Question 1

QUESTION 3

Simple Familiar
Technology Active
2021

Given $n \in Z^+$, for which proposition can the initial statement for mathematical induction be proven?

(A) $x^{2n} - y^{2n}$ is divisible by $(x+y) \forall (x+y) \neq 0$

(B) $1^2 + 2^2 + 3^2 + \cdots + n^2 = \frac{1}{6}n\left(2n^2 + 3n - 1\right)$

(C) $(n+1)^3 + (n+2)^3$ is divisible by 3

(D) $\sum_{r=1}^{n} \frac{1}{(2r-1)(2r+1)} = \frac{n}{n+1}$

Question 2

QUESTION 7

Simple Familiar
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Given $\boldsymbol{a} = (3n+2)\hat{\boldsymbol{i}} + 2\hat{\boldsymbol{j}}$, $\boldsymbol{b} = (n-2)\hat{\boldsymbol{j}}$ and $\boldsymbol{a} \times \boldsymbol{b} = (1-2n)\hat{\boldsymbol{k}}$, the possible values of n are

(A) -5 and $\frac{1}{3}$

(B) -1 and $\frac{5}{3}$

(C) 1 and $-\frac{5}{3}$

(D) 5 and $-\frac{1}{3}$

Question 3

QUESTION 9

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Consider the matrix equation.

$$\mathbf{X}\begin{bmatrix} 0 & 0 & 1 \\ 0 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 2 & 2 \\ 2 & 1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$$

Matrix $\mathbf{X}$ is

(A) $\begin{bmatrix} 0 & 1 & 1 \\ 1 & -1 & 2 \\ -1 & 0 & 2 \end{bmatrix}$

(B) $\begin{bmatrix} 0 & 1 & -1 \\ 1 & -1 & 0 \\ 1 & 2 & 2 \end{bmatrix}$

(C) $\begin{bmatrix} 2 & 2 & 1 \\ 4 & 3 & 3 \\ 5 & 5 & 5 \end{bmatrix}$

(D) $\begin{bmatrix} 2 & 4 & 5 \\ 2 & 3 & 5 \\ 1 & 3 & 5 \end{bmatrix}$

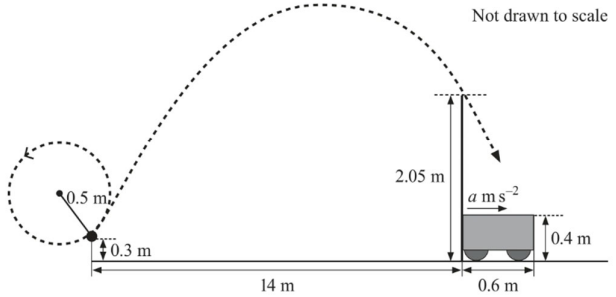
Question 4

QUESTION 19 (7 marks)

Complex Unfamiliar
Technology Active
2020

An object is swinging at the end of a 0.5 m length of string in a vertical circular path with a constant angular speed, completing each revolution in 0.24 seconds.

The object is projected from a height of 0.3 m above the ground in a vertical plane and **just** passes over a narrow pole as shown in the diagram. The pole is 2.05 m high and its base is 14 m horizontally from where the object was projected.



A flat-topped vehicle of length 0.6 m and height 0.4 m is initially at rest against the pole as shown in the diagram. At the instant that the object is projected, the vehicle moves in a horizontal direction away from the pole in the same vertical plane with an acceleration of magnitude of a m s^{-2}. The object strikes the middle of the top of the vehicle.

Assuming that air resistance is negligible, use vector calculus to model the motion of the projectile in order to determine the value of a.