SECTION 1

INSTRUCTIONS TO CANDIDATES

Please read these instructions carefully, but do not open this question paper until you are told that you may do so. This paper is Section 1 of 2.

A separate answer sheet is provided for this paper. A separate text booklet is also provided for Part C. Please check you have these. You also require a soft pencil and an eraser.

Please complete the answer sheet with your candidate number, centre number, date of birth, and name.

At the end of the 80 minutes, your supervisor will collect this question paper and answer sheet before giving out Section 2.

This paper contains three parts, A, B, and C.

All candidates should complete Part A Thinking Skills (22 questions).

All candidates should then complete one further part chosen from:

Part B  Mathematics and Biology (30 questions)
Part C  Reading Comprehension (24 questions)

You are advised to spend 40 minutes on Part A and 40 minutes on your chosen part.

There are no penalties for incorrect responses, only marks for correct answers, so you should attempt all of the questions in your two parts.

Questions ask you to show your choice between options. Choose the one option you consider correct and record your choice on the separate answer sheet. If you make a mistake, erase thoroughly and try again.

You can use the question paper and text booklet for rough working, but no extra paper is allowed. Only your responses on the answer sheet will be marked.

Dictionaries and calculators may NOT be used.

Please wait to be told you may begin before turning this page.

This question paper consists of 46 printed pages and 2 blank pages.
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PART B Mathematics and Biology .................................................... 19
PART C Reading Comprehension .................................................... 40
We need to accept flooding as a regular occurrence in the UK. Statistics show that days of 'extreme rain' (very heavy rainfall) have become more common since 1960, moving from one in a hundred days on average in the 1960s to one in seventy days in 2015. The apparent trend mirrors increases in extreme rain seen in other parts of the world. Countries such as India and China expect and prepare for this, but in the UK we have to change our thinking and plan our infrastructure to cope with it. The damage caused to homes and businesses as well as the risk of injury and death through flooding are very significant. Scientists say that, as the world has warmed by 0.7 °C, the atmosphere is able to hold 4% more moisture, which means more potential rain.

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

A  The UK has been underprepared for the effects of flooding.
B  The UK could learn from countries such as India and China about flood defences.
C  Global warming could be halted if there was political will.
D  The UK must plan its infrastructure to deal with a high risk of flooding.
E  The world temperature will continue to rise in the future.

An unusual dartboard is used in a playground game:

In order to win the big prize, contestants must score exactly 50 with three darts, all of which must be in different sectors.

Which number must they hit with one of the three darts in order to score 50?

A  8
B  11
C  18
D  21
E  24
There is a lot more to interpreting and recognising faces than you might think. Forgetting people we used to know is not that uncommon, and is something we are in fact all guilty of. But next time you’re standing in the supermarket having a conversation with someone you don’t recognise but act like you remember them, take heed that the likelihood is that they will know you are lying. Lying is a lot harder than most people realise, and hiding the fact we are lying is harder still. This is because we all make brief, involuntary facial expressions when we try to conceal or repress something, such as trying to remember someone. These have been termed micro-expressions. So when someone you don’t recognise starts talking to you, you should just confess straight away because your micro-expressions will probably give you away anyway.

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

A When someone that you don’t recognise starts to talk to you, it is never because they have mistaken you for someone else.
B People are able to recognise the micro-expressions that show that someone is lying.
C People would prefer to know that they have not been recognised rather than have someone pretend to know them.
D The person talking to you will not be embarrassed that you did not recognise them.
E People who are talking to someone that they know never lie.

Some say that religion is crucial for providing us with a moral framework, for giving clear strong moral guidance. Without religion, some say, people might lose their sense of morality altogether. But those who argue this ought to consider the Ancient Greeks. The Greeks pondered obsessively the question of what makes a good life and how to live well. In fact the word ‘ethics’ comes from them. And although they had their own set of gods, those gods were hardly moral role models (Zeus himself was a serial adulterer). Moreover, there was nothing by way of an agreed religious text from which to obtain their moral rules. There was even an atheist movement in Ancient Greece. The Greeks alone are proof that if we are to lose our faith in God, this does not mean we must also lose our faith in morality.

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

A Some Greek gods were capable of great and heroic deeds.
B The Ancient Greeks took their moral guidance as much from poetry and drama as from religion.
C Many Ancient Greeks questioned the value or purpose of being moral.
D In many parts of the world faith in God is currently getting stronger.
E Believers often disagree about how best to interpret their own religious text.
It is all very well for Europeans to expect African farmers and villagers to show the same enthusiasm for lion protection schemes as 'wildlife tourists' and armchair conservationists who deplore the killing or even the fencing-in of these noble and celebrated creatures. But it is estimated that the average farm in Tanzania loses the equivalent of £600 a year in livestock due to lions straying outside the boundaries of the national parks where they are protected and growing in numbers. When out hunting, lions do not respect the difference between another wild animal and a domesticated beast that is owned by someone and often of priceless value to that person. Most European countries would not tolerate the presence of huge, wild, man-eating cats roaming wild in the countryside, decimating their profits and killing their children. They have proved this by hunting many native species perceived as dangerous – wolves, bears, boar – to extinction, or by destroying their habitats. Why should Africa be different?

Which one of the following identifies a flaw in the above reasoning?

A. The fact that other countries have failed to protect their wildlife heritage does not make it right.
B. Farmers in the UK are strong advocates of the culling of badgers to protect cattle from TB.
C. Many rural African communities are very poor and lions are a serious threat to their economic survival.
D. Without protection lions would soon become an endangered species in the wild.
E. Tourism has already suffered in Africa due to the scarcity of many large game animals.

