

# **BioMedical Admissions Test**

4500/11

Wednesday 2<sup>nd</sup> November 2011

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 27 printed pages and 5 blank pages.

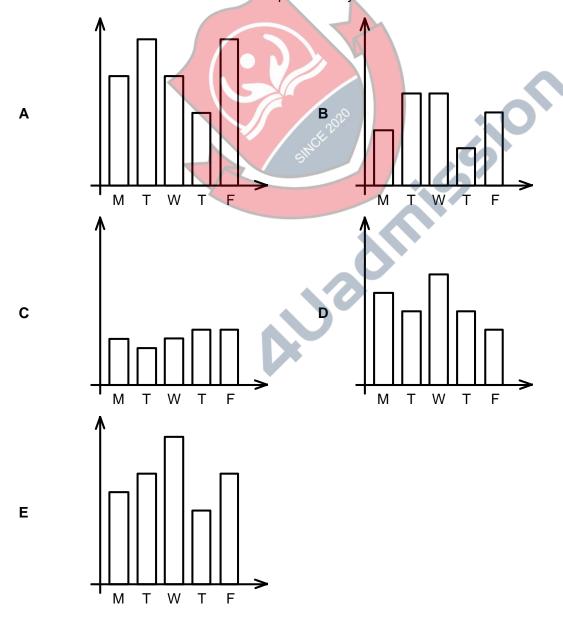


1 The weather forecast for a five day period is summarised in the table below:

	Monday	Tuesday	Wednesday	Thursday	Friday
Maximum temperature (°C)	5	6	8	4	6
Average wind speed (mph)	25	20	25	30	30
Chance of rain (%)	30	50	50	20	40
Cloud cover (%)	60	80	60	40	80

For each of the rows of the table one of the bar charts  ${\bf A}$  to  ${\bf E}$  could represent the data if it were suitably labelled.

Which one of the bar charts does **not** represent any of the rows in the table?



The seas around the UK have become so noisy that whales are having to sing louder to make themselves heard above the din created by ships, wind farms and oil exploration. With whale numbers severely depleted, the ability to communicate over long distances could be key to their finding a mate. According to a study by marine biologists, around the coast of the UK whale song is now ten times louder than it was fifty years ago, and also higher pitched. Whales are trying to adapt to increased man made noise either by emitting much louder noises or by calling at higher frequencies. Their messages are getting simpler and repeated more often, like a person being forced to shout.

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

- A The noise of modern human life will eventually cause whales to become extinct.
- **B** Sea-based wind farms should not be built because of the danger to whales.
- C Whales will be able to adapt their communication methods to overcome the problem of human noise.
- **D** The depletion of whale numbers is caused by the growth of human noise.
- E None of the above.



I want to stay for six nights in a deluxe room, but I don't want my meals included in the price that I pay. I also want to hire a car for the duration of the stay.

What will be the total cost of my stay?

- **A** \$365
- **B** \$390
- **C** \$425
- **D** \$435
- **E** \$480

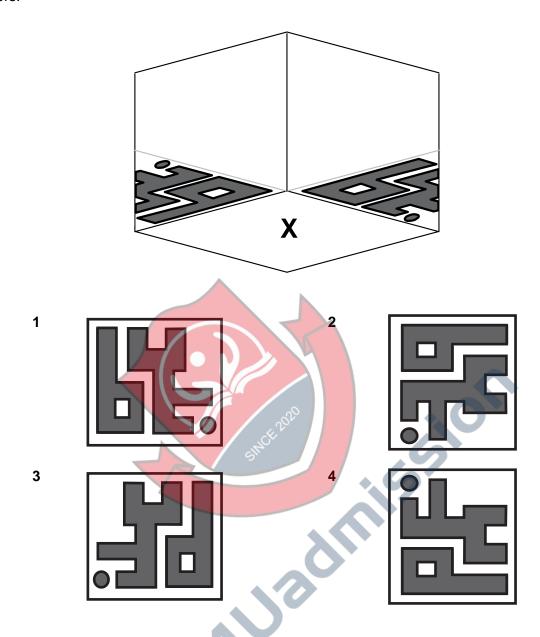
When children are young they often play games. These games are useful as they teach children how to interact with each other. In recent years the growth of computer games has meant that now many children play most of their games on computers and across the internet. Thus the way in which children interact with each other has changed. When these children grow up they will need to work in jobs that require interaction with co-workers. The increased popularity of computer games is therefore going to mean that they are less likely to be able to function socially within their workplace.

