Task
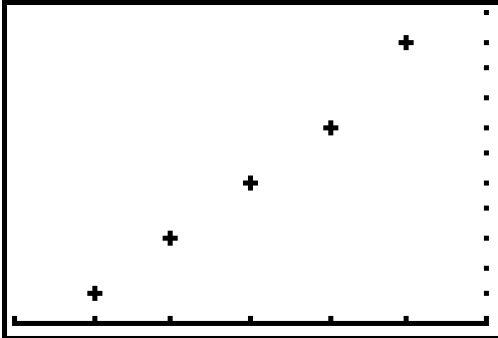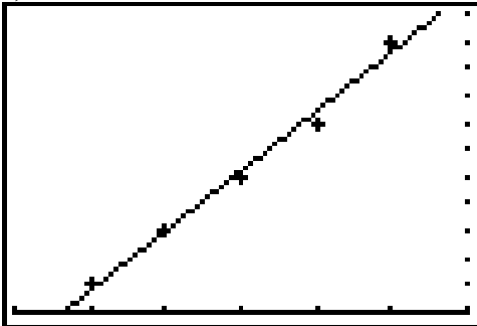**World Population**
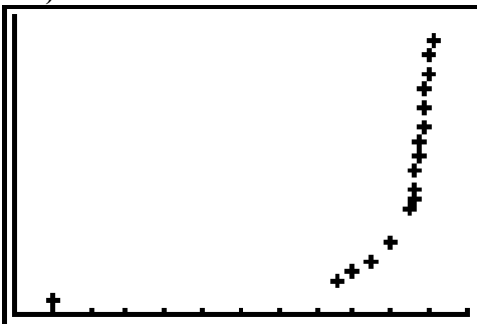**Sample Solution**

1. a)

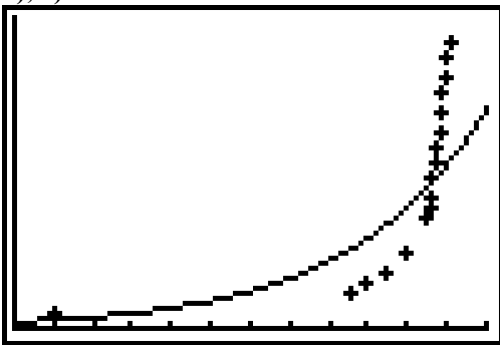**b)** Predictions may vary. For example, a linear model seems to be the best fit.
c)

The equation of the line of best fit is $y = 2200x + 22\ 800\ 000$. The correlation coefficient is $r^2 = 0.9918$, which is a very strong fit. This confirms my prediction.

2. a)

b) Predictions may vary. For example, an exponential model seems to be the best fit.
Yes. A quadratic model might also fit.

a), c)

The equation of the exponential curve of best fit is $y = (9\ 644\ 469)(1.002\ 979\ 206)^x$. The correlation coefficient is $r^2 = 0.7143$, which is not a very strong fit.
The equation of the quadratic curve of best fit is $y = 21\ 948x^2 - 61\ 266\ 187x + 39\ 693\ 764\ 925$.
The correlation coefficient is $r^2 = 0.8230$, which is a stronger fit than the exponential model. But according to the quadratic model, the world's population was negative from 1022 until 1769. Therefore, the exponential model is a better fit. My prediction was correct.

3. The graph in question 1 is a line, while the graph in question 2 is a curve. The world's population started increasing rapidly in the 20th century.

4. a) $y = 2200(2060) + 22\ 800\ 000$
         $= 27\ 332\ 000$
According to the linear model, the world's population in 2060 will be 27 332 000.
b) $y = (9\ 644\ 469)(1.002\ 979\ 206)^{(2060)}$
         $= 4\ 422\ 340\ 000$
According to the exponential model, the world's population in 2060 will be 4 422 340 000.
c) The prediction from part b) seems more reasonable. The population in 2005 is 6 453 628 000. Both predictions are lower than the 2005 population, but the prediction from the exponential model is much closer to the 2005 value.

5. Use the exponential function.
  $14\ 000\ 000\ 000 = (9\ 644\ 469)(1.002\ 979\ 206)^x$

  $\dfrac{14\ 000\ 000\ 000}{9\ 644\ 469} = (1.002\ 979\ 206)^x$

         $1451.6 \doteq (1.002\ 979\ 206)^x$

Use systematic trial.
$(1.002\ 979\ 206)^{2100} \doteq 516.5$ too low
$(1.002\ 979\ 206)^{2500} \doteq 1697.6$ too high
$(1.002\ 979\ 206)^{2400} \doteq 1260.8$ too low
$(1.002\ 979\ 206)^{2450} \doteq 1462.9$ too high
$(1.002\ 979\ 206)^{2440} \doteq 1420.1$ too low
$(1.002\ 979\ 206)^{2445} \doteq 1441.3$ too low
$(1.002\ 979\ 206)^{2446} \doteq 1445.6$ too low
$(1.002\ 979\ 206)^{2447} \doteq 1449.9$ too low
$(1.002\ 979\ 206)^{2448} \doteq 1454.3$ too high

According to the exponential model, the world's population will reach 14 000 000 000 between 2447 and 2448.