BIOMEDICAL ADMISSIONS TEST (BMAT) SAMPLE QUESTIONS WITH ANSWERS

October 2014

SECTION 1

1 I want to create a simple jigsaw puzzle. I have five pieces as shown below. Each piece is made from four identical squares. I want to choose three of the pieces to make up either a 4x3 rectangle or a 6x2 rectangle.
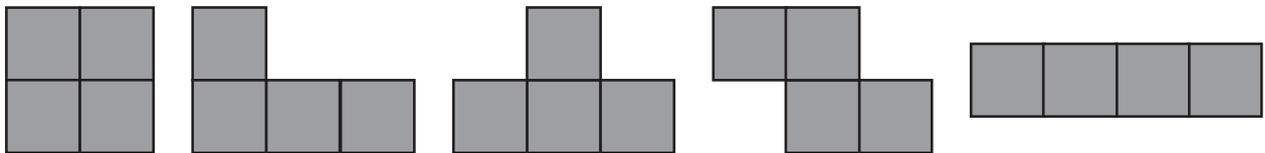
How many choices do I have for the three different pieces?

A 0

B 1

C 4

D 9

E 10

2 A group of ten teenagers attending a meal are each given a card numbered from 3 to 12 as they arrive at the venue. The card is to be used to find their places at the table when it is time for the meal. Some of the places at the table already have the numbers showing but the teenagers have to solve the problem of where the rest of them should sit in order to meet a list of criteria given to them by their host. The partial seating plan is shown below:
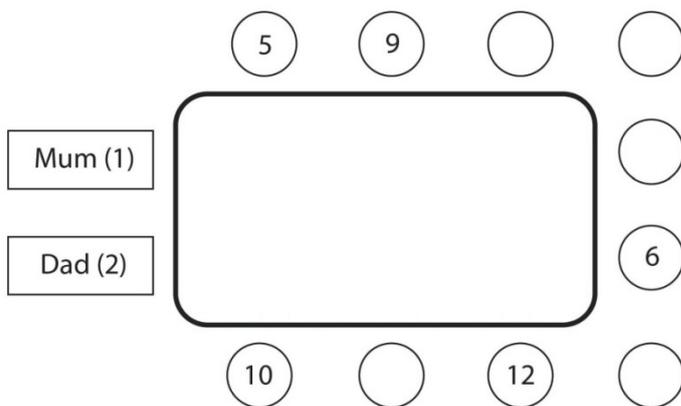
The remaining guests must sit in places such that the sum of any four place numbers that fall in a straight row makes 29.

What will be the number of the person sitting opposite number 9?

A 3

B 4

C 7

D 8

E 11

3 Simon, Liam, Ian, Dylan and Eric make up the boy band Slide. Their surnames are Doyle, Floyd, Hyde, Rush and Shore, but I can't remember which surname goes with which first name.

My friend tells me that no letter of the alphabet appears twice in any of the boys' full names (first name and surname combined) and the surname of each boy has a different number of letters from his first name.

What is Ian's surname?

A Doyle

B Floyd

C Hyde

D Rush

E Shore

4 Al was looking at Beth (and only at Beth); but Beth was looking at Charles. Al was married; Charles was unmarried.

Dave was given the above information and asked whether, out of these three people, anyone married was looking at anyone unmarried. He was asked to answer: 'Yes', 'No', or 'Cannot be determined from the information'; and to give a reason for his answer.

Dave answered correctly, giving one of the following responses. Which one was it?

A It couldn't be determined because it was not stated whether Beth was married or unmarried.

B No, because Charles was unmarried and Al was looking only at Beth.

C Yes, because Beth was either unmarried and being looked at by Al or she was married and looking at Charles.

D No, because although it was not stated whether Charles was looking at anyone, Charles was unmarried anyway.

E Yes, if Beth was unmarried, but No if she was married; so it could not be determined.

1 Is forgery 'art'? Received opinion says not, despite it unquestionably being a craft. This has nothing to do with it being illegal or immoral, though it may be both. The standard objection is that it is copying, and therefore not creative. But how is that an objection when all art is ultimately a copy of something? Is a picture of a ship or a hay-wagon or a bowl of fruit not art? If all art is copying, then forgery, by definition, is art.

Which one of the following makes the same reasoning error as the above argument?

A Water is liquid and liquid is fluid, so water is a fluid.

B Petrol is flammable and volatile, so everything volatile is flammable.

C Being overweight is unhealthy so maintaining the right weight is healthy.

D The French are European and Spaniards are European, so the French are Spaniards.

2 The brain disease vCJD was caused by eating beef from cattle infected with BSE. Susceptibility to this type of disease amongst humans is associated with a particular gene. There are two variants of this gene – M and V, so there are three possible combinations that we can inherit – M-M, M-V and V-V. All infections so far in the UK have been in young people with the M-M combination. Most victims of a similar disease in Papua New Guinea also had the M-M combination and were also young, but a group who developed it later in life all had the M-V combination. Therefore the gene variants one inherits determine the incubation period for such diseases. So there will be two further outbreaks of vCJD, as those who consumed infected beef grow older.

