

7. A bacterial culture has area  $p \text{ mm}^2$  at time  $t$  hours after the culture was placed onto a circular dish.

A scientist states that at time  $t$  hours, the rate of increase of the area of the culture can be modelled as being proportional to the area of the culture.

(a) Show that the scientist's model for  $p$  leads to the equation

$$p = ae^{kt}$$

where  $a$  and  $k$  are constants.

(4)

The scientist measures the values for  $p$  at regular intervals during the first 24 hours after the culture was placed onto the dish.

She plots a graph of  $\ln p$  against  $t$  and finds that the points on the graph lie close to a straight line with gradient 0.14 and vertical intercept 3.95

(b) Estimate, to 2 significant figures, the value of  $a$  and the value of  $k$ .

(3)

(c) Hence show that the model for  $p$  can be rewritten as

$$p = ab^t$$

stating, to 3 significant figures, the value of the constant  $b$ .

(2)

With reference to this model,

(d) (i) interpret the value of the constant  $a$ ,

(ii) interpret the value of the constant  $b$ .

(2)

(e) State a long term limitation of the model for  $p$ .

(1)