**1.*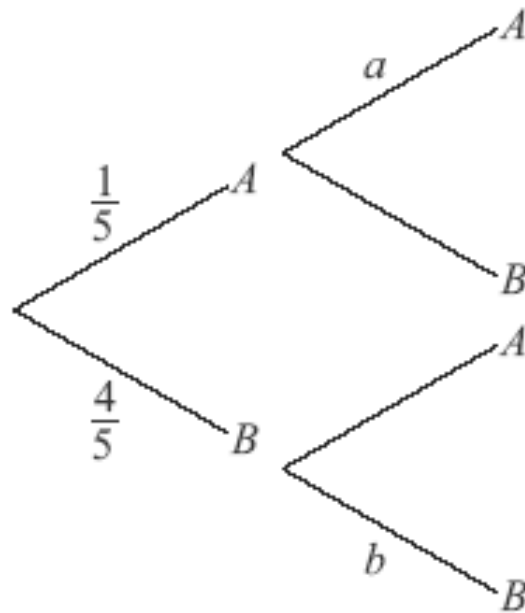* (a) Phoebe chooses a biscuit from a blue tin on a shelf. The tin contains one chocolate biscuit and four plain biscuits. She eats the biscuit and chooses another one from the tin. The tree diagram below represents the situation with the four possible outcomes where *A* stands for chocolate biscuit and *B* for plain biscuit.

(i) Write down the value of *a*.

(ii) Write down the value of *b*.

(iii) Find the probability that both biscuits are plain.

(6)

On another shelf there are two tins, one red and one green. The red tin contains three chocolate biscuits and seven plain biscuits and the green tin contains one chocolate biscuit and four plain biscuits. Andrew randomly chooses either the red or the green tin and randomly selects a biscuit.

(b) **Complete** the tree diagram below.
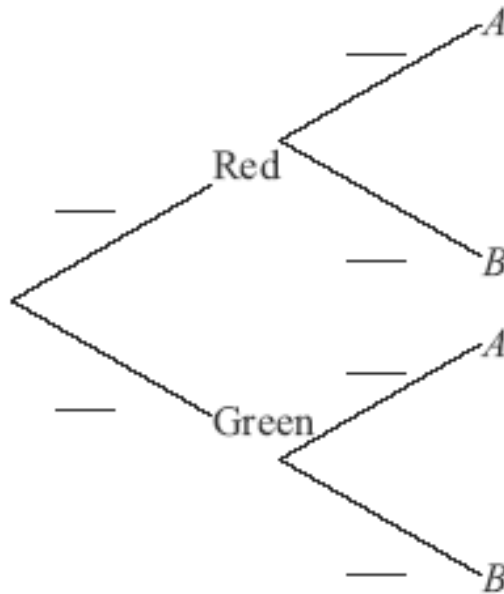
(3)

(c) Find the probability that

(i)   he chooses a chocolate biscuit;

(ii) he chooses a biscuit from the red tin given that it is a chocolate biscuit.

(6)

(Total 15 marks)

2. **Throughout this question *all* the numerical answers must be given correct to the nearest whole number.**

Park School started in January 2000 with 100 students. Every full year, there is an increase of 6 % in the number of students.

(a) Find the number of students attending Park School in

   (i) January 2001;

   (ii) January 2003.

(4)

(b) Show that the number of students attending Park School in January 2007 is 150.

(2)

Grove School had 110 students in January 2000. Every full year, the number of students is 10 more than in the previous year.

(c) Find the number of students attending Grove School in January 2003.

(2)

(d) Find the year in which the number of students attending Grove School will be first 60 % **more than** in January 2000.

(4)

Each January, one of these two schools, the one that has more students, is given extra money to spend on sports equipment.

(e) (i) Decide which school gets the money in 2007. Justify your answer.

   (ii) Find the first year in which Park School will be given this extra money.

(5)
(Total 17 marks)

3. (a) A function $f(x)$ is defined by $f(x) = 2x^2 - 10x + 60$, $-5 \leq x \leq 8$.

x	-5	0	2	5	8
$f(x)$	160	a	b	60	108

(i) Write down the values of a and b.

