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H31 数学 本試

1 (1) $\frac{2}{3} \div \left(-\frac{4}{9}\right) + (-2)^2 \times \frac{1}{5} = -\frac{2}{3} \times \frac{9}{4} + 4 \times \frac{1}{5}$

$= -\frac{3}{2} + \frac{4}{5}$

$= \frac{-3\times5+4\times2}{10} = -\frac{7}{10}$

(2) $\frac{1}{\sqrt{75}} \times \frac{\sqrt{45}}{2} \div \frac{\sqrt{3}}{\sqrt{20}} = \sqrt{\frac{1}{3\times5^2} \times \frac{3^2\times5}{2^2} \times \frac{2^2\times5}{3}} = 1$

(3) $x^2-3x-1=0$ $x = \frac{-(-3) \pm \sqrt{(-3)^2-4\cdot1\cdot(-1)}}{2} = \frac{3\pm\sqrt{9+4}}{2} = \frac{3\pm\sqrt{13}}{2}$

(4) $y=\frac{a}{x}$ に $(x,y)=(2,9)$ を代入 $9=\frac{a}{2}$ $\therefore a=18$

$y=\frac{18}{x}$ に $x=2$, $x=6$ を代入 $y=\frac{18}{2}=9$, $y=\frac{18}{6}=3$

よって変化の割合は $\frac{3-9}{6-2} = \frac{-6}{4} = -\frac{3}{2}$

(5) 5枚のコインの表裏の出方は $2^5=32$ 通り

	100	100		50	50	50		
(i)	0	0	のとき	1	1	1	1通り	7通り
(ii)	0	1	のとき	0	0	1		
				0	1	0	3通り	
				1	0	0		
(iii)	1	0	のとき	0	0	1		
				0	1	0	3通り	
				1	0	1		
(iv)	1	1	のとき				0通り	

$\therefore \frac{7}{32}$

(6) 1, 0, 2, 10, 8, 6, 1, 5, 9, 3

小さい順

0, 1, 1, 2, 3, 5, 6, 8, 9, 10

平均値：$\frac{1}{10}(1+0+2+10+8+6+1+5+9+3) = \frac{45}{10} = 4.5$

中央値：$\frac{3+5}{2} = 4$

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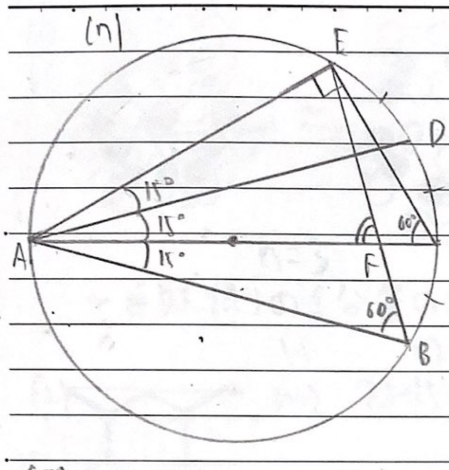
(7)



円周角の定理より

$\angle BAC = \angle CAD = \angle DAE = 15^\circ$

$\angle AEC = 90^\circ$ より

$\angle ACE = 180^\circ - \angle AEC - \angle CAE$

$= 180^\circ - 90^\circ - 30^\circ = 60^\circ$

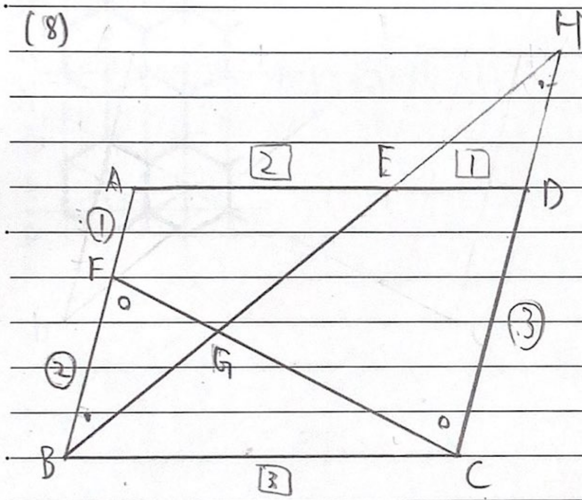
円周角の定理より

$\angle ABE = \angle ACE = 60^\circ$

よって

$\angle AFE = \angle ABF + \angle BAF = 60^\circ + 15^\circ = \underline{75^\circ}$

(8)



$HD : (HD + DC) = ED : BC$

$HD : (HD + 3) = 1 : 3$

$3HD = HD + 3$

$HD = \frac{3}{2}$

$\angle FBG = \angle CHG$, $\angle BFG = \angle HCG$ より

$\triangle GBF \sim \triangle GHC$

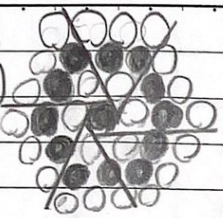
$FG : GC = BF : HC$

$= 2 : \left(\frac{3}{2} + 3\right)$

$= \underline{4 : 9}$

$\boxed{2}$

(1)