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

1 Most of the population have eaten beef infected with BSE.

2 Inheriting the V variant prevents infection with vCJD.

3 Inheriting the M variant is not necessary for susceptibility to vCJD.

A 1 only

B 2 only

C 3 only

D 1 and 2 only

E 1 and 3 only

F 2 and 3 only

G None of the statements

3 A neutrino is an elementary particle that is able to pass through ordinary matter, but is difficult to detect. Physicists have hypothesised that there is a particular type of neutrino – a sterile neutrino – that cannot be detected at all by their instruments. Relevant evidence comes from supernovae, i.e. exploding stars. If sterile neutrinos did exist, supernovae would shoot them out, and the recoil from this blast would send pulsars (rotating stars that emit a beam of electromagnetic radiation) travelling at high speed through the universe. It turns out that astronomers observe precisely that: pulsars whizzing through the universe at speeds of thousands of kilometres per second.

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

A Sterile neutrinos must be the cause of the phenomenon of pulsars travelling at high speed through the universe.

B The phenomenon of pulsars travelling at high speed through the universe could be caused by the existence of sterile neutrinos.

C The sterile neutrino hypothesis is the best explanation of the phenomenon of pulsars travelling at high speed through the universe.

D If sterile neutrinos did not exist, pulsars would not be observed travelling at high speed through the universe.

4 Patients admitted to hospital as an emergency at the weekend have a higher chance of dying than those who are brought in during the week, according to a study which showed that the death rate among emergency admissions increased by 7% at the weekend.

Staffing levels are often lower at weekends, with fewer senior medical staff around, and some specialist services are less available. This may be contributing to the increase in mortality rates on Saturdays and Sundays. As well as lower staffing levels in hospitals, there may be a reduced service in specialist community and primary care services at the weekend, which may result in some terminally ill patients being admitted to hospital and dying there (instead of at home) at the weekends.

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

1 Improved staffing levels in hospitals at weekends would reduce death rates.

2 Weekend provision of community and primary care services should be enhanced.

3 Fewer patients should be admitted to hospital at times when staffing levels are low.

A 1 only

B 2 only

C 3 only

D 1 and 2 only

E 1 and 3 only

F 2 and 3 only

G none of the above statements

Questions 1 - 4 refer to the following information:

Are Britain's roads getting safer? By Lucy Wilkins, BBC News
The first recorded road death in a motor accident in Britain was in London over 100 years ago. More than a century on, roads may be busier than ever - but are they any safer?

On 17 August, 1896, a South London housewife entered the history books by being run over. Bridget Driscoll, 44, became the first person recorded to have died in a motor accident in Britain. The 20-year-old driver was a car company worker, and there were reports he had adjusted the engine to increase its maximum speed to 8mph. Ever since that first death - and the first recorded death of a driver 18 months later - the number of vehicles on the roads has multiplied.

Increasing number of vehicles
According to the Department for Transport (DfT), in 1930 there were only 2.3 million motor vehicles in Great Britain, but more than 7,000 people were killed in road accidents. In contrast nowadays there are more vehicles but fewer deaths - there are 27 million vehicles and 3,180 people were killed in the 12 months to March this year, provisional results show.

The DfT is meeting its 10-year safety target of cutting the number of road accident deaths and injuries to 40% of the 1994-98 average - 319,928 casualties. Five years into the policy, the statistics show casualties are 33% below the earlier average. In actual numbers, 268,900 people were either injured or killed in the 12 months to this March.

But are Britain's roads really becoming safer? The statistics paint a confusing picture
Many road accidents, where there are slight injuries or even more severe ones, bypass police records. This could be because some of the people involved in accidents do not want to tell the police because they are uninsured, unlicensed, or drunk, says head of road safety at the AA Motoring Trust, Andrew Howard. But even if injuries are reported, it does not mean the police will record them. The severity of the injury will also be under-estimated, research in the 1990s suggested.

"The combined effect of under-reporting, under-recording and misclassification suggests that there may be 2.76 times as many killed or seriously injured casualties than are recorded in the national casualty figures and 1.70 times as many slight casualties," the DfT says.

In June, three Oxford University researchers queried the figures after comparing them to hospital admissions from road accidents. The DfT statistics, from the police and including all hospital admissions, showed a fall from 85.9 people killed or seriously injured per 100,000 in 1996 to 59.4 per 100,000 in 2004. However, hospital admissions were almost unchanged at 90 per 100,000 in 1996 and 91.1 in 2004. They said the disparity was probably due to under-reporting and/or fewer minor injuries.