I have booked a flight from London to Auckland, which is in a time zone 12 hours ahead of GMT. I am due to leave London at 17:30 GMT on 19 August and will arrive in Auckland at 06:15 on 21 August (local time). My journey includes a 1-hour stop in Los Angeles and a 1.5-hour stop in Hawaii.

How many hours am I due to spend in the air?

A. 12¼
B. 22¼
C. 23¼
D. 24¼
E. 34¼
As a treat for my sixth birthday I am going swimming with my family next Saturday afternoon. My mum is a nurse and my dad is unemployed. My sister is three years younger than me and my brother is two years older but they will both enjoy the treat too. Grandma is coming but she will watch rather than swim. Grandpa loves swimming even though he is nearly 72 years old, so he will be in the pool enjoying the swim.

The charges at the local swimming centre are shown below:

<table>
<thead>
<tr>
<th>Admission for:</th>
<th>Peak Times</th>
<th>Off-Peak Times</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult</td>
<td>£3.80</td>
<td>£2.90</td>
</tr>
<tr>
<td>Unemployed Adult</td>
<td>£2.10</td>
<td>£1.50</td>
</tr>
<tr>
<td>Child/Senior Citizen (over 65 years)</td>
<td>£1.90</td>
<td>£1.50</td>
</tr>
<tr>
<td>Family ticket (2 adults and 2 children)</td>
<td>£9.50</td>
<td>£7.10</td>
</tr>
<tr>
<td>*Concession family ticket (2 adults and 2 children)</td>
<td>£4.80</td>
<td>£3.60</td>
</tr>
<tr>
<td>Family ticket (1 adult and 2 children)</td>
<td>£5.70</td>
<td>£4.30</td>
</tr>
<tr>
<td>*Concession family ticket (1 adult and 2 children)</td>
<td>£3.60</td>
<td>£2.85</td>
</tr>
<tr>
<td>Spectators</td>
<td>£0.70</td>
<td>£0.50</td>
</tr>
<tr>
<td>Under 4s</td>
<td>free</td>
<td>free</td>
</tr>
</tbody>
</table>

*Adults must be Unemployed or Senior Citizens
Off-peak – Monday to Friday 9 am to 5 pm
Peak – all other times and school holidays

What is the lowest price that we could pay for our tickets?

A  £7.00
B  £9.10
C  £9.30
D  £12.10
E  £12.30
One of the exhibits in the Interactive Art Exhibition at the Hanson Gallery consists of 16 identical free-standing cubes. Visitors to the exhibition are invited to handle these cubes and rearrange them to create their own work of art.

This is the arrangement that I have made:

What is the side view of my arrangement from the direction indicated by the arrow?

A

B

C

D

E
9 It is time for prostitution to be legalised. It has been illegal for millennia, and yet it is still present in modern society. Clearly, its being illegal does not provide enough deterrent to prevent people from engaging in it. We are never going to eradicate prostitution, so we should give up trying, and legalise it. Money that is spent in prosecuting prostitutes and their clients could be better used elsewhere.

Which one of the following illustrates the principle used in the above argument?

A Prostitutes’ clients should be prosecuted, but not prostitutes themselves.
B Some people will commit murders, whether or not murder is illegal, so murder should not be illegal.
C People who are involved with dealing in illegal substances largely as a result of a background of poverty should not be prosecuted.
D Modern crimes, such as internet hacking, should be the focus of police forces.
E We should not waste money trying to rehabilitate young offenders.

10 The apostrophe has limited usefulness as a punctuation mark, so it will be no loss if it disappears altogether from the English language. The fact that it can’t be heard at all in speech suggests we can make our meaning clear without it. It is already disappearing from much business correspondence without commerce grinding to a halt. The apostrophe is also widely misused, which is surely another measure of its unimportance. Many people apparently think it belongs in any word that ends with an ‘s’, as demonstrated by this sign seen in an off-licence window: ‘Beer’s, wine’s and spirit’s at pre-budget price’s’. Yet judging by the queue in the shop, nobody had failed to get the message that there were bargains to be had.

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

A It doesn’t matter whether we use the apostrophe correctly or not.
B It will be no loss if the apostrophe disappears from English punctuation.
C The apostrophe is particularly unnecessary in business correspondence.
D There is no sound in speech that corresponds to the apostrophe.
E We should all stop using apostrophes from now on.
11 Political legitimacy, the moral right to use state power, can only be derived from the consent of the governed. So, in democracies that uphold this principle, regular elections are held to ensure that political power is legitimate. Therefore, in these cases, the more voters participate in elections, the more legitimate the democratic political system is.

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

A Electoral turnout is always higher in democratic political systems.
B Voting at elections implies consent to the political system as a whole.
C There is always a need for a government.
D The more people who vote, the more the common interests are met.
E Non-democratic political systems rely on coercion as a basis of state power.

12 A company is producing a one-page flysheet 24 cm high by 18 cm wide. It will have a text area in the centre which has a margin of the same width all the way around. The text must occupy exactly half of the total area:

What is the width of the margin?

A 3.00 cm
B 4.50 cm
C 5.25 cm
D 6.00 cm
E 12.00 cm
I need to buy new printer paper for my fax machine. The paper comes in rolls. My machine needs paper 210 mm wide and will take a roll up to 25.4 mm in diameter.

I do not really care how long the paper in the roll is and will buy rolls in bulk if they are cheaper. I will just buy the most economical paper to use. I cannot, however, afford to spend more than £30.00.

