SO-IN EDU. (S.S.)
數研教育(中學部)

2025-DSE MATHEMATICS Compulsory Part Paper 2 Suggested Solution

1.	C	26.	B
2.	B	27.	A
3.	D	28.	C
4.	A	29.	A
5.	A	30.	B
6.	D	31.	D
7.	D	32.	C
8.	C	33.	C
9.	D	34.	D
10.	C	35.	A
11.	A	36.	B
12.	C	37.	A
13.	A	38.	A
14.	A	39.	B
15.	D	40.	B
16.	B	41.	C
17.	B	42.	B
18.	C	43.	C
19.	D	44.	A
20.	D	45.	D
21.	B		
22.	D		
23.	C		
24.	C		
25.	B		

SECTION A

1. C

$$\frac{(27x)^5}{(3x^{-2})^4}$$
$$=\frac{3^{15}x^5}{3^4x^{-8}}$$
$$=3^{11}x^{13}$$

2. B

$$36-(3m+4n)^2$$
$$=6^2-(3m+4n)^2$$
$$=(6+3m+4n)(6-3m-4n)$$

3. D

$$(x+8)(x+a)+b\equiv x^2+5a(x+3)$$
$$x^2+8x+ax+8a+b\equiv x^2+5ax+15a$$

By comparing the like terms on both sides,

$$8+a=5a$$
$$a=2$$
$$8a+b=15a$$
$$b=7a$$
$$=7(2)$$
$$=14$$

4. A

$$(3c+1)(d-4)=2d(5c-1)$$
$$3cd-12c+d-4=10cd-2d$$
$$-7cd-12c=4-3d$$
$$-c(7d+12)=4-3d$$
$$c=\frac{3d-4}{7d+12}$$

5. A

$$x^2+4x=k^2-2k-3$$
$$x(x+4)=(k-3)(k+1)$$

For $x = k - 3$,

$$\begin{aligned} &x(x+4) \\ =&(k-3)(k-3+4) \\ =&(k-3)(k+1) \end{aligned}$$

For $x = -k - 1$,

$$\begin{aligned} &x(x+4) \\ =&(-k-1)(-k-1+4) \\ =&(-k-1)(-k+3) \\ =&(k+1)(k-3) \end{aligned}$$

> Alternative solution:
>
> $$\begin{aligned} x^2+4x&=k^2-2k-3 \\ x^2+4x&=(k-3)(k+1) \\ x^2+4x-(k-3)(k+1)&=0 \\ (x+k+1)\left[x-(k-3)\right]&=0 \\ x=-k-1 \text{ or } x&=k-3 \end{aligned}$$
>
> $$\begin{array}{cc} x & (k+1) \\ x & -(k-3) \\ \hline (k+1)x & -(k-3)x=4x \end{array}$$

6. D

Since x is corrected to 2 decimal places, the range of values of x has 3 decimal places.

5.665 = 5.67 (correct to 2 decimal places) , 5.675 = 5.68 (correct to 2 decimal places)

$\therefore 5.665 \le x < 5.675$

> Alternative solution:
>
> $$5.67-\frac{0.01}{2} \le x < 5.67+\frac{0.01}{2}$$
> $$5.665 \le x < 5.675$$

7. D

$$\begin{array}{lcl} 4y+1<5y-3 & \text{and} & 5y-3 \le 8y-9 \\ 4<y & & 6 \le 3y \\ y>4 & & y \ge 2 \end{array}$$

$\therefore y>4$

8. C

$$\begin{aligned} f(4)+f(-4)&=38 \\ 4^2+7(4)+k+(-4)^2+7(-4)+k&=38 \\ 2k&=6 \\ k&=3 \end{aligned}$$