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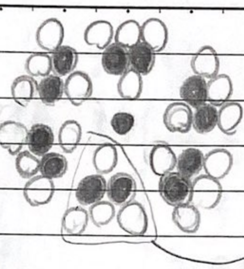
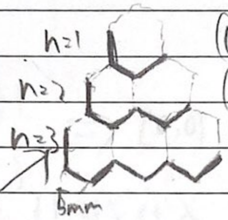


$n=3$



$(1+2) \times 5$

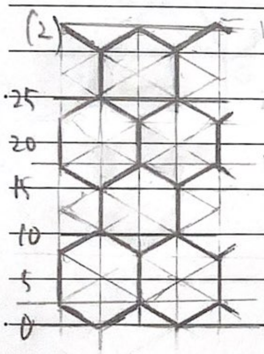
$(1+2+2) \times 5$

$(1+2+2+2) \times 5$

一番外側の鉛筆の本数は　$6n$ 本　$n=6 \Rightarrow 6 \times 6 = 36$ 本

〃　の辺の長さの合計は $6 \times 5(2n+1)$ mm　$30(2 \times 6+1) = 390$mm

(2)



$n=2$　$25+15+15$

$n=1$: $25+15$

$2n$ 段の鉛筆の束の高さは

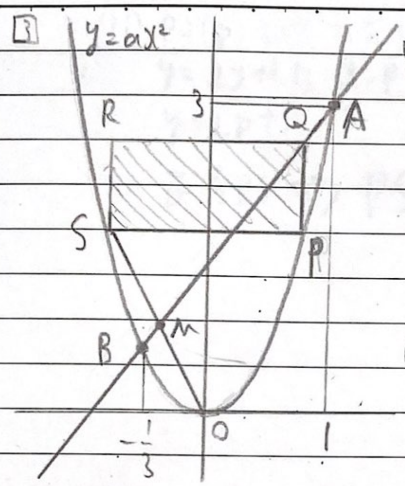
$15n + \frac{5}{2}$ mm

$15n + \frac{5}{2} = 182.5$

$15n = 180$

$\therefore n = 12$ 本

3



(1) $\begin{cases} -\frac{1}{3} \leqq x \leqq 1 \\ 0 \leqq y \leqq 3 \end{cases} \Rightarrow (0,0),\ (1,3)$ を含む

$y=ax^2$ に $(1,3)$ を代入

$3=a\times1^2$　$\underline{a=3}$

(2) $y=3x^2$ に $x=-\frac{1}{3}$ を代入　　$A=(1,3)$

$y=3\times\left(-\frac{1}{3}\right)^2=3\times\frac{1}{9}=\frac{1}{3}$　　よって $B=\left(-\frac{1}{3},\frac{1}{3}\right)$

$y=mx+n$ に $A(1,3)$, $B\left(-\frac{1}{3},\frac{1}{3}\right)$ を代入

$\begin{cases} 3=m\times1+n & ① \\ \frac{1}{3}=m\times\left(-\frac{1}{3}\right)+n & ② \end{cases}$　　③を①へ代入　$3=m+1$　$\therefore m=2$

$$\begin{array}{rl} ① & 3=m+n \\ +)\ ②\times3 & 1=-m+3n \\ \hline & 4=4n \quad \therefore n=1\ ③ \end{array}$$

$\underline{(m,n)=(2,1)}$

(3) $y=3x^2$ に $x=\frac{1}{2}$ を代入　$y=3\times\left(\frac{1}{2}\right)^2=\frac{3}{4}$

$\therefore P=\left(\frac{1}{2},\frac{3}{4}\right) \Rightarrow S=\left(-\frac{1}{2},\frac{3}{4}\right)$

直線OSの傾きは $\frac{\frac{3}{4}}{-\frac{1}{2}}=-\frac{3}{2}$, 切片は0 より　$y=-\frac{3}{2}x$

直線AB $\begin{cases} y=2x+1 & ① \\ y=-\frac{3}{2}x & ② \end{cases}$ 直線OS　　①=②　$2x+1=-\frac{3}{2}x$　　$x=-\frac{2}{7}$ ③

③を②へ代入　$y=-\frac{3}{2}\times\left(-\frac{2}{7}\right)=\frac{3}{7}$

$\therefore \underline{M=\left(-\frac{2}{7},\frac{3}{7}\right)}$

(4) (i) 直線ABが長方形を二等分 ⇒ 点Bと点Sが一致

$S=B=\left(-\frac{1}{3},\frac{1}{3}\right)$　$\therefore P=\left(\frac{1}{3},\frac{1}{3}\right)$　|　$x=\frac{1}{3}$ を $y=2x+1$ へ代入　$y=2\times\frac{1}{3}+1=\frac{5}{3}$