Statistical 'utopia'
Paul Smith, from Safe Speed, said: "For every 100 accidents reported, there's 180 that aren't reported." Cars are safer, paramedics better trained, there are more air ambulances and roads have improved, said Mr Smith. The only factor that has not changed is drivers who "are getting worse" in his opinion. He urged the department to focus on educating drivers about their responsibilities, rather than just getting them to drive slower.

But Mr Howard, from the AA Motoring Trust, is encouraged by the statistics: "My view, and I would say this is true of most of those involved in road safety, is that the statistics do show the roads are getting safer."

1 By what factor is the reported annual number of deaths per vehicle on the road higher or lower at the time of the above report than it was in 1930?

    A   0.04 times as much

    B   0.4 times as much

    C   1.2 times as much

    D   2.2 times as much

    E   25 times as much

2 There is disagreement in the article about whether roads are becoming more or less safe. In addition to the reasons given in the text, which one of the following, if true, would strengthen the case for roads becoming safer?

    A   The police do not record accidents where no injuries are sustained.

    B   Cars have become stronger, reducing the chances of injury in an accident.

    C   The proportion of accidents reported has fallen.

    D   Hospital reporting of road accidents has become more accurate.

    E   Hospitals have become better at saving the lives of severe trauma victims.

3 The second section refers to a DfT 10 year target. To the nearest 1000, what is the DfT's target?

    A   102,000

    B   108,000

    C   128,000

    D   161,000

    E   192,000

4 Which one of the following could explain the discrepancy between the DfT statistics and hospital admissions for deaths and serious injuries on the road?

    A   The DfT collection method must underestimate the number of deaths and serious injuries.

    B   The roads are not getting safer.

    C   Fewer people are being admitted to hospital for minor injuries.

    D   There has been a decrease in less serious injuries.

    E   The police include accident injuries which do not involve hospitalisation.

Problem solving answers

1 If the first shape is used, then it must be at the end of the 6 × 2 rectangle, meaning that the remaining region will have to be split into two identical pieces.

Similarly, if the final piece is used then it will have to be along an edge of the 4 × 3 rectangle, meaning that the remaining region will have to be split into two identical pieces.

It is then quite easy to check that the remaining three pieces cannot be arranged to form either of the rectangles.

B Identifies the problem with two of the pieces and assumes that the other three can be used.
C Identifies the problem with one piece and assumes that any choice from the other four will be OK.
D Identifies a case that does not work and assumes that the rest will be OK.
E Assumes that all choices of three pieces will be OK.

The answer is **A**.

2 One way to solve this is to start by looking at each row and calculate what the numbers add up to.

For the bottom row, we can see that the numbers add up to 22, so the missing numbers must add up to 7 (29-22). As numbers 1, 2, 5 and 6 are already in place, these must be 3 and 4 but at this stage we don't know which goes where.

Looking at the top row, the missing numbers must add up to 15. The only possibilities here would be 7, 8 or 11 so they must be 7 and 8.

Therefore, number 11 must be above number 6. Which means that our side column must be:

7 or 8
11
6
3 or 4

7, 11, 6, 3 do not add up to 29
7, 11, 6, 4 do not add up to 29
8, 11, 6, 3 do not add up to 29
8, 11, 6, 4 do add up to 29 so they must form the side column.

Top row would then be 5 9 7 8. Bottom row would be 10 3 12 4. So number 3 is opposite number 9. The correct answer is **A**.

3 Every surname has a different number of letters from Ian and would produce a full name with no letter repeated. However the others can only be Simon Hyde, Liam Shore, Dylan Rush and Eric Floyd. The answer is **A**.

4 The answer is **C**. Beth is the crucial character. It may appear that an answer cannot be determined because, as in **A**, we are not told Beth's marital status. But it must be one or the other, and on reflection it doesn't matter which it is. Either the married Al is looking at an unmarried Beth or a married Beth is looking at the unmarried Charles. Either way, the correct answer is Yes, and **C** explains it. **B**, **D**, and **E** go for the wrong answer, and their explanations fail.

Understanding argument answers

1 The core of the argument is that forgery is copying and (but) *art* is copying so forgery is art. Formally this is:

F is C; A is C; so F is A
which is invalid. **D** has the same form and is clearly in error

A is valid, so it is not in error.
B makes a different error, generalising from the particular.
C has the form: O is not-H, so not-O is H, which is not the same as the passage.

The answer is **D**.

2 The argument uses evidence from a disease which occurred in Papua New Guinea. The disease was similar to vCJD, and affected two groups – young people with the M-M gene variant, and older people with the M-V variant. On this basis it draws the intermediate conclusion that the gene variants determine the incubation period of the disease. The main conclusion is that as the population exposed to infected beef ages, two further outbreaks may occur. These would have to be amongst the other two groups of the population, i.e. those with the M-V variant and those with the V-V variant, on the assumption that both are at risk but that the incubation periods are longer. Thus in assuming that those with the V-V variant may get the disease, it must be assuming that one can be susceptible to vCJD without inheriting the M variant. This is expressed in statement 3.

