BioMedical Admissions Test   4500/11

Wednesday 6th November 2013   One hour

SECTION 1   Aptitude and Skills

Instructions to Candidates

Please read this page carefully, but do not open the question paper until you are told that you may do so.

A separate answer sheet is provided for this section. Please check you have one.
You also require a soft pencil and an eraser.

Please complete the answer sheet with your:

- BMAT candidate number
- centre number
- date of birth
- name

Speed as well as accuracy is important in this section. ***Work quickly, or you may not finish the paper.*** There are no penalties for incorrect responses, only points for correct answers, so you should attempt all 35 questions. All questions are worth one mark.

Answer on the sheet provided. Most questions ask you to show your choice between options by shading a circle. If questions ask you to write in words or numbers, be sure to write clearly in the spaces provided. If you make a mistake, erase thoroughly and try again.

Any rough work should be done on this question paper.

Calculators are NOT permitted.

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

This paper consists of 23 printed pages and 1 blank page.

1 The INCO company switchboard is covered by three operators, exactly two being on duty on any day. Bob works on the switchboard for a maximum of three days a week. None of the operators work for four consecutive days in a week.

The manager is preparing a new rota and, due to other constraints, has filled it in as far as shown below:

	Monday	Tuesday	Wednesday	Thursday	Friday
Amy					
Bob		✓			✓
Carla	x				

Which days will Carla work?

A Tuesday, Wednesday, Thursday

B Tuesday, Wednesday, Friday

C Tuesday, Thursday, Friday

D Wednesday, Thursday, Friday

E Tuesday, Wednesday, Thursday, Friday

2 Cosmologists have suggested new criteria for the boundaries of the 'habitable zone' – i.e. the region around a star, such as the Sun, in which liquid water can theoretically exist. This zone is also called the Goldilocks zone, because temperatures are 'just right' for life there. The new criteria make many planets look too hot for liquid water. One example is Kepler-22b, which was once deemed the most habitable world outside our solar system. Surprisingly Earth, which by the old criteria used to be in the middle of our sun's habitable zone, is now much closer to the warm edge, so that it seems to be almost too hot for liquid water. Of course, we know that Earth is robustly life-friendly. The mismatch is probably because neither set of criteria accounts for clouds, which reflect sunlight away from Earth.

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

A It is not possible for life to exist on Kepler-22b.

B Many more planets are habitable than cosmologists previously thought.

C The criteria cannot give an accurate judgement as to whether a planet is habitable.

D If Kepler-22b had clouds, it would be possible for life to exist there.

3 My four grandchildren are called Ben, Maria, Adam and Tara. Their birthdays are on the 128th, 182nd, 218th and 281st days of the year respectively (except in leap years).

Which two of my grandchildren have their birthdays on the same day of the week as each other every year?

A Adam and Ben

B Adam and Maria

C Adam and Tara

D Ben and Maria

E Ben and Tara

F Maria and Tara

4 It seems that, no matter how obvious the connection between eating too much and gaining weight, we are all looking for a simple way to cheat our biology and eat more than we need. Although there is a great deal that we do not understand about the individual differences in calorie burn and fat storage in the body, we do know that our bodies burn calories in relation to our level of physical activity. Effectively, our bodies are like vehicles: if we are using fuel quickly we need to put more in, but if we hardly use any fuel up it is a mistake to keep adding more. Therefore, the secret to losing weight is painfully simple – do more and/or eat less.

Which one of the following is the best expression of the main conclusion in the above argument?

A Our bodies are like vehicles.

B We do not understand everything about the way in which calories are used by the body.

C Greater levels of activity and lower calorie consumption are the keys to weight loss.

D People burn calories at different rates.

E Physical activity is the only way in which we can burn up calories.

5 Jason had 240 Spruggles that he wanted to sell, so he rented a market stall for two days.

He set the price at £12 each, and was disappointed when he sold less than a quarter of them on the first day.

He decided that he would reduce the price by 25% for the second day.

On the second day he sold exactly twice as many, and took £342 more than the previous day, leaving him with less than one third of his original stock.

How many Spruggles did Jason sell altogether during the two days?

A 162

B 165

C 168

D 171

E 174

F 177

6 Though it has now been contested, it is still believed by many archaeologists that the first inhabitants of the Americas were a group of people from Asia who walked across from Siberia to Alaska and headed south. They were the Clovis, accomplished toolmakers and hunters who subsisted on big game killed with their characteristic flint spears. Around 13,500 years ago, near the end of the last ice age, a brief window of opportunity opened up for humans to enter North America. The sea level was lower than it is today and Siberia and Alaska were connected by a now-submerged land bridge. As the world began to warm, the huge ice sheets that blocked entry into North America began to retreat, leaving an ice-free corridor to the east of the Rockies. The Clovis walked right in before the sea rose again. The presence of distinctive stone tools throughout the US and northern Mexico supports the 'Clovis-First' theory, as does the timing of an extinction that wiped out more than 30 groups of large mammals, including mammoths, camelids and sabre-toothed cats.

