THINKING SKILLS **9694/31**

Paper 3: Problem Solving and Critical Thinking (Advanced) **May/June 2010**

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/Paper 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/Paper.

Start each question on a new line.

INFORMATION FOR CANDIDATES

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

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1 **(i)** Which **one** of the following is an argument?

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

A Recent research suggests there may be some biological basis to the idea that females have a preference for the colour pink. Feminists will not be pleased with these findings, as their argument is that such gender differences are cultural rather than biological.

B Recent research suggests there may be some biological basis to the idea that females have a preference for the colour pink. The researchers found that women throughout the world preferred pink, irrespective of their cultural background.

C Recent research suggests there may be some biological basis to the idea that females have a preference for the colour pink. The researchers suggest that this is a product of evolution; so colour preference may not be just a question of upbringing, as many people assume.

D Recent research suggests they may be some biological basis to the idea that females have a preference for the colour pink. The suggestion is that this preference is a product of evolution, as spotting pink would be important in finding edible fruits in prehistoric times.

E Recent research suggests there may be some biological basis to the idea that females have a preference for the colour pink. This is yet another blow to the theory that male and female differences are largely due to differences in upbringing.

2 Over a five-year period biologists and ecologists collected information about the impact of tourism on wildlife and the environment in and around a large lake. During this five-year period they recorded an increase in water sport activities on the lake. These activities included both the use of speed boats and jet skiing. Each of the five years saw an increase in these activities. During the same period temperatures in the summer months were on average one degree centigrade higher than in previous decades and on average the winter months experienced temperatures one degree centigrade lower than in previous decades. Despite these unusual weather conditions and the increased sporting activity on the lake, there was no significant change in the size or health of bird populations living on or around the lake. However, fishermen using the lake complained that increased water sport activities were polluting the lake and having a negative impact on the fish population. Recorded catches of fish on the lake, which have otherwise remained constant for many decades, dropped year by year throughout this five year period.

(i) Which **one** of the following is a conclusion which can be drawn from the above data?

A Changes in seasonal temperatures will be one factor in explaining the drop in fish catches.

B Fish are more sensitive to environmental change than birds living on or around the lake.

C Fishermen would welcome a reduction in water sport activities on the lake.

D Increase in water sport activities has had a negative impact on the fish population.

E The impact of water sport activities on the fish population has been exaggerated by the fishermen.

It is further observed that a neighbouring and otherwise identical lake, which however does not permit any water sports other than fishing, has seen a similar decrease in fish catches each year over the same five year period.

(ii) Which **one** of the following is a conclusion which can be drawn from **all** of the above data?

A The fish population is certainly declining on the second lake but not necessarily on the first lake.

B The fish population is declining in both lakes as a result of seasonal changes in temperature.

C The fish population may be declining on one or other of the two lakes.

D There is no causal connection between the seasonal changes in temperature and the size of the fish population.

E There will be many causes for the decline in the fish population on the two lakes.

3 For thousands of years mankind has been domesticating and taming animals to serve its own purposes. Animals have been specifically bred to be more docile, fitter, fatter or simply more beautiful. People have been taming animals as pets, work animals, or for entertainment in circuses for centuries. Through selective breeding these animals have lost the very traits that they need to survive and without human care some species or breeds would die out. Many argue that endangered animals bred in zoos or in captivity could be released to increase wild populations, but these animals are unlikely to survive in the wild as their survival instincts may have been lost through selective breeding over the generations. It seems, therefore, very unlikely that breeding captive animals will ever restock wild numbers.

(i) Provided it is true, which **one** of the following statements most weakens the above argument?

(ii) Provided it is true, which **one** of the following statements most strengthens the above argument?

A Animals bred or kept in captivity are likely to be better fed and less prone to some diseases than those in the wild.

B Domesticated animals are often susceptible to different diseases from those in the wild.

C Many of the endangered animals bred in zoos are descendants of circus trained animals.

D Some of the most endangered species of animals have never been successfully domesticated or tamed even when bred in captivity.