Which one of the following is a flaw in the above argument?

- A It ignores the benefits that are brought by the internet, such as easy access to more information.
- B It does not consider that games on a computer can teach many other skills as it is possible for their rules to be more complex.
- **C** It does not consider the fact that adults also play computer games.
- **D** It is restricted to just one negative aspect of computer games.

E It does not establish that children who play computer games no longer interact with each other.

5 The diagram below shows two perpendicular mirrors with a reflected tile on the faces of both mirrors.



The tiles shown above have a pattern printed on one side. Which two of the tiles if placed in position 'X' would be consistent with the image reflected in the mirrors? (Tiles can be rotated.)

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

Becoming a London taxi driver isn't as easy as you may think. Unlike other London folk who choose to take the tube or bus, taxi drivers have to spend hours learning the city's road network for a face-to-face exam at the Public Carriage Office to get a licence to start their careers. Recent brain scans on a group of taxi drivers revealed that areas of their brains associated with memory were more developed than would be normal for the general population. So all that learning not only makes them money, but also increases their memory power.

Which one of the following is an assumption made in the above argument?

- A People who have a poor memory do not become taxi drivers.
- **B** Many people believe that it is easy to become a taxi driver.
- **C** Brain scans on the same group before they became taxi drivers would not have shown the same results.
- People usually become taxi drivers in order to make money rather than to improve their memory.
- An airline has decided to introduce a flight from London, England to St. John's, Antigua. The airline owns a range of aeroplanes as shown in the table below. It needs to decide which one would be best suited to do this flight. The distance travelled between London and St John's is a maximum of 5600 miles; variability is due to different flight paths. A weekly flight would have between 163 and 177 passengers.

Which plane (A - H) is the most fuel efficient plane per passenger per mile that would be suitable for this flight?

			Maximum	Range of	Takeoff	Fuel consumption per mile (gallons)			
	Aeroplane	Number of engines	Passenger Capacity	miles per journey	weight (lbs)	empty plane	additional per passenger		
Α	Boeing 737	2	189	6500	130,000	3.0	0.01		
В	Boeing 747	4	569	6500	875,000	5.6	0.01		
С	Boeing 757	2	239	5500	220,000	4.4	0.08		
D	Boeing 777	2	440	8270	545,000	4.8	0.01		
E	Boeing 787	2	330	3050	364,000	4.5	0.01		
F	Saab 2000	2	58	1380	50,265	2.4	0.09		
G	Airbus A-380	4	853	8000	1,400,000	9.2	0.05		
Н	Airbus A-320	2	179	6305	77,000	3.0	0.07		

# Questions 8 - 11 refer to the following information:

The difference between men's and women's pay is still at unacceptable levels, according to recent TUC research. It found that from the age of 18 - and throughout the rest of their working lives - women earn less than men.

In their 20s, the pay gap for full-timers is a modest 3.3%, but in their 30s women take home 11.2% less than men. And in their 40s - the peak age for discrimination - the gap rises to 22.8%



The TUC said the undervaluing of women in the workplace was partly due to a "motherhood penalty". The long hours and intensity of senior positions deterred mothers from seeking promotions for which they were qualified. The TUC said there was direct discrimination against mothers and their choice became limited to jobs that could be combined with looking after children.

The "motherhood penalty" became even more severe for women who switched to part-time work. They were more likely to change employer or occupation, often taking jobs with lower hourly earnings. The hourly earnings of women working part-time were 23.4% less than the equivalent male rate in their 30s, and 41.2% in their 40s.

- 8 On the basis of the above data which one of the following is a reliable conclusion to draw?
  - A On average, men's earnings peak before they reach 50.
  - B Employers are less willing to employ women over 30 than they are to employ women under 30.
  - The percentage difference between men's and women's pay more than trebles between the ages of 22 and 30.
  - On average, a woman in her 40s or 50s earns less than £0.80 for every £1 earned by a man in that age range.