Which one of the following, if true, would most seriously challenge the Clovis-First theory?

A The discovery of other tools and artefacts unlike those found in Siberia.

B Evidence that the ice age lasted longer than was previously thought.

C The discovery of a human settlement in America dating to around 12,000 BC/BCE.

D Evidence of a natural disaster that would explain the extinction of sabre-toothed cats, mammoths and many other large mammals.

E The discovery of ocean currents which could have carried boats from Asia to America.

7 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

[Turn Over

Questions 8–11 refer to the following transcript of a radio broadcast:

It's one of those pieces of research I love. Like 'chocolate makes you happy' or 'blondes have more fun'. Now it's 'childhood is less carefree than it used to be'. No, really?

Studies have shown for some time that we're not getting happier as we get richer – though I realise, if you've just lost your job, you might think a spot of dosh might come in pretty handy for cheering you up. Nevertheless, the evidence is sound. Over the last half century we've acquired twice as much money and a lot more misery. Children in particular exemplify this. Their depression and anxiety have increased alongside their material well-being. At first it seems counter-intuitive. Wealth should bring ease and security. But psychologist Daniel Kahneman, in this programme on Saturday, made the link between success and stress. Presumably the better you're going to be at your job, the more time and energy you must invest in it – which is bound to leave you less elsewhere. Which is going to affect your children.

I remember our history teacher describing a cruel experiment in an eighteenth-century French orphanage. A hundred babies were fed and kept warm and clothed. But they were not picked up or cuddled or spoken to, she told us. Every one died. I've never been able to trace the account, but I've never forgotten it.

Children need their basic physical needs met: of course they do. But after that, what they care about most is relationships. I saw this eloquently demonstrated in a family I'm intimately involved with. They suddenly found they had nowhere to live, and were scattered hundreds of miles from each other, moving from friend to friend: what was described recently as 'middle-class homeless'. The adults and older children were deeply traumatised by the experience. The one who seemed unscathed was the two-year-old. There was never a day when she wasn't with someone she loved and trusted, and that was enough. What did it matter to her whose roof was over her head or where she would be tomorrow? Today, she was hugged and kissed and tucked up in bed.

So what is important to very young children? They neither know nor care whether their parents are top earners with houses in Park Lane, or unable to afford a mortgage on the Old Kent Road. What they need, which lasts their life long, is to be loved unconditionally, preferably by two people who also love each other enough to stay together forever.

<div align="right">BBC Radio 4: 'Thought for the Day', 3 February 2009, Anne Atkins</div>
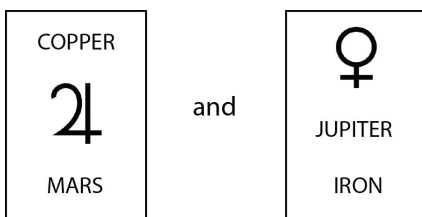
8   The first paragraph ends with the sarcastic comment: 'No, really?'
In the context of the whole article, which one of the following best expresses the point the author is making by this comment?

    A   Children are not less carefree today than they were in the past.

    B   Chocolate does not make people happy.

    C   Blondes do not necessarily have more fun than other people.

    D   It is no surprise to hear that childhood is now less carefree than it was.

9 Consider the 'evidence' that the author cites: 'Over the last half century we've acquired twice as much money and a lot more misery' (3rd sentence, paragraph 2). Assuming this is correct, which of the following does it most reliably support?

    A   We're not necessarily getting happier as we get richer.

    B   Wealth should bring ease and security.

    C   Children in particular show that material well-being increases depression and anxiety.

    D   Less wealth would make children's lives happier.

10 Also in paragraph 2: which (if either) of the following is an assumption required by the argument attributed to the psychologist Daniel Kahneman?

    1. People who work shorter hours will give more time to their children.
    2. Failing to achieve wealth and success does not cause stress.

    A   1 only

    B   2 only

    C   Both 1 and 2

    D   Neither 1 nor 2

11 'What (children) care about most is relationships' (paragraph 4).
Which one of the following best describes the evidence that is offered in the remainder of paragraph 4 for the above conclusion?

