



Instituto Tecnológico de Aeronáutica

Programa de Pós-Graduação em Engenharia de Infraestrutura Aeronáutica
Programa de Pós-Graduação em Engenharia Aeronáutica e Mecânica

Prova de Seleção – 1º semestre de 2019 – Questões de Matemática

5 de novembro de 2018

Nome do Candidato

Observações

1. Duração da prova: 90 minutos (uma hora e meia)
2. Não é permitido o uso de calculadoras ou outros dispositivos eletrônicos
3. Cada pergunta admite uma única resposta
4. Marque a alternativa que considerar correta na tabela abaixo
5. Utilize o verso das folhas para a resolução das questões

Questão	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
Resp.	e	d	e	c	a	b	e	d	e	b	a	d	a	d	b	d

Questões em Português

1. As equações paramétricas das coordenadas x e y de uma reta no plano cartesiano são $x = (\lambda+1)/4$ e $y = (\lambda+7)/3$. Nessas condições, a menor distância do ponto de coordenadas $(3, 2)$ à equação da reta com parâmetro λ , é:
(a) 4
(b) $18/5$
(c) 3
(d) $14/5$
(e) $12/5$

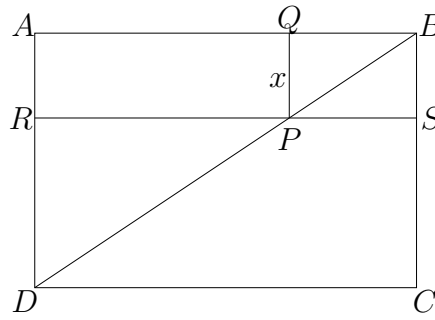


Figura 1: Retângulo $ABCD$

2. Na Figura 1, $ABCD$ é um retângulo em que $AB = l$ e $BC = L$. Seja P um ponto pertencente à diagonal BD , e Q , R e S , as projeções do ponto P em relação aos lados AB , AD e BC , respectivamente. Sabendo-se que x é a distância do ponto P ao lado AB , determine o valor de x , tal que a soma das áreas dos quadriláteros $AQPR$ e $PSCD$ seja máxima.

- (a) $L/4$
- (b) $3L/10$
- (c) $3L/7$
- (d) $L/3$
- (e) $2L/5$

3. Seja o seguinte sistema de equações com incógnitas x e y :

$$\begin{cases} [\text{sen}(\alpha)]x - [\text{cos}(\alpha)]y = \text{cos}(\beta) \\ [\text{cos}(\alpha)]x + [\text{sen}(\alpha)]y = \text{sen}(\beta) \end{cases} \quad (1)$$

Os valores de x e y são:

- (a) $x = \text{sen}(\alpha - \beta)$; $y = \text{cos}(\alpha + \beta)$
- (b) $x = \text{sen}(\alpha + \beta)$; $y = \text{cos}(\alpha - \beta)$
- (c) $x = -\text{sen}(\alpha + \beta)$; $y = \text{cos}(\alpha + \beta)$
- (d) $x = \text{sen}(\alpha - \beta)$; $y = \text{cos}(\alpha - \beta)$
- (e) $x = \text{sen}(\alpha + \beta)$; $y = -\text{cos}(\alpha + \beta)$

4. Em uma escola de línguas há somente cursos de inglês, francês e espanhol. Sabe-se que 262 alunos não cursam espanhol, 100 alunos cursam francês, 231 alunos cursam francês ou espanhol, 13 alunos cursam inglês e francês, 9 alunos cursam francês e espanhol, 36 alunos cursam pelo menos duas línguas e 2 alunos cursam as três línguas. Quantos alunos cursam pelo menos um dos três cursos nesta escola?

- (a) 440
- (b) 415
- (c) 402
- (d) 395
- (e) 366

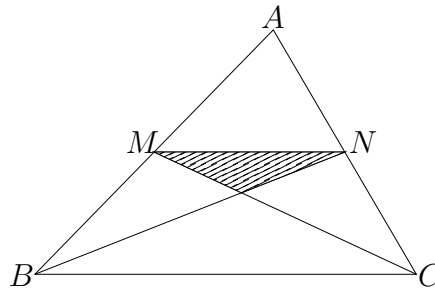


Figura 2: Triângulo com área hachurada

5. Se $\log_b(x) = m$ e $\log_b(y) = n$, então $\log_b \sqrt[3]{x^2 y^3}$ é igual a

(a) $\frac{2m + 3n}{3}$

(b) $\frac{3m + 2n}{3}$

(c) $\frac{2m + 3n}{6}$

(d) $\frac{3m + 2n}{3}$

(e) $\frac{2m + 3n}{2}$

6. Na figura 2, o triângulo ABC possui área S . BN e CM são as medianas relativas aos lados AC e AB , respectivamente. Nessas condições, a área hachurada vale:

(a) $S/15$

(b) $S/12$

(c) $S/10$

(d) $S/9$

(e) $S/8$

7. Tomam-se 24 blocos quadrados, que podem ser agrupados em 6 conjuntos de 4 blocos da mesma cor. Você deve empilhar 4 blocos de modo que blocos consecutivos não tenham a mesma cor. De quantos modos pode-se fazer isso?