The prices in the catalogue are as follows:

<table>
<thead>
<tr>
<th>Width (mm)</th>
<th>Length (m)</th>
<th>Diameter (mm)</th>
<th>RRP</th>
<th>Price</th>
<th>Saving</th>
<th>RRP</th>
<th>Price</th>
<th>Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>216</td>
<td>100</td>
<td>25.4</td>
<td>£12.84</td>
<td>£7.99</td>
<td>38%</td>
<td>£77.04</td>
<td>£39.54</td>
<td>49%</td>
</tr>
<tr>
<td>210</td>
<td>25</td>
<td>12.7</td>
<td>£4.16</td>
<td>£2.49</td>
<td>40%</td>
<td>£24.96</td>
<td>£13.14</td>
<td>47%</td>
</tr>
<tr>
<td>210</td>
<td>100</td>
<td>25.4</td>
<td>£12.13</td>
<td>£7.49</td>
<td>38%</td>
<td>£72.78</td>
<td>£38.10</td>
<td>48%</td>
</tr>
<tr>
<td>210</td>
<td>100</td>
<td>50.8</td>
<td>£12.24</td>
<td>£7.59</td>
<td>38%</td>
<td>£73.44</td>
<td>£38.94</td>
<td>47%</td>
</tr>
<tr>
<td>210</td>
<td>50</td>
<td>25.4</td>
<td>£6.62</td>
<td>£4.19</td>
<td>37%</td>
<td>£39.72</td>
<td>£20.94</td>
<td>47%</td>
</tr>
</tbody>
</table>

(RRP=Recommended Retail Price)

How much will the transaction cost me?

A  £2.49
B  £4.16
C  £7.49
D  £20.94
E  £24.96
Water was poured into five containers at a steady rate until each was full. A graph of the depth of water \( h \) in the container against time \( t \) was sketched for each container. One of the graphs has been lost.

Which one of the following containers is not represented by any of the above graphs?

A  

B  

C  

D  

E
15 High street stores should not be able to sell financial products, because consumers should not be misled into buying products they may not need by staff who do not understand what they are selling. Financial products require an understanding of financial services, and very few high street retailers have members of staff in store who can fully explain the benefits and disadvantages of the financial products being sold.

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

A Many high street stores have been fined by the financial regulator for mis-selling financial products.
B Many stores offer incentives to customers to encourage them to sign up for store cards.
C Consumers are supplied with full details of the terms and conditions for all financial products that they sign up for.
D Many people do not understand the financial products they purchase yet still benefit from them.
E Most people do not read the terms and conditions of products and services that they sign up to.

16 When it comes to genius, the only possibilities are that it is something innate in people, or it is something to do with their upbringing. It is hard to imagine how simply bringing someone up in a certain way would be enough to turn them into a Mozart or a Shakespeare or an Einstein. Mozart after all was writing complex music as a young child; it is difficult to explain how environment could have had such a significant influence by the age of five. It must therefore be the case that genius is something that is wholly innate.

Which one of the following is the best statement of the flaw in the above argument?

A It assumes that genius has to be evident at an early age.
B It is impossible to draw conclusions about questions of nature and nurture with such certainty.
C Just because genius cannot be wholly explained by upbringing, this does not mean that upbringing is not an important factor.
D The argument does not specify exactly what is meant by 'genius'.
E The fact that something is hard to imagine does not mean that it is not true.
17 It is both morally and economically wrong for the Government to give implicit approval to an employment system that lands the state with a huge bill to top up the incomes of the lowest earners. The holes in millions of pay cheques are being plugged by in-work support to the tune of £4 bn a year. But why aren’t those who are profiting from their workers paying up? Why is the Government having to subsidise businesses who don’t pay their employees enough to live on? It is a question we need to answer and act on – fast. The cost of living is rising but wages are not. In the rush for profit, and for high pay at the top, too many companies have forgotten the basic moral imperative that employees be paid enough to live on.

Which one of the following is the best statement of the principle underlying the above argument?

A The Government is responsible for the employment system that leaves holes in millions of pay cheques.

B It is morally wrong of the Government to assist people on low incomes.

C High pay at the top end is responsible for low wages at the bottom end of the employment ladder.

D All pay should increase each year at the same rate as the cost of living.

E Every worker should be paid at least a living wage by those who profit from their work.

18 Anna buys potatoes in the local market. She has noticed that the price on Saturday morning is 5p per kilo more than the normal weekday price. However, an hour before the stall closes on a Saturday afternoon, the price drops to 5p per kilo below the weekday price. She spends £3.00 a week on potatoes. This will buy her 3 kilos less in weight on a Saturday morning than on a weekday, but 5 kilos more in weight at the low Saturday afternoon price than on a weekday.

What is the weekday price of potatoes per kilo?

A 12p

B 15p

C 20p

D 25p

E 30p
Mike wants to buy a second-hand car that offers the lowest depreciation per mile. He is not worried about the model. His family insist that the car has 4 or 5 doors and an engine of at least 1.6 litres so that it can tow a caravan. Mike plans to keep the car until it has covered 100 000 miles and then sell it for £1,000. He scans the following price list from his local garage:

