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雅思 · 托福双料满分教师领衔授课

地址　江苏省无锡市中山路 288 号
云蝠大厦 1201–1202

电话　0510-80702828

HEKADEMIA 海客学院

博士执教 · 人文为本 · 学者养成

地址　525 W 8th Ave #717,
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Answer **all** the questions.

1 **(i)** On the same axes, sketch the curves $y = e^{-x}$ and $y = \ln x$, showing the intercepts clearly. [2]

(ii) Hence state the number of solution(s) for the equation $e^{-x} = \ln x$. [1]

2 Find the coordinates of the points of intersection of the line $y = 2x + 3$ and the curve $y^2 = x + 3$. [4]

3 In the NBA finals, Chris Paul and Giannis are facing off against each other. The path, which the basketball travels from Chris Paul's hand to the hoops, is modelled by the equation $h = -2t^2 + 3t + c$, such that the height of the ball at time t seconds is h metres. It is given that Giannis can reach a blocking height of 3 metres.

Find the range of values of c such that Chris Paul's shot will not be blocked. [3]

4 The triangle ABC is such that its area is $\left(24+15\sqrt{3}\right)$ cm^2, the length of AB is $\left(4+8\sqrt{3}\right)$ cm and angle BAC is $60°$. **Without using a calculator**, find the length, in cm, of AC in the form $a+b\sqrt{3}$, where a and b are integers. [5]

5 Express $\frac{8x^2 - 3x - 6}{(x-3)(2x^2+1)}$ in partial fractions. [5]

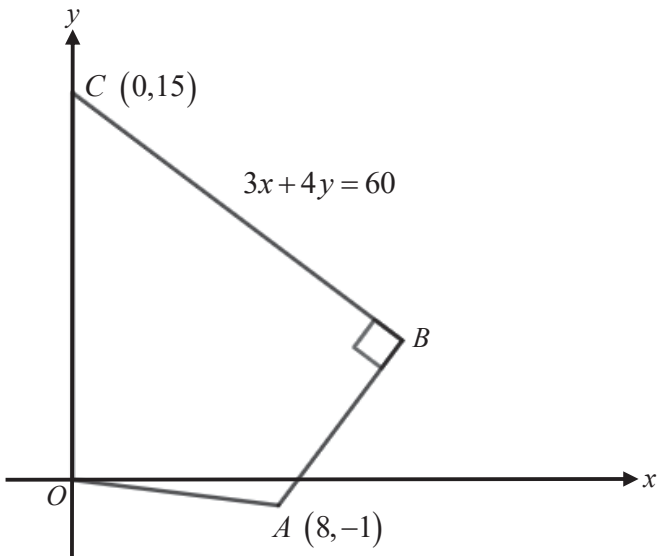
6 The total number of COVID-19 cases, C, in Singapore is given by $C = Ae^{kt}$, where A and k are constants and t is measured in months. The initial reported COVID-19 cases was 13 in January 2020 and there were 65 686 cases in July 2021.

(i) Find the value of A and of k. [4]

(ii) Calculate, to the nearest whole number, the minimum number of months for the total number of COVID-19 cases to exceed one hundred thousand in Singapore if there are no further measures to restrict the spread of COVID-19. [2]

7 **Solutions to this question by accurate drawing will not be accepted.**

In the diagram, the equation of BC is $3x+4y=60$, angle $ABC = 90°$, and the coordinates of A is $(8,-1)$ and C is $(0,15)$.



(i) Find the coordinates of B. [4]

(ii) Find the area of the quadrilateral $OABC$. [2]

8 **(a)** **Without using a calculator**, evaluate $\log_a 5a^2 + \log_a 2a^3 - \log_a 10$. [2]

(b) Solve the equation $\log_3 \frac{3}{p} + 2\log_{\frac{1}{9}} p = 3$. [5]

9 Given that the coefficient of x^3 in the expansion of $\left(x^2 - \frac{m}{x}\right)^9$ is $-\frac{14}{27}$,

(i) show that $m = \frac{1}{3}$, [3]

(ii) explain why there is no term independent of x in the expansion of $\left(243 + \frac{54}{x^3}\right)\left(x^2 - \frac{m}{x}\right)^9$. [4]

10 Given that $f(x) = 2x^3 - 5x^2 - 9$,

(i) find the remainder when $f(x)$ is divided by $x + 2$, [2]

(ii) show that $x - 3$ is a factor of $f(x)$ and hence explain why there is only one solution for the equation $f(x) = 0$. [5]

11 A circle passes through the points $A(3,3)$ and $B(7,-5)$. Its centre lies on the line $6y = x - 15$.

(i) Show that the coordinates of the centre of the circle is $(3,-2)$. [4]

(ii) Find the equation of the circle. [2]

Another circle has the equation $x^2 + y^2 - 10x - 12y + 36 = 0$.

(iii) Will the two circles intersect?
Justify your answer with clear working. [3]

12 **(a)** Given that $\sin A = \frac{5}{13}$ and $\cos B = -\frac{7}{25}$, where A and B are in the same quadrant. **Without using a calculator**, find the exact value of

(i) $\cos A$, [1]

(ii) $\cos(A + B)$, [2]

(iii) $\sin\frac{A}{2}$, [4]

(iv) $\tan C$, given that $\tan(A+C) = -\frac{3}{41}$ and C is an acute angle. [2]

(b) The equation of a curve is $y = 3\sin\frac{1}{2}x - 2$.

(i) State the amplitude of y. [1]

(ii) State the period of y. [1]

(iii) Sketch the graph of $y = 3\sin\frac{1}{2}x - 2$ for $0 \le x \le 2\pi$. [3]