THINKING SKILLS **9694/03**

Paper 3: Problem Solving and Critical Thinking (Advanced) **May/June 2009**

1 hour and 15 minutes

Additional Materials: Answer Booklet/Paper

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on the Answer Booklet in the space provided unless this has been done for you.

Write in dark blue or black pen.

Do not use staples, paper clips, highlighters, glue or correction fluid.

DO **NOT** WRITE ON ANY BARCODES.

Electronic Calculators should be used.

There are **20** questions on this paper. Answer **all** questions. Each question has two parts.

For each part of the question there are five possible answers **A**, **B**, **C**, **D** and **E**. Select the **one** answer you think is correct for that part.

Record your choice(s) in the separate Answer Booklet.

Start each question on a new line.

INFORMATION FOR CANDIDATES

Each question is worth 2 marks. Marks will not be deducted for wrong answers.

This document consists of **22** printed pages and **2** blank pages.

UNIVERSITY *of* CAMBRIDGE
International Examinations

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1 In an argument there must be a conclusion and one or more reasons given to support the conclusion.
An explanation takes a given fact and explains why it is so.

(i) From the above definition which **one** of the following is most obviously an argument?

(ii) Which **one** of the following is most obviously an explanation?

A Doctors are required to have a long period of training in understanding the workings of the human body. This is because the body is so complicated that nobody could fully understand how it works in a short period of time.

B If the government spends more money on medical training the standard of medical care will not necessarily increase. There are better ways of spending money on health care such as improving the standards of hygiene in hospitals.

C If you train to be a doctor it will take many years. Only the dedicated will be able to do this. There won't be much time or money for parties whilst training. Moreover the work once qualified can be stressful and not as well paid as some other jobs requiring less training.

D If you wish to become a doctor you will need to be prepared to study for many years. You should consider how you will finance yourself through this long period of training. You will not be earning any money during this time.

E If we want the highest standards of medical care we should make our doctors study for many years. A bad cook or a bad mechanic will not usually kill us but a there is every chance a bad doctor will.

2 Global warming, pollution, land degradation and hunger alongside obesity are the litany of disasters daily confronting our world. We need to get 'back to nature'. The fundamental cause of our crisis is a growing disconnection from our natural world. We would build a more sustainable, more inhabitable and ultimately more fulfilling world if we could only reconnect to nature. We can do this by creating more green spaces in our cities, providing natural areas for recreation, putting nature back into agriculture through organic farming that rejects the use of chemical fertilisers, and treating animals with greater respect.

(i) Which **one** of the following statements, if true, would most strengthen the above argument?

(ii) Which **one** of the following statements, if true, would most weaken the argument?

A Living off the land and rejecting technological advances will promote equality in the world.

B Most farmers in developed countries are unwilling to reject the use of chemical fertilisers and pesticides.

C The majority of the world's population, especially in developing countries, live close to nature but are still hungry, sick and miserable.

D Long term use of chemical fertilisers is destroying the productivity of the land.

E Most of the crises we face in the modern world are caused by human greed rather than by science and technology.

3 Art, music and literature can have a powerful influence on national identity. However, political leaders cannot hope to be successful if they try to use art to mould national identity to suit their purposes. This is partly because human creativity is not subject to political control. The state-controlled socialist realists in 1950s and 1960s Russia produced flat, uninspired art, music and literature. More recently, North Korea has restricted music to marches celebrating a former leader, Kim Il-Sung, written by the current leader. Furthermore, art, music and literature tend to influence national identity spontaneously, and from a position of opposition to dominant political power. Some of the best Indian literature of the 1930s, for example, opposed British colonial rule.

'The state-controlled socialist realists in 1950s and 1960s Russia produced flat, uninspired art, music and literature.'

(i) What is the function of this element in the structure of the argument?

A Assumption.

B Example.

C Intermediate conclusion.

D Main conclusion.

E Reason.

(ii) Which **one** of the following is an assumption underlying the argument?