9. D

$$\mathrm{p}(-3)=0$$
$$n(-3)^3-3n(-3)+36=0$$
$$-27n+9n+36=0$$
$$n=2$$

$$\mathrm{p}(x)=2x^3-6x+36$$
$$\mathrm{p}(3)=2(3)^3-6(3)+36$$
$$=72$$

10. C

$$40\ 000\times\left(1+\frac{3\%}{2}\right)^{5\times 2}$$
$$=46\ 421.633$$
$$=\$46\ 422 \text{ (corr. to the nearest dollar)}$$

11. A

$$\frac{\alpha+2\beta}{\beta+2\gamma}=\frac{4}{9}$$
$$9\alpha+18\beta=4\beta+8\gamma$$
$$9\alpha+14\beta=8\gamma$$

$$\frac{\alpha+2\beta}{\gamma+2\alpha}=\frac{4}{5}$$
$$5\alpha+10\beta=4\gamma+8\alpha$$
$$-3\alpha+10\beta=4\gamma$$

$$\therefore\quad 9\alpha+14\beta=-6\alpha+20\beta$$
$$15\alpha=6\beta$$
$$\frac{\alpha}{\beta}=\frac{2}{5}$$

12. C

$$z=\frac{kx^3}{y^2}$$
$$3=\frac{k(3)^3}{(6)^2}$$
$$k=4$$
$$z=\frac{4(5)^3}{(2)^2}$$
$$=125$$

13. A

$a_5 = 2a_4 + a_3$

$41 = 2a_4 + a_3 \ldots(1)$

$a_4 = 2a_3 + a_2$

$a_4 = 2a_3 + 3 \ldots(2)$

Sub. (2) into (1) ,

$41 = 2(2a_3 + 3) + a_3$

$a_3 = 7$

$a_4 = 2(7) + 3 = 17$

$$\begin{aligned} a_6 &= 2a_5 + a_4 \\ &= 2(41) + 17 \\ &= 99 \end{aligned}$$

14. A

Consider the x-intercept,

$$\begin{aligned} px + q(0) &= 7 \\ x &= \frac{7}{p} \end{aligned}$$

$$\begin{aligned} \therefore \frac{7}{p} &< 1 \\ p &> 7 \end{aligned}$$

$\therefore$ I is true.

Consider the y-intercept,

$$\begin{aligned} p(0) + qy &= 7 \\ y &= \frac{7}{q} \end{aligned}$$

$$\begin{aligned} \therefore \frac{7}{q} &> 1 \\ q &< 7 \end{aligned}$$

$\therefore$ II is not true.

$\therefore p > q$

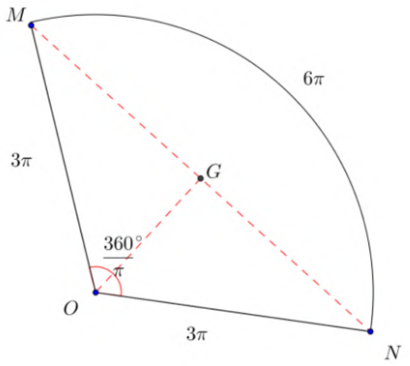
$\therefore$ III is not true.

5

15. D

Consider the perimeter of the sector OMN ,

$$2r + MN = 12\pi$$
$$2(3\pi) + MN = 12\pi$$
$$MN = 6\pi$$



$$2\pi r \times \frac{\theta}{360°} = 6\pi$$
$$2\pi(3\pi) \times \frac{\theta}{360°} = 6\pi$$
$$\theta = \frac{360°}{\pi}$$

$\therefore$ III is true.

$$\text{Area of the sector} = \pi r^2 \times \frac{\theta}{360°}$$
$$= \pi(3\pi)^2 \times \frac{\frac{360°}{\pi}}{360°}$$
$$= 9\pi^2 \text{ cm}^2$$

$\therefore$ I is true.

$$MN = 2NG$$
$$= 2(3\pi)\sin\left(\frac{1}{2} \times \frac{360°}{\pi}\right)$$
$$= 15.86135438...\text{cm}$$

Alternative solution:
By cosine formula,

$$MN^2 = OM^2 + ON^2 - 2(OM)(ON)\cos\theta$$
$$MN^2 = (3\pi)^2 + (3\pi)^2 - 2(3\pi)(3\pi)\cos\frac{360°}{\pi}$$
$$MN = 15.86135438...\text{cm}$$

$$\therefore \text{The perimeter of } \Delta OMN = 3\pi + 3\pi + MN$$
$$= 34.71091031...\text{cm}$$
$$< 35 \text{ cm}$$

$\therefore$ II is true.

