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QUESTION 6

5 marks

Consider the following functions:

$$\begin{aligned} f(n) &= 2^n \\ g(n) &= n! \\ h(n) &= n^{\log(n)} \end{aligned}$$

Which of the following statements about the asymptotic behavior of $f(n)$, $g(n)$, and $h(n)$ is true?

- (A) $f(n) = O(g(n))$; $g(n) = O(h(n))$
- (B) $f(n) = \Omega(g(n))$; $g(n) = O(h(n))$
- (C) $g(n) = O(f(n))$; $h(n) = O(f(n))$
- (D) $h(n) = O(f(n))$; $g(n) = \Omega(f(n))$

☐ A

☐ B

☐ C

☒ D

Your submitted response was correct.

Explanation

According to the order of growth: $h(n) < f(n) < g(n)$ ($g(n)$ is asymptotically greater than $f(n)$ and $f(n)$ is asymptotically greater than $h(n)$) We can easily see above order by taking logs of the given 3 functions

$$\log(n \cdot \log(n)) < n < \log(n!) \quad (\text{logs of the given } f(n), g(n) \text{ and } h(n)).$$

Note that $\log(n!) = \Theta(n \log n)$

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