8 hours ahead of British time.

I spoke to both of them on the telephone today. My brother told me it was 9 am in New York when he rang me, and my sister said it was 9 pm in Hong Kong when she called.

What was the time interval between the start of the two calls?

- A** 1 hour
  - B** 3 hours
  - C** 9 hours
  - D** 13 hours
  - E** 15 hours
- 12** I am a member of a book club from which I buy books by mail order. At the start of last year, I owed the club £10. I paid £50 during the course of that year. At the end of last year, I owed £8. Apart from the price of the books, no additional charges are made.

What was the value of the books I bought from the book club last year?

- A** £48
- B** £32
- C** £40
- D** £52
- E** £58

- 13** The village hall has just set up a toy library where parents can borrow toys for their children for a certain period of time. It is only open on Saturday mornings and parents may borrow toys from their stock of 50 for 1, 2 or 3 weeks.

On the first four weeks, the toy library lends 40, 13, 8 and 12 toys. No toys were returned late.

What is the lowest number of toys the library could have in stock at the end of the fourth Saturday?

- A** 17
  - B** 0
  - C** 29
  - D** 33
  - E** 38
- 14** Two people were asked to think about their ages, add them together and then give the sum as the answer. The younger one gave the answer as 11 and the older one gave the answer as 102. Both were incorrect: one of these two people had subtracted one age from the other, while the other had multiplied them together.

What is the age of the older person?

- A** 17
- B** 6
- C** 11
- D** 23
- E** 34

**15** The table below gives information about five different types of vehicle:

<i>type of vehicle</i>	<i>size of fuel tank (litres)</i>	<i>fuel consumption (miles per litre)</i>	<i>type of fuel</i>	<i>top speed (miles per hour)</i>
pick-up truck	100	6	petrol	100
city car	30	12	petrol	95
sports car	40	6	petrol	145
hatchback	50	10	diesel	80
saloon	70	8	diesel	78

Which type of vehicle can travel the furthest distance on a full tank of fuel before needing to refuel?

- A** pick-up truck
- B** city car
- C** sports car
- D** hatchback
- E** saloon

- 16** To decide which House at Three Oaks School should be awarded the annual House Competitive Shield, the results of the Winter and Summer Sports Competitions were added to the results of the Track and Field Competitions on Sports Day. The winning team in each category was awarded 30 marks, the second 20 marks, and the third 10 marks. The last team got nothing.

In an attempt to improve student behaviour, the Principal decided that good and bad conduct marks would be included in the calculation for the House Shield, with bad conduct marks being subtracted from their overall score. The results were as follows:

	<i>Blue House</i>	<i>Green House</i>	<i>Red House</i>	<i>Yellow House</i>
<i>winter sports</i>	1 <sup>st</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	2 <sup>nd</sup>
<i>summer sports</i>	2 <sup>nd</sup>	4 <sup>th</sup>	1 <sup>st</sup>	3 <sup>rd</sup>
<i>track events</i>	1 <sup>st</sup>	4 <sup>th</sup>	3 <sup>rd</sup>	2 <sup>nd</sup>
<i>field events</i>	3 <sup>rd</sup>	2 <sup>nd</sup>	4 <sup>th</sup>	1 <sup>st</sup>
<i>good conduct</i>	31 marks	13 marks	47 marks	36 marks
<i>bad conduct</i>	8 marks	34 marks	2 marks	4 marks

What difference did the inclusion of good and bad conduct marks make to the result of the competition?

- A** Blue House still won.
- B** Red House won instead of Blue.
- C** Red House still won.
- D** Yellow House still won.
- E** Yellow House won instead of Blue.

- 17 A care home needs to have regular carpet cleaning throughout the year. Some areas of the home need a more frequent clean. Carpet cleaning can only be scheduled for the months of January, April, July and October. During the month of July, the carpet cleaning-company has a discounted price for carpet cleaning. The aim is to schedule cleaning so that the lowest possible cost for the year can be achieved.

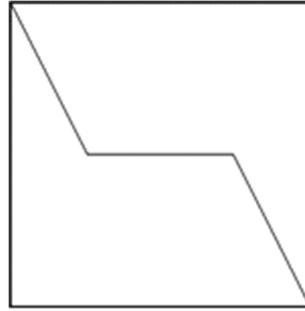
<i>carpets</i>	<i>average size</i>	<i>price</i>	<i>discount price</i>
lounge	15' × 12'	£64.00	£32.00
through lounge	20' × 12'	£84.00	£42.00
stairs and landing	standard	£76.00	£38.00
hall	10' × 3'	£24.00	£12.00
dining room	12' × 11'	£60.00	£30.00
kitchen	12' × 11'	£64.00	£32.00

<i>area</i>	<i>frequency of clean</i>
lounge	every 6 months
through lounge	every 6 months
stairs and landing	every 3 months
hall	every 3 months
dining room	every 6 months
kitchen	every 3 months