16. B

Let the radius of the cylinder be r cm .

Consider the total surface area of the circular cylinder,

$$2\pi r^2 + 2\pi r(35) = 492\pi$$
$$2r^2 + 70r - 492 = 0$$
$$r = 6 \text{ or } r = -41 \text{ (rej.)}$$

The volume of the sphere

$$= \frac{4}{3}\pi(6)^3$$
$$= 288\pi \text{ cm}^3$$

17. B

$DG : CG = 2 : 1$

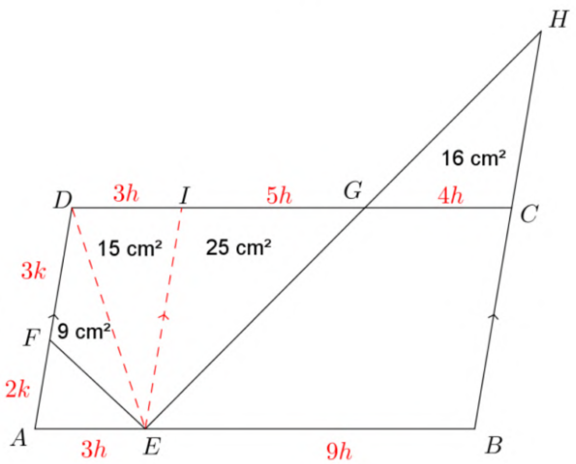
$AE : BE = 1 : 3$

Let $DG = 8h$ and $CG = 4h$.

Let $AE = 3h$ and $BE = 9h$.

Let I be a point on DC such that $EI \,//\, AD \,//\, BC$.

So, $DI = 3h$ and $IG = 5h$.



$$\frac{\text{The area of } \Delta EGI}{\text{The area of } \Delta HGC} = \left(\frac{IG}{CG}\right)^2$$
$$\frac{\text{The area of } \Delta EGI}{16} = \left(\frac{5h}{4h}\right)^2$$
The area of $\Delta EGI = 25 \text{ cm}^2$

$$\frac{\text{The area of } \Delta DEI}{\text{The area of } \Delta EGI} = \frac{DI}{GI}$$
$$\frac{\text{The area of } \Delta DEI}{25} = \frac{3h}{5h}$$
The area of $\Delta DEI = 15 \text{ cm}^2$

Note that the area of ΔAED = the area of ΔDEI = 15 cm^2 .

Let $AF = 2k$ and $DF = 3k$.

The area of ΔDFE

$$= 15 \times \frac{3k}{2k + 3k}$$
$$= 9 \text{ cm}^2$$

The area of quadrilateral $DFEG$ = 25 + 15 + 9 = 49 cm^2

Alternative solution:

$DG : CG = 2 : 1$

$AE : BE = 1 : 3$

Let $DG = 8h$ and $CG = 4h$.

Let $AE = 3h$ and $BE = 9h$.

$\because \Delta HGC \sim \Delta HEB$ (AAA)

$$\text{Area of } GEBC = 16 \times \left(\frac{9h}{4h}\right)^2 - 16$$
$$= 65 \text{ cm}^2$$

$$\frac{\text{The area of } \Delta DAE}{\text{The area of } \Delta FAE} = \frac{DA}{FA}$$
$$\frac{\text{The area of } \Delta DAE}{\text{The area of } \Delta FAE} = \frac{3+2}{2}$$
$$= \frac{5}{2}$$

