THINKING SKILLS **9694/33**

Paper 3 Problem Analysis and Solution **October/November 2018**

2 hours

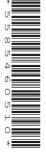Additional Materials: Electronic Calculator

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READ THESE INSTRUCTIONS FIRST

An answer booklet is provided inside this question paper. You should follow the instructions on the front cover of the answer booklet. If you need additional answer paper ask the invigilator for a continuation booklet.

Answer **all** the questions.

Show your working. Marks may be awarded for correct steps towards a solution, even if the final answer is not correct. Marks may be lost if working needed to support an answer is not shown.

Calculators should be used where appropriate.

The number of marks is given in brackets [ ] at the end of each question or part question.

1 Fred likes to go out and will do so every day unless he has a reason not to. He is superstitious and will not go out on odd-numbered dates (i.e., the 1st, 3rd, 5th and so on of every month). He also never goes out on any Wednesdays.

The month of June has 30 days, and begins on a Tuesday this year.

(a) On how many days in June will Fred go out? [1]

Fred has some pills called *Makemewell* that he must take during June. He can take his first pill on any date, but he must then keep taking another pill every 5 days, and must take a total of 6 pills during the month of June. Fred's pills make him feel tired, so he does not go out on any day when he takes his pill.

(b) If Fred takes his first pill on 4th June, on how many days in June will he be able to go out? [2]

Fred likes to attend his social club, which holds events every weekend. He would like to be able to go out on the largest total number of weekend days (Saturdays and Sundays) as possible in June.

(c) State all the possible dates on which he could take his first pill to ensure that this would happen. [2]

Fred's doctor would like him to consider a long-term treatment plan, using a different pill instead of *Makemewell*. The doctor suggests either *Treatme* or *Sortmeout*. Fred has tried both of these pills previously; they are equally effective for his condition, but he experiences different side effects.

Pill	Frequency of dose	Fred's side effects
Treatme	1 pill every 7 days	Feel too tired to go out on the day I take the pill and the following day.
Sortmeout	1 pill every 8 days	Feel too tired to go out on the day I take the pill and the following **two** days.

Fred thinks about how taking these pills would have affected his ability to go out in June.

(d) If he had taken his first pill on 4 June, which of these two pills would have enabled him to have gone out on more days? For each pill, state how many days in total (both weekdays and weekend days) he would have been able to go out. [2]

Before he makes a decision, Fred wants to compare the costs of the three types of pill. His doctor gives him the following information:

Pill	Frequency of dose	Number of pills in a box	Cost of 1 box	Expiry date (from the day the box is first opened)
Makemewell	1 pill every 5 days	35	$4.50	150 days
Treatme	1 pill every 7 days	50	$6.00	400 days
Sortmeout	1 pill every 8 days	60	$10.00	400 days

Fred will open each box of pills on the day that he uses the first pill from it, and will never use a pill from a box that has passed its expiry date.

(e) Use the information from the doctor to estimate which pill will be cheapest for Fred in the long run. Justify your answer. [3]

2 Birdnest village school educates children for 5 years. All the children from the village of Birdnest attend the school; they are known as *Nesters*. Children from other villages also attend; they are known as *Cuckoos*. To get to school, all of the children walk, cycle or travel by car, because there is no school bus available. Each child uses the same method to get home as they do to get to school.

There used to be 5 classes, one for each school year, each with 20 children. It was decided that the number of children in the school will be doubled over time, with an extra class of 20 being added each year for 5 consecutive years, starting with the youngest and working up. All the extra children will be *Cuckoos*.

The local residents are concerned about the number of cars that will be parked near the school at the end of the day, and are trying to work out how many to expect. They assume that:

- Each car provides transport for one child only.
- There is the same total number of *Nesters*, year after year.
- Each school year has the same proportion of *Nesters* who travel by car.
- Each school year has the same proportion of *Cuckoos* who travel by car.

In years before the expansion began, there were consistently 35 cars parked near the school to collect children at the end of the day. During the first year of the expansion, however, this number increased to 45.

(a) How many cars would be parked near the school once the expansion was complete? [1]

(b) (i) What proportion of *Cuckoos* travel by car? [1]

    (ii) How many *Nesters* would you conclude were at the school, if you assumed that none of the *Nesters* travel by car? [1]

In fact, some of the *Nesters* do travel by car.

At the beginning of the second year of expansion, it was agreed that all the *Nesters* in the final year would walk or cycle. As a result, there were 52 cars parked near the school during the second year.

(c) How many *Nesters* are there at the school? [3]

At the beginning of the third year of expansion, all final year children, both *Nesters* and *Cuckoos*, were told that they must walk or cycle to school.

(d) How many cars were parked near the school during the third year of expansion? [2]

This policy was continued during the fourth year of the expansion. However, the local residents noticed what they considered to be a large increase in the number of cars parked near the school. They suggested that, during the fifth year of expansion, all the *Nesters* at the school should walk or cycle, but that no restrictions should be imposed on the *Cuckoos*.

(e) Would this suggested change have resulted in fewer cars being parked near the school than there would have been otherwise? Provide figures to support your answer. [2]

3 Jaspreet owns a business making suits to order – he only makes the suits once a customer has ordered them. Customers can order any number of pairs of trousers, jackets and waistcoats at the following prices:

Pair of trousers	$40
Jacket	$85
Waistcoat	$50

If a jacket is bought with a pair of trousers, the price is reduced by $10, meaning that the two items together cost just $115.