Statement 1 is not assumed, since there could be two future outbreaks of vCJD even if only a minority of the population had eaten infected beef, provided that this minority included members of both the M-V and V-V groups.

Statement 2 is not assumed, since the conclusion implies that those with one or two V variants could get the disease. Thus it is not assumed that the V variant protects against becoming infected with the disease, simply that it increases the incubation period.

The answer is **C**.

3 The passage asserts that if sterile neutrinos exist, pulsars would travel at high speed through the universe, and that pulsars have been observed doing exactly that. It follows that the hypothesis of physicists that sterile neutrinos exist could be true, and that these neutrinos could be causing this phenomenon.

A does not follow from the passage, because the assertions 'P implies Q' and 'Q is true' do not imply that P is true. So we cannot conclude that sterile neutrinos do exist, and therefore cannot conclude that they must be the cause of the observed phenomenon.
C does not follow from the passage, because it contains no information about other possible explanations of the phenomenon.
D does not follow from the passage, because the assertion 'P implies Q' does not imply that 'not P' implies 'not Q'.

The answer is **B**.

4 Reason 1: Death rates in hospitals are higher at weekends than on weekdays.

Reason 2: Staffing levels are often lower at weekends and access to senior staff and specialist resources tend to be limited.

Reason 3: Reduced community services at weekends may lead to more terminally ill people being admitted to hospital and dying there.

None of the three statements can be drawn as a conclusion from this evidence.
The passage says that lower staffing levels (Reason 2) *may* be contributing to higher death rates but it is not conclusive, therefore 1 cannot be concluded.

Statement 2 goes too far in moving from a possible link between reduced community services (Reason 2) and higher admissions of terminally ill people to a conclusion that community services *should be* improved. For this to be concluded, an assumption would be needed that dying at home is preferable to dying in hospital.

Similarly Statement 3 assumes that hospital admission should be avoided, without evidence that this is necessarily less desirable even if staffing levels are low.

The answer is **G**.

Data analysis and inference answers

1 A is the answer. 1930: 7000/2.3 million: now 3180/27 million: ratio is .00012/.0030; .04 times or 1/25.

B Uses 2.7 million instead of 27 million: 0.4 times
C Uses figure in next paragraph for current (deaths + serious) 268900/27 million: .001; ratio is .0012/.001 or 1.2 times
D 7000/3180 just ratio of deaths: 2.2 times
E Reverse of correct answer: 25 times

2 D is the answer. If hospitals used to under-report road accidents, they may actually have decreased.

A This would have no effect as such accidents are not reported by hospitals either.
B This would not explain the discrepancy in the statistics and, in any case, would bias the figures in the wrong direction.
C This is the wrong way round - if fewer accidents were reported, there would actually be more, so the roads would be less safe.
E This does not work for the same reasons as **B**.

3 C is the answer. The 1994-1998 number was 319,928. The target is to reduce this to 40% or to 128,000.

A Reduces by 33% (takes wrong figure) 102,000
B Reduces the latest reported figure to 40%: 0.4 x 268900 = 108,000
D Reduces the latest figure by 40%: 0.6 x 268900 = 161,000
E Reduces by 40% (i.e. to 60%): 192,000

4 The passage states that "the disparity was probably due to under-reporting and/or fewer minor injuries.". So the DfT collection method must underestimate the number of deaths and accidents. The answer is **A**.

B This is the source of the conflict - that data disagree on this so it is not implied.
C The police should count these as well, so it does not explain the discrepancy.
D If these were counted originally by the police, it would explain the decline, but the hospital admissions are higher than the police figure for both time periods.
E Once again, this would make the police figures higher.

SECTION 2

Sample questions

1 Which of the four statements below about natural selection are correct?

      1   Competition occurs between individuals of the same species.

      2   Competition occurs between individuals of different species.

      3   Selection can lead to evolution.

      4   Selection can lead to extinction.

    A   1 and 3 only

    B   2 and 4 only

    C   1, 2 and 4 only

    D   1, 3 and 4 only

    E   2, 3 and 4 only

    F   1, 2, 3 and 4

2 In addition to diamond and graphite, another allotrope of carbon is Buckminster fullerene, C_{60}, which is in the shape of a sphere.

Which one of the following statements applies to all three allotropes?

    A   Weak intermolecular forces hold the structures together.

    B   Carbon atoms are bonded to four other carbon atoms.

    C   They have similar physical properties.

    D   They would all form the same product when reacted completely with O_2.

    E   They are electrical insulators.

3 A parachutist of total mass 90 kg (including the parachute) is falling at a terminal velocity of 6 m/s. Take the force due to gravity on a mass of 1 kg to be 10 N.

