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 – 2º semestre de 2019 – Questões de Matemática

27 de maio de 2019

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.																

Questões em Português

1. Uma certa reta passa pelos pontos $(x, y) = (2, 0)$ e $(x, y) = (0, 2)$ do plano cartesiano. Uma outra reta passa pelos pontos $(x, y) = (0, 2.5)$ e $(x, y) = (5, 0)$. A interseção entre estas duas retas se dará no ponto $(x, y) =$

   (a) $(1.25, 3.5)$

   (b) $(-1, 3)$

   (c) $(3, 0.5)$

   (d) $\left(\dfrac{10}{17}, \dfrac{30}{17}\right)$

   (e) não existe interseção entre estas retas

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2. Um jogo baralho comum possui, além dos coringas, 52 cartas, onde cada uma pertence um entre quatro naipes, sejam eles paus (♣), copas (♡), ouros (♢) e espadas (♠). Cada carta também é caracterizada por um dos treze valores, sejam eles ás (A), 2, 3, 4, … 10, valete (J), dama (Q) e rei (K). Uma trinca consiste de três cartas de quaisquer naipes, mas valores iguais, não importando a ordem. Tomam-se dois baralhos completos, mas sem os coringas, perfazendo então 104 cartas, nos quais as cartas de valores e naipes iguais são indistinguíveis. Quantas trincas distintas podem ser feitas com tais cartas?

   (a) 39
   (b) 78
   (c) 208
   (d) 234
   (e) 728

3. A entrega de suprimentos em uma frente de batalha depende de se vencer um percurso de 200 km em terra com caminhões e, depois, 30 km de pântano por barco. Um caminhão pode viajar a 40 km/h e levar 10 toneladas de carga. Um barco atravessa o pântano a 24 km/h e leva uma tonelada de carga. Supondo que dois caminhões operem no percurso continuamente, quantos barcos seriam necessários para levar continuamente à frente de batalha a carga pelos caminhões?

   (a) 2 barcos
   (b) 3 barcos
   (c) 5 barcos
   (d) 10 barcos
   (e) 20 barcos

4. Na Figura **??**, $ABGH$, $BCFG$, $CDEF$ são quadrados adjacentes, assim como $IDFB$ e $BFJH$. Assinale a alternativa *falsa*:

   (a) $\widehat{BHD} = \widehat{HDJ}$
   (b) $\triangle BHD$ e $\triangle FGD$ são triângulos semelhantes
   (c) $\widehat{DHE} + \widehat{DGE} = 45°$
   (d) $\overline{BF} \cdot \overline{GF} = \overline{DF}^2$
   (e) $\tan\left(\widehat{DHE}\right)$, $\tan\left(\widehat{DGE}\right)$ e $\tan\left(\widehat{DFE}\right)$ estão em progressao aritmética