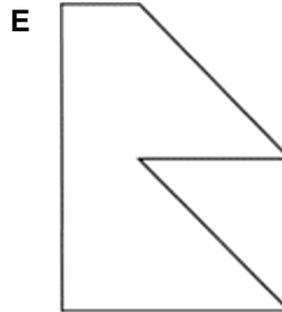
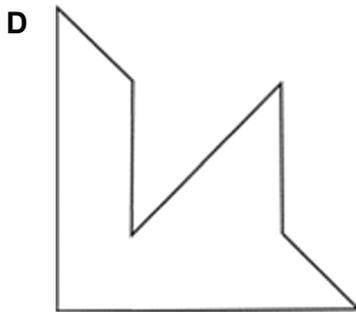
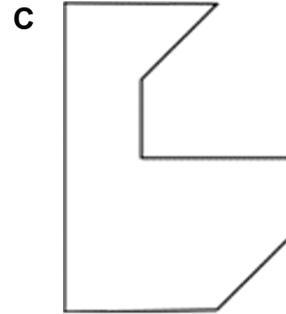
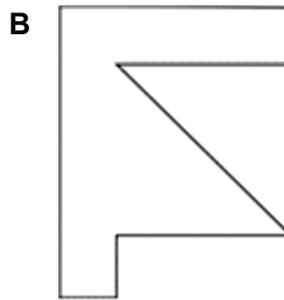
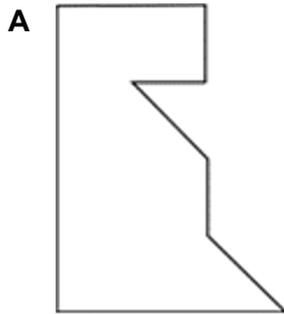
What is the lowest yearly cost of cleaning the carpets in the care home?

- A £886
- B £372
- C £536
- D £744
- E £1072

18 The diagram below shows an example of how a square can be divided into two equal halves:



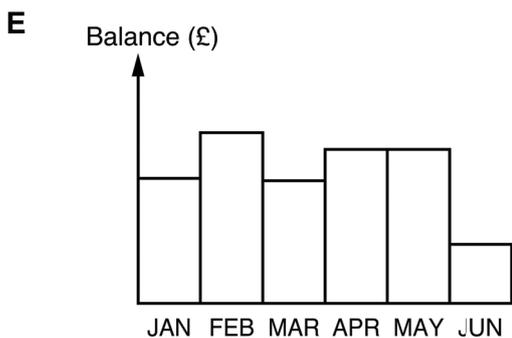
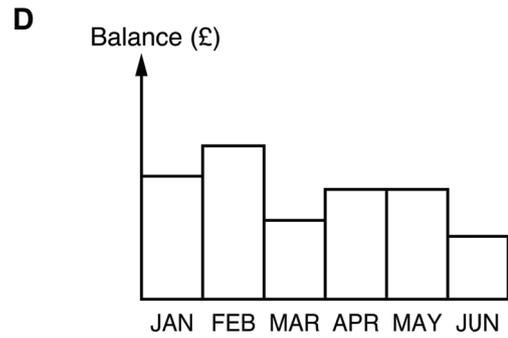
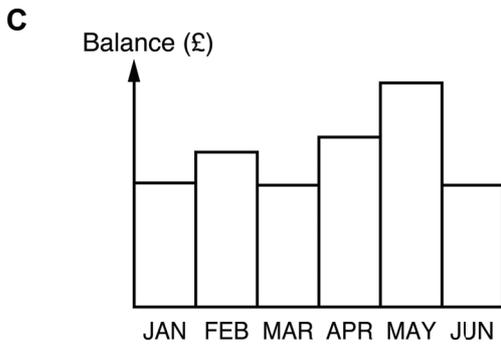
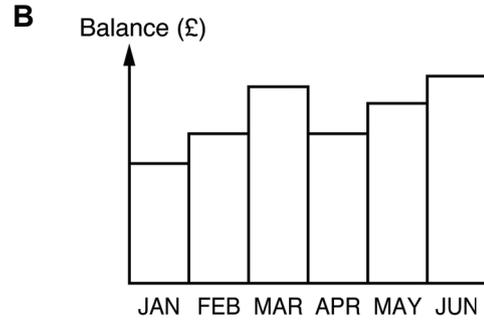
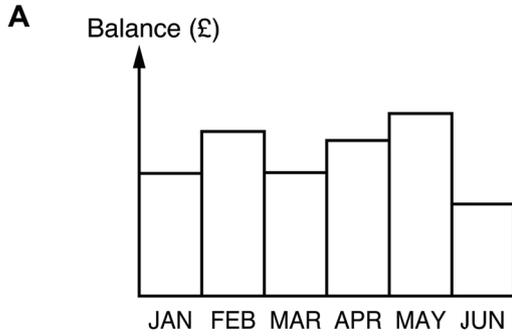
Which one of the following shapes CANNOT be one of two identical halves of a square?



- 19 This table shows a summary of the amounts paid into, and the withdrawals from, my savings account during each of the last six months.