E The most successfully domesticated animals are livestock such as cows, sheep and pigs.

4 Investment in professional astronomy is vitally important if we are to continue to understand our place in the universe. New telescopes and observation equipment have greatly increased our knowledge of our solar system and beyond. The data provided from the Hubble telescope has refined and enhanced our understanding and will continue to provide us with data for scientists to interpret for many years to come. Yet frequently it is the amateurs, rather than the professional observers, who make the most valuable and exciting discoveries. Many argue that if an amateur astronomer can identify and record new discoveries, governments and universities should not spend so much money on equipment and research; but without investment in new technology these discoveries could not be investigated by the scientists who have made this their lives' work.

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

A Amateur astronomers may make exciting discoveries, but professional scientists investigate them.

B Investment in professional astronomy is necessary if we want to understand our place in the universe.

C It is wrong to argue that government spending on astronomy is unnecessary.

D Many of the most important discoveries are made by amateur rather than professional astronomers.

E The Hubble telescope is vitally important as it will provide data for scientists for many years.

(ii) What function below is performed by the following phrase in the argument above?

"Many argue that if an amateur astronomer can identify and record new discoveries, governments and universities should not spend so much money on equipment and research".

A Conclusion

B Counter-claim

C Example

D Intermediate conclusion

E Reason

5 The debate over nature versus nurture is seemingly endless. Social scientists have long debated whether our most basic tastes and preferences are innate, part of our biological inheritance, or simply culturally acquired. Do people enjoy Mozart because they are exposed to his melodies from a young age, or do his melodies appeal to us because of basic facts about the way human brains work? Well, it appears that scientists are close to answering this question once and for all. Experiments conducted with a young chimpanzee, called Sakura, have established that the chimpanzee has a clear preference for pleasant melodies over unpleasant sounds. The young chimpanzee, never before exposed to music, was played examples of tuneful sounds and discordant sounds and then allowed to select which sounds to replay by pulling on a cord. Sakura consistently, over a long experimental trial, pulled the cord which played the tuneful melodies. This shows that the preference for pleasant sounds, at least in chimps, is innate and not culturally acquired. It can reasonably be believed that what is true of Sakura is true also of us. For Sakura is in biological terms our closest animal relative. Chimps share 96% of human DNA, have brains which are similar to human brains and their social behaviour resembles in many respects human behaviour. So _____ that our basic tastes in music are innate.

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

A It is certain

B It is highly likely

C It is implausible to conclude

D It is improbable

E It is possible

(ii) The claim, "what is true of Sakura is true also of us", functions within the argument as

A Assumption

B Example

C General Principle

D Intermediate Conclusion

E Main Conclusion

6 Lobham Tennis Club is more of a social club than a sports club. Only 32% of the members play tennis.
35% of the members who do play tennis are under 30, even though this age group makes up just 20% of the total membership.

(i) What percentage of the members who are under 30 play tennis?

A 38%

B 44%

C 47%

D 56%

E 67%

(ii) What percentage of the members who are 30 or over play tennis?

A 8%

B 11%

C 26%

D 29%

E 40%

7 The table below shows the top 25 countries in the medals table at the Athens Olympics (2004) along with the medals won per $billion GDP (Gross Domestic Product) and per million population.