<table>
<thead>
<tr>
<th>Make</th>
<th>Model</th>
<th>Engine</th>
<th>Mileage</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ford</td>
<td>Escort 3 door</td>
<td>1.6 litre</td>
<td>70 000</td>
<td>£2,500</td>
</tr>
<tr>
<td>Rover</td>
<td>214 SLi 3 door</td>
<td>1.4 litre</td>
<td>30 000</td>
<td>£4,500</td>
</tr>
<tr>
<td>Rover</td>
<td>414 Si 4 door</td>
<td>1.4 litre</td>
<td>40 000</td>
<td>£4,500</td>
</tr>
<tr>
<td>VW</td>
<td>Golf CL 3 door</td>
<td>1.6 litre</td>
<td>95 000</td>
<td>£1,200</td>
</tr>
<tr>
<td>Rover</td>
<td>820 4 door</td>
<td>1.6 litre</td>
<td>30 000</td>
<td>£7,000</td>
</tr>
<tr>
<td>Vauxhall</td>
<td>Vectra 3 door</td>
<td>1.8 litre</td>
<td>10 000</td>
<td>£8,000</td>
</tr>
<tr>
<td>Vauxhall</td>
<td>Astra 3 door</td>
<td>1.4 litre</td>
<td>50 000</td>
<td>£3,500</td>
</tr>
<tr>
<td>Ford</td>
<td>Escort 5 door</td>
<td>1.4 litre</td>
<td>40 000</td>
<td>£4,000</td>
</tr>
<tr>
<td>Renault</td>
<td>Clio 3 door</td>
<td>1.6 litre</td>
<td>80 000</td>
<td>£2,000</td>
</tr>
<tr>
<td>Renault</td>
<td>Laguna 5 door</td>
<td>1.8 litre</td>
<td>20 000</td>
<td>£7,000</td>
</tr>
<tr>
<td>Rover</td>
<td>825 4 door</td>
<td>2.5 litre</td>
<td>90 000</td>
<td>£1,500</td>
</tr>
<tr>
<td>Ford</td>
<td>Sierra 4 door</td>
<td>2.0 litre</td>
<td>70 000</td>
<td>£2,000</td>
</tr>
</tbody>
</table>

Which make of car does Mike buy?

A  Ford
B  Rover
C  VW
D  Vauxhall
E  Renault
Bob, Eve, Nan, Pip and Viv took part in a 6-hour sponsored bowling marathon to raise money for charity. They were all sponsored per complete 100 points scored.

Bob was sponsored for a total of £63 per 100 points.
Eve was sponsored for a total of £56 per 100 points.
Nan was sponsored for a total of £72 per 100 points.
Pip was sponsored for a total of £54 per 100 points.
Viv was sponsored for a total of £68 per 100 points.

During the 6-hour marathon:
Pip scored 2,835 points.
Eve scored 2,782 points.
Bob scored 2,407 points.
Viv scored 2,293 points.
Nan scored 2,169 points.

Remarkably, four of them raised exactly the same amount. Who raised a different amount to the other four?

A Bob
B Eve
C Nan
D Pip
E Viv
Many people criticise what they call ‘the younger generation’ for what their seniors regard as immoral behaviour. These critics need to realise that because the world has changed, moral standards have changed with it. In fact, technology is advancing so rapidly that it is only the young who understand the world in which they live. It is they, not their parents or grandparents, who should be setting moral standards. Anyone over the age of 25 cannot help but be blinded by what they learned in the past. Their education has prevented them from perceiving and responding to the demands of the modern day, and so their moral judgments have no validity.

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

A  Moral judgments made by people over the age of 25 are not valid.

B  Moral standards have changed.

C  Moral standards should be set by people under the age of 25.

D  The younger generation is guilty of what older people regard as immoral behaviour.

E  Young people are the only ones who understand the contemporary world.
22 I have a square field which is exactly one hectare (100 m × 100 m). On Monday I was surprised to find 4 mushrooms growing in a 1 m square formation, in the centre of my field. On Tuesday the group of mushrooms had expanded to 16, which were all 1 m apart.

When I looked at the group of mushrooms today (Wednesday), it had expanded to 36.

If the area covered by mushrooms continues to expand at this rate, how many days (including today) will it be until my field is covered in mushrooms?

A 48
B 50
C 96
D 100
E 192
23  Find the complete set of solutions to \(-8 < 6 - \frac{x}{2}\)

A  \(x < 4\)

B  \(x > 4\)

C  \(x < 20\)

D  \(x > 20\)

E  \(x < 22\)

F  \(x > 22\)

G  \(x < 28\)

H  \(x > 28\)

24  Which one of the following is a simplification of \((\sqrt{3} - \sqrt{2})^2\) ?

A  \(1 - 2\sqrt{3}\sqrt{2}\)

B  \(5 - 2\sqrt{2}\sqrt{3}\)

C  \(2\sqrt{3} - 2\sqrt{2}\)

D  \(1\)

E  \(5 - \sqrt{2}\sqrt{3}\)

F  \(13 - 2\sqrt{2}\sqrt{3}\)

G  \(5 + 2\sqrt{2}\sqrt{3}\)

H  \(5\)
25 The ratio of Q:R is 5:2 and the ratio of R:S is 3:10

Which one of the following gives the ratio Q:S in its simplest form?

A  1:2
B  2:1
C  3:4
D  3:25
E  4:3
F  25:3

26 The mean age of the twenty members of a running club is exactly 28.
The mean age increases by exactly 2 years when two new members join.
What is the mean age of the two new members?

A  20 years
B  22 years
C  30 years
D  40 years
E  50 years
F  52 years

27 A medical scanner is bought for £15 000.
The value of the scanner depreciates by 20% every year.
By how much has the scanner reduced in value after 2 years?

A  £600
B  £3000
C  £5400
D  £6000
E  £9000
F  £9600
G  £12 000
28 The point A is 4 km due East of the point B.

The bearing of the point C from A is $330^\circ$ and the bearing of C from B is $060^\circ$.

Find the distance BC.

A  2 km
B  $2\sqrt{3}$ km
C  4 km
D  $2\sqrt{5}$ km
E  $4\sqrt{2}$ km

29 The quantities $x$ and $y$ are positive.

$x$ is inversely proportional to the square root of $y$.

When $x = 8$, $y = 9$.

What is the value of $y$ when $x = 6$?

A  $\frac{3}{2}$
B  2
C  $\frac{81}{16}$
D  $\frac{27}{14}$
E  12
F  16
30 In a trapezium $PQRS$, the parallel sides are $PQ$ and $RS$.

