

BAR-ILAN UNIVERSITY

DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE

ENTRANCE EXAMINATION FOR COMPUTER SCIENCE. PART TWO: MATHEMATICAL THOUGHT

TAHMUZ 29, 5736

Duration of the examination: 2 hours. Logarithm tables may be used; it is doubtful that they will be beneficial.

1) In Kiryat Arba municipal coins were coined.

- 1 Hevron = 4 Agorot
- 1 Kiryah = 4 Hevronim
- 1 Ahiman = 4 Krayot
- 1 Shayshy = 4 Ahimanim
- 1 Talmal = 4 Shayshyim
- 1 Anak = 4 Talmaim

The Israeli "Agora" is used in Kiryat Arba (and also in Kiryat Malachi).

a) A new settler in Kiryat Arba wants to exchange 35.91 Lira for the municipal coins in such a way that he will receive a minimal number of coins. How many coins of each type will he receive?

In Kiryat Malachi municipal coins were coined (according to base 12, in honor of Malachi, the last of the twelve minor prophets).

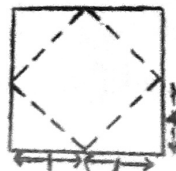
- 1 Tresar = 12 Agorot
- 1 Shevet = 12 Tresarim

b) A resident of Kiryat Malachi comes to visit Kiryat Arba and wishes to exchange 11 Shevatim, 7 Tresarim, and 9 Agorot for the minimal number of Kiryat Arba coins of equivalent value. How many coins of each type will he receive?

2) David has a Square Tallit (prayer shawl) 2 meters by 2 meters. The Tallit bag is also square, 40 cm. by 40 cm.

On weekdays David folds his Tallit in half, lengthwise and widthwise alternately. On Shabbat he folds his Tallit differently, along the dotted lines shown in the picture. The resulting square he continues to fold in the same way.

a) After how many foldings will the Tallit fit into the bag on weekdays? On Shabbat? Explain!



2) Continued:

Shmuel has a similar Tallit and Tallit bag, but on Shabbat he folds his Tallit in yet another way. He folds it in half along a diagonal. Then he folds the resulting right triangle in half by joining the ends of the hypotenuse. He continues to fold the resulting right triangles in the same manner.

b) After how many foldings will Shmuel be able to fit his Tallit into the bag on Shabbat? Explain!

3) Let n be a positive integer. The following computational process is to be executed step after step unless an instruction to the contrary is encountered. Start with step (i), and proceed until told to stop.

- (i) Give the value 1 to the variables A , B , Y .
- (ii) If the value of B is greater than or equal to the value of n , go to step (vi). Otherwise continue with step (iii).
- (iii) Increase the value of Y by 1; increase the value of A by 2.
- (iv) Add the value of A to the value of B .
- (v) Return to step (ii).
- (vi) If the value of B is greater than the value of n , decrease Y by 1.
- (vii) Stop; the result of the computation is the value of Y .

Compute the value of Y for $n = 20$, $n = 50$, and $n = 100$.

4) A Kibbutz decided to raise sheep for their wool. They began with a pair of newborn sheep. The sheep multiply according to the following rules:

- (i) A pair of sheep bear offspring at age one year, and thereafter after every six months.
- (ii) At every birth a pair of sheep are born, male and female, and this pair will bear sheep.
- (iii) No sheep will die during the period under consideration.

- a) How many pair of sheep will there be after four years?
- b) If the sheep of age at least one year are shorn at the end of each year, how many fleeces will have accumulated at the end of four years?

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- 5) In Rabat-Bnei-Ammon an honor guard of bedbugs guards the bed of Og, King of Bashan. At all times there is a bedbug patrolling back and forth on the bed, which is 9 cubits by 4 cubits, as follows:

The bedbug begins from a corner of the bed at a 45° angle with the sides. When he reaches an opposite side, he turns and continues in a direction perpendicular to that by which he came, except that if he enters a corner, he leaves by the same path by which he entered. When he returns to his starting point, another member of the honor guard will relieve him.

If a bedbug leaves from a corner at 00:00 at a fixed rate of speed and first encounters an opposite wall at 00:20, when will he be relieved?

GOOD LUCK