Since ΔDAE and ΔFAE have the same base AE ,

The altitude from D to AE : the altitude from F to AE = 5 : 2

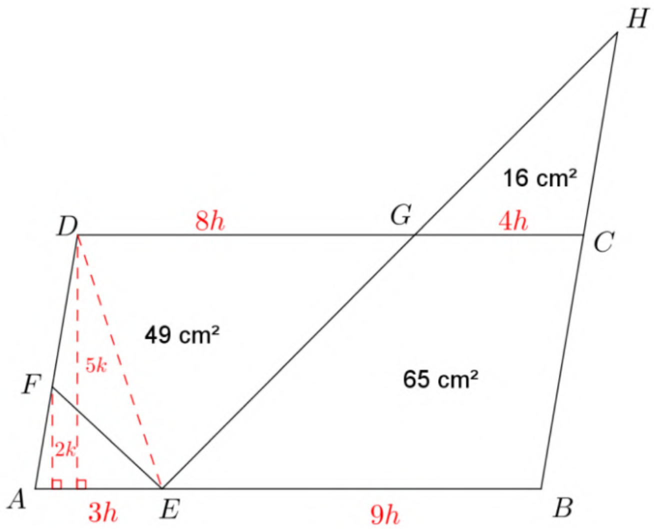
Let the altitude from D to $AE = 5k$.

Let the altitude from F to $AE = 2k$.

$$\frac{(4h+9h)(5k)}{2} = 65$$
$$hk = 2$$

The area of $DFEG$

$$= \frac{(3h+8h)(5k)}{2} - \frac{(3h)(2k)}{2}$$
$$= \frac{49hk}{2}$$
$$= 49 \text{ cm}^2$$



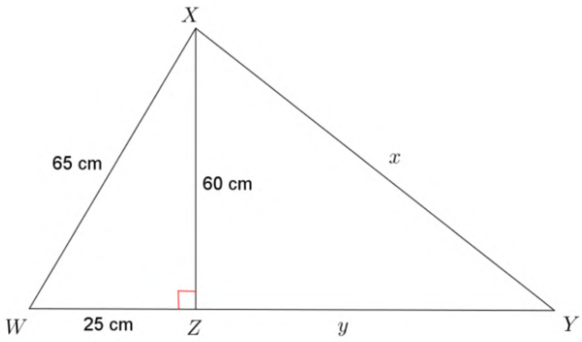
18. C

Note that $\angle WZX = 90°$ (converse of Pyth. thm.)

Consider ΔXYZ ,

$y^2 + 60^2 = x^2$ (Pyth. thm.)

Consider $WY : XY = XY : YZ$,



$$\frac{WY}{XY} = \frac{XY}{YZ}$$

$$\frac{25+y}{x} = \frac{x}{y}$$

$25y + y^2 = x^2$

$25y + y^2 = 60^2 + y^2$

$y = 144$ cm

$x^2 = 60^2 + 144^2$

$x = 156$ cm

19. D

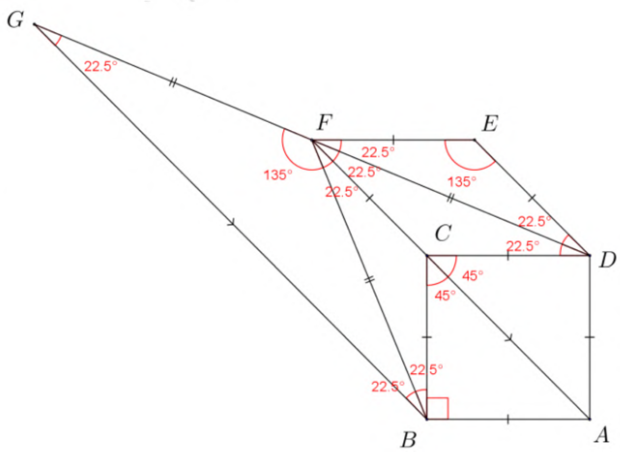
$\Delta DFC \cong \Delta BFC$ (SAS)

$DF = FB$ (corr. sides, $\cong \Delta$s)

$FG = FB$ (sides opp. equal $\angle$s)

$\therefore DF = FG$

$\therefore$ I is true.