A Art, music and literature which have a powerful influence on national identity cannot support dominant political power.

B Only inspiring, high quality art, music and literature have a powerful influence on national and political identity.

C Only spontaneous art, music and literature can have a powerful influence on national and political identity.

D Art, music and literature which influence national identity spontaneously are always more inspiring than state controlled culture.

E State control cannot have a powerful influence on national and political identity.

4 By the time the average US schoolchild leaves elementary school, he or she will have witnessed more than 8000 murders and 100 000 other acts of violence on television. If they use violent computer games these figures will be far, far higher. People generally seem to doubt that there is a connection between media consumption and aggression, yet researchers see a clear link. Analysis shows that the statistical correlation between exposure to media violence and aggression is not quite as strong as that linking smoking to an increased risk of lung cancer. It is, however, double the strength of the correlation between passive smoking and lung cancer, and more than three times as strong as the correlation between time spent doing homework and academic achievement. Like cigarette smoke, _____. It is neither a necessary nor a sufficient cause of violent behaviour. But it is probably not harmless entertainment either.

(i) Which **one** of the following phrases, inserted in the blank space, most logically completes the passage?

A screen violence is difficult to avoid

B screen violence is unpleasant to some of us

C screen violence will affect us all

D screen violence will not affect us all

E screen violence will not affect us at all

(ii) The above passage reports that there is a strong correlation between exposure to media violence and aggression.

Which **one** of the following gives a reason why this does not support a conclusion that watching violence on screen makes people more likely to behave aggressively?

A Aggression was a feature of human societies before television and computer games were invented.

B Having an innately aggressive nature may lead to the choice to watch screen violence.

C Not all of those who behave aggressively watch a great deal of screen violence.

D Not all of those who watch a great deal of screen violence behave aggressively.

E Watching screen violence may lead some people to campaign against the showing of violence on television.

5 Living opposite a school is a mixed blessing. On one hand, you get a wide area of space and probably some trees. This is better than being in the middle of a row of houses or surrounded by flats. Open space and trees are psychologically beneficial to city dwellers. The school occupants also do not play thumping music all night, come home shouting in the early hours of the morning, or light a barbecue just when you have hung your white sheets out to dry. On the other hand, the children make a huge amount of noise during break times, drop crisp packets in your garden and some of the very small ones cry a lot. This is distracting if you work at home. And their parents are worse. They block driveways, stop in the middle of the road, shout abuse at their children and are rude to residents. So the disadvantages are pretty big too.

(i) 'Living opposite a school is a mixed blessing.'

(ii) 'So the disadvantages are pretty big too.'

For each statement, decide whether it is:

A Counter argument.

B Evidence.

C Intermediate conclusion.

D Main conclusion.

E Reason.

6 The following table gives details of the extraordinary long lives attributed to successive generations from Adam.

Name	Age (in years) when the son (next in list) was born	Remainder of life after birth of son	Age at death
Adam	130	800	930
Seth	105	807	912
Enos	90	815	905
Cainan	70	840	910
Mahaleel	65	830	895
Jared	162	800	962
Enoch	65	300	365
Methuselah	187	782	969
Lamech	182	595	777
Noah	502	448	950
Shem	100	500	
Arphaxad			

It is also remarkable that there is no rounding, but that means we can work in whole years.