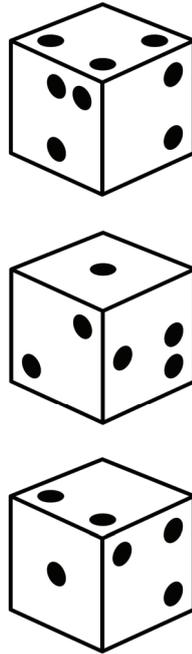
	<i>JAN</i>	<i>FEB</i>	<i>MAR</i>	<i>APR</i>	<i>MAY</i>	<i>JUN</i>
<i>paid in (£)</i>	400	500	250	350	350	200
<i>withdrawn</i>	300	350	400	250	250	500

Which one of the following charts could correctly show the balance of my account at the end of each month?



- 20** I have a very old die. It WAS a conventional die, in which the total of the spots on opposite faces is always seven, but a number of spots are now missing.

These are three views of the die as it is now:



How many spots are missing from my die?

- A** 9
  - B** 3
  - C** 5
  - D** 7
  - E** 10
- 21** In geological terms, what does the term 'Ring of Fire' commonly refer to?
- A** The region around the Pacific edge, prone to earthquakes and volcanic activity.
  - B** Ring-shaped metal deposits found in hearths on archaeological sites.
  - C** The outline of a crater, when still at high temperature after meteoritic collision.
  - D** The atmospheric phenomena visible in polar regions due to solar activity.
  - E** The rim of a volcano during active eruptions.

**22** Which one of the following politicians was awarded the Nobel Prize in Literature?

**A** Winston Churchill

**B** Nelson Mandela

**C** Barack Obama

**D** Charles de Gaulle

**E** Indira Gandhi

**23** Which of the following statements about monoclonal antibodies are correct?

- 1** They react against a single specific region of an antigen.
- 2** They are secreted by descendants of single B cells.
- 3** They are secreted by descendants of single T cells.
- 4** They are produced artificially in a laboratory.

- A** 1, 2 and 4 only
- B** 1 and 2 only
- C** 1 and 3 only
- D** 1, 3 and 4 only
- E** 2, 3 and 4 only

**24** Which statement about biological processes is correct?

- A** Active transport allows some molecules to enter intestinal villi cells from the intestinal lumen.
- B** Oxidative phosphorylation takes place on the cristae of chloroplasts.
- C** Photolysis takes place in the matrix of mitochondria.
- D** Hydrolysis takes place as a polypeptide is synthesised at a ribosome.
- E** Decarboxylation takes place on the outer membrane of a mitochondrion.

**25** Which of the following types of cells contain both DNA molecules and a nucleolus?

- 1 mature red blood cell
  - 2 motor neuron
  - 3 *Staphylococcus aureus*
- A** 2 only
- B** 1 only
- C** 3 only
- D** 1 and 2 only
- E** 2 and 3 only