$PQ = (x - 1) \text{ cm}$, $RS = (x + 5) \text{ cm}$ and the vertical height $QR = x \text{ cm}$.

The area of the trapezium is 120 cm$^2$.

What is the length of $RS$?

A 9 cm  
B 10 cm  
C 11 cm  
D 12 cm  
E 15 cm  
F 17 cm

31 Make $b$ the subject of the formula:

$$a = \frac{b^2 + 2}{3b^2 - 1}$$

A $b = \pm \sqrt{\frac{a + 2}{3a + 1}}$  
B $b = \pm \sqrt{\frac{a + 2}{3a - 1}}$  
C $b = \pm \sqrt{\frac{2 - a}{3a + 1}}$  
D $b = \pm \sqrt{\frac{2 - a}{3a - 1}}$  
E $b = \pm \sqrt{\frac{3}{3a + 1}}$  
F $b = \pm \sqrt{\frac{3}{3a - 1}}$
PART B Mathematics and Biology

32 A thin rectangular sheet of metal 10 m by 5 m is made into an open ended cylinder by joining the edges $PS$ and $QR$.

The height of the cylinder is 10 m.

What is the volume, in cubic metres, enclosed by this cylinder?

![Diagram of the cylinder](image)

A $\frac{5}{2\pi}$  
B $\frac{25}{4\pi}$  
C $\frac{125}{2\pi}$  
D $62.5\pi$  
E $\frac{125}{\pi}$  
F $250\pi$

33 Which one of the following is a simplification of $4 + \frac{4-x^2}{x^2-2x}$?

A $3 - \frac{2}{x}$  
B $3 + \frac{2}{x}$  
C $4 - \frac{2}{x}$  
D $4 + \frac{2}{x}$  
E $5 - \frac{2}{x}$  
F $5 + \frac{2}{x}$
34. During summer activities week 120 students each chose one activity from swimming, archery, and tennis.

46 of the students were girls.

36 of the students chose tennis, and \( \frac{2}{3} \) of these were boys; 25 girls chose swimming, and 27 students chose archery.

A boy is picked at random. What is the probability that he chose swimming?

A \( \frac{3}{20} \)  
B \( \frac{9}{37} \)  
C \( \frac{4}{15} \)  
D \( \frac{16}{37} \)  
E \( \frac{32}{57} \)

35. Which one of the following expressions is equivalent to \( \frac{9^{2n+1} \times 3^{4-3n}}{27^{2-n}} \)?

A \( 3^0 \)  
B \( 3^{-2n} \)  
C \( 3^{2-2n} \)  
D \( 3^{4n} \)  
E \( 3^{6n-2} \)  
F \( 3^6 \)
In the diagram below, $PQRS$ is part of a regular polygon.

The polygon has $n$ sides.

The side $PQ$ is extended to $T$ such that $PQT$ is a straight line.

The length of $RQ$ is the same as the length of $RT$.

Find an equation for $n$ in terms of $x$, where $x$ is the size of angle $\angle QRT$ in degrees.

A $n = \frac{180}{x - 90}$

B $n = \frac{180 - x}{720}$

C $n = \frac{360 - x}{90}$

D $n = \frac{360}{180 - x}$

E $n = \frac{720}{180 - x}$

F $n = \frac{720}{360 - x}$

G $n = \frac{360}{360 - x}$
In a population, \( \frac{3}{5} \) of the adults are overweight.

The probability of an overweight adult having Type 2 diabetes is \( \frac{9}{50} \); this probability is 6 times the probability of an adult who is not overweight having the disease.

An adult is chosen at random from the population.

What is the probability the chosen adult has Type 2 diabetes?

A \( \frac{27}{250} \)

B \( \frac{3}{25} \)

C \( \frac{63}{500} \)

D \( \frac{37}{250} \)

E \( \frac{39}{50} \)

F \( \frac{21}{100} \)

Between 1954 and 1971 a mine in Northern Australia was releasing excess copper into the nearby Finnis River. Copper ions are poisonous and most of the types of fish living in the river died. The river still remains polluted with copper, but scientists have discovered one type of rainbow fish that is able to survive and live in the river.

A student wrote the following statements in order to explain this information.

1 One type of rainbow fish did not die out in the river because this type was able to adapt to the changing environment.
2 None of the other types of fish showed any type of genetic variation.
3 The presence of copper ions acted as a selective pressure.

Which of the student’s statements could be correct?

A 1 only
B 1 and 2 only
C 1 and 3 only
D 2 and 3 only
E 1, 2 and 3
The diagram shows a plant cell.

Which of the arrows on the diagram show the net movement of water molecules, by osmosis, when the cell is surrounded by a solution that is more concentrated than the solution in the cytoplasm?

A 1 only
B 2 only
C 1 and 3 only
D 1 and 4 only
E 2 and 3 only
F 2 and 4 only
A student carried out an experiment to investigate how temperature affects the rate of activity of an enzyme found in potatoes. This enzyme breaks down the substrate hydrogen peroxide to produce water and oxygen.

The apparatus was set up as shown in the diagram and the experiment carried out at 30 °C.

The student counted the number of bubbles of oxygen produced in one minute.

The experiment was repeated at 40 °C, 50 °C, 60 °C, and 70 °C.

The table shows the results collected by the student.

<table>
<thead>
<tr>
<th>temperature/°C</th>
<th>number of bubbles of oxygen gas produced in one minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>32</td>
</tr>
<tr>
<td>40</td>
<td>27</td>
</tr>
<tr>
<td>50</td>
<td>23</td>
</tr>
<tr>
<td>60</td>
<td>8</td>
</tr>
<tr>
<td>70</td>
<td>2</td>
</tr>
</tbody>
</table>

A group of students were given these results and asked to calculate the percentage decrease in the number of bubbles produced between 30 °C and 60 °C. Each student was also asked to write a conclusion to explain the results. These are shown in the table below.