    A   conclusive

    B   anecdotal

    C   statistical

    D   irrelevant
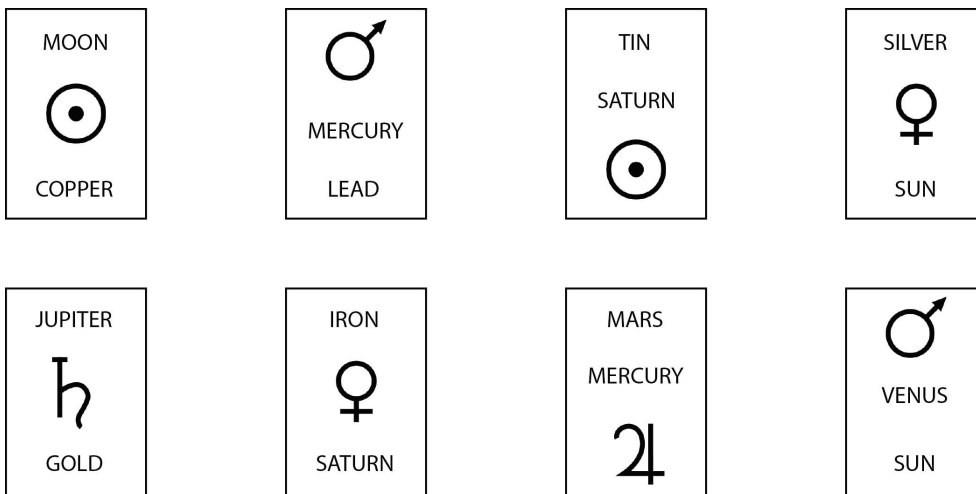
    E   hearsay

12 Historically, alchemists associated seven particular metals with the seven bodies of the solar system that are visible to the naked eye. They used the corresponding astrological symbols for these metals. Thus:

⊙ is the symbol for the Sun and for Gold. ♃ is the symbol for Jupiter and for Tin.

☽ is the symbol for the Moon and for Silver. ♄ is the symbol for Saturn and for Lead.

♀ is the symbol for Venus and for Copper. ☿ is the symbol for both Mercurys.

♂ is the symbol for Mars and for Iron.

The card game Alchemy involves identifying pairs of cards that are equivalent to each other. There are 36 pairs in the pack of 72 cards. Each card contains the name of a metal, the name of a heavenly body and a symbol. A pair consists of two cards that have the same three equivalent items in the same order, e.g.:

COPPER		♀
♃	and	JUPITER
MARS		IRON

These eight cards have just been laid out in front of the players.

MOON	♂	TIN	SILVER
⊙	MERCURY	SATURN	♀
COPPER	LEAD	⊙	SUN

JUPITER	IRON	MARS	♂
♄	♀	MERCURY	VENUS
GOLD	SATURN	♃	SUN

How many pairs are there in these eight cards?

A 0

B 1

C 2

D 3

E 4

9

13 There has been a great deal of research into the use of placebos and, whilst it remains unclear why they work, the research clearly shows that placebos can have a powerful effect. Placebos present in some cases an ideal therapy; they are cheap and have few or no side effects. Those who argue that the prescription of a placebo represents a breach of patient-doctor trust should recognise that whilst placebos may not contain any active ingredients, a doctor may prescribe one in the genuine hope that this will offer their patient a real therapeutic benefit. In the interests of providing the most desirable outcomes, it is clear that placebos should be used as a treatment offered by the NHS.

Which one of the following principles can be best used to support the above argument?

A Doctors should use only treatments that they know will work.

B Doctors should not use treatments that cause harm to their patients.

C Doctors should not mislead their patients.

D Doctors should offer treatments on the basis of the outcome for the patient.

E Doctors should use only treatments that are proven.

14 The four digits of the PIN for my credit card are all different. When the digits are written as words they are in alphabetical order and the total number of letters is the same as the numerical sum of the digits themselves.

The first digit of my PIN is four and the last digit is zero.

What is the total number of letters that make up the other two digits?

A 6

B 7

C 8

D 9

E 10

F 11

15 Risk of death contradicts the very concept of sport, since sport is generally considered to belong to the less serious side of life. Sport is what people do to counter the stress and pressure of work, not to increase them. The growth in the popularity of so-called extreme sports, where there is a real risk of death, is therefore puzzling; particularly since the modifications in equipment which are designed to make the sports safer do not lead to fewer accidents but to ever higher performance levels and greater exposure to danger.

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

A Improved performance in extreme sports does not lessen the risk of death.

B Most people want to escape from the modern obsession with safety at work.

C By claiming to enhance safety, sports-equipment designers merely encourage risk-taking.

D The popularity of extreme sports means that sport is sometimes a serious matter.

16 I have three children. The eldest is Jenny, the middle one is Alice and the youngest is Michael.

They were all born on the 17th of the month, and their names all begin with the first letter of the month in which they were born.

Within the same calendar year:

- Jenny's and Alice's birthdays are 2 months apart.
- Alice's and Michael's birthdays are 5 months apart.