**26** During which cell cycle phase does DNA replication occur?

- A** interphase
- B** prophase
- C** metaphase
- D** anaphase
- E** telophase

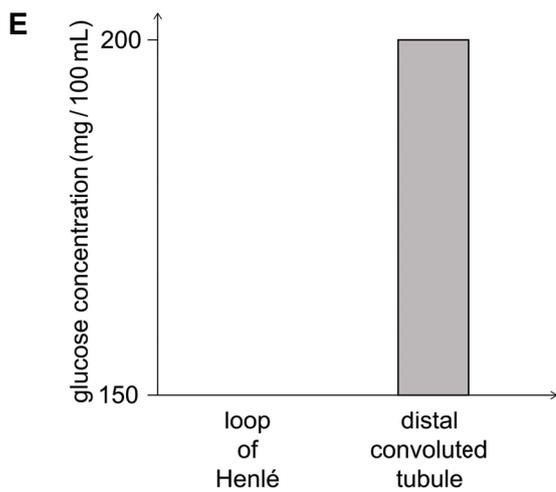
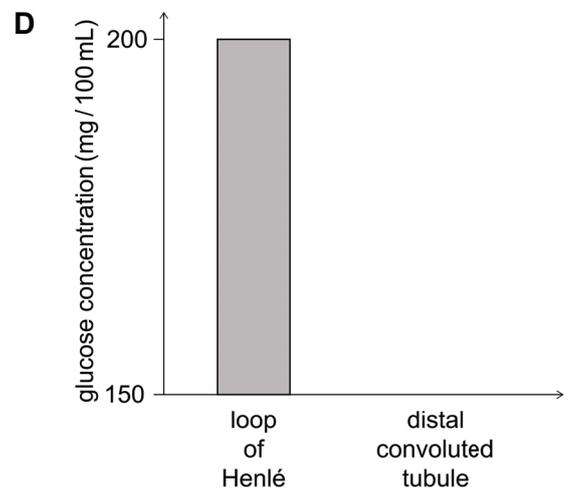
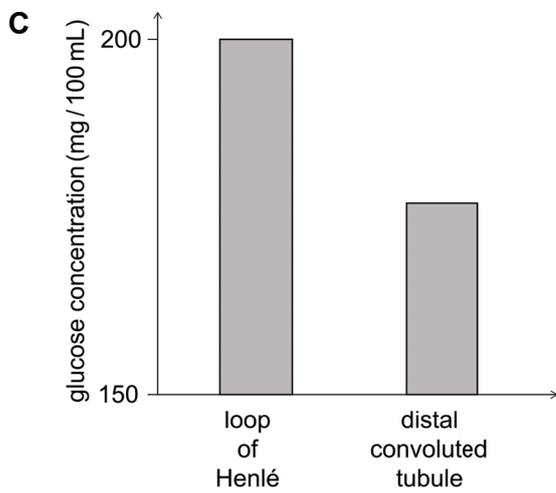
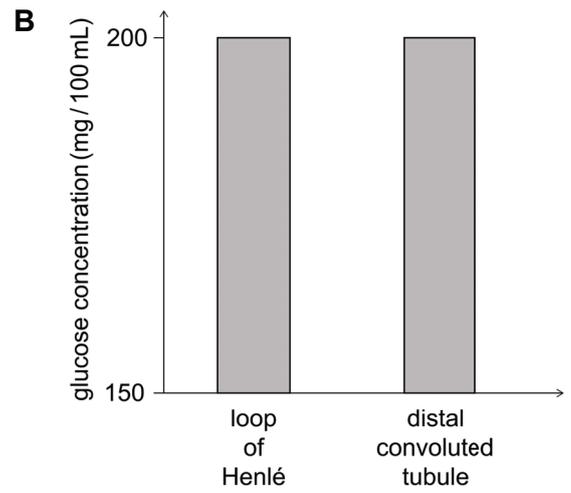
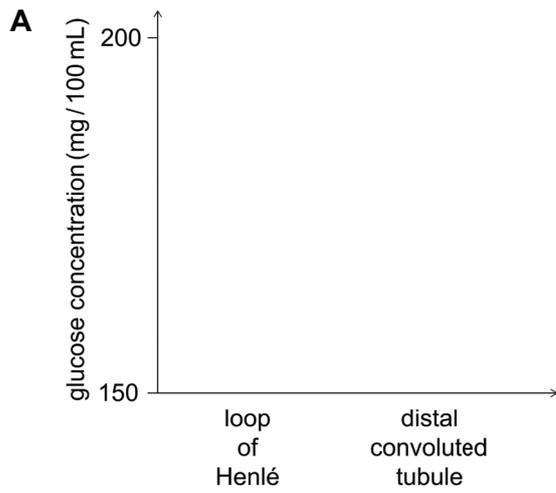
**27** A polysaccharide (X) is formed by the joining of individual sub-units (Y) through the formation of bonds (Z).

Which row correctly identifies polysaccharide X, sub-unit Y and bond Z?

	<i>polysaccharide X</i>	<i>sub-unit Y</i>	<i>bond Z</i>
row 1	amylopectin	starch	hydrogen
row 2	glycogen	glycerol	glycosidic
row 3	starch	ribose	glycosidic
row 4	amylopectin	amino acid	hydrogen
row 5	glycogen	glucose	glycosidic

- A** row 5
- B** row 1
- C** row 2
- D** row 3
- E** row 4

28 Which chart correctly illustrates the glucose concentration in the ascending limb of the loop of Henlé and the distal convoluted tubule of a nephron from a healthy human?



**29** A student described three different microscopic structures distinguished by their nucleic acid.

- Structure 1 contains nucleic acid inside a capsid. This structure has no ribosomes and no cytoplasm.
- Structure 2 has one circular chromosome made of a double strand of DNA. This structure also has a cell wall, ribosomes and mitochondria.
- Structure 3 has many coiled chromosomes made of double strands of DNA and protein. This structure also has mitochondria, ribosomes and endoplasmic reticulum.

The student made one error when writing the description.

