1

(1) (Answer) 6 cm

(2) Since P and Q are midpoints of BE and CD, respectively, we have

$$BP=\frac{1}{2}BE=8\ (\text{cm})$$

$$CQ=\frac{1}{2}CD=5\ (\text{cm})$$

Let H be the point on BE such that BE and CH is perpendicular. Quadrilateral CQPH is a rectangle with

$$HC=PQ$$

$$HP=CQ=5\ \text{cm}$$

Thus,

$$BH=BP-HP$$

$$=8-5=3\ (\text{cm})$$

Using the Pythagorean theorem for right-angled triangle BCH,

$$HC^2=BC^2-BH^2$$

$$=100-9=91$$

Since $HC>0$, $HC=\sqrt{91}$ cm.

Therefore, $PQ=\sqrt{91}$ cm

(Answer) $\sqrt{91}$ cm

2

(3) The area of the equilateral triangle of sides $(a+2)$ cm is $\frac{\sqrt{3}}{4}(a+2)^2$ cm^2. Thus

$$\frac{\sqrt{3}}{4}(a+2)^2-\frac{\sqrt{3}}{4}a^2$$

$$=\frac{\sqrt{3}}{4}(a^2+4a+4)-\frac{\sqrt{3}}{4}a^2$$

$$=\frac{\sqrt{3}}{4}a^2+\sqrt{3}a+\sqrt{3}-\frac{\sqrt{3}}{4}a^2$$

$$=\sqrt{3}a+\sqrt{3}$$

Therefore, the difference of the areas of the two triangles is

$$(\sqrt{3}a+\sqrt{3})\ \text{cm}^2.$$

(Answer) $(\sqrt{3}a+\sqrt{3})$ cm^2

3

(4) (Answer) $n=65,\ 260$

4

(5) (Answer) $(a,\ a^2+a)$

(6) The graph of the quadratic function is a parabola that opens downward. Since the y-coordinate of the vertex must be negative,

$$a^2+a<0.$$

Solving this inequality,

$$a(a+1)<0,$$

so that $-1<a<0$.

(Answer) $-1<a<0$

5

(7) Since $\cos^2 A=1-\left(\frac{12}{13}\right)^2=\frac{25}{169}$, $\cos A=\pm\frac{5}{13}$. Using the law of cosines for △ABC,

$$x^2=13^2+14^2-2\cdot 13\cdot 14\cos A$$

$$=169+196\mp 140$$

$$=365\mp 140$$

(Signs correspond respectively)

Thus, $x^2=225,\ 505$.

Since $x>0$,

$$x=15,\ \sqrt{505}$$

(Answer) $x=15,\ \sqrt{505}$

6

(8) (Answer) 750 ways

(9) Let A be the event that

$$(a-b)(b-c)(c-d)\neq 0$$

The event that $(a-b)(b-c)(c-d)=0$ is the complement of A, written $\overline{A}$. The total number of outcomes when a die is rolled 4 times is

$$6^4=1296\ \ (\text{ways}).$$

From (8), we have

$$P(A)=\frac{750}{1296}.$$

Thus, the required probability is

$$P(\overline{A})=1-P(A)$$

$$=\frac{91}{216}$$

(Answer) $\frac{91}{216}$

7

(10) (Answer) One of the following figures.