Rank	Country	Total medals	Medals per $billion GDP	Medals per million population
1	UNITED STATES	103	0.010	0.354
2	RUSSIA	92	0.212	0.642
3	CHINA	63	0.045	0.049
4	AUSTRALIA	49	0.095	2.464
5	GERMANY	48	0.020	0.582
6	JAPAN	37	0.009	0.291
7	FRANCE	33	0.019	0.553
8	ITALY	32	0.022	0.555
9=	SOUTH KOREA	30	0.050	0.626
9=	UNITED KINGDOM	30	0.017	0.506
11	CUBA	27	0.855	2.390
12	UKRAINE	23	0.464	0.476
13	NETHERLANDS	22	0.043	1.357
14=	ROMANIA	19	0.315	0.856
14=	SPAIN	19	0.023	0.462
16	HUNGARY	17	0.205	1.680
17	GREECE	16	0.093	1.498
18	BELARUS	15	0.858	1.518
19=	BULGARIA	12	0.604	1.534
19=	CANADA	12	0.014	0.379
21=	POLAND	10	0.048	0.262
21=	TURKEY	10	0.042	0.141
21=	BRAZIL	10	0.020	0.057
24=	KAZAKHSTAN	8	0.269	0.537
24=	CZECH REPUBLIC	8	0.094	0.784
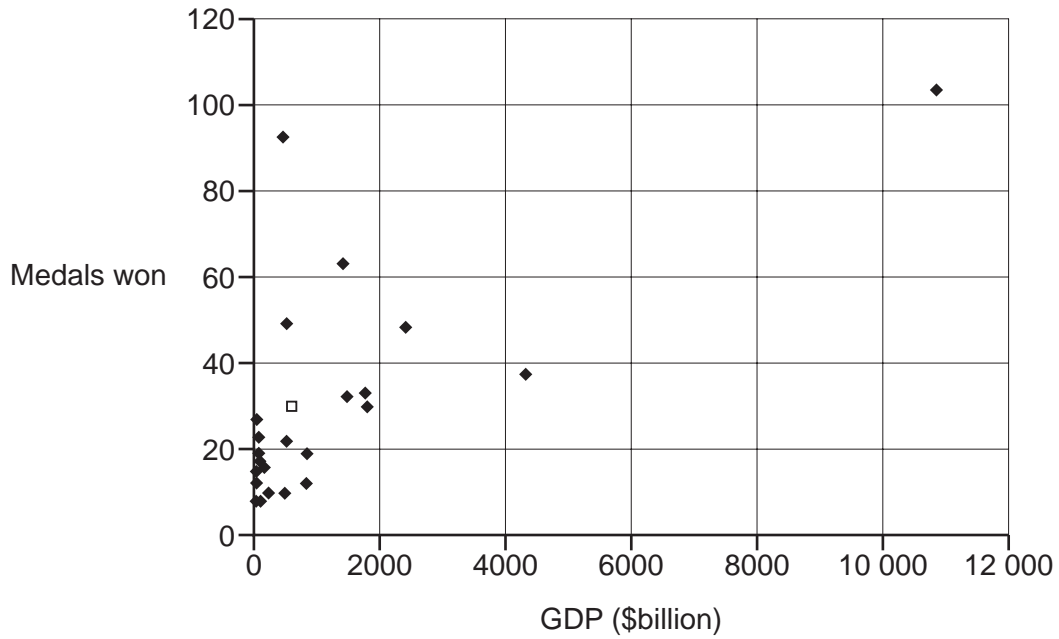
(i) The graph shows the medals won plotted against GDP. Which country is shown by the open square (□)?

A France

B Italy

C Japan

D South Korea

E United Kingdom

(ii) Which **one** of the top five countries in the medal table has the lowest GDP per million population?

A Australia

B China

C Germany

D Russia

E United States

8 The Chairman's Trophy is presented annually to the Buttonhook Basketball Club player with the highest average of points scored per game he has played during the season. A player must have played at least 10 games to qualify.

Before Buttonhook's 20th, and final, game of last season, Dan Ribble and Duncan Slamm had both already qualified and were tied in first place with exactly 18 points per game played.

Both scored 24 points in the game. This raised Dan's average to 18.4, but he was beaten to the trophy by Duncan, whose final average was 18.5. Dan was, however, presented with a special award to recognise his achievement in becoming the first Buttonhook Basketball Club player to ever score 250 points or more in a season.

(i) How many more games than Duncan did Dan play for Buttonhook last season?

A 1

B 3

C 5

D 7

E 9

(ii) How many points in total did Dan score for Buttonhook last season?