5. Na Figura **??**, $\widehat{DA} = \widehat{AE}$. Assinale a alternativa *falsa*:

   (a) $\alpha = \dfrac{\widehat{DA} + \widehat{EC} + \widehat{CB}}{2} = \dfrac{\widehat{AE} + \widehat{EC} + \widehat{CB}}{2}$
   (b) $\beta = \dfrac{\widehat{AD} + \widehat{DB}}{2}$
   (c) $\overline{AG} \cdot \overline{GB} = \overline{DG} \cdot \overline{GE}$
   (d) o quadrilátero $GFCB$ terá sempre um círculo circunscrito a ele.
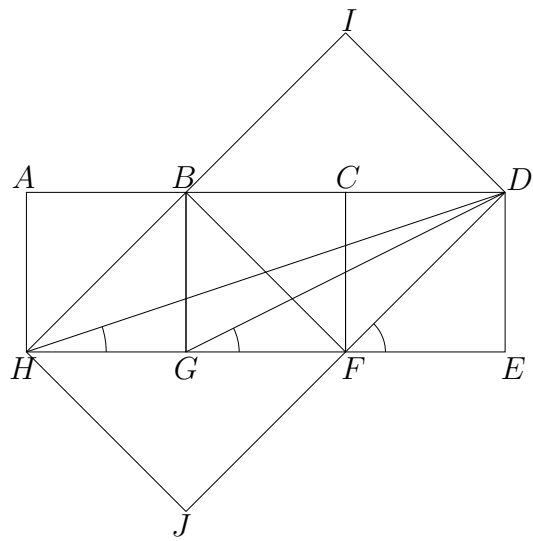   (e) o quadrilátero $GFCB$ terá sempre um círculo inscrito a ele.
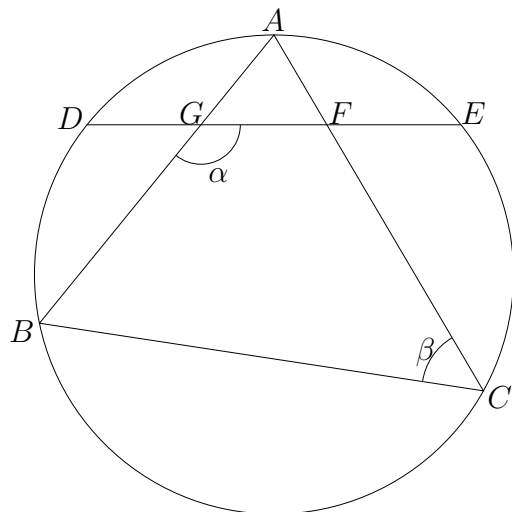
Figura 1: Quadrados adjacentes

Figura 2: Quadrilátero interno a um círculo

6. Se o sistema de equações

$$\begin{cases} \ln\left(\frac{x^4}{y}\right) &= 5 \\ \ln\left(x\,y^2\right) &= 8 \end{cases}$$

tem a mesma solução que a equação, então $y = x^\alpha$,

   (a) $\alpha = \log_3(2)$

   (b) $\alpha = \frac{\log(3)}{\log(2)}$

   (c) $\alpha = \ln(6)$

   (d) $\alpha = 1.5$

   (e) $\alpha \notin \mathbb{R}$ (i.e., não existe solução real para α)

7. O termo independente de x na expansão de $\left(x^2 - \frac{1}{x^3}\right)^5$ tem coeficiente igual a

   (a) 1

   (b) -1

   (c) -5

   (d) 10

   (e) Não existe termo independente nesta expansão

8. Qual dos seguintes números aproxima melhor a expressão $\dfrac{0.2222 \cdot 0.6666 \cdot 0.375}{0.1666 \cdot 0.8333 \cdot 0.3333}$?

   (a) 1.5

   (b) 1.25

   (c) 1.234

   (d) 1.2

   (e) 0.875

Questões em Inglês

9. An artist wishes to paint a circular region on a square poster that is 2 feet on a side. If the area of the circular region is to be $\dfrac{1}{4}$ the area of the poster, what must be the radius of the circular region in feet?

   (a) $\dfrac{\sqrt{2}}{2\pi}$

   (b) $\sqrt{\dfrac{1}{\pi}}$

   (c) 1

   (d) $\sqrt{\dfrac{2}{\pi}}$

   (e) $\dfrac{\pi\sqrt{2}}{2}$

Table 1: Chart comparing calories and protein content of two kinds of food

Food	Calories per kilogram	Protein per kilogram
X	4000	450
Y	450	270

10. The product of two integer numbers is $x \cdot y = 7$ and its difference is $x - y = 6$. The problem of finding x, y as an ordered pair of real numbers

    (a) has no solution
    (b) has only one solution
    (c) has two distinct solutions
    (d) has three distinct solutions
    (e) has several solutions

11. In a mayoral election, Candidate A received $\frac{1}{4}$ more votes than Candidate B, and Candidate B received $\frac{1}{5}$ fewer votes than Candidate C. If Candidate C received 30000 votes, how many votes did Candidate A receive?