(i) There was a flood when Shem was 98. How many members of his paternal line were alive just before the flood, i.e. when he was 97?
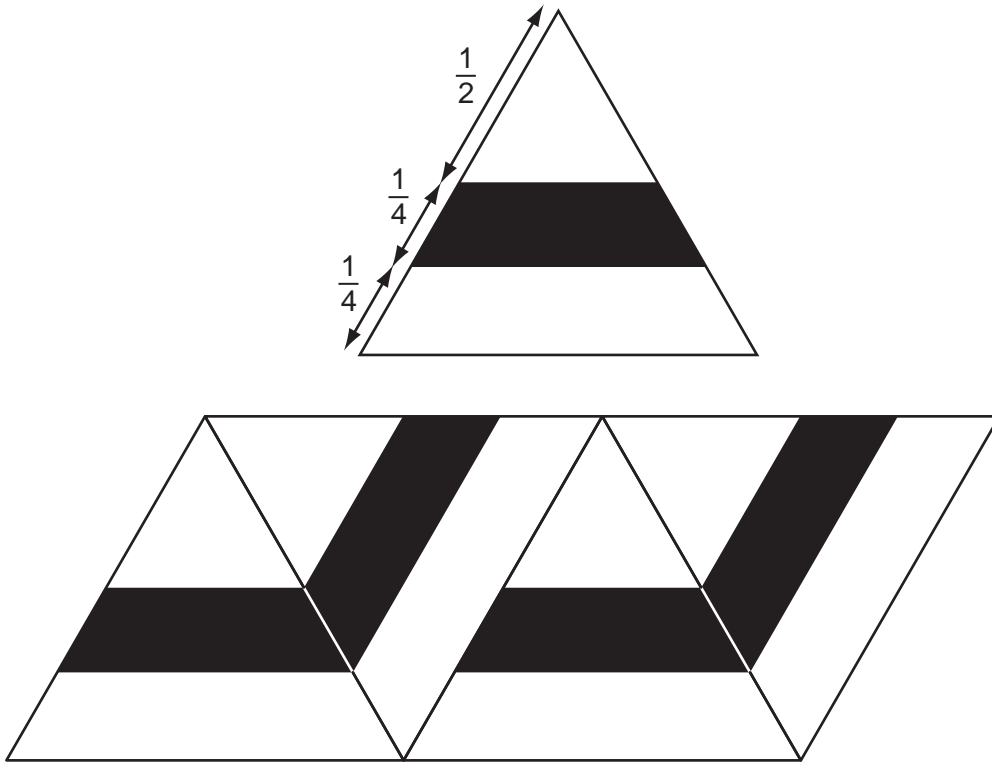
A 1

B 2

C 3

D 4

E 8

(ii) Which **one** of Noah's forefathers lived to see the most generations of his descendants?

A Adam

B Enos

C Cainan

D Mahaleel

E Methuselah

7 I have two old clocks in my house which do not keep perfect time. One loses 2 minutes in every hour and the other gains 3 minutes in every hour. One day I set them both correct at noon.

(i) What is the next time the two minute hands will both be pointing to 12?

A 6 pm the same day

B 8 am the following day

C 12 noon the following day

D 6 pm the following day

E 12 midnight two and a half days later

(ii) How long from setting the correct time will it be until both clocks again show exactly the correct time?

A 2 ½ days

B 6 days

C 15 days

D 30 days

E 60 days

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8 Four identical equilateral triangles with proportions as shown below are joined to make up a piece of cardboard as shown.
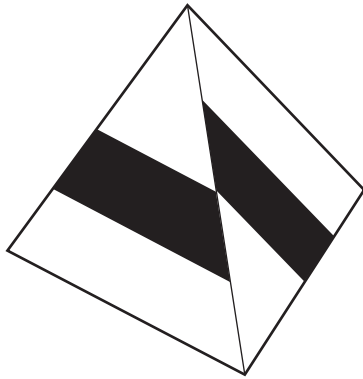

This piece of cardboard is then folded to make a tetrahedron (a pyramid with a triangular base).

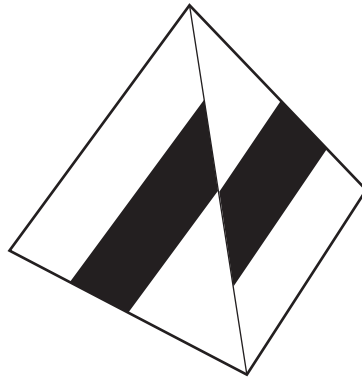(i) What proportion of the surface of the pyramid is black?