$PS=\frac{1}{3}-\left(-\frac{1}{3}\right)=\frac{2}{3}$　|　$Q=\left(\frac{1}{3},\frac{5}{3}\right)$　$PQ=\frac{5}{3}-\frac{1}{3}=\frac{4}{3}$

四角形PQRS $=\frac{2}{3}\times\frac{4}{3}=\underline{\frac{8}{9}}$

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(4)(ii) $P=(p,3p^2)$ とおくと $\Rightarrow S=(-p,3p^2)$ $PS=2p$

$y=2x+1$ に $x=p$ を代入 $\Rightarrow Q=(p,2p+1)$ $PQ=-3p^2+2p+1$

$y=2p+1$

正方形 $\Rightarrow PS=PQ$ $2p=-3p^2+2p+1$

$3p^2=1$ $p=\underline{\frac{1}{\sqrt{3}}}$ $(p>0)$

$r \quad \frac{3}{2}r \qquad 2r + \frac{3}{2}r + \frac{3}{4}r = \left(2 + \frac{9}{4}\right)r = \frac{17}{4}r = 17\sqrt{5}$

$r = 4\sqrt{5}$

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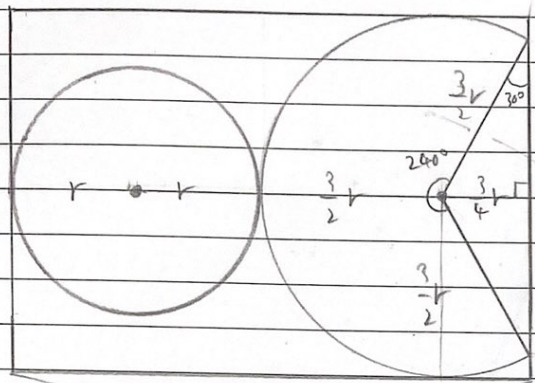
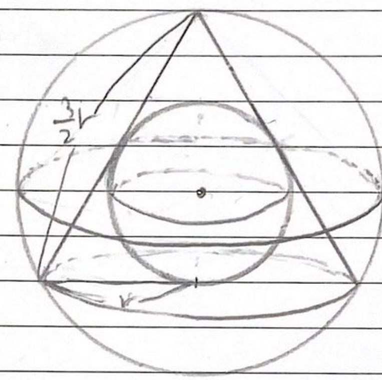
$\boxed{4}$

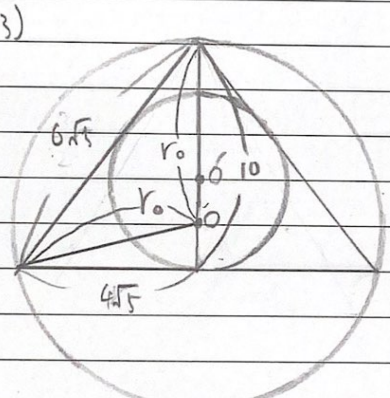




(1) $r + r + \frac{3}{2}r + \frac{3}{4}r = 17\sqrt{5} \qquad \frac{17}{4}r = 17\sqrt{5} \qquad r = \underline{4\sqrt{5}\ \text{cm}}$

(2) $h = \sqrt{\left(\frac{3}{2}r\right)^2 - r^2} = \sqrt{\left(\frac{9}{4} - 1\right)r^2} = r\sqrt{\frac{5}{4}} = \frac{\sqrt{5}}{2}r = \frac{\sqrt{5}}{2} \times 4\sqrt{5} = \underline{10\ \text{cm}}$

(3)



$r_0 + \sqrt{r_0^2 + (4\sqrt{5})^2} = 10$

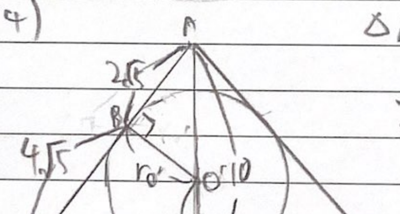
$r_0^2 - 80 = (10 - r_0)^2$

$= r_0^2 - 20r_0 + 100$

$20r_0 = 180$

$r_0 = \underline{9\ \text{cm}}$

(4)



$\triangle ABC \sim \triangle ADE$ より

$AB : BC = AD : DE$

$2\sqrt{5} : r_0' = 10 : 4\sqrt{5}$

$10r_0' = 2\sqrt{5} \cdot 4\sqrt{5} = 40$

$r_0' = 4$

$V = \frac{1}{3} \times (4\sqrt{5})^2 \pi \times 10$

$= \frac{16 \times 5 \times 10}{3}$

$W = \frac{4}{3}\pi \times 4^3 = \frac{4^4}{3}\pi$

$\therefore V : W = 16 \times 5 \times 10 : 4^4 = \underline{25 : 8}$

(5) $OO' = r_0 + r_0' - 10 = 9 + 4 - 10 = \underline{3\ \text{cm}}$