Last Monday morning Roger ordered two pairs of trousers and one jacket.

(a) What was the total price of this order? [1]

Jaspreet does not make any of the items himself, but employs two tailors, Harry and Joe, for this. Each of them works for a total of 8 hours each day from Monday to Friday. Only one tailor can work on any one item at any time. When one item is finished the tailor will immediately start work on another, if there are more items still to be made. Each tailor takes a total of 10 hours to make a pair of trousers, 20 hours to make a jacket and 15 hours to make a waistcoat. Each item must be entirely made by one tailor.

The tailors were able to start working on Roger's order at the start of work on Tuesday. Their work was planned so that the order would be completed as quickly as possible.

(b) On which day was the order completed? [1]

(c) What is the maximum total price of an order that the two tailors would be able to complete within four working days, if they had no other work needing to be done? [3]

Priya is organising a large event and wants to know how long an order would take to be completed. The order would be for 5 pairs of trousers, 7 jackets and 3 waistcoats.

(d) What is the minimum number of hours in which the work on this order could be completed? Suggest a set of items that each tailor should make. [3]

Customers come into Jaspreet's shop and are measured for the items that they want. He then tells them which day they can come to collect their items.

On Monday morning this week, both of the tailors still had work to do on orders from last week. Harry had 4 hours of work left on a waistcoat, while Joe had 3 hours left to work on a jacket. Following this there were two further orders to be completed, the details of which are below:

Order	Collection day
1 pair of trousers	Wednesday
1 waistcoat 1 pair of trousers	Friday

A customer urgently needs a jacket, a waistcoat and pair of trousers for an event this weekend and asked on Monday morning if his order can be completed to collect on Friday, at the end of the working day. Both of the tailors are willing to work for more hours this week.

(e) How many extra hours would Jaspreet need to ask the tailors to work in order to get the order ready to collect before the end of normal working hours on Friday, without completing either of the other orders late? Suggest a set of items that each tailor should make. [3]

(f) How many extra hours would be needed to complete the orders on time if Harry was unable to work any extra hours? [1]

If an order is not ready on the agreed collection day, Jaspreet reduces the price by 20%. The reduction increases by an additional 10% for each extra weekday that the order is late, as compensation. For example, if an order for which the agreed collection day was Thursday is not ready until Monday, the price will be reduced by 30%.

Jaspreet has decided that he will not pay for any additional hours of work from the tailors, but he will make sure that the urgent order is completed by Friday.

(g) If he allocates the work in the best possible way, how much money will he lose? [3]

4 David is trying to work out the bonuses that he will pay to his employees for their work over the past six months. The city in which they work is divided into four zones and each of the employees works in just one of the zones. The sales made by each employee in each month are shown in the table below.

Employee	Zone	Sales						Total sales
		Jan	Feb	Mar	Apr	May	Jun	
Anna	North	13	10	12	20	12	13	80
Carol	East	16	12	20	19	14	14	95
Frank	East	9	15	13	17	21	17	92
John	South	5	8	4	13	5	1	36
Martin	North	18	11	18	12	18	22	99
Oliver	West	10	18	14	11	17	16	86
Rachel	South	7	8	11	9	9	9	53
Tanya	West	11	14	16	15	20	9	85

(a) In which zone have the most sales taken place? [1]

Bonuses have already been paid at the end of each month according to the following rules:

- The employee with the highest number of sales in the month receives $150
- The employee with the second-highest receives $50

(There has never been a tie, but if there were, David would decide what to do.)

(b) How much has Carol already received in bonuses from the first six months? [2]

David is aware that the South zone is a more difficult one to make sales in and so wants to alter the way in which he pays bonuses to reflect this. He has decided to allocate different numbers of points to sales in each of the zones based on the difficulty of making sales. The points are awarded for the sales in any one month.

Zone	Points per sale			
	Sales 1–10	Sales 11–15	Sales 16–20	Sales 21+
North	1	1	1	1
East	1	1	1	2
South	2	2	3	5
West	1	2	2	3

So, for example, in the East zone sales are worth one point each for the first 20 sales and then any further sales are worth 2 points each.

David is going to use this system to award additional bonuses for the past six months.

(c) How many points were Tanya's sales in May worth? [2]

The total number of points awarded over the six months is calculated. Each employee receives a bonus of $100 for every point above 100 that they have earned. This bonus is in addition to the monthly bonuses that have already been awarded.

(d) Which employees will receive bonuses based on their points scores, and how much will each bonus be? [4]

Some of the employees suggest that it would be better if **all** the monthly bonuses were cancelled and the bonuses were instead calculated every three months. They suggest that the number of points for each of the three months should be added up and a bonus of $100 awarded for every point above 50. Had this system applied to the first six months, the bonuses would have been calculated based on the periods Jan–Mar and Apr–Jun.

(e) How would Martin's total bonus for the six months have changed if the employees' proposed new system were in place? [3]

David decides to adopt the employees' proposed new system for bonuses.

Oliver wishes to earn a bonus of at least $1000 for the next three months. He sets himself a target number of sales per month, so that if he achieves this number in each of the three months, he will get the bonus he wants. John also wishes to earn a bonus of at least $1000 for the next three months, and adopts the same strategy as Oliver.

(f) How many more sales per month will Oliver need to make than John, if they both set the lowest target that they can? [3]

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