Which student correctly calculated the percentage decrease in the number of bubbles between 30 °C and 60 °C and wrote an appropriate conclusion which explains the reason for this decrease?

<table>
<thead>
<tr>
<th>percentage decrease in the number of bubbles between 30°C and 60°C</th>
<th>conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 20</td>
<td>the high temperature causes the bonds maintaining the structure of the enzyme to break</td>
</tr>
<tr>
<td>B 20</td>
<td>the temperature of the environment is too hot and the enzyme dies</td>
</tr>
<tr>
<td>C 75</td>
<td>the high temperature causes the bonds maintaining the structure of the enzyme to break</td>
</tr>
<tr>
<td>D 75</td>
<td>the temperature of the environment is too hot and the enzyme dies</td>
</tr>
<tr>
<td>E 300</td>
<td>the high temperature causes the bonds maintaining the structure of the enzyme to break</td>
</tr>
<tr>
<td>F 300</td>
<td>the temperature of the environment is too hot and the enzyme dies</td>
</tr>
</tbody>
</table>
41. Albinism is a recessive genetic condition that results in the absence of the pigment melanin in the skin, hair and eyes. In a population of 580,000 people there were 29 albinos and 81,200 symptomless carriers. One living cheek cell was collected from every individual in the population.

What is the number of albinism alleles in these cells?

A. 0
B. 29
C. 58
D. 81,229
E. 81,258
F. 162,458

42. A student set up the following apparatus at a temperature of 25°C and at pH 7.

10 cm³ of a human enzyme solution added

protein solution

cloudy cloudy clear

15 minutes later

What could the student change so that it would take less than 15 minutes for the solution to become clear?

A. Carry out the experiment at pH 7, but increase the temperature to 70°C.
B. Carry out the experiment, stirring the mixture once every 30 seconds.
C. Carry out the experiment at a temperature of 25°C and a pH of 13.
D. Double the volume of both the protein solution and the enzyme solution.
E. Halve the volume of both the protein solution and the enzyme solution.
The diagram shows the apparatus used by a student to carry out an investigation into the rate of photosynthesis in pondweed.

The student measured the distance the gas bubble moved along the capillary tube in 3 minutes as 16 mm. The student calculated the volume of gas produced using the distance moved and the diameter of the capillary tube which was 1.0 mm. After 3 minutes the rate of gas production is reduced.

Which row represents the correct statements for this experiment?

<table>
<thead>
<tr>
<th>volume of gas produced / mm$^3$</th>
<th>reason for reduction in rate of gas production after 3 minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A $4\pi$</td>
<td>all enzyme active sites are occupied</td>
</tr>
<tr>
<td>B $4\pi$</td>
<td>carbon dioxide concentration is too low</td>
</tr>
<tr>
<td>C $16\pi$</td>
<td>carbon dioxide concentration is too low</td>
</tr>
<tr>
<td>D $16\pi$</td>
<td>photosynthesis enzymes denatured</td>
</tr>
<tr>
<td>E $16.5\pi$</td>
<td>carbon dioxide concentration is too low</td>
</tr>
<tr>
<td>F $16.5\pi$</td>
<td>photosynthesis enzymes denatured</td>
</tr>
<tr>
<td>G $34\pi$</td>
<td>all enzyme active sites are occupied</td>
</tr>
<tr>
<td>H $34\pi$</td>
<td>photosynthesis enzymes denatured</td>
</tr>
</tbody>
</table>
A student used a light microscope at a magnification of 40x to observe a slide of a stained non-dividing tissue. In the cells of this tissue, the student noted the presence of a large central vacuole and cytoplasm containing a single, stained, round structure.

Which of the following structures, if any, might the student also have seen in this tissue at this magnification?

1. cell wall
2. mitochondria
3. chromosomes

A. none of them
B. 1 only
C. 2 only
D. 3 only
E. 1 and 2 only
F. 1 and 3 only
G. 2 and 3 only
H. 1, 2 and 3
The diagram shows the tip of a plant shoot, with two areas labelled P and Q.

A student wrote the following statements to explain the growth of this shoot:

1. Cells at P are smaller than the cells at Q.
2. Concentration of plant hormone is higher at Q than P.
3. Unidirectional light has caused a change in the concentration of plant hormone at P.

Which of the student’s statements, if any, could be correct?

A  none of them
B  1 only
C  2 only
D  3 only
E  1 and 2 only
F  1 and 3 only
G  2 and 3 only
H  1, 2 and 3
In an investigation, a molecule of DNA was extracted and separated into its single strands 1 and 2. The percentage of each base present in each strand was found.

The table shows some of the results for strand 1.

<table>
<thead>
<tr>
<th>DNA sample</th>
<th>base present (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>adenine [A]</td>
</tr>
<tr>
<td></td>
<td>cytosine [C]</td>
</tr>
<tr>
<td></td>
<td>guanine [G]</td>
</tr>
<tr>
<td></td>
<td>thymine [T]</td>
</tr>
<tr>
<td>strand 1</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>?</td>
</tr>
<tr>
<td></td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>14</td>
</tr>
</tbody>
</table>

P, Q, R and S are the percentages of each base in the complementary strand 2.