A   3/16

B   1/4

C   1/3

D   5/16

E   3/8

(ii) Which **one** of the following cannot be a view of the tetrahedron made from the piece of card as above in some orientation?

A

B

C

D

E

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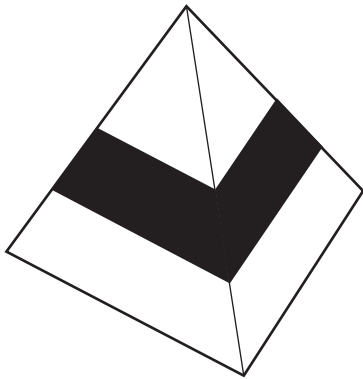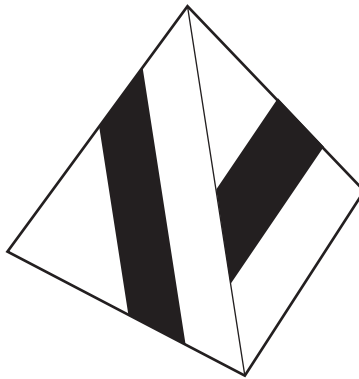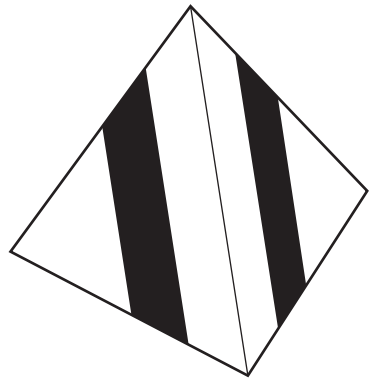**9** Foods are required to list their ingredients in non-increasing order*, but it is often not clear whether there is a substantial amount or only a tiny amount (which is rounded to 0%) of a particular ingredient.

My 'almond and sesame seed' breakfast bar shows:

Oats, glucose, vegetable oil, almonds (5%), sunflower seeds, sesame seeds (4%), buckwheat, honey.

(i) What is the **greatest** amount of vegetable oil that there could be?

A 5%

B 6%

C 29%

D 30%

E 91%

(ii) What is the **least** amount of oats that there could be?

A 0%

B 5%

C 26%

D 29%

E 30%

*The quantity of an ingredient must not be greater than that of any previous one.

10 The rows, columns and diagonals of a magic square all add up to the same total. The numbers 1 to 16 can be arranged in a variety of ways to create a 4 x 4 magic square with totals of 34.

16	3	2	13
5	10	11	8
9	6	7	12
4	15	14	1

The above magic square appears in an engraving by the artist Albrecht Dürer entitled 'Melancholy', completed in 1514.

The four corners of Dürer's magic square also add up to 34, and so do **some** of the 2 x 2 blocks of four (e.g. 2 + 13 + 11 + 8). It is possible, however, to construct a magic square in which the four corners and **all** of the 2 x 2 blocks of four add up to 34. This arrangement is known as a diabolic magic square.

This is a partially completed diabolic magic square:

		X	
		16	
14	11		
	Y	13	12

(i) What number should be placed in the square marked X?

A 1

B 2

C 3

D 4

E 5

(ii) What number should be placed in the square marked Y?

A 6

B 7

C 8

D 9

E 10

11 Over the last twenty years, there has been a steady decline in the number of pupils taking A-level in Physics. The main reason for this decline is the shortage of qualified Physics teachers. The Government's latest response to this problem is to provide conversion courses to qualify graduates in other subjects to teach Physics, but this misses the point, because in almost every case such a conversion course is either unnecessary or inadequate. Below A-level, such further training is unnecessary, because enthusiasm and inspired teaching are far more important than specialist subject knowledge. The proposed re-training is also inadequate, because teaching successfully at A-level requires subject knowledge at least up to degree level, and preferably higher, which could not be attained by a conversion course.

(i) Which **one** of the following expresses the main conclusion of the passage?

    A No conversion course could give teachers the personal qualities they need to teach successfully.