9	following i	the average pay for women in full-time work aged 40-49 was £16,000. Which of the is the best approximation of the average pay for a man in the same age-range, at that ed on the above figures?
	Α	£19,700
	В	£20,300
	С	£20,700
	D	£21,300
10	Which one paragraph	e of the following is an assumption behind the TUC's reasoning, as reported in the third n?
	Α	It is mainly men who are responsible for recruiting and promoting staff.
	В	Women are less well qualified than men for senior positions which attract higher pay.
	С	Mothers would choose to take up higher positions for which they are qualified after they have started a family.
	D	Motherhood is the only reason for the pay discrimination against women.
11	same gen	that the figures in paragraph 4 for part-time pay are correct, and that they follow the leral trend as the full-time pay gap, which one of the following is most strongly supported a provided?
		A woman over 60 working part-time will earn £8.57 for every £10 earned by a man

Α over 60 working part-time.

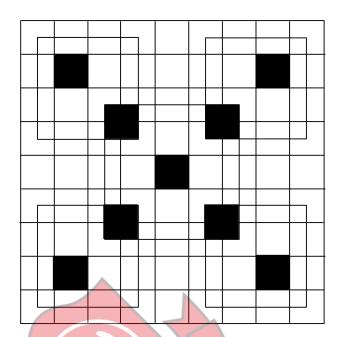
On average, a man in his 40s working part-time earns 80% more than a man working В part-time in his 30s.

A woman working part-time in her 20s will earn more than a woman working part-time С in her 30s.

If the average part-time pay for men in their 40s is £15 per hour, women of the same D age, on average, will earn £8.82 per hour.

[Turn over © UCLES 2011

12 This is the floor of a room in my house, which is tiled with 81 tiles of the same size.



How many different types of individual tile are there on this floor? (Tiles may be rotated.)

- **A** 3
- **B** 4
- **C** 5
- **D** 6
- **E** 7
- **F** 8

The ability to use language (to communicate using symbols and words to represent objects, feelings and thoughts) separates humans from all other animals on earth. By the age of 18, humans know more than 60,000 words, which is a surprising figure when you consider the monosyllabic vocabulary used by most teenagers. From the age of six months babies begin to recognise their own language. There are genetic reasons why this form of communication is unique to humans. Humans and chimps actually share 99% of their DNA, but in 2006 researchers comparing the two species found a gene, HAR1, that makes us dramatically different. It is expressed in the human cerebral cortex, a part of the brain that is particularly associated with language.

Which one of the following pieces of evidence would strengthen the hypothesis that HAR1 explains the human language ability?

- A A chimpanzee gene is found to be 98% identical to HAR1.
- A human genetic disorder (of specific language impairment) is found to be caused by a mutation in HAR1.
- C HAR1 is found to be expressed in parts of the human brain that are not related to communication.
- D HAR1 is expressed in the brain before birth.
- E Some chimps can be taught to communicate with symbols.



14 The final league table for the inter-regional cribbage competition is shown below (in alphabetical order). Five teams took part and all played each other once. The points system is 3 for a win, 1 for a draw and 0 for a loss. Unfortunately, the points for the Eastern Region team have been obliterated.

Team	Points			
Central	2			
Eastern				
Northern	8			
Southern	5			
Western	1			

How many points did the Eastern team score?

**A** 4

**B** 5

**C** 10

**D** 12

**E** 15

The UK should not comply with the ruling by the European Court of Human Rights (ECHR) that prisoners should be allowed to vote in general and local elections. European member states are bound to respect human rights, and the ECHR is the organisation that defines those rights. However, although freedom and democracy are human rights, voting is not. It is a constitutional right, because it is conferred by nations that practise democracy. It is a fundamental aspect of the relationship between individuals and the state. Obedience to the law is also an aspect of this relationship. Thus it is entirely proper that the state should be free to decide that those who are imprisoned because they have broken the law should temporarily be deprived of their right to vote.

Which of the following could be a weakness of the above argument?