    (a) 22500
    (b) 27500
    (c) 30000
    (d) 32500
    (e) 40000

12. Table **??** gives the number of calories and grams of protein per kilogram of foods X and Y. A total of 7 kilograms of X and Y are combined to make a certain food mixture. About this mixture, two statements are given:

    I. The mixture has a total of 24000 calories.
    II. The mixture has a total of 2430 grams of protein.

    If it is asked to determine how many kilograms of food X are in the mixture, mark the right answer about the statements above:

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

13. Which of the following is equal to the average (arithmetic mean) of $(x+2)^3$ and $(x-2)^3$?

  (a) x^3

  (b) $x^3 + 8$

  (c) $x^3 + 3x$

  (d) $x^3 - 12x$

  (e) $x^3 + 12x$

14. If $\dfrac{1}{2} - \dfrac{1}{3} + \dfrac{1}{4} = \dfrac{5}{x}$, which of the following must be an integer?

  I. $\dfrac{x}{8}$

  II. $\dfrac{x}{12}$

  III. $\dfrac{x}{24}$

  (a) I only

  (b) II only

  (c) I and III only

  (d) II and III only

  (e) I, II, and III

15. Coins are to be put into 8 pockets so that each pocket contains at least one coin. At most 3 of the pockets are to contain the same number of coins, and no two of the remaining pockets are to contain an equal number of coins. What is the least possible number of coins needed for the pockets?

  (a) 8

  (b) 12

  (c) 18

  (d) 23

  (e) 27

16. In how many arrangements can a teacher seat 4 girls and 4 boys in a row of 8 seats if the boys are to have the first, third, fifth and seventh seats?

  (a) 16

  (b) 48

  (c) 72

  (d) 128

  (e) 576

Cópia das respostas da prova

Nome do Candidato

O condidato poderá copiar suas respostas para as questões da prova na tabela desta folha e poderá levá-la consigo ao término da prova. É importante lembrar que não será dado tempo adicional para o preenchimento da mesma. Assim caso o candidato tenha interesse, ele deverá preenche-la no tempo regular da prova (90 minutos).

Questão	Resposta
1	b
2	c
3	c
4	anulada
5	e
6	d
7	d
8	d
9	b
10	c
11	c
12	d
13	e
14	b
15	d
16	e

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Processo Seletivo ITA - PG-EIA - 2º semestre de 2019

Prova Escrita/Língua Inglesa

27 de maio de 2019

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.

What China Can Learn from New York City about Wastewater Management

Millions of Chinese citizens are flooding into urban areas throughout the country, with 70 percent of the nation's population expected to reside in cities by 2030. As cities face an influx of residents, they also face an influx of wastewater and sludge. Currently, 80 percent of sludge in China is improperly dumped—an increasingly controversial environmental issue that has urban centers scrambling to decrease pollution by improving their wastewater treatment plants (WWTPs). As it grapples with these challenges, China could use an example to follow. New York City's large size and innovative wastewater system make it one of the only municipalities in the United States that can serve as a useful case study for China's growing cities.

New York City's five boroughs must manage and treat the wastewater and waste generated by its 8.6 million residents. The city's households and businesses typically produce tons of waste, about one quarter of which is organic. Fortunately, this organic waste isn't actually waste at all; it can be processed in ways that produce energy. Some of New York City's advanced treatment plants use innovative methods to capture valuable by-products of organic waste, such as methane and digestate, which can then be reused or sold.

In addition to the standardized multi-stage wastewater treatment process, all NYC wastewater treatment includes an advanced process called anaerobic digestion (AD). This process allows anaerobic bacteria to "eat away" the organics in sludge, generating methane biogas as they do so. This methane—a notorious greenhouse gas that causes 25 percent of man-made global warming-—can be captured in vessels called digesters, preventing it from entering the atmosphere. The captured methane can then be used as a source of energy in the form of heat, renewable natural gas or even vehicle biofuel.

The private company Waste Management is partnering with Newtown Creek in a pilot co-digestion project. Both partners reap benefits: Newtown Creek receives higher quality methane gas and Waste Management gets a low cost and eco-friendly alternative to disposing food waste into landfills.