What is the magnitude of the air resistance force acting on her?

    A zero

    B 150 N

    C 540 N

    D 900 N

    E 5400 N

4 A builder is cutting beams of wood to build a symmetrical sloping roof. A cross-section of the roof is shown in the diagram. The width of the building is s metres, and the beams are at an angle of θ to the horizontal. The beams overhang the edge of the building by a sloping length x metres, as shown.
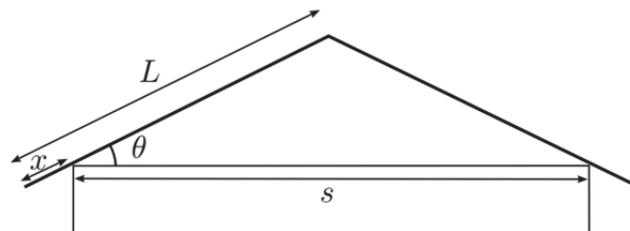
(not to scale)

Which formula below gives the correct length L (in metres), in terms of s, x, and $\cos\theta$ or $\sin\theta$?

A $L = \dfrac{s\sin\theta}{2} + x$

B $L = \dfrac{s}{2\sin\theta} + x$

C $L = \left(\dfrac{s}{2} + x\right)\sin\theta$

D $L = \dfrac{\frac{s}{2}+x}{\sin\theta}$

E $L = \dfrac{s\cos\theta}{2} + x$

F $L = \dfrac{s}{2\cos\theta} + x$

G $L = \left(\dfrac{s}{2} + x\right)\cos\theta$

H $L = \dfrac{\frac{s}{2}+x}{\cos\theta}$

5 The table below shows the proportions of undigested and digested carbohydrates, fats and proteins in three regions of the digestive system.

Which row of the table below correctly identifies the types of nutrient **1**, **2** and **3**?

	1	2	3
A	protein	fat	starch
B	starch	protein	fat
C	protein	starch	fat
D	fat	protein	starch
E	starch	fat	protein
F	fat	starch	protein

6 Naturally occurring chlorine is a mixture of two isotopes with mass numbers 35 and 37. The isotope with mass number 35 is three times as common as the isotope with mass number 37.
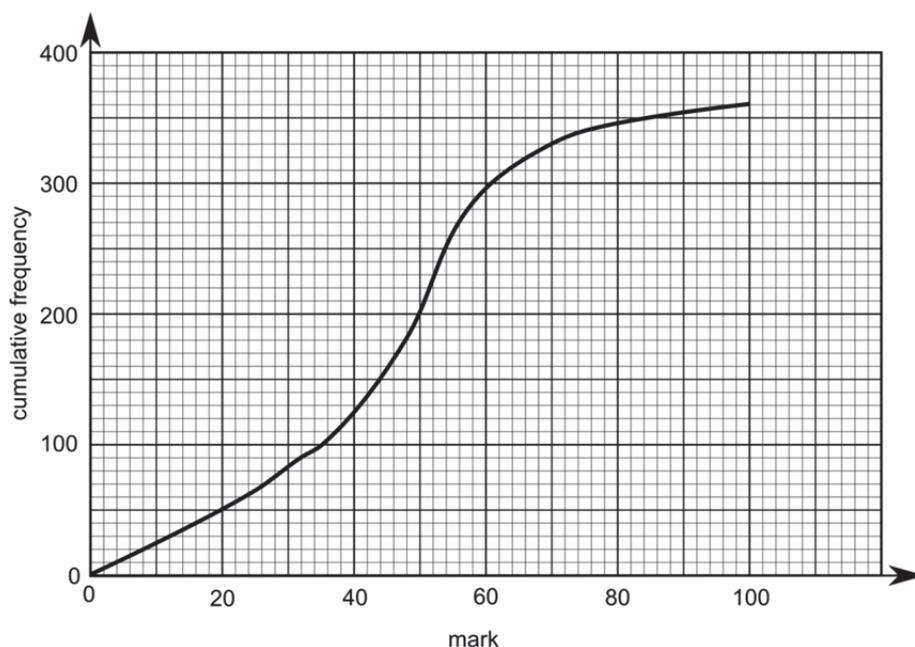
Naturally occurring bromine is a mixture of two isotopes with mass numbers 79 and 81. They are present in equal amounts.

What fraction of the naturally occurring compound CH_2BrCl has a relative molecular mass of 128?

[A_r: H = 1; C = 12]

A $\dfrac{1}{8}$

B $\dfrac{1}{4}$

C $\dfrac{3}{8}$

D $\dfrac{1}{2}$

E $\dfrac{5}{8}$

7 The cumulative frequency graph shows information about the marks scored by the candidates in an examination.

Which of the following is the closest estimate to the inter-quartile range of the candidates' marks?