    B Teachers do not need a conversion course in Physics.

    C Teachers need personal qualities more than they need specialist subject knowledge.

    D The Government's proposal to solve the shortage of Physics teachers is misconceived.

    E The number of candidates taking A-level in Physics would rise if more qualified Physics teachers were available.

(ii) Which **one** of the following statements expresses a flaw in the above reasoning?

    A If more people take Physics at A-level, the number of graduates in the subject is also likely to increase.

    B If the A-level exam were to be made easier, more students might choose to take it.

    C Some teachers have enthusiasm and an inspirational style in addition to specialist subject knowledge.

    D The fact that personal qualities are more important than specialist subject knowledge does not mean that such knowledge is not needed.

    E The Government is right to be concerned about the reduced numbers of candidates taking Physics at A-level.

12 The World Health Organisation claims that migration of African-born doctors and nurses to developed countries damages medical care in African countries. However, this economic migration of medical professionals may be advantageous overall. Countries with a high proportion of health workers abroad also have a high number at home. This may be because strong links with developed countries might encourage more people to train as health professionals. Furthermore, not all these professionals migrate permanently; many return to their home countries to work. These people bring significant knowledge and experience home with them. Even those who do not return home are able to share knowledge with friends who have stayed in their country of birth.

What is the function of the following elements in the structure of the argument?

(i) 'migration of African-born doctors and nurses to developed countries damages medical care in African countries.'

(ii) 'this economic migration of medical professionals may be advantageous overall.'

A Conclusion.

B Counter assertion.

C Explanation.

D Intermediate conclusion.

E Reason.

13 Biofuels may be an environmental disaster rather than a green alternative to fossil fuels. Some people argue that the increasing use of land for fuel rather than food is driving food prices higher and threatening more plant and animal species. However, just because biofuels might have some negative consequences does not mean that _____. We do not stop eating all food because chocolate is ruining our teeth. Plant science can help farmers to increase the crop yield from the same area of land, protecting the natural habitat and keeping food costs down. There are also lots of different biofuels. We need to consider which biofuels can be grown with the least impact on global food and agriculture and the maximum impact on reducing use of fossil fuels.

(i) Which **one** of the following phrases, inserted into the gap, most logically completes the passage?

A biofuels are a green alternative to fossil fuels

B chocolate could power our cars

C fossil fuels are the only answer

D we should consider renewable energy sources

E we should not use biofuels at all

(ii) Which **one** of the following best expresses a problem with the analogy used in the argument?

A All biofuels grow on land that could be used to grow food or support wildlife, whereas not all food rots our teeth to the same extent as sugary chocolate.

B All food rots our teeth if we do not clean them, so the key point is how well we clean up the environmental mess we make, not whether or not to make the mess.

C There are lots of different biofuels with different effects on the planet, just as there are lots of different foods with different effects on our teeth and body.

D Using biofuels will not address the significant problem of our extravagant lifestyles, whereas not eating chocolate would address the problem of an extravagant diet.

E We often do not stop eating chocolate because it is having a harmful effect on us, so the analogy only highlights our inability to make good decisions.

14 Reference books are limited. They cannot easily be updated to include new knowledge or understanding. Furthermore the entries are chosen by a small group of people and will therefore reflect the biases and vested interests of those people. For example, a group of white, European men will be inclined to know about, and value, the achievements of other white, European men. So their work may not do justice to the achievements of other groups of people.

Wikipedia, the online, user-generated encyclopaedia, corrects these problems. Anyone can edit the entries at any time. If you think an article is lacking an important piece of information, you can add it. If you know about endangered mammals of the Seychelles, you can post an entry on Wikipedia, and you don't even need to be an academic. Because Wikipedia is democratic, it is always possible to improve it. So information that is more reliable emerges through continual revision. Wikipedia is therefore a wonderful way of spreading knowledge between people around the world.

(i) Which **one** of the following is an assumption underlying the above argument?