A 252

B 258

C 270

D 276

E 294

9 Four neighbours are going to a wedding. They intend to travel together and share all the costs equally.

Their options for travelling are as follows:

1. To share a car journey. This costs 35¢ per kilometre for 60 kilometres each way. In addition they will have to pay $10 for a day's car parking.

2. To travel by train and metro (subway). The train fare is $15 each return, although two will only be charged ⅓ of the fare by using their senior citizen's railcards. The group will also have to pay a $5 taxi fare to the station and from the station, and $2 each return for metro fares.

3. To travel by bus and taxi. Taxis to and from the bus station at their home end will cost $5 each way. The bus fare is $7.50 per person return and a taxi at the wedding end will cost $10 each way.

(i) By how much (in total for the four of them) will the cheapest of the three options given be less than the most expensive?

A $6

B $8

C $13

D $26

E $29

(ii) If they choose option 2 but, instead of using a taxi, take a car to the railway station (2 kilometres each way) and pay $5 for a day's parking, what will be the difference between using a car and taking a taxi?

A $1.40 more expensive by car

B $3.60 more expensive by taxi.

C $4.30 more expensive by taxi

D $5.00 more expensive by taxi

E $13.40 more expensive by taxi

10 One of the exhibits at Lookensee art galley, entitled "Variations", consists of eight identical free-standing cubes. Every morning before the gallery opens the cubes are assembled as follows on the floor:
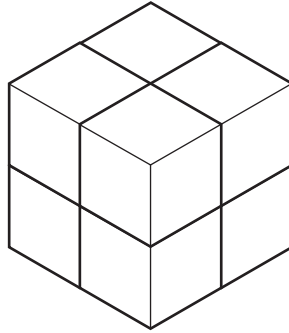
The first visitor of the morning is invited to remove **one** of the four cubes from the upper layer and reposition it **elsewhere** with the whole of one of its faces in contact with the whole of one of the face of another cube.

Subsequently, every twenty minutes during the day, other visitors, selected at random, are invited to do similar. They must always remove a cube that does not have other cubes above it (to prevent the collapse of part of the assembly) and when repositioned at least one of its faces must have full contact with that of another cube.

At present this is the appearance of "Variations":
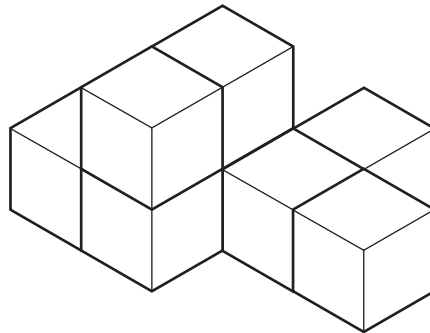
(i) If the next participant were to decide to move the cube at the bottom right of the picture above, how many **new** positions would they have to choose from?
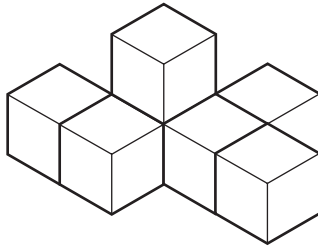
A 13

B 14

C 15

D 16

E 17

(ii) Regardless of which cube the next participant moves, which **one** of the following could **not** be the appearance from the same direction of the new arrangement?
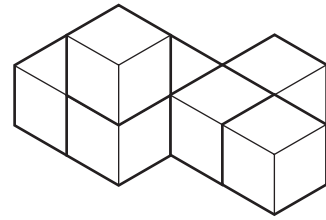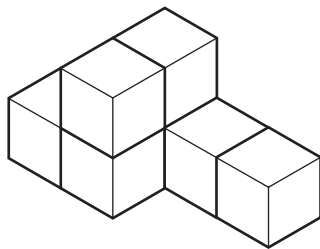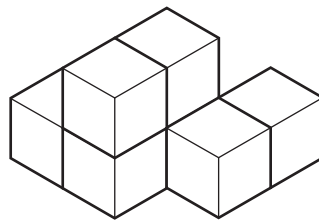
A