How far apart are Jenny's and Michael's birthdays?

A 1 month

B 2 months

C 3 months

D 4 months

E 5 months

F 6 months

G 7 months

17 Lack of sleep is known to adversely affect our attention, alertness, concentration, judgement and problem-solving abilities. Every human faculty deteriorates with age, and the ability to sleep well is no exception. Old people have more difficulty falling asleep, and thus on average have less sleep than young people. This must account for the impairment in memory which often occurs with ageing.

Which of the following identify/identifies a weakness in the above argument?

    1. Impairment in memory may cause worry which leads to lack of sleep.

    2. Individuals may vary in the extent to which they experience memory loss and lack of sleep.

    3. Changes in the brain due to ageing may cause deterioration in memory and sleep patterns.

A   1 only

B   2 only

C   3 only

D   1 and 3

E   2 and 3

F   1, 2 and 3

18 I have a digital clock that displays the date as well as the time. Just after 4 p.m. on 25th April I happened to glance at the clock and saw:
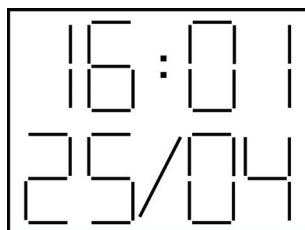
It struck me that the four numbers on the clock were all different square numbers. When I thought about it, I realised that this would occur another three times within the next hour, then not again until September.

How many times will my clock display four different non-zero square numbers during September?

A   32

B   36

C   40

D   44

E   48

Questions 19–22 refer to the following information:

The four colour theorem states that any map in the plane can be coloured using at most four colours such that no edge has the same colour on both sides. The map of an island below shows the simplest configuration which needs four colours: red (R); green (G); yellow (Y) and blue (B):
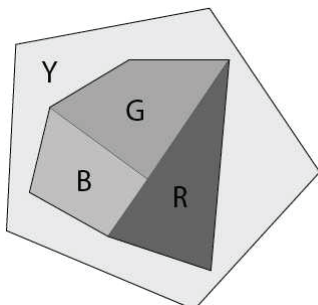

In order to analyse more complicated maps, it is often convenient to represent them as graphs, where points represent regions and lines joining the points represent edges. The map above becomes:
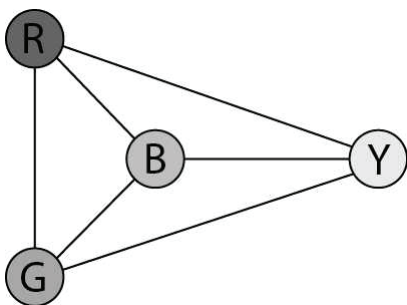
In this case all points are joined to each other as all regions touch. In more complicated maps there will be more points (areas) with each colour.

19 The following map of an island is only partially coloured. What is the most that can be said about region X?
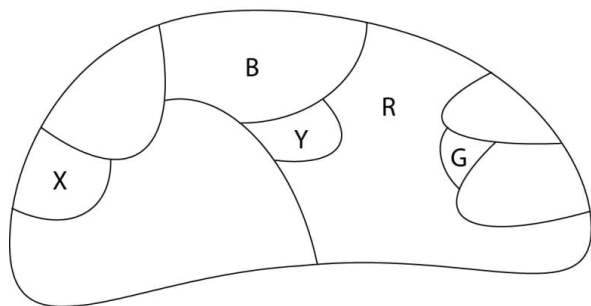

    A   It could be any of blue, red, yellow or green.

    B   It could only be yellow, blue or red.

    C   It could only be yellow or blue.

    D   It could only be red or blue

    E   It could only be red or yellow.

20 A chessboard can be coloured with two colours. If a circle is placed somewhere on the chess board, how many possible extra colours might be needed, depending on its size and position?

    A   No extra colours would be needed, whatever the size or position.

    B   One extra colour would always be needed.

    C   Either none or one extra colour might be needed.

    D   Two extra colours would always be needed.

    E   None, one or two extra colours might be needed.

21 An island is divided into regions using only straight lines; for example, the island shown below is divided using two lines:
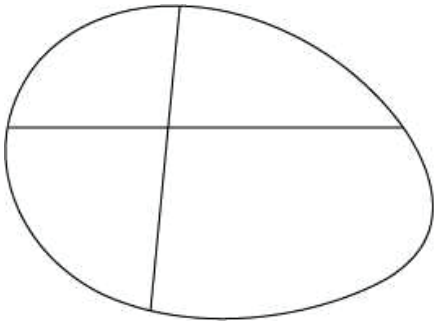
If an island is divided using three straight lines in all ways possible and each map is coloured using the minimum number of colours necessary, how many different combinations of colours will be needed?