$\Delta BFG \sim \Delta DEF$ (AAA)

$\therefore$ II is true.

$\angle ABG + \angle BFD$

$= (90° + 22.5° + 22.5°) + (22.5° + 22.5°)$

$= 180°$

$\therefore$ III is true.

20. D

Let T be a point on PQ such that $PS\ //\ TR$.

$\angle TRS + \angle PSR = 180°$ (int. $\angle$s, $PS\ //\ TR$)

$\angle TRS + 120° = 180°$

$\angle TRS = 60°$

$\angle TRQ = \angle QRS - \angle TRS$

$= 150° - 60°$

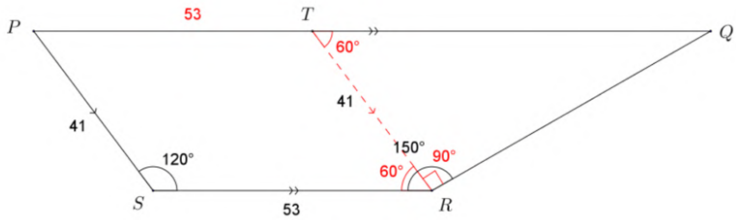
$= 90°$

In ΔTRQ,

$\frac{TR}{TQ} = \cos \angle QTR$

$\frac{41}{TQ} = \cos 60°$

$TQ = 82$ cm



PQ

$= PT + TQ$

$= 53 + 82$

$= 135$ cm

21. B

Consider the area of ΔADE,

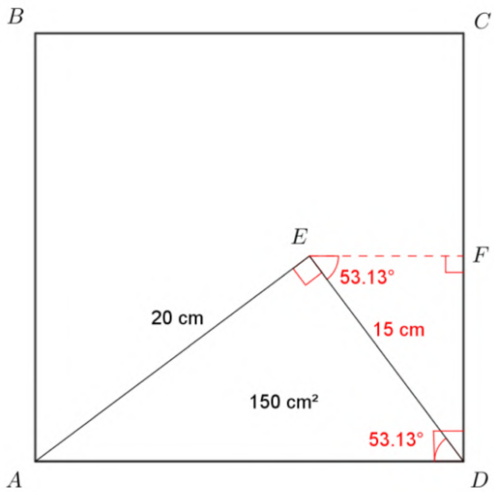
$\frac{20 \times ED}{2} = 150$

$ED = 15$ cm

$\tan \angle ADE = \frac{AE}{ED}$

$\tan \angle ADE = \frac{20}{15}$

$\angle ADE = 53.13010235...°$



Let F be a point on CD such that $EF \perp CD$.

In ΔDEF,

$\frac{EF}{ED} = \cos \angle DEF$

$EF = 15 \cos 53.13010235...°$

$= 9$ cm

22. D

Let $\angle SRT = x$.

Since RT is the angle bisector of $\angle SRU$, then

$\angle URT = \angle SRT = x$

$\angle VUR = \angle URT = x$ (alt. $\angle$s, $RT//VU$)

$\angle SUT = x$ ($\angle$s in the same segment)

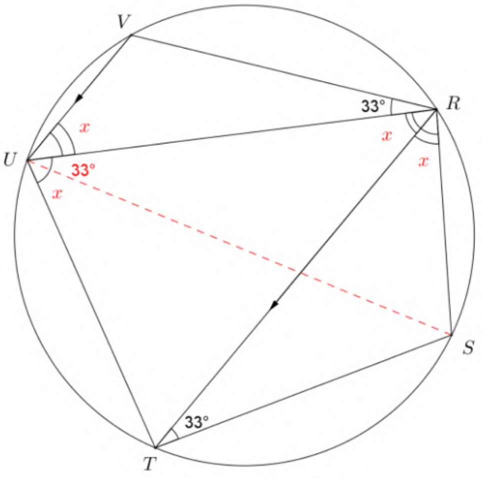
$\angle SUR = 33°$ ($\angle$s in the same segment)

$$\angle VUT + \angle VRT = 180° \text{ (opp. } \angle\text{s, cyclic quad.)}$$

$$x + x + 33° + x + 33° = 180°$$

$$x = 38°$$

$$\angle RUT = 33° + 38°$$
$$= 71°$$



23. C

Let $\angle ADC = x$, then $\angle ABC = 90° - x$.