(ii) Which **one** of the following, if true, most weakens the above argument?

A People who edit Wikipedia think that knowledge is unchanging.

B People who edit Wikipedia have the relevant knowledge to improve entries.

C Some people edit Wikipedia because they think it is important to share knowledge.

D Some companies edit Wikipedia to remove accurate but negative claims about them.

E Some people who edit Wikipedia are white, European men.

15 Many of the world's developed countries are looking to revitalise their railway networks as an alternative to building more roads. Building new track is expensive and as potentially environmentally damaging as building new roads. This means looking for ways of transporting more passengers on the track that exists. The easiest solution is to run more trains but many countries are already reaching a situation where the existing track cannot take any more trains. One can run longer trains but this entails costly and time-consuming lengthening of platforms in most stations. Double-decker trains have also been suggested but then one has to make tunnels and bridges higher and this is a remarkably complex and expensive exercise. So rail travel is unlikely to be the major form of transport for people in the future in developed countries.

(i) Which **one** of the following is an implicit assumption the author makes in drawing the conclusion in the above argument?

A Future advances in technology will not offer further solutions to revitalising the rail network.

B No countries will have rail as their major mode of transport.

C Road and rail are the only overland ways of transporting people.

D Solutions that are effective but expensive are unlikely to be rejected.

E The demand for transport will go on increasing at its present rate.

(ii) Which **one** of the following is a statement of an intermediate conclusion in the above argument?

A Any solution to increasing rail travel lies in increasing track capacity.

B Building new track is expensive and environmentally damaging.

C Many countries are considering developing their railway systems.

D Many countries are unable to run any more trains on existing track.

E Railways are unlikely to replace roads in developed countries in the future.

16 The insurance company Coveritt has 11 offices worldwide. Its head office is in New York.

Office Location	Local time (compared to New York)
New York	0 hours
Brisbane	+ 15 hours
Dallas	- 1 hour
Johannesburg	+ 7 hours
London	+ 5 hours
Mumbai	+ 10 ½ hours
Rome	+ 6 hours
San Francisco	- 3 hours
Santiago	+ 2 hours
Singapore	+ 13 hours
Tokyo	+ 14 hours

All the offices are open Monday to Friday, from 9 am to 5 pm (local time).

(i) How many of the offices are never open at the same time as the Mumbai office?

A 3

B 4

C 5

D 6

E 7

(ii) For how long are **all** the offices closed simultaneously at the weekend?

A 46 hours

B 49 hours

C 61 hours

D 66 hours

E 70 hours

17 Waking early one morning I noticed that the digital clock on my bedside table read `05:20`, and in the mirror on the wall opposite I could also see `05:20`.

Next time I looked at the clock it read `05:50`, which I realised would show the same time if the clock were to be turned upside down.

Later that morning, I happened to look at another digital clock as it read `10:01`, which would show the same time both in the mirror or when turned upside down.

(i) Including 05:20 and 10:01, how many times during one day does the time on a 24-hour digital clock show the same time when viewed in the mirror?

(ii) Including 05:50 and 10:01, how many times during one day would the time on a 24-hour digital clock show the same time if the clock were to be turned upside down?