A 22

B 24

C 26

D 32

E 48

F 180

G 275

8 A 100% efficient transformer has 1500 turns on its primary coil. The input to the transformer is 250 V ac. The output is connected to a resistor. The output current is 10 A and the output power is 0.50 kW.

What is the number of turns on the secondary coil?

A   75

B   300

C   750

D   7500

E   30000

Section 2 sample question answers

1 This question requires you to draw on your knowledge of natural selection.

There is variation within a species that results from differences in the genes of individuals within that species. Most organisms produce more offspring than can survive into adulthood, and these offspring must compete for resources with individuals of the same species and other species (Statements 1 and 2 respectively).

Individuals with useful characteristics that are better suited to their environment are more likely to survive to adulthood and breed successfully, and the alleles for their useful characteristics are more likely to be passed on to the next generation. Individuals that are less well adapted to their environment are less likely to survive and pass on their alleles. Over time, this process of natural selection can lead to the evolution of a species (Statement 3).

If a species is unable to adapt quickly enough to changes in the environment or to compete successfully with other species, the process of natural selection can lead to extinction of that species (Statement 4).

All of the statements are correct, so the answer is **F**.

2 One way to tackle this question is to consider counter-examples that disprove these statements.

A We know graphite has weak intermolecular forces between layers, but diamond uses all the valence electrons of carbon to form 4 covalent bonds, these are only intra-molecular (i.e. within the molecule, not inter-, which is between molecules). So diamond disproves this.
B Graphite disproves this, because the atoms in the layers only form 3 covalent bonds.
C Electrical conductivity is one physical property that differs between diamond and graphite; graphite conducts, while diamond doesn't. So this disproves the statement.
D Given that they all are simply carbon in different arrangements, when reacted with oxygen completely, they will only form carbon dioxide, so this one is true.
E See **C**.

The answer is **D**.

3 Terminal velocity means a constant velocity and therefore zero acceleration. There is no resultant force acting on a body when it is not accelerating.

The air resistance force must be equal and opposite to the weight of the parachutist so that the resultant force is zero.

Weight of parachutist = mg = 90 × 10 = 900 N.
Hence the air resistance force must also be 900 N.
(The actual value of the terminal velocity is irrelevant to the solution.)

The answer is **D**.

4 To tackle this question, you should look for a mathematical relationship (in this case a formula) relating L to some or all of the variables given.

From studying the diagram, if you try to find $(L - x)$ then you are dealing with finding the length of an isosceles triangle, for which you are given an angle and a side. So solving the question probably involves trigonometry, and possibly Pythagoras' theorem. Trigonometry is based on right-angle triangles.

You can draw a perpendicular line to the base, and make a right-angle triangle, and because the triangle was isosceles, the base of the right-angle triangle will be $\frac{s}{2}$.

You can now relate these sides of the triangle, by using $\cos \theta$, it gives the ratio of the adjacent side to the hypotenuse:

$$\cos \theta = \frac{Adjacent}{Hypotenuse} = \frac{\frac{s}{2}}{(L - x)}$$

Looking at the options, you need to give L as the subject. People have many different ways of rearranging formulae, and many different ways of visualising them. One approach is to do the equal and opposite to both sides, with the objective in this case being to get L on the top, and then effectively peel away the layers of maths around the L.

Multiplying both sides by $(L - x)$:

$$\cos \theta \times (L - x) = \frac{\frac{s}{2}}{(L - x)} \times (L - x)$$

Becomes:

$$\cos \theta \times (L - x) = \frac{s}{2}$$

Which gets L on the top line.

Dividing by $\cos \theta$ will remove the factor of $\cos \theta$ from it so that we can then remove the brackets:

$$L - x = \frac{s}{2} \div \cos \theta$$
$$L - x = \frac{s}{2\cos \theta}$$

Now adding x to both sides will give us L as the subject of the formula:

$$L - x + x = \frac{s}{2 \cos \theta} + x$$

Hence:

$$L = \frac{s}{2 \cos \theta} + x$$

The answer is **F**.

5 This question requires you to draw on your knowledge of the regions of the digestive system where the three types of nutrient are broken down.

1. The table indicates that nutrient 1 undergoes some digestion in the mouth; very little, if any, digestion in the stomach; and the remainder of the digestion in the small intestine. That some digestion takes place in the mouth, should indicate to you that this nutrient is likely to be starch, which is acted on by amylase produced by the salivary glands. This is supported by the observation that very little, if any, digestion of this nutrient takes place in the stomach, but is completed in the small intestine, the site of further amylase activity.

2. Digestion of nutrient 2 begins in the stomach. This alone should tell you that this nutrient is likely to be protein, since the stomach is the site of protease activity, which also occurs in the small intestine.

By this stage, you should be fairly sure that the correct answer is **B**.

3. Digestion of nutrient 3 takes place only in the small intestine, which should confirm that this is fat, which is acted on by lipase in the small intestine, but is not digested in significant quantities in either the mouth or the stomach.