<table>
<thead>
<tr>
<th>DNA sample</th>
<th>base present (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>adenine [A]</td>
</tr>
<tr>
<td></td>
<td>cytosine [C]</td>
</tr>
<tr>
<td></td>
<td>guanine [G]</td>
</tr>
<tr>
<td></td>
<td>thymine [T]</td>
</tr>
<tr>
<td>strand 2</td>
<td>P</td>
</tr>
<tr>
<td></td>
<td>Q</td>
</tr>
<tr>
<td></td>
<td>R</td>
</tr>
<tr>
<td></td>
<td>S</td>
</tr>
</tbody>
</table>

A student calculates the following percentages for P, Q, R and S:

- P 14%
- Q 28%
- R 26%
- S 28%

Which of the percentages is/are correct?

A P only
B Q only
C R only
D S only
E P and Q only
F R and S only
47 A diploid cell from a type of fly that contains 8 chromosomes, divides to form sperm cells.

Which row is correct for the number of strands of DNA in each sperm cell and the number of sperm cells produced?

<table>
<thead>
<tr>
<th>number of strands of DNA in each sperm cell</th>
<th>number of sperm cells produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 4</td>
<td>2</td>
</tr>
<tr>
<td>B 4</td>
<td>4</td>
</tr>
<tr>
<td>C 8</td>
<td>2</td>
</tr>
<tr>
<td>D 8</td>
<td>4</td>
</tr>
<tr>
<td>E 16</td>
<td>2</td>
</tr>
<tr>
<td>F 16</td>
<td>4</td>
</tr>
</tbody>
</table>

48 A healthy human is running a race over a distance of 1500 metres as fast as possible.

Which row shows molecules that would be in a higher concentration in a vein carrying blood away from an actively contracting leg muscle of the runner compared to an artery carrying blood to the capillaries in the muscle?

Key
✓ higher
X not higher

<table>
<thead>
<tr>
<th>glucose</th>
<th>carbon dioxide</th>
<th>lactic acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>A ✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>B X</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>C X</td>
<td>X</td>
<td>✓</td>
</tr>
<tr>
<td>D X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>E ✓</td>
<td>✓</td>
<td>X</td>
</tr>
<tr>
<td>F ✓</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>G X</td>
<td>✓</td>
<td>X</td>
</tr>
</tbody>
</table>
The sex of species Q is controlled by two chromosomes X and Y.

The sex of females of species Q is controlled by inheriting the same combination of sex chromosomes as healthy male humans. The sex of males in species Q is inherited in the same way as healthy female humans.

The family tree for one population of species Q is shown.

What is the ratio in its simplest form of males to females and the total number of Y chromosomes in this family tree?

<table>
<thead>
<tr>
<th>ratio</th>
<th>total number of Y chromosomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A 1 : 0.5</td>
<td>9</td>
</tr>
<tr>
<td>B 1.8 : 1</td>
<td>9</td>
</tr>
<tr>
<td>C 5 : 9</td>
<td>5</td>
</tr>
<tr>
<td>D 5 : 9</td>
<td>9</td>
</tr>
<tr>
<td>E 9 : 5</td>
<td>9</td>
</tr>
<tr>
<td>F 9 : 5</td>
<td>19</td>
</tr>
<tr>
<td>G 1 : 2</td>
<td>19</td>
</tr>
</tbody>
</table>
The graph shows how a number of factors vary with the distance down a river, after a source of pollution flowed in.

(Assume the oxygen concentration is changing only based on the species present in the river.)

Which one of the statements below can be correctly concluded from the graph?

A  At point 1, the oxygen concentration is decreasing because of increased anaerobic respiration.

B  At point 2, the oxygen concentration is decreasing because high numbers of algae are photosynthesising.

C  At point 3, the oxygen concentration is decreasing because bacteria are using up more oxygen than the algae are producing.

D  At point 4, the number of bloodworms and sludgeworms will be lowest because they lack oxygen.

E  At point 5, fish numbers increase because there is less competition with algae for oxygen.
The graph shows the effect of increasing the substrate concentration on an enzyme-controlled reaction when all the other variables were kept constant.

Which of the following labels, if any, could be correct for the $y$-axis?

1. rate of substrate loss / mg min$^{-1}$
2. rate of enzyme-substrate complex formation / number of complexes s$^{-1}$
3. rate of product formed per enzyme molecule / mg min$^{-1}$

A none of them
B 1 only
C 2 only
D 3 only
E 1 and 2 only
F 1 and 3 only
G 2 and 3 only
H 1, 2 and 3
The table shows the DNA base triplet codes that are valid for this question and the amino acids that they code for.

<table>
<thead>
<tr>
<th>DNA base triplet</th>
<th>amino acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>CGT</td>
<td>arginine</td>
</tr>
<tr>
<td>CGC</td>
<td>arginine</td>
</tr>
<tr>
<td>CGA</td>
<td>arginine</td>
</tr>
<tr>
<td>CGG</td>
<td>arginine</td>
</tr>
<tr>
<td>CTG</td>
<td>leucine</td>
</tr>
<tr>
<td>CCG</td>
<td>proline</td>
</tr>
<tr>
<td>CAG</td>
<td>glutamine</td>
</tr>
<tr>
<td>CAT</td>
<td>histidine</td>
</tr>
<tr>
<td>AGT</td>
<td>serine</td>
</tr>
</tbody>
</table>

Consider the part of the DNA sequence shown:

... CGC AGT ...

Two mutations will occur in the DNA sequence. The initial mutation is an insertion of an additional base between the first and second bases in the sequence. The second mutation, which takes place some time after the first mutation, is a deletion that removes one base from the sequence.

Assuming that this DNA sequence is part of a longer sequence coding for a protein, and that no other mutations are occurring, what are the probabilities of the following?