B

C

D

E

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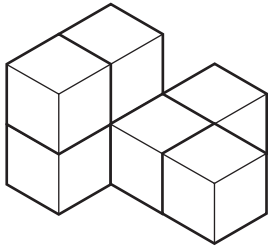
11 Doctors should warn their patients that the standard treatments for Type 2 diabetes cause weight gain. Most of the men and women in their 60s and 70s I know who suffer from Type 2 diabetes are significantly overweight. The link between obesity and diabetes is confirmed by medical research. Therefore it cannot be a coincidence. It is well known that obesity creates serious health risks. So the treatment for diabetes may be doing more harm than good.

(i) Which **one** of the following statements expresses the main conclusion of the above argument?

A Diabetics should be warned that the treatment they are given may cause obesity.

B Medical researchers should look for drugs which will control the symptoms of diabetes without causing weight gain.

C The connection between obesity and diabetes is unlikely to be coincidental.

D The dangers of obesity to people's health are well known.

E The risks of treatment for diabetes may outweigh its benefits.

(ii) Which **one** of the following statements best explains a flaw in the above argument?

A Many people in their 60s and 70s take less exercise than they did when they were younger.

B People who are seriously overweight are more likely to develop diabetes.

C Some people who are seriously overweight do not have diabetes.

D The apparent link between diabetes and obesity may be a coincidence.

E The author draws a general conclusion from only one person's experience.

12 **(i)** Which **one** of the following is an argument?

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

  A Boxing has been crucial in providing a route out of a life of poverty for a significant minority of males from underprivileged backgrounds. This is because conventional routes out of poverty such as educational achievement were unavailable to such young men.

  B Boxing is a sport that is often condemned for its level of violence. In particular, it is singled out as involving intentional violence. However, other sports are characterised by intentional violence (for example eye gouging in rugby) and serious injuries can result.

  C Boxing is an excellent sport for young males, particularly those who are attracted by violence and gang culture. It provides a regulated way of expressing violent instincts which might otherwise find their expression in these anti-social forms of behaviour.

  D Boxing is highly regulated. For example, there are several different weights such as middle-weight and heavy-weight. This ensures that opponents are equally matched in size and that a fair contest takes place.

  E Many people find boxing unattractive and seek to discourage or even ban it. However, such people fail to recognise that violence is, unfortunately, an inherent part of human nature and that nothing can be done about this.

13 Scientists are paid a very small amount of money for developing, inventing and innovating. Marketing people are often paid very large amounts of money for selling these new products. Whilst it is probably true that the products would not sell such quantities without marketing and advertising people, it is also true that there would be nothing to sell without the creative intelligence of the scientists. Yet both groups put as much effort into their work and are equally skilled. So it is unfair to pay the scientists so much less than the marketing people.

(i) Which **one** of the following, if true, is most likely to explain the difference in pay between the two groups?

A Marketing is a popular subject at university.

B Science is not as interesting to study as marketing.

C Scientists study much longer at university than marketing people.

D There are fewer scientists than marketing people.

E There are more scientists than marketing people.

(ii) Which **one** of the following is an assumption underlying the argument for not paying marketing employees higher wages than the scientists who develop new products?

A Employees should be paid according to the level of their effort and skill.

B Employees should be paid according to the rarity of their skill.

C Employees should be paid according to their creativity.

D Employees should be paid according to their productivity.

E Employees should be paid according to their value to society.

14 Scientists are close to being able to clone animals. This means that all those characteristics of an individual animal that are genetically determined will be reproducible by scientists in the future. Whilst some people attribute personality to pet animals such as cats and dogs, in reality they like them for a combination of physical appearance, such as their fur colour, and of being generally cat-like or dog-like in their behaviour. So if somebody's Golden Labrador died and scientists were able to clone it physically, it would not be long before they were declaring that Rover had indeed been reborn. We can conclude, equally, that if scientists cloned somebody's ginger tom-cat then they would soon be declaring the same thing about Ginger Mark 2.

