The State of Israel
Ministry of Education
Exam Type: *Bagrut*
Exam Date: Winter 2018
Exam Number: 035481, 035804, 314
Appendix: Formula sheets for 4 points
English Translation (3)

Mathematics

4 Points — 1st Exam

Instructions for examinees

א. Duration of the exam: Three and a half hours

ב. Exam structure and breakdown of points:
This exam has three parts.
Part One: Algebra, Analytical Geometry, Probability – 2×20 — 40 points
Part Two: Planar Geometry and Planar Trigonometry – 1×20 — 20 points
Part Three: Differential and Integral Calculus of Polynomials, Rational Functions, and Root Functions – 2×20 — 40 points
Total — 100 points

ג. Material that may be used during the exam:
(1) A non-graphing calculator. You may not use the programming options of a programmable calculator. Use of a graphing calculator or programming options may lead to the disqualification of your exam.
(2) Formula sheets (attached).
(3) A Hebrew-foreign language/foreign language-Hebrew dictionary.

ד. Special instructions:
(1) Do not copy the question, but do indicate the number of the question you are answering.
(2) Start each question on a new page. Write the steps of the solution in the answer booklet, even when the calculations are done with a calculator.
Explain all of your work, including calculations, in detail and in a clear and organized fashion.
Lack of detail may lower your score or lead to the disqualification of your exam.
(3) For draft paper, use pages in the answer booklet. Use of other draft paper may lead to the disqualification of your exam.

Good Luck!

מדינת ישראל
משרד החינוך
סוג הבחינה: בגרות
מועד הבחינה: חורף תשע"ח, 2018
מספר השאלון: 035481, 035804, 314
נספח: דפי נוסחאות ל־4 יחידות לימוד
תרגום לאנגלית (3)

מתמטיקה

4 יחידות לימוד — שאלון ראשון

הוראות לנבחן

א. משך הבחינה: שלוש שעות וחצי.

ב. מבנה השאלון ומפתח ההערכה:
בשאלון זה שלושה פרקים.
פרק ראשון: אלגברה, גאומטריה אנליטית, הסתברות 2×20 — 40 נקודות
פרק שני: גאומטריה וטריגונומטריה במישור 1×20 — 20 נקודות
פרק שלישי: חשבון דיפרנציאלי ואינטגרלי של פולינומים, של פונקציות רציונליות ושל פונקציות שורש 2×20 — 40 נקודות
סה"כ — 100 נקודות

ג. חומר עזר מותר בשימוש:
(1) מחשבון לא גרפי. אין להשתמש באפשרויות התכנות במחשבון הניתן לתכנות. שימוש במחשבון גרפי או באפשרויות התכנות במחשבון עלול לגרום לפסילת הבחינה.
(2) דפי נוסחאות (מצורפים).
(3) מילון עברי-לועזי/לועזי-עברי.

ד. הוראות מיוחדות:
(1) אל תעתיק את השאלה; סמן את מספרה בלבד.
(2) התחל כל שאלה בעמוד חדש. רשום במחברת את שלבי הפתרון, גם כאשר החישובים מתבצעים בעזרת מחשבון.
הסבר את כל פעולותיך, כולל חישובים, בפירוט ובצורה ברורה ומסודרת.
חוסר פירוט עלול לגרום לפגיעה בציון או לפסילת הבחינה.
(3) לטיוטה יש להשתמש במחברת הבחינה.
שימוש בטיוטה אחרת עלול לגרום לפסילת הבחינה.

בהצלחה!

Questions

Note! Explain all of your work, including calculations, clearly and in detail.
Lack of detail may lower your score or lead to the disqualification of your exam.

Part One — Algebra, Analytical Geometry, Probability (40 points)

Answer two of the questions 1-3 (each question — 20 points).

Note! If you answer more than two questions, only the first two answers in your answer booklet will be graded.

1. A merchant bought a number of items at an identical price and paid a total of 6,000 shekels for them.

He sold 10% of all the items at a discount price of 40 shekels each, left 20 items in storage, and sold the rest at a profit of 60% per item.

His income from the sale of these items was 7,520 shekels.

א. How many items did the merchant buy?

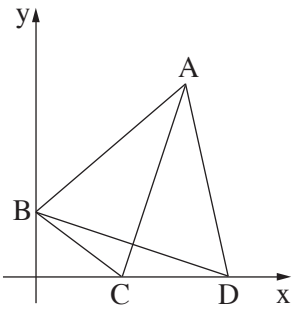
Later, the merchant sold the 20 items he left in storage, at a profit of 200% per item.

ב. What was the merchant's income from the sale of these 20 items?

2. Given: Kite (deltoid) [דלתון] ABCD (AB = AD, CB = CD).

Vertex B is located on the y-axis and Vertices C and D are located on the x-axis, as shown in the figure.

The equation of Line BD is: $y = -\frac{1}{3}x + 3$.



א. Find the coordinates of Vertices B, D, and C.

The coordinates of Vertex A are (7, 9).

ב. Calculate the area of Kite ABCD.

The line y = 5.4 intersects Lines AB and AD at Points E and F, respectively.

The length of Segment EF is 5.

ג. **(1)** Calculate the area of Triangle AEF.

(2) Calculate the area of Pentagon EFDCB.

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3. Shira is playing with a balanced, traditional die [קוביית משחק הוגנת] and a balanced coin.
Shira is playing by the following rules: she tosses the die once and the coin twice.
If the number that comes up on the die is greater than 2 and both coin tosses come up "tails", Shira wins a prize.

א. **(1)** What is the probability that Shira will win a prize?