This confirms that the correct answer is **B**.

6 This question is about identifying which possible isotopes can give rise to CH_2BrCl with $M_r = 128$, and the proportion of these isotopes that exist. The first thing that you can do is identify which isotope combinations give $M_r = 128$.

If $M_r = 128$, then Br + Cl = 114

$^{79}Br + {}^{35}Cl = 114$
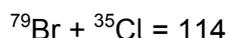
Since these are the smallest isotopic masses you can use, any other combination will be too large.

The next bit can be solved in several ways, including probability trees and two-way tables, and you could choose a sample of 100 atoms of Cl and 100 of Br and then work through to find the number of CH_2BrCl with the correct mass (there is nothing special about the choice of 100, it is simply a convenient number to deal with, and the desired fraction is independent of sample size if it is big enough not to need rounding).

The quickest way is in fact to use compound probability*. The fraction occurring is relative frequency and is akin to probability. We want the probability that Br = ^{79}Br AND Cl = ^{35}Cl, in CH_2BrCl and these events are independent of each other.

Hence $P\left(\text{Br} = {}^{79}\text{Br AND Cl} = {}^{35}\text{Cl}\right) = P\left(\text{Br} = {}^{79}\text{Br}\right) \times P\left(\text{Cl} = {}^{35}\text{Cl}\right)$

^{35}Cl is three times as common as ^{37}Cl, and the question states that there are only 2 isotopes to be considered (3:1), so the relative frequency of ^{35}Cl is $\frac{3}{4}$, and for ^{37}Cl it is $\frac{1}{4}$, and we can treat these as probabilities.

For bromine by similar interpretation the relative frequency of ^{79}Br is $\frac{1}{2}$, and it is the same for ^{81}Br.

Hence $P\left(\text{Br} = {}^{79}\text{Br AND Cl} = {}^{35}\text{Cl}\right) = \frac{3}{4} \times \frac{1}{2} = \frac{3}{8}$

The answer is **C**.

* If several combinations of isotopes gave the correct mass, then a tree diagram may have been a more efficient way of solving this problem.

7 This is a familiar application of statistical techniques. The interquartile range is the difference between the upper quartile and the lower quartile. Just as the median is the middle value of the data set when arranged in ascending order, and therefore the value at the half way point through the data. The lower quartile is the value at the point that is ¼ of the way through the data, and the upper quartile is the value at the point that is ¾ of the way through the data.

To find the quartiles in the data set, you first need to know how big the data set is; this can be found by reading off the highest value of the cumulative frequency (360).

Hence the position of the lower quartile is at $90 \left(i.e. \; \frac{1}{4} \times 360 \right)$ in the cumulative frequency, and the upper quartile is at $270 \left(i.e. \; \frac{3}{4} \times 360 \right)$ in the cumulative frequency. Reading off the marks at these positions gives us the values for these quartiles. The value of the lower quartile is 32, and the upper quartile value is 56, so the interquartile range is 24.

The answer is **B**.

Interquartile range = 56 - 32 = 24
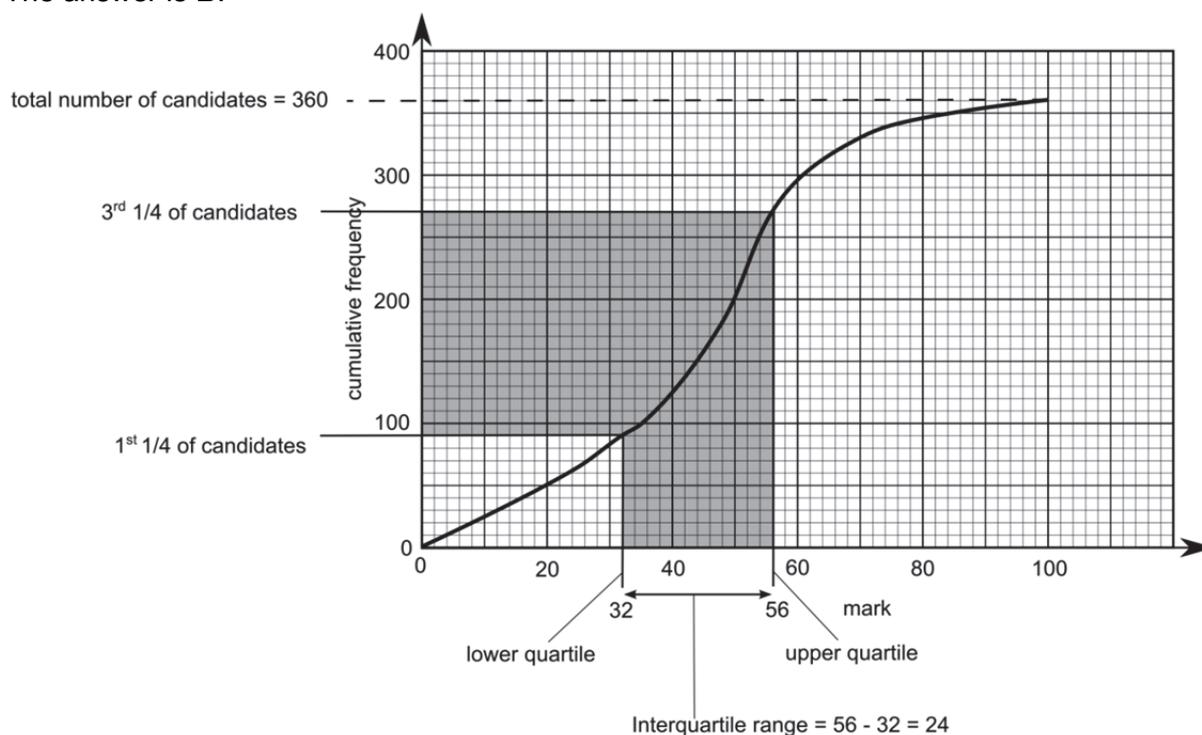
8 We know that for transformers $\frac{V_p}{V_s} = \frac{n_p}{n_s}$, and that for electrical power $P = VI$, when SI units for the quantities are used.