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

A All physical characteristics of pets are genetically determined.

B Fur colour is the most important physical characteristic of cats and dogs.

C Fur colour is a physical characteristic which is genetically determined.

D Pets do not have individual personalities.

E Pets such as cats and dogs will frequently be cloned in the future.

(ii) A student says, "no clone will ever be a substitute for a loved pet."

Has the student

A contradicted the conclusion?

B expressed a counter-argument?

C expressed a moral principle?

D expressed the conclusion fairly and accurately?

E identified the wrong part of the argument as the conclusion?

15 Some people argue that it may be unwise to visit the dentist. Their argument is that people who go to the dentist seem to have more trouble with their teeth than those who do not, which suggests that dentists may actually cause more problems with teeth than they solve. Dentists have a vested interest in patients returning for treatment because their income is directly related to the number of patients they treat, so it would be tempting for them to ensure that a patient will return with a tooth problem. However, this argument just offers an untested theory that it is the dentists who cause the teeth problems. So it would be wise to go on visiting your dentist.

(i) Which **one** of the following identifies a flaw in the author's reasoning in reaching the main conclusion?

A No evidence is given to show that dentists are causing the tooth problems.

B People who have problem teeth may have cause to go to the dentist more often.

C The main cause of tooth problems is lack of brushing and poor diet.

D There may be other reasons which cause people to be unwilling to visit the dentist.

E There may be other reasons why it is unwise to visit the dentist.

(ii) Which **one** of the following is a further conclusion that can be drawn from the above passage?

A Dentists decisions about treatment are always influenced by non-medical factors.

B It is essential that people look after their teeth.

C Paying dentists by number of patients treated may be unwise.

D We should be wary of other forms of medical treatment.

E We should not be worried about going to the dentist.

16 1 kg of leaf tea contains half as much caffeine as 1 kg of instant coffee. 1 kg of tea makes 400 cups, 1 kg of coffee makes 500 cups. 1 cup of instant coffee contains $1\frac{1}{2}$ times as much caffeine as 1 can of cola.

(i) How much caffeine is there in a cup of coffee compared with a cup of tea?

A A cup of coffee has $1\frac{1}{4}$ times as much caffeine as a cup of tea.

B A cup of coffee has $1\frac{3}{8}$ times as much caffeine as a cup of tea.

C A cup of coffee has $1\frac{3}{5}$ times as much caffeine as a cup of tea.

D A cup of coffee has $1\frac{5}{8}$ times as much caffeine as a cup of tea.

E A cup of coffee has 2 times as much caffeine as a cup of tea.

(ii) How much caffeine is there in a cup of tea compared with a can of cola (to the nearest 1%)?

A A can of cola has 94% of the caffeine of a cup of tea.

B A can of cola has 7% more caffeine than a cup of tea.

C A can of cola has 40% more caffeine than a cup of tea.

D A can of cola has 50% more caffeine than a cup of tea.

E A can of cola has 67% more caffeine than a cup of tea.

17 My bath takes 16 minutes to fill from the hot water tap, but only 10 minutes from the cold tap. It takes 12 minutes to empty completely from full when the plug is removed.

When I run a bath it is my habit to turn both taps on to start with, then turn the cold tap off after 3 minutes.

(i) When I run a bath, how long does it normally take to fill?

A   8 min 07.5 sec

B   8 min 12 sec

C   10 min 48 sec

D   11 min 00 sec

E   11 min 12 sec

(ii) This morning, when I went to turn the cold tap off, I discovered that I had forgotten to put the plug in. I put it in at once, but I kept the cold tap on for a further 2 minutes before I turned it off.

Assuming that water flows out through the plughole at the same rate whatever the level of water in the bath, how long did it take to fill this morning?

A   11 min 20 sec

B   12 min 00 sec

C   14 min 00 sec

D   14 min 40 sec

E   15 min 12 sec

18 An unusual pack of cards has four families (coloured blue, green, red and yellow) each with the number 1 to 5 written on them: 20 cards in total.