(2) Shira plays her game 4 times. What is the probability that she will win exactly 2 prizes?

Avigail also is playing with a balanced, traditional die and a balanced coin.
Avigail is playing by different rules: she tosses the die twice and then the coin once.
If the sum of the numbers that come up on the two tosses of the die is less than 10 and the coin comes up "heads", Avigail wins a prize.

ב. **(1)** What is the probability that in two tosses of the die, the sum of the numbers that will come up is less than 10?

(2) Avigail plays her game once. What is the probability that Avigail will win a prize?

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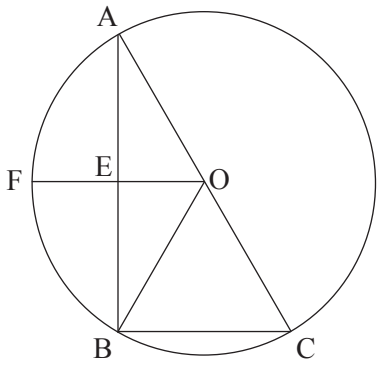
Part Two — Planar Geometry and Planar Trigonometry (20 points)

Answer one of the questions 4-5.

Note! If you answer more than one question, only the first answer in your answer booklet will be graded.

4. Triangle ABC is inscribed in a circle. The center of the circle, O, is located on Side AC.

Point E is located on Side AB such that OE ⊥ AB (see figure).



א. Prove that OE is a midsegment [קטע אמצעים] in Triangle ABC.

The extension of Segment OE intersects the circle at Point F, as shown in the figure.

ב. Prove that Triangle AFB is an isosceles triangle.

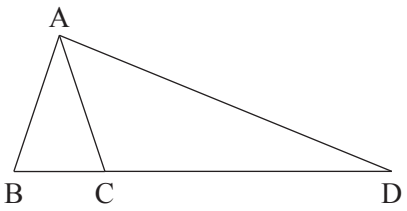
Given: $\sphericalangle ACB = 60^{o}$.

ג. Prove that the quadrilateral FOCB is a rhombus.

5. ABC is an acute isosceles triangle (AB = AC).

The length of the radius of the circle that circumscribes Triangle ABC is R.

Given: BC = 1.2R.



א. **(1)** Calculate the angles of Triangle ABC.

(2) Express the length of Side AB in terms of R.

Side BC was extended to Point D, as shown in the figure, such that CD = 3.8R.

ב. Express the length of Segment AD in terms of R.

ג. AE is a height [גובה] in Triangle ACD.

The length of the height AE is 9.

Calculate R.

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Part Three — Differential and Integral Calculus of Polynomials, Rational Functions, and Root Functions (40 points)

Answer two of the questions 6-8 (each question — 20 points).

Note! If you answer more than two questions, only the first two answers in your answer booklet will be graded.

6. Given: The function $f(x)=\frac{4x}{(x-1)^2}+a$. a is a parameter.

Answer Item א. Write your answers in terms of a , if necessary.

א. **(1)** What is the domain [תחום ההגדרה] of the function f(x)?

(2) What are the equations of the asymptotes of the function f(x) that are perpendicular to the axes?

(3) Find the coordinates of the extremum [נקודת הקיצון] of the function f(x) and determine what type of extremum it is.

(4) What are the intervals on which the function f(x) is increasing and decreasing?

Given: The function f(x) has an asymptote whose equation is y = –3.

ב. What is the value of the parameter a ?

Insert the value of a that you found and answer Items ג and ד.

ג. **(1)** Find the coordinates of the point at which the graph of function f(x) intersects the y-axis.

(2) Sketch the graph of the function f(x).

ד. For which values of k does the line y = k intersect the graph of function f(x) at exactly one point?

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7. Given: The function $f(x) = \sqrt{49 - x^2}$.

א. **(1)** Find the domain [תחום ההגדרה] of the function f(x).

(2) Find the coordinates of the extrema [נקודות הקיצון] of the function f(x) and determine what type of extrema they are.

(3) Sketch the graph of the function f(x).

ב. **(1)** Find the equations of the asymptotes of the derivative function, $f'(x)$, that are perpendicular to the x-axis.

(2) What are the intervals on which the derivative function, $f'(x)$, is positive and on which it is negative?

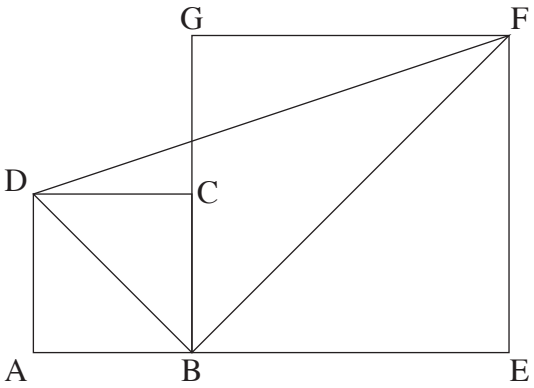
(3) Sketch the graph of the derivative function, $f'(x)$. You may make use of your answers to the preceding items.

ג. Find the area of the region bounded by the graph of the derivative function, $f'(x)$, the negative part of the x-axis and the line $x = -6$.
In your answer, leave two digits after the decimal point.

8. ABCD and BEFG are two squares.
Side BC lies on Side BG.
Given: $DB + BF = a$. $a > 0$ is a parameter.

א. Find the length of Diagonal DB for which the length of Segment DF is minimal (smallest).
Express in terms of a.

ב. For the length of DB that you found in Item א, what is the ratio $\frac{AB}{BE}$?



Good Luck!

בהצלחה!