AP PRECALCULUS • EXERCISE SHEET

4.14 Matrices Modeling Contexts

Name: _____ Class: _____ Date: _____ **Total: 8 marks**

Objective

Build the skills to answer exam questions on **matrices modeling contexts**.

You must be able to:

- use a **transition matrix** 转移矩阵 to step a state vector forward

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Transition matrices

A transition matrix models a process that moves between states each step:

$$\text{next state} = (\text{transition matrix}) \times (\text{current state}).$$

Repeated multiplication steps the model forward in time.

■ Example

State $\begin{bmatrix} \text{city} \\ \text{suburb} \end{bmatrix}$: each year a transition matrix redistributes the population; multiply to get next year's distribution.

2 Practice

2.1 State what a transition matrix models. [1]

2.2 State how to get the next state from the current state. [1]

2.3 If the current state is $\begin{bmatrix} 10 \\ 20 \end{bmatrix}$ and the transition is the identity matrix, state the next

state. [1]

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3 Exam-style questions

3.1 A transition matrix models [1]

- **A** a single number
- **B** movement between states over steps
- **C** a static picture
- **D** an angle

3.2 The next state equals [1]

- **A** current state minus the matrix
- **B** matrix times current state
- **C** matrix plus current state
- **D** the current state alone

3.3 Current state $\begin{bmatrix}100\\0\end{bmatrix}$; transition $\begin{bmatrix}0.5 & 0\\0.5 & 1\end{bmatrix}$ (half of state 1 moves to state 2 each step).

(a) Compute the next state. [1]

(b) State the new value of state 1. [1]

(c) State the new value of state 2. [1]

4 Go further

- work through the **4.14 Matrices Modeling Contexts** lesson on the **Learn** page;
- read the **Functions Involving Parameters, Vectors, and Matrices** section of the AP Precalculus handout on the **Know** page.

Solutions

2.1 a process that moves between states each step.

2.2 multiply the transition matrix by the current state vector.

2.3 $\begin{bmatrix}10\\20\end{bmatrix}$ (unchanged).

3.1 B.

3.2 B.

3.3 (a) $\begin{bmatrix}0.5(100)+0\\0.5(100)+1(0)\end{bmatrix} = \begin{bmatrix}50\\50\end{bmatrix}$. (b) 50. (c) 50.