A Two colours will always be sufficient.

B Either two or three colours will be needed.

C Three colours will always be needed.

D Two, three or four colours might be needed.

E Either three or four colours will be needed.

22 The net shown below folds to make a pentagonal dipyramid (two pentagonal pyramids stuck together by their pentagonal face).
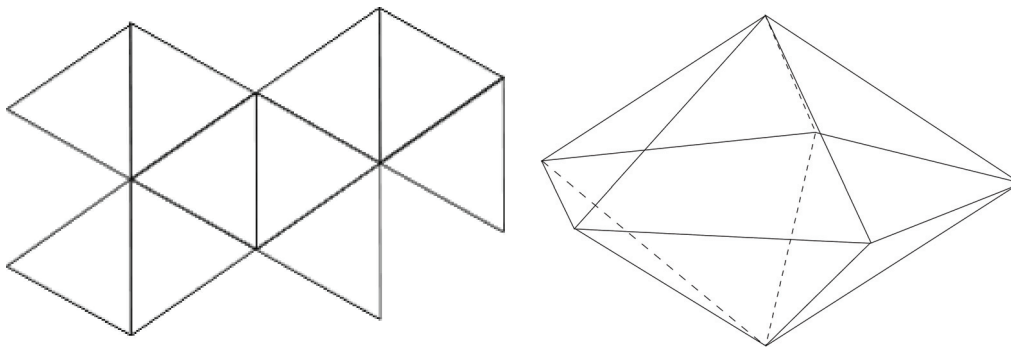
What is the minimum number of different colours required so that no two adjacent faces of the pentagonal dipyramid are the same colour?

A 2

B 3

C 4

D 5

23 The floor of a room in my house is covered with 121 tiles to form an 11 by 11 square.
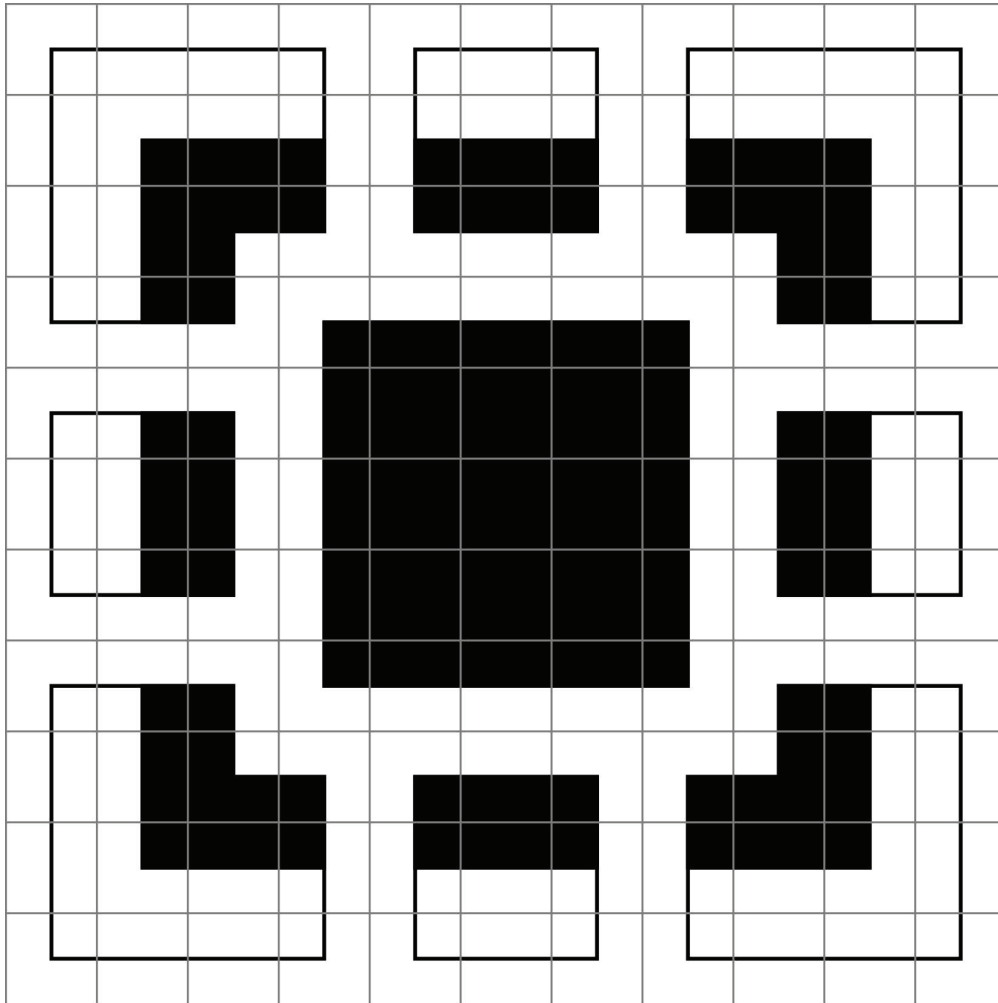
How many different types of individual tile are there on this floor?