(a) 15

(b) 120

(c) 250

(d) 360

(e) 750

8. No ano passado, os primeiros U\$ 30 000.00 do rendimento tributável de cada residente de um determinado país eram taxados em 15%, enquanto os rendimentos excedentes a U\$ 30 000.00 eram taxados em 27%. Deseja-se saber se todos os rendimentos do senhor Silva foram taxados em 15%. Para tanto, são colocadas as seguintes afirmações:

- I. Os impostos do senhor Silva no ano passado foram de U\$ 3 750.00
- II. Se os rendimentos tributáveis do senhor Silva fossem o dobro do que foram, ele pagaria U\$ 9 900.00 de impostos

A este respeito, marque a opção correta:

- (a) a afirmação I *somente* é suficiente, mas a afirmação II *somente* não é suficiente para determinar a taxa de impostos do senhor Silva;
- (b) a afirmação II *somente* é suficiente, mas a afirmação I *somente* não é suficiente para determinar a taxa de impostos do senhor Silva;
- (c) *Ambas* as afirmações I e II *juntas* são suficientes para determinar a taxa de impostos, mas *nenhuma* afirmação *isolada* é suficiente;
- (d)** *Cada* afirmação *isolada* é suficiente para determinar a taxa de impostos;
- (e) As afirmações I e II *juntas não são* suficientes para determinar a taxa de impostos, e dados adicionais do problema específico são necessários.

Questões em Inglês

9. The equation

$$ax^2 + 2\sqrt{ab}x + 2b = 0 \quad (2)$$

has x as unknown and $a > 0$ and $b > 0$ as parameters. One can tell that its roots are

- (a) natural numbers
- (b) real, not positive
- (c) rational, not integer numbers
- (d) irrational numbers
- (e)** not real numbers

10. Let

$$(a + 2)x + ay = 2a + 2, \quad (3)$$

with a , x and y being *natural (positive integers) numbers*. One can say that this equation

- (a) has no natural solution for any value of a
- (b)** has one and only one natural solution for any value of a
- (c) has exactly two natural solutions for any value of a
- (d) has more than two natural solutions for any value of a
- (e)** the number of natural solutions will depend on the value of a

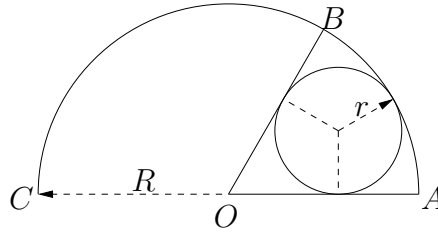


Figure 3: Circle tangent to arc and lines

11. In Figure 3, the small circle of radius r is tangent to arc \widehat{ABC} of radius R as well as it is tangent to lines OA and OB . Given the angle $\widehat{AOB} = 60^\circ$, one can say that

- (a) R/r is an integer number
- (b) R/r is a rational, non integer number (smaller than one)
- (c) R/r is a rational, non integer number (larger than one)
- (d) R/r is a irrational number
- (e) It is necessary to know R in order to determine the characteristics of R/r

12. Let k be a non-negative integer and let $n = (5 \cdot 10^2) + (4 \cdot 10^k) + 5$. About these numbers, two statement are posed:

- I. $k \geq 3$
- II. $n \leq 1000$

If it is asked to determine the tens digit of n , mark the right answer about the statements above:

- (a) statement I *alone* is sufficient, but statement II alone is not sufficient to determine the tens digit;
- (b) statement II *alone* is sufficient, but statement I alone is not sufficient to determine the tens digit;
- (c) *Both* statements I and II *together* are sufficient to determine the tens digit, but *neither* statement *alone* is sufficient;
- (d) *Each* statement *alone* is sufficient to determine the tens digit;
- (e) statements I and II *together* are *not* sufficient to determine the tens digit, and additional data specific to the problem are needed.

13. Of the 3,600 employees of a company, $1/3$ are clerical. If the clerical staff were to be reduced by $1/4$, what percent of the total number of the remaining employees would then be clerical?