(2)

(ii) Using the values in the above table, draw the graph of $f(x)$ on a set of coordinate axes. Use a scale of 1 cm to represent 1 unit on the horizontal axis and 1 cm to represent 20 units on the vertical axis.

(4)

(iii) Show that the coordinates of the vertex of the graph are (2.5, 47.5)

(3)

(iv) State the values of x for which the function is increasing.

(2)

(b) A second function $h(x)$ is defined by:

$$h(x) = 80, \ 0 \leq x \leq 8.$$

(i) On the same axes used for part (a), draw the graph of $h(x)$.

(2)

(ii) Find the coordinates of the point at which $f(x) = h(x)$.

(2)

(iii) Find the vertical distance from the vertex of the graph of $f(x)$ to the line $h(x)$.

(2)
(Total 17 marks)

4. The number of bottles of water sold at a railway station on each day is given in the following table.

Day	0	1	2	3	4	5	6	7	8	9	10	11	12
Temperature ($T°$)	21	20.7	20	19	18	17.3	17	17.3	18	19	20	20.7	21
Number of bottles sold (n)	150	141	126	125	98	101	93	99	116	121	119	134	141

(a) Write down

    (i) the mean temperature;

    (ii) the standard deviation of the temperatures.

(2)

(b) Write down the correlation coefficient, r, for the variables n and T.

(1)

(c) Comment on your value for r.

(2)

(d) The equation of the line of regression for n on T is $n = dT - 100$.

    (i) Write down the value of d.

    (ii) Estimate how many bottles of water will be sold when the temperature is 19.6°.

(2)

(e) On a day when the temperature was 36° Peter calculates that 314 bottles would be sold. Give one reason why his answer might be unreliable.

(1)
(Total 8 marks)

5. The triangular faces of a square based pyramid, ABCDE, are all inclined at 70° to the base. The edges of the base ABCD are all 10 cm and M is the centre. G is the mid-point of CD.

(Diagram not to scale)
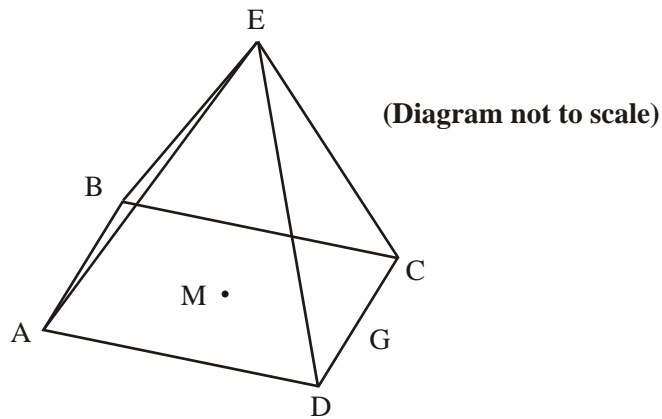
(a) Using the letters on the diagram draw a triangle showing the position of a 70° angle.

(1)

(b) Show that the height of the pyramid is 13.7 cm, to 3 significant figures.

(2)

(c) Calculate

    (i)   the length of EG;

    (ii)   the size of angle $D\hat{E}C$.

(4)

(d) Find the total surface area of the pyramid.

(2)

(e) Find the volume of the pyramid.

(2)
(Total 11 marks)

6. The function $f(x)$ is defined by $f(x) = 1.5x + 4 + \dfrac{6}{x}$, $x \neq 0$.

(a)   Write down the equation of the vertical asymptote.

(2)

(b)   Find $f'(x)$.

(3)

(c)   Find the gradient of the graph of the function at $x = -1$.

(2)

(d)   Using your answer to part (c), decide whether the function $f(x)$ is increasing or decreasing at $x = -1$. Justify your answer.

(2)

(e)   Sketch the graph of $f(x)$ for $-10 \leq x \leq 10$ and $-20 \leq y \leq 20$.

(4)

P_1 is the local maximum point and P_2 is the local minimum point on the graph of $f(x)$.

(f)   Using your graphic display calculator, write down the coordinates of

   (i) P_1;

   (ii) P_2.

(4)

(g)   Using your sketch from (e), determine the range of the function $f(x)$ for $-10 \leq x \leq 10$.

(3)
(Total 20 marks)