A 5

B 6

C 7

D 8

E 9

24 Alcohol is relatively cheap, widely available and addictive. It is now the world's third biggest cause of illness and premature death, behind smoking and high blood pressure. According to the World Health Organization (WHO)'s figures, harmful drinking kills 2.5 million people annually, about twice as many as die in road accidents. To reduce the harm caused by alcohol, it is vital to reduce consumption, which is roughly the same worldwide as it was twenty years ago. Governments should follow the WHO's advice on how to treat humanity's collective drink problem, i.e. make alcohol more expensive with a minimum price per unit, and make it less appealing by banning advertising. The alcohol industry, of course, suggests a different approach – encouraging 'responsible drinking', targeting problem drinkers and persuading alcohol companies not to aim their advertising at children.

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

A In the UK the heaviest drinking 10% of the population consumes 45% of the alcohol sold.

B In Scotland consumption of alcohol has doubled over the past five decades as prices have fallen.

C A minimum price per unit of alcohol would penalise less wealthy people who do not drink heavily.

D Some alcohol producers invest heavily in advertising.

25 My neighbour has two 24-hour digital clocks in her living room. One of them is always 25 minutes fast and the other is always 16 minutes slow. Why she keeps them like this I don't know, but it does mean that once every day, for two successive minutes, the eight digits displayed on the two clocks are all different.

What is the only digit that does **not** appear on either clock during the two successive minutes when all eight digits are different?

A 3

B 4

C 5

D 6

E 7

F 8

26 An octahedral die numbered 1 to 8 is shown below. Opposite faces add up to 9.
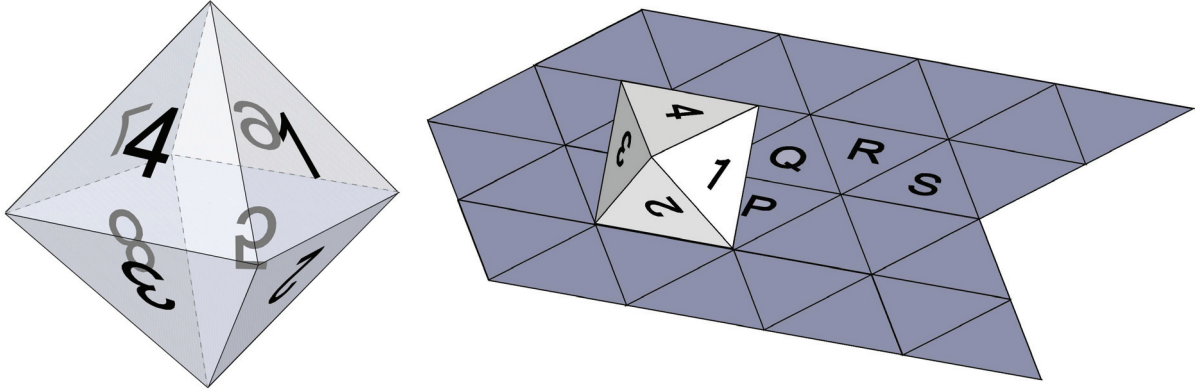
It is being rolled on a plane surface covered with equilateral triangles so it rolls over an edge each time, a face of the octahedron exactly covering one of the triangles. As it rolls, its bottom face covers triangles P, Q, R and S in that order, as shown.

Which face of the octahedron is in contact with triangle S?

A 1

B 2

C 4

D 5

E 8

27 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.

[Turn Over

28 In an effort to make children understand where their food comes from many schools are now keeping chickens and other livestock on school grounds. Whilst this does help children to learn about the realities of the origins of their dinner, this is an unwise policy from which schools should refrain. It seems that many children and their parents are unprepared for the harsh, yet obvious reality that this will eventually mean the slaughter of these animals. There have been parental complaints in some cases and reports that some children have opted to become vegetarian when faced so cruelly with this outcome. Whilst some point to the apparent hypocrisy of eating meat yet not wanting to see where it comes from, it seems that many children are simply not ready to face this reality at such a young age without damaging consequences.

Which one of the following is a principle that could give support to the above argument?

A Schools should educate their students about the realities of life, however unpleasant.

B Parents and schools should educate children about matters of life and death.