- (a) 27.27%
- (b) 16.67%
- (c) 12.50%
- (d) 9.09%
- (e) 8.33%

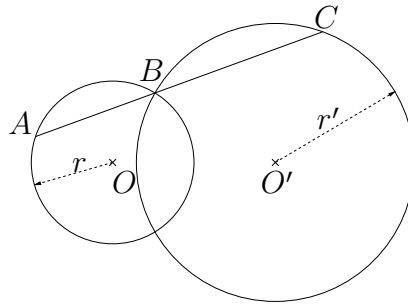


Figure 4: Circles with line passing through their intersection

14. In Figure 4, the chords AB and BC are aligned. Mark the characteristic that would make the length of AC maximum:
- (a) The extremum point A must be aligned to OO'
 - (b) AB must be equal to BC
 - (c) $AB/r = BC/r'$
 - (d) AC must be parallel to OO'
 - (e) None of the above characteristics would maximize AC
15. If n is a positive integer and $k + 1 = 3^n$, which of the following could *not* be a value of k ?
- (a) 2
 - (b) 5**
 - (c) 8
 - (d) 26
 - (e) 80
16. In 2005, 45% of a document storage facility's 120 customers were banks, and in 2017, 25% of its 288 customers were banks. What was the percent increase from 2005 to 2017 in the number of bank customers the facility had?
- (a) 10.7%
 - (b) 20%
 - (c) 25%
 - (d) $33\frac{1}{3}\%$**
 - (e) $58\frac{1}{5}\%$



Instituto Tecnológico de Aeronáutica
Programa de Pós-Graduação em Engenharia de Infraestrutura Aeronáutica
Processo Seletivo ITA - PG-EIA - 1º semestre de 2019

Prova Escrita/Língua Inglesa

5 de novembro de 2018

Nome do Candidato

Instruções: Abaixo é apresentado um texto em inglês onde o candidato deverá efetuar sua tradução para a língua portuguesa. Não é permitida consulta, uso de dicionários ou de dispositivos eletrônicos. Duração da prova: 1 (uma) hora.

Carbon dioxide levels on flight deck affect airline pilot performance

Commercial airline pilots were significantly better at performing advanced maneuvers in a flight simulator when carbon dioxide (CO₂) levels on the flight deck (cockpit) were 700 parts per million (ppm) and 1500 ppm than when they were 2,500 ppm, according to new research led by Harvard T.H. School of Public Health. The study indicates that CO₂ levels directly affect pilots' flight performance.

Previous research led by Allen and colleagues found that, in office buildings, CO₂ concentrations between 1,000 ppm and 2,500 ppm -- levels once thought to be benign -- negatively impact the cognitive function of employees. For the new study, they wanted to determine if higher CO₂ levels on the flight deck would impair a pilot's ability to perform advanced maneuvers and manage emergency situations, such as a single-engine failure during takeoff.

The researchers recruited 30 male commercial airline pilots and split them into teams of two. Each team was asked to perform three 3-hour-long flight simulations that consisted of 21 maneuvers of varying degrees of difficulty without the aid of autopilot. Both pilots on each team took a 90-minute turn as the flying pilot during each simulation. CO₂ levels were randomized to either 700 ppm, 1,500 ppm, or 2,500 ppm, and each pilot flew one flight at each CO₂ level over the course of the study. A Federal Aviation Administration (FAA) Designated Pilot Examiner monitored and assessed all simulations, and the pilots and the FAA examiner were unaware of the CO₂ levels during the simulations.

The findings showed that the pilots were 69% more likely to receive a passing grade on a maneuver when CO₂ levels were 700 ppm compared with 2,500 ppm. When CO₂ levels were 1,500

ppm, the pilots were 52% more likely to successfully perform a maneuver than when CO2 levels were 2,500 ppm. When the researchers compared the difference in pilot performance at 700 ppm and 1,500 ppm, the difference was not statistically significant, but they did find that pilots were more likely to successfully perform some of the most difficult maneuvers at the lower CO2 level. The study also found that the negative effects of CO2 on flight performance became more pronounced the longer the pilots were in the simulator.

While data on CO2 levels on flight decks are limited, previous research has shown that average CO2 levels on the flight deck are less than 800 ppm. However, they have been measured as high as 2,000 ppm on the flight deck and even higher in the cabin during the boarding process, depending on the type of airplane and other factors. While the FAA has regulations pertaining to airplanes' environmental control systems, the National Research Council has suggested that current standards for ventilation rates on flight decks may be inadequate.

"Using a flight simulator gave us a unique opportunity to test the impact of extreme, but rare, events in airplanes," said Piers MacNaughton, research fellow and one of the investigators on the study. "Our results suggest that we need to know more about how air quality on the flight deck can be used to enhance pilot performance."

Source: www.sciencedaily.com (August 8, 2018)