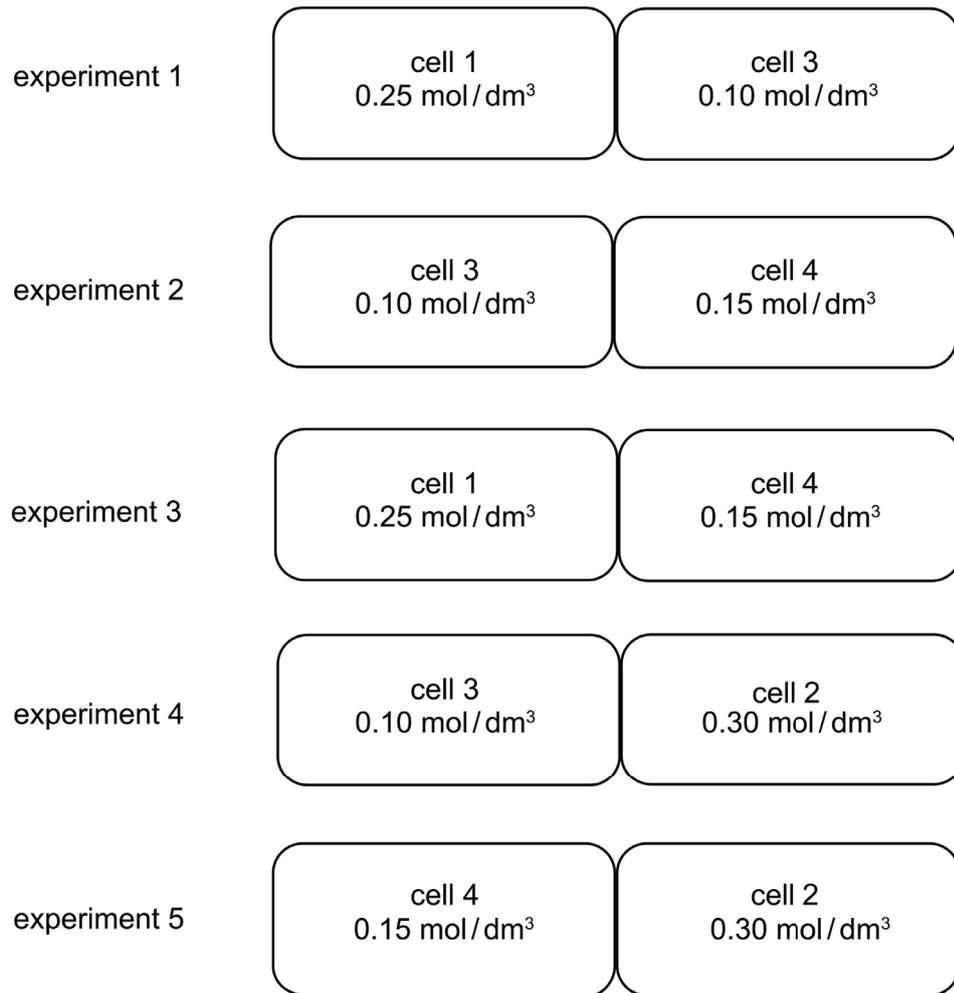
Which of the following is the error?

- A** The presence of mitochondria in structure 2.
- B** The absence of ribosomes in structure 1.
- C** The presence of a cell wall in structure 2.
- D** The absence of cytoplasm in structure 1.
- E** The presence of endoplasmic reticulum in structure 3.

**30** Which of the following enzymes are NOT found in a retrovirus such as HIV?

- 1** DNA ligase
  - 2** protease
  - 3** reverse transcriptase
  - 4** restriction enzyme
- A** 1 and 4 only
  - B** 1, 2 and 3 only
  - C** 1, 2 and 4 only
  - D** 2, 3 and 4 only
  - E** 3 only

- 31** In a series of five experiments, plant cells containing cell sap of different concentrations were placed in contact with each other as shown in the diagrams.



Which of the following statements about movement of liquid between the cells is correct?

- A** In experiment 4 water will move out of cell 3 into cell 2, until equilibrium is achieved.
- B** In experiment 5 water will move out of cell 4 into cell 2, until cell 2 bursts.
- C** In experiment 1 water will move out of cell 1 into cell 3, until cell 3 becomes turgid.
- D** In experiment 2 the solution will move out of cell 4 into cell 3, until equilibrium is achieved.
- E** In experiment 3 the solution will move out of cell 1 into cell 4, until cell 4 bursts.

**32** Which of the following occur in the light-dependent reactions in a healthy wheat plant?

- 1**  $\text{NAD}^+$  is converted to NADH
- 2**  $\text{ADP} + \text{P}_i$  are converted to ATP
- 3**  $\text{CO}_2$  and  $\text{H}_2\text{O}$  are used

- A** 2 only
- B** 1 only
- C** 3 only
- D** 1 and 2 only
- E** 1 and 3 only

**33** A student wrote the following statements about reproduction of organisms.

- 1** Some plants and animals can reproduce both sexually and asexually.
- 2** Sexual reproduction produces offspring which usually maintain the diploid number.
- 3** Gametes show variation as a result of mitosis.

Which of these statements is/are correct?

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

**34** Some human conditions, inherited on the sex chromosomes, are described as sex-linked.

Which of the following statements about human conditions involving the X chromosomes is INCORRECT?

- A** X-linked recessive conditions are expressed in all males, but are only expressed in females who are heterozygous for the recessive allele.
- B** If the allele for the condition is dominant and the father is affected but not the mother, then all his daughters will be affected, but not his sons.
- C** If the allele for the condition is dominant and the father is not affected but the mother is heterozygous, then in theory half of their children will be affected whether they are boys or girls.
- D** If the allele for the condition is recessive and the father is affected but not the mother, then the outcome depends on whether the mother is homozygous or heterozygous.
- E** There are comparatively few genes on the Y chromosome, so almost all sex-linked conditions involve the X chromosome but mostly affect males.