- 1 It assumes that individual states should define human rights.
- 2 It assumes that a constitutional right cannot be a human right.
- 3 It assumes that prisoners want to be allowed to vote in general elections.



# Data for the world's largest 10 lakes are shown below:

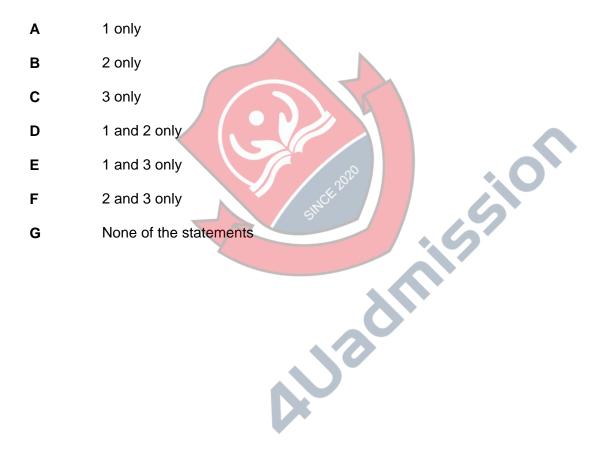
Name and Location	Area sq km	Length km	Volume cu km		
Caspian Sea, Asia	394,299	1,199	78,200		
Michigan – Huron, US – Canada	117,612	397	8,458		
Superior, US – Canada	82,414	616	12,100		
Victoria, Tanzania – Uganda	69,485	322	2,750		
Tanganyika, Tanzania – Congo	32,893	676	18,900		
Baikal, Russia	31,500	636	23,600		
Great Bear, Canada	31,080	373	2,236		
Great Slave, Canada	28,930	480	2,090		
Erie, US – Canada	25,719	388	489		
Winnipeg, Canada	23,553	425	283		



17 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.



**18** Employees at Grindstone Ltd are paid a weekly wage according to the following formula:

£240 + £5 for every year of their age above 21 (where appropriate) + £20 for every full year of service with the company.

Jasper is 43 years old and has worked for Grindstone for 6 years. Although Ruby is 8 years younger, she earns £40 per week more than Jasper.

For how much longer than Jasper has Ruby been employed by Grindstone Ltd?

A 2 years

B 4 years

C 6 years

**D** 8 years

E 10 years



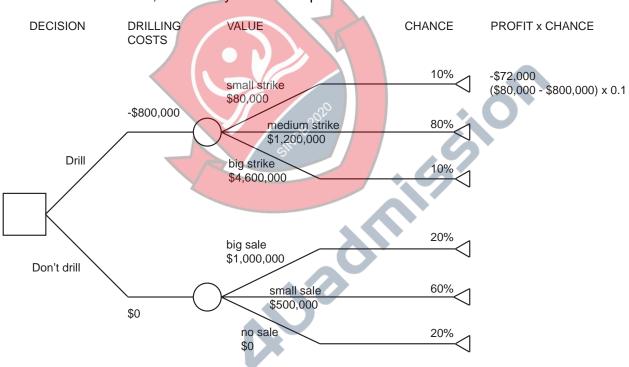
### Questions 19 - 22 refer to the following information:

Tree diagrams are used in decision making by predicting the various possible outcomes and their likelihood. The diagram below represents the choices facing an oil company - call it 'X-Oil' - who have discovered a possible oil deposit and are deciding whether or not to drill at the site. They will make the decision on purely financial terms - i.e. likely profits or losses.

The key factors are the *known* drilling costs (\$800,000) and the *unknown* returns, which depend on how big the oil strike is. A 'small' oil strike, worth only \$80,000, would mean a net *loss* of \$720,000 when drilling costs are factored in. But there is only a small chance of this, 0.1 or 10%. There is an equally small (10%) chance of a big and very profitable strike, approaching \$5 million. The most likely outcome is a medium strike.

If the company decides not to drill, there is a 20% chance of finding a buyer for the drilling rights at \$1 million, and a 60% chance of a buyer at \$500,000.

To assist the decision whether to drill or not, each of the possible outcomes is assessed by multiplying the chance (probability) of each outcome by the potential profit or loss. If the sum of the possible outcomes (profit x chance) of a decision to drill is greater than the sum of outcomes of a decision not to drill, statistically the better option is to drill.