C Realities, however harsh, should be acknowledged.
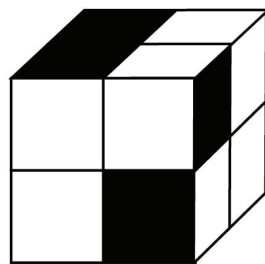
D Children should be protected from harm.

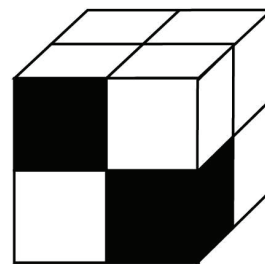**29** The net shown below can be folded to make a cube.
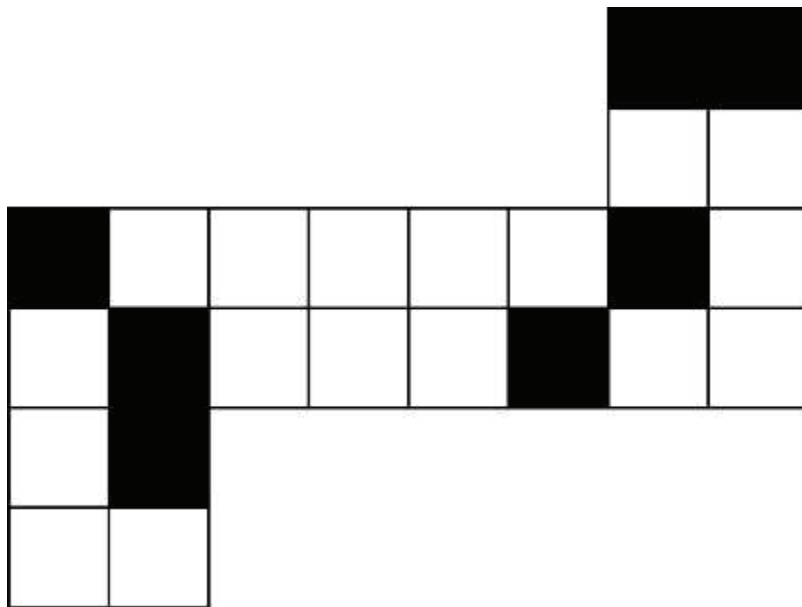
Which of the following are possible views of the cube that can be made from the net above?
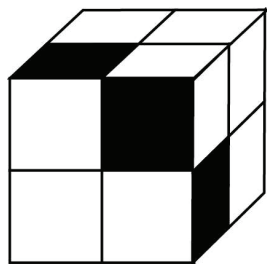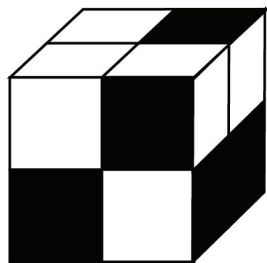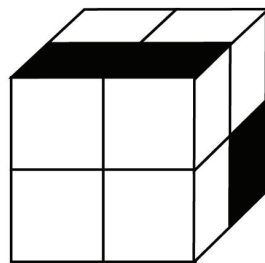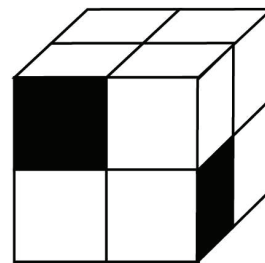

A 1, 2, 3, 4

B 1, 3, 4, 5, 6

C 1, 4, 5, 6

D 2, 3, 4, 5

E 2, 4, 5, 6

F 2, 3, 4, 5, 6

30 When our hands are soaked in water the skin on them becomes wrinkled. These wrinkles form a pattern of channels (similar to rain treads on tyres) that direct water away from the fingertip. Research shows that this characteristic must have evolved because it gave human beings a better grip underwater. The researchers timed people as they transferred wet or dry objects from one box to another, either with or without wrinkled fingers. Wet objects were transferred faster with wrinkled fingers than without, but the time it took to transfer dry objects was the same as without wrinkles. This suggests that wrinkled fingers are advantageous to us in that they help us to grip wet objects.

Which of the following is an assumption/are assumptions underlying the above argument?