**35** Which of the following processes require complementary base pairing to take place?

- 1** The making of copies of existing DNA molecules.
  - 2** The use of an mRNA transcript to produce a polypeptide.
  - 3** The formation of an mRNA transcript using a DNA copy sequence.
  - 4** The use of reverse transcriptase to make a copy of viral RNA.
- A** 1, 2, 3 and 4
  - B** 1, 2 and 3 only
  - C** 2, 3 and 4 only
  - D** 1, 2 and 4 only
  - E** 1, 3 and 4 only

**36** In London, there is one kind of mosquito that may be undergoing speciation. It has a population that lives and breeds in the underground railway tunnels, and a separate population that lives and breeds above ground.

Which of the following research results indicates that the underground mosquitoes should be considered a different species from the surface mosquitoes?

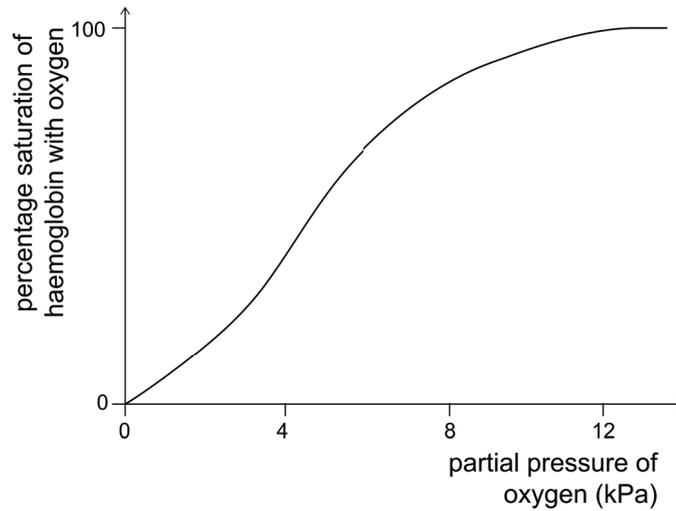
- A** Female underground mosquitoes did not lay fertilised eggs when mated with surface males of the same locality.
- B** Crosses between underground mosquitoes resulted in an F1 generation which went on to produce an F2 generation.
- C** Female mosquitoes above ground needed a blood meal before they could lay eggs, but the underground female mosquitoes did not.
- D** Surface mosquitoes did not mate in small spaces, but underground mosquitoes did.
- E** Underground mosquitoes were heterozygous for fewer genes than were surface mosquitoes.

**37** Which of the following releases the most molecules of water?

- A** Synthesis of one peptide molecule from 9 amino acid molecules.
- B** Hydrolysis of one polysaccharide molecule to its 20 hexose monomers.
- C** The complete oxidation of one glucose molecule in a cardiac muscle cell.
- D** Cutting DNA to produce a section with two sticky ends, each comprising 5 unpaired bases.
- E** Formation of one triglyceride molecule from glycerol and fatty acids.

38 A wide variety of animals have haemoglobin in their blood. Different haemoglobins have properties related to the animal's level of activity and the partial pressure of oxygen in their surroundings. Small mammals have a higher metabolic rate than humans. Animals that live in conditions of low partial pressure of oxygen have haemoglobin with a greater affinity for oxygen.

The graph shows the oxygen dissociation curve for human haemoglobin.



A scientist plotted the oxygen dissociation curves for three animals on the same graph:

- a mouse
- a llama from high altitude (5000 m above sea level)
- a lugworm which spends its life in a U-shaped burrow in muddy sand on a seashore

Which row of the table correctly indicates the position of the curve for each animal relative to the human oxygen dissociation curve?

[Assume that temperature and concentrations of carbon dioxide are the same for all three.]

	<i>mouse</i>	<i>llama</i>	<i>lugworm</i>
row 1	left	left	right
row 2	left	right	right
row 3	left	right	left
row 4	right	left	left
row 5	right	left	right

- A row 4
- B row 2
- C row 3
- D row 1
- E row 5

- 39** In a human skeletal muscle how will the appearance of a contracted sarcomere compare to its appearance when it is relaxed?
- 1** A-band is narrower
  - 2** H-band / H-zone are the same width
  - 3** I-band is narrower
  - 4** Z-lines are closer together
- A** 3 and 4 only
- B** 1 and 2 only
- C** 1 and 3 only
- D** 2, 3 and 4 only
- E** 1 only