- 19 On the basis of the data shown in the diagram, which one of the following conclusions can most reliably be drawn?
  - A Drilling represents a more favourable option than not drilling.
  - **B** Not drilling represents a more favourable option than drilling.
  - C Neither option is financially more favourable than the other.
  - **D** A decision to try and sell the drilling rights will guarantee the best profit.
  - **E** Either decision, to drill or not to drill, could make a loss.

- 20 Which one of the following can correctly be inferred from the data in the decision tree?
  - A Drilling for oil is unlikely to make X-Oil a profit unless there is a 'big' strike.
  - **B** A 'medium' strike would be a better outcome for X-Oil than a sale of drilling rights.
  - The risk for X-Oil of making a loss by drilling at the site is greater than the probability of making a profit.
  - The probability of a 'medium' strike is the same as the probability of selling the drilling rights at \$500,000 or more.
- 21 For a company (Y-Oil) that bought the drilling rights for \$500,000 and proceeded to drill for oil, which of the following statements are true?
  - Given the estimated costs, Y-Oil would not make a profit if there was only a 'medium' strike.
  - 2 Given the estimated costs, the chances of Y-Oil making a profit are less than 80%.
  - Y-Oil could make a profit from a 'medium' strike if they could reduce drilling costs by 25%.

A 1 only

B 2 only

C 3 only

**D** 1 and 3 only

E 2 and 3 only

**F** 1, 2 and 3

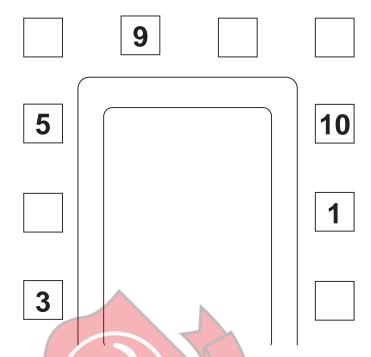
Health and Safety advisors have warned that an accidental oil-spill at the site during drilling, resulting in compensation of up to \$10,000,000, has a probability of 0.03 of occurring during a drill of the kind proposed. Insurance premiums against such an incident would cost the company \$200,000.

Using the above information and assuming the data given in the tree diagram remains the same, place the following options in the most favourable order:

#### X-Oil should:

- 1 pay the insurance and proceed with the drilling.
- **2** proceed with the drilling without insurance.
- 3 decide against drilling.





There are ten houses on Horseshoe Road, situated as shown above. They are numbered from 1 to 10, but not conventionally, and the numbers are missing on five of them. However, it is known that wherever four houses lie along a straight line, the four house numbers add up to 21.

What is the number of the house between numbers 3 and 5?

- **A** 2
- **B** 4
- **C** 6
- **D** 7
- **E** 8

Asked at a press conference whether the new signing, Petermass, would be playing in the big match on Saturday, the Manager replied: "Only if Fredericks isn't fit."

Three of the journalists present noted the announcement as follows:

Jed wrote: "If Fredericks is fit Petermass won't be playing."

Ned wrote: "If Fredericks isn't fit, Petermass will be playing."

Ted wrote: "If Petermass doesn't play it'll mean Fredericks is fit."

Which of them got the facts right?



В Ned only

C Ted only

D Jed and Ned only

Ε Jed and Ted only

F Ned and Ted only

G Jed, Ned and Ted



25 other has 2/3 oil and 1/3 vinegar. He has 180ml of each.

He wants to use them to make 2 x 180ml, each containing the same proportions, so he removes 90ml from the one with equal proportions and adds it to the other. He mixes well and takes 90ml from the new larger mix and adds it to the small one, so he once again has 2 x 180ml.

What is the result - does one vinaigrette have a higher proportion of oil than the other or are they equal?

Α One mix has 70ml oil, the other has 80ml oil.

В One mix has 90ml oil, the other has 120ml oil.

C One mix has 100ml oil, the other has 110ml oil.