1. It is advantageous for humans to be able to grip objects underwater.

2. Some human characteristics are not advantageous to us.

3. Advantageous characteristics must have evolved because they were advantageous.

A   1 only

B   2 only

C   3 only

D   1 and 3

E   2 and 3

F   1, 2 and 3

31 A group of ten teenagers attending a party 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:
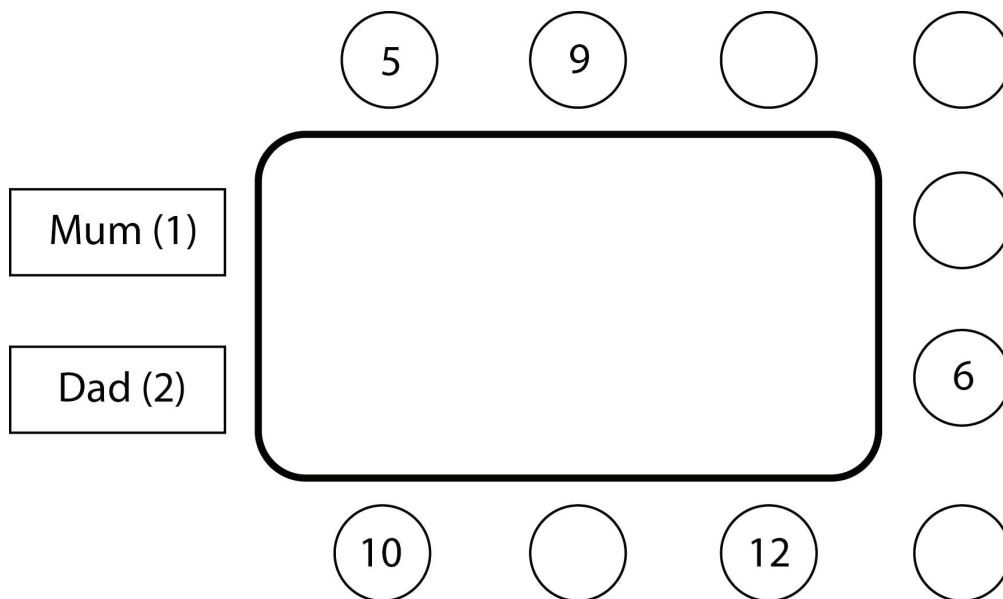
The remaining guests must sit in places such that the sum of any four place numbers that fall in a straight row makes 29.

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

A 3

B 4

C 7

D 8

E 11

Questions 32–35 refer to the following information based on a press release issued 27th July 2007:

Cannabis increases risk of psychotic illness later in life

Evidence that using cannabis could increase the risk of developing a psychotic illness such as schizophrenia subsequently is revealed in a study published in *The Lancet*.

Cannabis, or marijuana, is the most commonly used illegal substance in most countries. About 20% of young people now report using cannabis at least once per week.

The study analysed 35 studies dated up to 2006. They assessed the strength of evidence for a causal relationship between cannabis use and the subsequent occurrence of psychotic or other mental health disorders.

The study found that individuals who used cannabis were 41% more likely to have any psychosis than those who had never used the drug. The risk increased relative to dose, with the most frequent cannabis users more than twice as likely to have a psychotic outcome.

Professor Glyn Lewis from the University of Bristol, and senior author on the paper, said: 'It is difficult to be certain about whether cannabis use causes psychotic illnesses such as schizophrenia. However, all the studies have found an association and it seems appropriate to warn members of the public about the possible risk.'

The authors estimate that, if cannabis had a causal relationship with psychosis, about 14% of psychotic illnesses in young adults in the UK could be prevented if cannabis were not consumed.

32   In 10,000 typical young people, if 1% of non-cannabis users develop psychosis, how many cannabis users would be expected to develop psychosis?

    A   20

    B   28

    C   41

    D   112

    E   141

33 The report states:

'About 20% of young people now report using cannabis'

'... individuals who used cannabis were 41% more likely to have any psychosis'

Given these two figures, and assuming that the incidence of psychosis for reasons other than cannabis use is the same in both users and non-users, what is the percentage of all those with psychosis who have it due to cannabis use? (answer to the nearest 1%).

    A   8%

    B   10%

    C   29%

    D   40%

    E   41%

34 Which one of the following, if true, would provide a plausible alternative reason for the link between cannabis use and psychotic illness?

    A   Cannabis is used more by people between the ages of 18 and 25. The first signs of psychotic illness tend to appear when people are in their 20s.

    B   Those people who have a tendency to develop a psychotic illness often turn to drugs to ease their mental problems.

    C   Since the report indicates that some people who have never used cannabis still develop psychotic illnesses, the observed link must be due to random influences on the data.

    D   As the use of cannabis is illegal, some people being treated for psychotic illness often deny having used cannabis.

35 Which one of the following, if true, would most strengthen the conclusion that there is a causal link between cannabis use and psychotic illness?

    A   Among older people the incidence of psychotic illness also increases with cannabis use.

    B   Psychosis has also been associated with the use of Ecstasy, which is also used by young people.

    C   A recent increase in the use of stronger types of cannabis has coincided with an increase in psychosis among users.

    D   People tend to start using cannabis at 15–18 years old. First signs of psychosis appear when patients are 18–22 years old.

    E   When referred for medical help, patients tend to deny both cannabis use and symptoms of psychosis.

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