<table>
<thead>
<tr>
<th>probability that after the first mutation, the first triplet in this sequence does not code for arginine</th>
<th>probability that after the second mutation, both of the triplets in this sequence code for arginine</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1/4</td>
</tr>
<tr>
<td>B</td>
<td>1/4</td>
</tr>
<tr>
<td>C</td>
<td>1/4</td>
</tr>
<tr>
<td>D</td>
<td>1/4</td>
</tr>
<tr>
<td>E</td>
<td>3/4</td>
</tr>
<tr>
<td>F</td>
<td>3/4</td>
</tr>
<tr>
<td>G</td>
<td>3/4</td>
</tr>
<tr>
<td>H</td>
<td>3/4</td>
</tr>
</tbody>
</table>
PART C Reading Comprehension

For part C, you will need to refer to the separate text booklet.
Task 1

Look at the two texts on page 3. For questions 53 – 58, choose the option (A, B, C or D) which you think fits best according to the texts.

53 In Review Extract 1, which term suggests a similar criticism of Diamond’s work to ‘broad brush-strokes’?

A ‘inevitable’
B ‘geographical’
C ‘compressed’
D ‘global’

54 Review Extract 1 refers to ‘the question about bronze tools and geographic connectedness’ to make the claim that Diamond

A diminishes the scope of a more wide-ranging discussion.
B wrongly minimises the geographic scale needed to address a question.
C concentrates on the wrong sources of evidence about a topic.
D ignores the significance of geographic links within a contemporary debate.

55 Review Extract 2 suggests that Diamond’s position is weakened by his failure to

A explore how human thought processes developed in prehistoric times.
B consider the impact of scholars’ own perspectives in influencing archaeology.
C assess whether archaeological methods are of use to the study of the mind.
D evaluate how a scientist’s approach to investigation might benefit archaeology.
56 In Review Extract 2, the reviewer contrasts human history with that of dinosaurs and glaciers to make the point that humans

A are more difficult to understand than other natural phenomena.
B cannot prevent themselves from trying to deceive historians.
C leave behind a greater number of different types of evidence to analyse.
D can intentionally shape what ends up being source material for historians.

57 Which review extract or extracts find fault with how Diamond draws inferences about prehistoric humans?

A Neither review extract
B Both review extracts
C Review Extract 1 only
D Review Extract 2 only

58 Which review extract or extracts assert that Diamond has failed to look critically at his sources of information?

A Neither review extract
B Both review extracts
C Review Extract 1 only
D Review Extract 2 only
Task 2

Look at the four texts on pages 4 and 5. For questions 59 – 66, choose the option (A, B, C or D) which you think best answers the question.

59  Which writer suggests that the public intellectual has been narrowly defined?

60  Which writer says certain public intellectuals should not restrict themselves to their specialism?

61  Which writer puts forward the notion of unacknowledged public intellectuals?

62  Which writer mentions the need for public intellectuals to go against the grain of public opinion?

63  Which writer argues that it is wrong to be nostalgic about public intellectuals?

64  Which writer says public intellectuals satisfy a desire for discussions that are not superficial?

65  Which writer mentions the necessity of providing credible support for one’s views?

66  Which writer says public intellectuals willingly take risks for the common good?
Task 3

Look at the text on pages 6 and 7. For questions 67 – 76, choose the option (A, B, C or D) which you think best answers the question.

67 The writer refers to black swans in paragraph 1 to make the point that

A  repeated observations are necessary for the establishment of a scientific fact.
B  unsupported beliefs may later be supported by empirical research.
C  our understanding is less secure and robust than we may suppose.
D  it is harder to prove a belief to be wrong than it is to prove it to be correct.

68 In paragraph 2, ‘concoct’ suggests that explanations for Black Swans

A  usually contain a mixture of more than one theory.
B  are somewhat fictitious or contrived.
C  may not be convincing.
D  are unlikely to survive critical examination.

69 The writer’s main point in paragraph 3 is that

A  the impact of the unpredicted has become more marked over time.
B  Black Swans are essentially a human phenomenon.
C  the world is becoming increasingly complicated as a result of technology.
D  the views of ordinary people are increasingly disregarded.
70 What point is exemplified in paragraph 4 by the series of events and movements cited?

A Events of great import are typically unpredictable.
B Inconsequential events do not shape world history.
C Informed speculation may be the best way of predicting the future.
D Predictions of the future are based on limited understanding of the present.

71 In paragraph 5 the writer suggests that

A maths is sometimes used to create a false impression of knowledge or expertise.
B it is unwise to leave your money in the hands of bankers or financial advisers.
C there are no such things as experts when it comes to making real-world decisions.
D social scientists are even worse than the average person at predicting events.

72 Which term in paragraph 6 is used to suggest a contrast to a ‘Black Swan’?

A ‘randomness’
B ‘minutiae’
C ‘significant events’
D ‘technological changes’

73 In paragraphs 7 and 8, the writer’s main point is that

A one way to prepare yourself for an enemy’s action is to disguise your own ignorance.
B we sometimes fail to recognise threats that are obvious.
C attempts to avert one disaster may increase the likelihood of another one happening.
D our expectations of what is likely to happen can shape what actually happens.
According to the writer, what characterises the ‘secret recipe’ for a successful business venture?

A. It involves a feature that is unique to that project.
B. Very few people believe that it will be effective.
C. It is based on thorough knowledge of the market.
D. Some of its elements are unachievable by rivals.

What does the author mean by ‘trivialities’ in paragraph 9?

A. theories that do not challenge people’s prior assumptions
B. theories that fail to have any real impact on people’s lives
C. theories that do not have huge commercial potential
D. theories that do not end up increasing people’s knowledge of the world

Throughout the text, the author invites us to reflect on

A. what it means to be a human being.
B. a series of paradoxes concerning our knowledge.
C. the real significance of major historical events.
D. a collection of purely abstract problems.
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