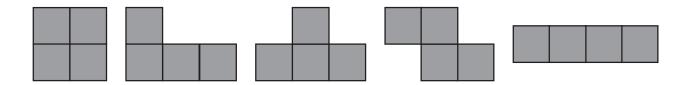
D Both mixes have 105ml oil. A rocky planet, whose mass is three times that of Earth's, could be the first ever to be found outside our solar system with the potential to support human life. Lying in the 'Goldilocks Zone' of the Milky Way, twenty light years away, the planet is said to have gravity similar to Earth and could well be capable of supporting life. The 'Goldilocks Zone' is a region in space where surface temperatures are neither too hot nor too cold for liquid water to form oceans, lakes and rivers. The fact that we were able to detect this planet so quickly and so nearby tells us that planets like this must be really common. The number of systems with potentially habitable planets is probably in the order of 10 or 20 per cent, and when you multiply that by the hundreds of billions of stars in the Milky Way, that's a large number. There could be tens of billions of these systems in our galaxy.

Which one of the following is the best statement of the conclusion of the above argument?

- A Planets with gravity similar to Earth could well be capable of supporting life.
- **B** For planets to be capable of supporting life, liquid water must be able to form oceans, lakes and rivers.

- **C** Planets with the potential to support human life are really common.
- **D** 10 or 20 per cent of systems have potentially habitable planets.
- E There are tens of billions of systems with habitable planets in our galaxy.

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



It has been celebrated recently that hydrogen fuelled buses are being introduced into London. This is because the use of hydrogen as a fuel is better for the environment as there are no emissions of carbon dioxide. The new buses carry the same number of passengers and will be travelling exactly the same routes as the ones that they are replacing. However, commercially sold hydrogen is produced from natural gas. The process to produce one tonne of hydrogen from natural gas puts, on average, eight tonnes of carbon dioxide into the atmosphere, whereas the production of fuel for the existing buses does not emit any carbon dioxide. The further costs of transporting the fuel to the bus depot also need to be considered. We should therefore not welcome the introduction of these buses.

Given that the following extra information is available:

- 1 The distance that each type of bus can travel using one tonne of fuel.
- 2 The distance that each bus needs to travel every week.
- The amount of carbon dioxide emitted when the existing buses use one tonne of fuel.
- For each type of fuel, the amount of carbon dioxide emitted in transporting one tonne of fuel to the bus depot.

Which of the pieces of information would we need to know in order to determine whether or not the argument is flawed?

**A** 1, 2 and 3 only

**B** 1, 2 and 4 only

**C** 1, 3 and 4 only

**D** 2, 3 and 4 only

**E** 1, 2, 3 and 4

29 Claire walks to work at 6km/hr and Charles cycles along the same route. Normally Charles overtakes Claire outside the public library. One day Claire leaves 20 minutes late and Charles overtakes her outside the swimming pool, 3km before she gets to the library.

At what speed does Charles cycle?

A 9km/hr

B 12km/hr

C 15km/hr

**D** 18km/hr

E 24km/hr

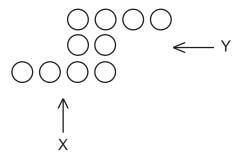
A neutrino is an elementary particle that is able to pass through ordinary matter, but is difficult to detect. Physicists have hypothesised that there is a particular type of neutrino – a sterile neutrino – that cannot be detected at all by their instruments. Relevant evidence comes from supernovae, 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.
- The sterile neutrino hypothesis is the best explanation of the phenomenon of pulsars travelling at high speed through the universe.
- If sterile neutrinos did not exist, pulsars would not be observed travelling at high speed through the universe.



An exhibition of the work of a modern artist is currently on display at an art gallery for a period of 30 days. One of the exhibits, entitled "Countdown", started off as 30 individual identical cylinders arranged in 10 stacks of 3, with the following appearance when viewed from above.

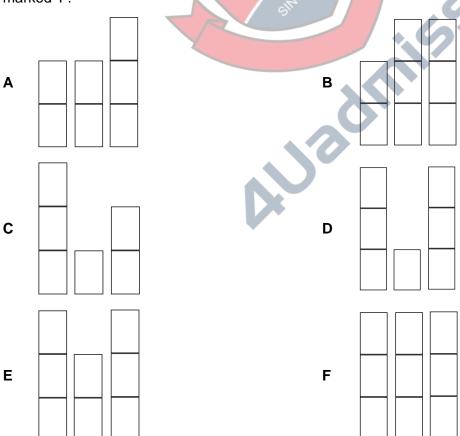


Each day since the exhibition began, one cylinder has been removed, and this will continue until there is just one left on day 30.