The first thing we need to do is to find the output (secondary) voltage:

$V_s = \frac{P_s}{I_s} = \frac{500}{10} = 50\text{V}$

Now that we know both the input and output voltages we can use the turns ratio equation to find the number of turns on the secondary. Re-arranging it, we get:

$$n_s = \frac{n_p V_s}{V_p}$$

Substituting in the values, n_s is therefore (1500 × 50)/250 = 300.
Hence 300 is the correct answer.

The answer is **B**.

SECTION 3

These are good quality responses in terms of content and language. However, alternative approaches to the question are possible and these should not be taken as model answers. They are only exemplars of good responses.

A little learning is a dangerous thing.
(Alexander Pope)

Explain what this statement means. Argue to the contrary to show that a little learning is not dangerous. To what extent do you think learning can be a dangerous thing?

By stating that 'a little learning is a dangerous thing' the author is implying that it is safer to know nothing about something than to know a little about it and form the misconception that you actually know more than you do.

There are, however, many situations in which a little learning can be extremely beneficial. A basic knowledge of first aid can help to save a person's life, even if it is the mere bandaging of a wound. The fact that the individual may not me aware of the need to elevate an injured limb is of negligible importance in comparison to the little knowledge they had of the need to call for an ambulance and to keep the victim calm and reassured.

In other circumstances, an individual who has witnessed a baby being delivered on television, will be better equipped to assist in the emergency delivery of the baby than someone who has not had the same exposure to this 'little knowledge'. They may not be at all as experienced as a midwife but, in emergency situations, it is better to have a little knowledge than none at all.

The matter that determines whether or not learning is dangerous is the way in which the individual uses their knowledge. As long as they do not become too overconfident of what they have learnt, and do not use it to the harm of others, their knowledge is not dangerous. However, if someone viewing a heart transplant on television believes they are now equipped to perform one themselves, then in this case, the 'little learning' has become a danger, particularly if they have no concept of human physiology or surgical procedures. It is essential that knowledge is used cautiously and sensibly and never to the disadvantage of others. In this way, a 'little learning' will not be dangerous.

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It is ridiculous to treat the living body as a mechanism.

Explain what this statement means. Argue to the contrary. To what extent do you think this apparent contradiction can be resolved?

This statement implies that the living body can not be treated as a mechanism but must be viewed as something different. One could argue, however, against this statement as the living body functions through different mechanisms i.e. pumping of the heart. With respect to medicine, it is necessary for the majority of cases to treat the living body as a mechanism. For example when diagnosing a patient's illness, the doctor has to take into account the symptoms of the patient and various other factors. By diagnosing on the basis of symptoms, the doctor is treating the body as a predictable mechanism as the symptoms have been matched with the corresponding disease or illness.

On the other hand, however, just as we are saying that the body is predictable it can be just as unpredictable and the mechanism definition of the living body seems useless. It is apparent that the living body responds to countless stimuli. This means that the body can not be viewed as a mechanism, as a mechanism is predictable and the living body is not.

In order to resolve this apparent contradiction it is necessary to take all the arguments into consideration. By doing this we can see that in fact the conclusion of this argument lies very much between the two extremes.

The living body is an extremely complex collection of mechanisms which interact and work with each other on an incomprehensibly complex level. Furthermore these mechanisms are influenced by countless factors that present themselves in everyday life. The result of these mechanisms working together is a living body. It is necessary to underline that as yet, science has not discovered and understood all of the mechanisms by which the living body functions, therefore, I believe we can not treat the body as a mechanism until this is the case.

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