A   9

B   10

C   11

D   12

E   13

18 When I go for a walk with my dog, there is a field where she likes to retrieve sticks. I throw a stick 25 m in front of my current position and she runs to collect it, immediately bringing it back. I then immediately throw it again. I do this 6 times, continuously walking in a straight line at my normal pace (1.5 m/s). My dog runs at 4.5 m/s.
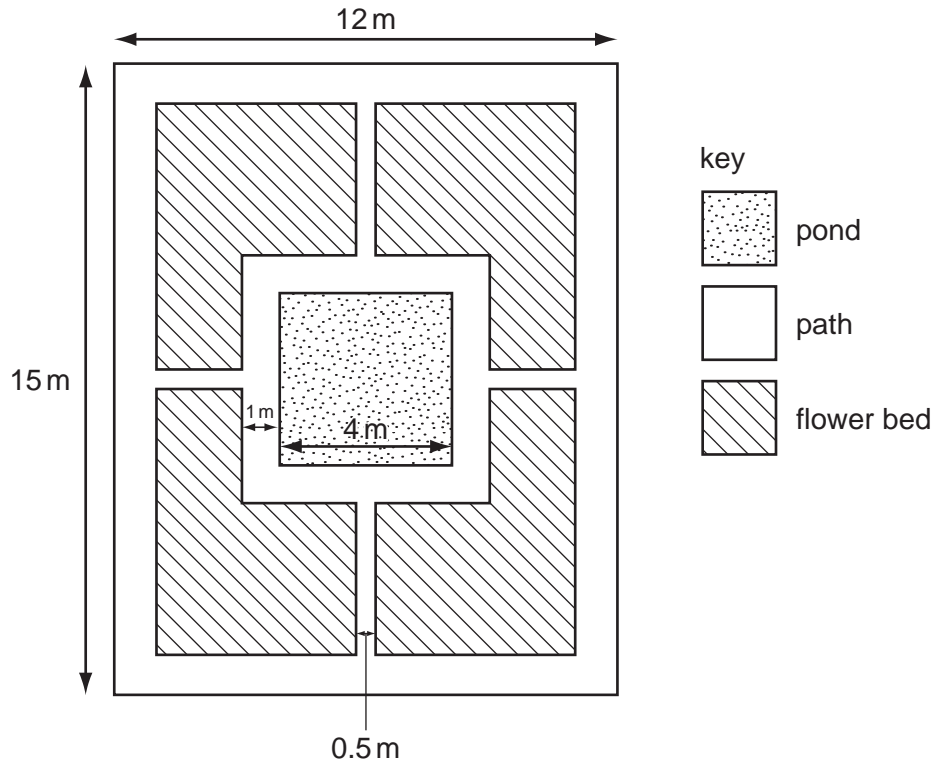
(i) How far do I walk between throwing the stick the first time and my dog returning it the sixth time?

A 50 m

B 75 m

C 100 m

D 225 m

E 450 m

(ii) What is the farthest my dog is away from me during this throwing and returning?

A 12.5 m

B 16.7 m

C 25 m

D 33.3 m

E 37.5 m

19 I have just moved into a new house. The back garden is rectangular, 15m long and 12m wide. At present it is a mess.
My intention is to dig it all up then create the following layout:

The pond will be square and measure 4m by 4m. The paths around the pond and the perimeter of the garden will both be 1m wide and the paths linking the pond and the perimeter will be 0.5m wide. The rest of the garden will be flower beds.

(i) What will be the total area of the flower beds?

A 80.5m^2

B 88.5m^2

C 98.5m^2

D 111.5m^2

E 121.5m^2

(ii) How many 0.5m by 0.5m square paving slabs will I need altogether to make the paths?

A 302

B 324

C 334

D 354

E 366

20 Forlang Inc. makes Felter Flanges on which they make $2 profit each. They know from experience that 1% of their output is faulty and cannot be used by the customer or repaired. It has been estimated that, for each faulty Felter Flange that gets to a customer, it will cost Forlang $30 in replacement costs and loss of trade. Inspecting Forlang's output to remove faulty items costs 20c for each item inspected. However, inspection is not perfect, so 1% of good flanges will be rejected and 10% of faulty flanges will pass inspection.

(i) If Forlang inspect 100% of their output, how many out of 10 000 Felter Flanges made will pass inspection?

A 9801

B 9811

C 9890

D 9900

E 9910

(ii) What are the financial implications, per 10 000 pieces made, to Forlang of 100% inspection versus no inspection? (Ignore any production costs of the faulty flanges as they would have been made anyway.)

A They will be $322 better off to inspect.

B They will be $520 better off to inspect.

C They will be $602 better off to inspect.

D They will be $2200 better off not to inspect.

E They will be $2378 better off not to inspect.

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