Today is day 11, so 20 cylinders remain. The view from above is still the same as it was on day 1, but the side view today from the direction marked X is:

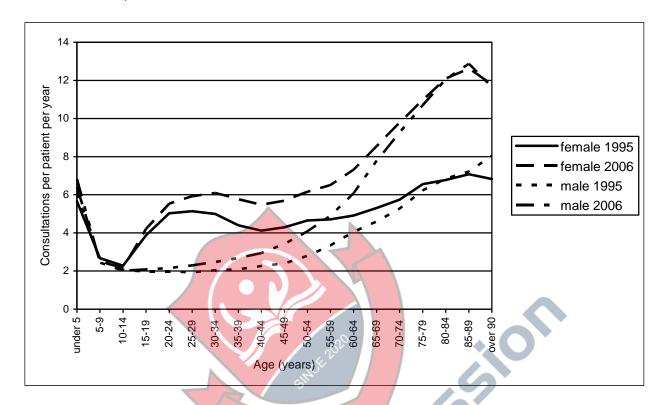


Which one of the following could not be the side view today of "Countdown" from the direction marked Y?



### Questions 32 - 35 refer to the following information:

The graph below shows the results of surveys of local medical practices on number of patient consultations in 1995 and 2006. Consultations include face-to-face meetings with both doctors and nurses, telephone consultations and home visits.



The overall mean consultation rate (per patient per year) was 3.90 in 1995 and 5.26 in 2006. Findings for all years in the survey are shown below:

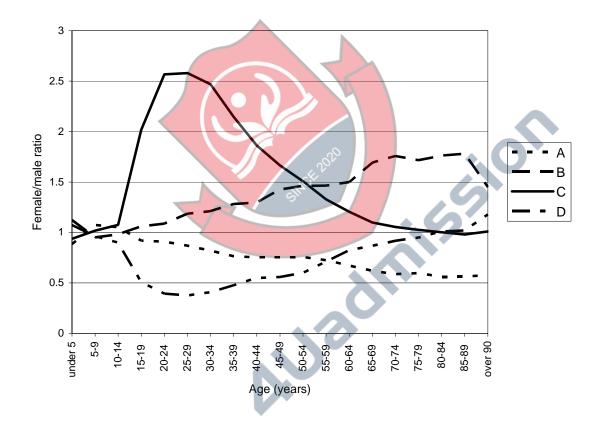
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Consultation												
rate per	3.90	4.02	4.09	4.04	4.18	4.29	4.52	4.63	4.75	5.02	5.19	5.26
person-year				<b>\</b>								

The consultation rate for doctors remained almost constant over the study period with 3.0 consultations per patient-year in 1995 and 3.3 in 2006. The consultation rate for nurses increased from 0.8 consultations per patient-year in 1995 to 1.8 in 2006. The consultation rate for other clinicians increased from 0.1 consultations per patient-year in 1995 to 0.2 in 2006.

32 If the average doctor has 1500 patients, and consultations are available on 250 days per year, approximately how many consultations per doctor (include consultations with all clinicians) per day were there on average in 2006?

Α	16
В	24
С	32
D	64

- What is the percentage increase in the proportion of patients seen by nurses from 1995 to 2006?
  - **A** 14%
  - **B** 26%
  - **C** 32%
  - **D** 67%
  - **E** 125%
- 34 Which line on the following graph best shows the female/male consultation ratio in 2006?



35 There has been a percentage increase in consultations between 1995 and 2006 for both sexes and all age groups.

Which one of the following would be **least** satisfactory as a potential explanation for this?

- A There has been an increased awareness of health issues among the general public.
- **B** People of all ages have become equally less healthy.
- **C** All the people surveyed have become 11 years older.
- **D** GPs have increased the amount of preventative medicine they do.