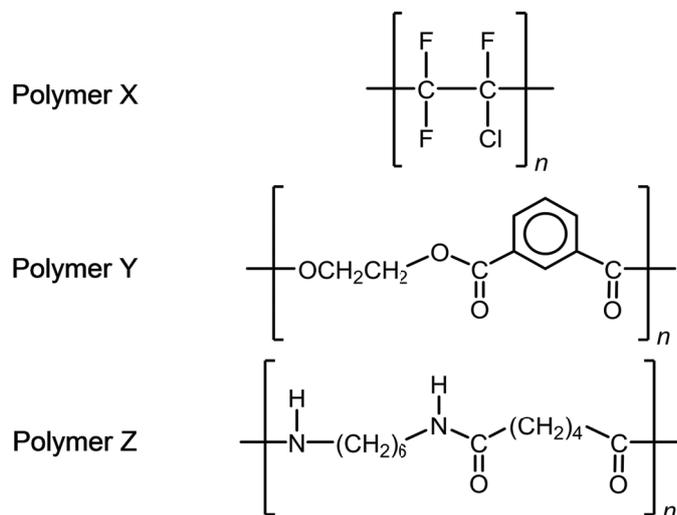
- 40** Which statement about characteristics of a healthy human male is correct?
- A** One response to a stimulus of light is that rhodopsin breaks down into opsin and retinal.
- B** Meiosis results in many sperm cells each with a nucleus containing only 23 strands of DNA.
- C** One cell division by mitosis immediately results in an increase in mass.
- D** Release of vasopressin (ADH) by the anterior pituitary gland is important in osmoregulation.
- E** Vasoconstriction of capillaries allows more radiation of heat in thermoregulation.

- 41** After fermentation and filtration, the final stage in the production of bioethanol isolates the ethanol from the aqueous solution.

Which two processes happen during this stage?

- A** boiling and then condensation
  - B** melting and then boiling
  - C** solvent extraction and then filtration
  - D** condensation and then evaporation
  - E** crystallisation and then filtration
- 42** The boiling point of hydrogen,  $\text{H}_2$ , is  $-253\text{ }^\circ\text{C}$ .
- The boiling point of hydrogen chloride,  $\text{HCl}$ , is  $-85\text{ }^\circ\text{C}$ .
- Which statement explains the difference in boiling point of these two substances?
- A** Hydrogen chloride has stronger intermolecular forces of attraction.
  - B** Hydrogen is an element but hydrogen chloride is a compound.
  - C** The two substances have different chemical properties.
  - D** Hydrogen has hydrogen bonds between molecules.
  - E** The  $\text{H}-\text{H}$  bond is weaker than the  $\text{H}-\text{Cl}$  bond.

43 The structure of three different polymers is given below.



Which of the following statements about the polymers X, Y and Z is/are correct?

- 1 All three polymers can be broken down by hydrolysis.
- 2 Polymer X and Z are each usually formed from two different monomers.
- 3 Only polymer Z has hydrogen bonding between its molecules.

- A** 3 only
- B** 2 only
- C** 1 only
- D** none of them
- E** 1, 2 and 3

44 Which of the following molecules have at least one bond angle of  $90^\circ$ ?



[C is in Group IV, F is in Group VII, P is in Group V, Xe is in Group VIII.]

A 1 and 2 only

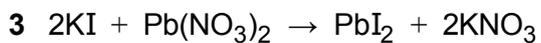
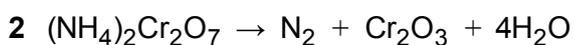
B 1, 2 and 3

C 1 and 3 only

D 2 and 3 only

E none of them

45 Which of the following equations represent redox reactions?



A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D none of them

E 1, 2 and 3

**46** The solubility of anhydrous calcium chloride at 20°C is 74.5 g per 100 g of water.

100 g of solid lumps of calcium chloride, CaCl<sub>2</sub>, is added to 100 g of water at 20°C and the mixture is allowed to reach equilibrium.

Which of the following changes will have the effect of reducing the mass of undissolved calcium chloride in the equilibrium mixture?

- 1 adding solid sodium chloride to the equilibrium mixture
- 2 adding water to the equilibrium mixture
- 3 crushing the calcium chloride

- A** 2 only  
**B** 1 and 2 only  
**C** 1 only  
**D** 2 and 3 only  
**E** 3 only

**47** Carboxylic acids react with alcohols to produce esters. A reaction producing an ester is shown in the equation:



What are the structural formulae of the reactants in this equation?

- A** CH<sub>3</sub>CH<sub>2</sub>COOH and CH<sub>3</sub>CH<sub>2</sub>OH  
**B** CH<sub>3</sub>CH<sub>2</sub>COOCH<sub>2</sub>CH<sub>3</sub> and H<sub>2</sub>O  
**C** CH<sub>3</sub>COCH<sub>3</sub> and CH<sub>3</sub>CH<sub>2</sub>OH  
**D** CH<sub>3</sub>CH<sub>2</sub>COOH and CH<sub>3</sub>CHO  
**E** CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>COOH and CH<sub>3</sub>CH<sub>2</sub>OH

- 48 0.1 mol of each of the following compounds is dissolved separately in water to make 1 L of a solution of each acid.



Which row shows the compound that will produce the highest hydrogen ion concentration,  $[\text{H}^+]$ , and the compound that will produce the lowest hydrogen ion concentration,  $[\text{H}^+]$ ?

	<i>the highest</i> $[\text{H}^+]$	<i>the lowest</i> $[\text{H}^+]$
row 1	$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$	HCl
row 2	$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$	$\text{H}_2\text{SO}_4$
row 3	HCl	$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$
row 4	$\text{H}_2\text{SO}_4$	$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$
row 5	$\text{H}_2\text{SO}_4$	HCl

- A row 4  
B row 2  
C row 3  
D row 1  
E row 5
- 49 An ion  $\text{X}^-$  has 20 neutrons and its lowest energy electron configuration ends in  $3s^23p^6$ .