Imagine that the cards are in order (with the families in alphabetical order of colour, as written above), and then are laid out on a table side by side with the first card (a blue "one") face up then alternately up and down right through the pack.

It is then discovered that the table has a sticky substance on its surface, and the pack is hastily collected back up in the same order (facing in the same direction), so that the cards are stuck together in pairs – the blue 2 stuck to the back of the blue 1, the blue 4 stuck to the back of the blue 3, and so on.

The 10 pairs are then randomly shuffled.

Eventually the stickiness wears off.

(i) Which of the following triplets of cards could **not** then be found in order (top to bottom) in the pack?

A Green 2, Blue 1, Blue 2

B Blue 5, Green 1, Yellow 2

C Green 4, Green 5, Red 1

D Yellow 1, Yellow 4, Yellow 5

E Blue 4, Red 5 and Yellow 1

Instead of the random shuffle described above, imagine the 10 pairs received one **perfect shuffle** after they were picked from the table (which means that they were separated into two equal piles, and then interlinked so that one pair from one pile was followed by one pair from the other, all through the pack).

(ii) When the stickiness wore off, which of the following pairs of cards **could** possibly be found next door to each other in the pack?

A Green 5 and Blue 1

B Yellow 1 and Green 1

C Red 4 and Blue 3

D Green 2 and Red 5

E Blue 1 and Red 5

19 The tables below show the ingredients and nutritional information for a 30 g energy bar.

Ingredients: (per 100 g)	
Yoghurt – 25 g	Starch Syrup – 20 g
Fruit – 20 g	Oat and Wheat Flakes – 20 g
Corn – 6 g	Semolina – 3 g
Vegetable Fat – 3 g	Roasted Hazelnut – 1 g
Soy Lecithin E322 – 1 g	Natural flavouring – 900 mg
Citric Acid – 100 mg	

Nutritional information: (per 100 g - remainder is water)	
Energy	450 kcal (1900 kJ)
Protein	8 g
Carbohydrate	48 g
Fat	12 g
Essential Amino Acids	10 g
Fibre	2 g
Sodium	20 mg

The manufacturers have come in for some criticism from sportsmen and women who use this bar for energy because of the relatively high fat content. They propose to change the yoghurt content from full fat yoghurt (8.8 g fat per 100 g) to low fat yoghurt (1.2 g fat per 100 g).

**(i)** What will be the fat content per 100 g of the modified bar (to the nearest 0.1 g)?

A 4.4 g

B 9.7 g

C 10.1 g

D 11.4 g

E 12.6 g

(ii) An alternative suggested was to replace 3 g of the entire bar with 3 g oat bran (by removing some of each ingredient in their current proportions). 100 g oat bran contains 40 kcal and 1 g fat.

How many calories per 100 g would the modified bar contain?

A 409 kcal

B 413 kcal

C 438 kcal

D 446 kcal

E 454 kcal

20 The following device is to be used to give signals at night. It consists of four lamps in a box.
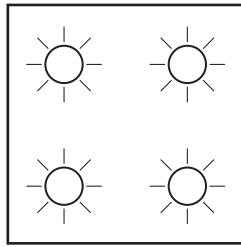
Each of the lamps may be turned on or off in order to configure a given signal. When the required combination is configured, the box is put on view so that it can be interpreted by the intended viewer.

When a combination of lamps are on, it must be assumed that only the relation to other lamps that are on can be identified by a viewer. It is not possible to relate them to the surrounding box (or the unlit lamps). Therefore, if only the top left lamp is lit, it is indistinguishable from only the top right lamp being lit, for instance.

It is assumed that having no lamps lit is not a signal at all.

(i) How many different signals can be given from a set of four lamps as shown above?

A 4

B 8

C 10

D 12

E 15

(ii) A similar box has six lamps in two vertical columns of three. How many distinguishable signals can be made if exactly two lamps are lit?

You can assume that it is possible to distinguish the following two signals:

A 4

B 7

C 9

D 15

E 30

24

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