What is the mass number of the atom X?

- A 37  
B 38  
C 20  
D 40  
E 17

- 50 Which of the following elements has the highest first ionisation energy?
- A Ne, electron configuration 2,8
  - B Li, electron configuration 2,1
  - C Na, electron configuration 2,8,1
  - D Al, electron configuration 2,8,3
  - E Ar, electron configuration 2,8,8
- 51 100 cm<sup>3</sup> of an alkane gas reacts completely with exactly 500 cm<sup>3</sup> of oxygen gas to form carbon dioxide and water only. The volume of each gas was measured at the same temperature and pressure.
- What is the molecular formula of the alkane?
- A C<sub>3</sub>H<sub>8</sub>
  - B C<sub>2</sub>H<sub>6</sub>
  - C C<sub>4</sub>H<sub>4</sub>
  - D C<sub>4</sub>H<sub>10</sub>
  - E C<sub>5</sub>H<sub>12</sub>
- 52 560 g of iron reacts with an excess of oxygen. Assume that iron(III) oxide is the only product.
- What mass of iron(III) oxide is produced if the yield is 60%?
- [A<sub>r</sub> values: Fe = 56; O = 16]
- A 480 g
  - B 960 g
  - C 800 g
  - D 1600 g
  - E 1920 g

53  $\sqrt{32} + \sqrt{50} - \frac{12}{\sqrt{8}}$  can be simplified to  $a\sqrt{2}$ .

What is the value of  $a$ ?

- A 6
- B 3
- C 7.5
- D 18
- E 26

54 Given that  $x = 4 \times 10^5$  and  $y = 8 \times 10^4$ , what is the value of  $\frac{x^2}{x-y}$ ?

- A  $5 \times 10^5$
- B  $5 \times 10^0$
- C  $5 \times 10^2$
- D  $2.5 \times 10^5$
- E  $2.5 \times 10^0$

**55** An equation of the straight line  $L$  is  $\frac{y+5}{x+4} = 2$

Which of the following lines is perpendicular to  $L$ ?

- A**  $x + 2y = 5$
- B**  $x + 3y = 7$
- C**  $3y - x = 1$
- D**  $2x + y = 3$
- E**  $2y - x = 4$

**56** Consider the equation below, where  $x$  and  $p$  are both real numbers:

$$x^2 + (p + 4)x + 5p = 1$$

There are two values of  $p$  for which this equation has one real repeated root for  $x$ .

What is the positive difference between the two values of  $p$ ?

- A** 8
- B** 17
- C** 4
- D** 5
- E** 12

**57** Which equation has equivalent units on each side?

**A**  $\frac{\text{mass}}{\text{length}} = \text{density} \times \text{area}$

**B**  $\text{speed} \times \text{area} = \text{volume} \times \text{time}$

**C**  $\frac{\text{volume}}{\text{speed}} = \text{distance} \times \text{acceleration}$

**D**  $\frac{\text{speed}}{\text{time}} = \text{acceleration} \times \text{time}$

**E**  $\text{mass} \times \text{distance} = \text{density} \times \text{speed}$

**58** A car travels in a straight line with a constant acceleration.

The speed of the car increases from 5.0 m / s to 8.0 m / s in a time of 6.0 s.

What is the magnitude of the acceleration and the average speed of the car?

**A** acceleration = 0.50 m / s<sup>2</sup>; average speed = 6.5 m / s

**B** acceleration = 0.50 m / s<sup>2</sup>; average speed = 4.0 m / s

**C** acceleration = 3.0 m / s<sup>2</sup>; average speed = 6.5 m / s

**D** acceleration = 3.0 m / s<sup>2</sup>; average speed = 8.0 m / s

**E** acceleration = 3.0 m / s<sup>2</sup>; average speed = 4.0 m / s

- 59 A tractor, travelling at a constant speed in a straight line, has front wheels of diameter  $D$  and rear wheels of diameter  $2D$ .

The angular velocity of the front wheels is  $\omega$ . Assuming that the wheels do NOT slip, what is the angular velocity of the rear wheels?

- A  $0.5\omega$
- B  $0.25\omega$
- C  $\omega$
- D  $2\omega$
- E  $4\omega$

- 60 A balloon filled with air is tied to a heavy rock and dropped into deep water. The balloon sinks deeper and deeper. No air enters or leaves the balloon, and the temperature of the air in the balloon stays constant.

Which row of the table identifies what happens to the upthrust acting on the balloon and to the volume of the air in the balloon as it sinks?

[Assume that air acts as an ideal gas and assume that the density of the water has the same value at all depths.]

	<i>upthrust</i>	<i>volume</i>
row 1	decreases	decreases
row 2	decreases	remains constant
row 3	increases	increases
row 4	remains constant	decreases
row 5	remains constant	remains constant

- A row 1
- B row 2
- C row 3
- D row 4
- E row 5