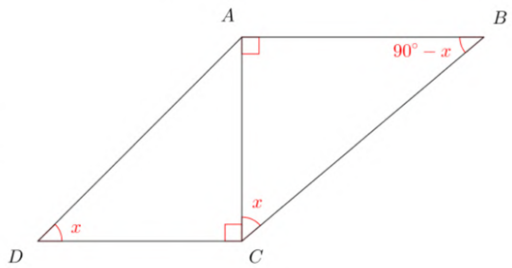
$\angle ACB + \angle CAB + \angle ABC = 180°$ ($\angle$ sum of Δ)

$$\angle ACB + 90° + 90° - x = 180°$$
$$\angle ACB = x$$

$$\frac{AC}{BC} = \cos x \qquad \frac{CD}{AD} = \cos x$$

$$AC = BC\cos x \qquad CD = AD\cos x$$

$$\tan\angle ADC = \frac{AC}{CD} = \frac{BC\cos x}{AD\cos x} = \frac{BC}{AD}$$



24. C

Note that ΔOXY is a right-angled triangle.

$OY^2 = OX^2 + XY^2$ (Pyth. thm.)

$2^2 = 1^2 + XY^2$

$XY = \sqrt{3}$

Alternative solution:

Consider ΔOXY, by cosine formula,

$XY^2 = OX^2 + OY^2 - 2(OX)(OY)\cos\angle XOY$

$XY^2 = 1^2 + 2^2 - 2(1)(2)\cos 60°$

$XY = \sqrt{3}$

$YZ = XY = \sqrt{3}$

$\angle OYX$

$= 180° - 90° - 60°$

$= 30°$

$\angle OYZ$

$= 30° + 60°$

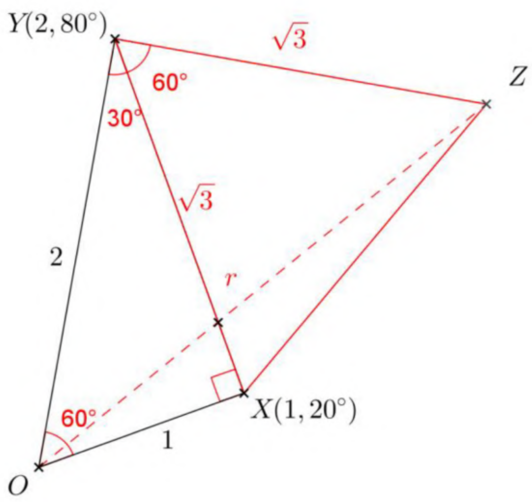
$= 90°$

$OZ^2 = OY^2 + YZ^2$ (Pyth. thm.)

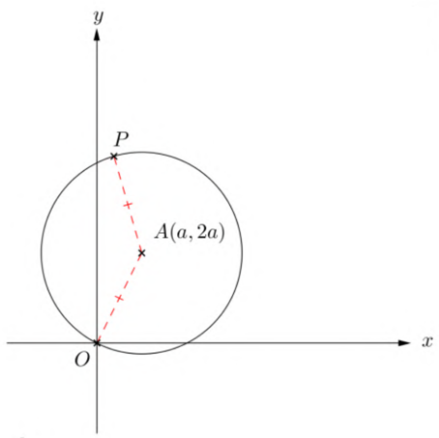
$OZ^2 = 2^2 + (\sqrt{3})^2$

$OZ = \sqrt{7}$

$r = \sqrt{7}$



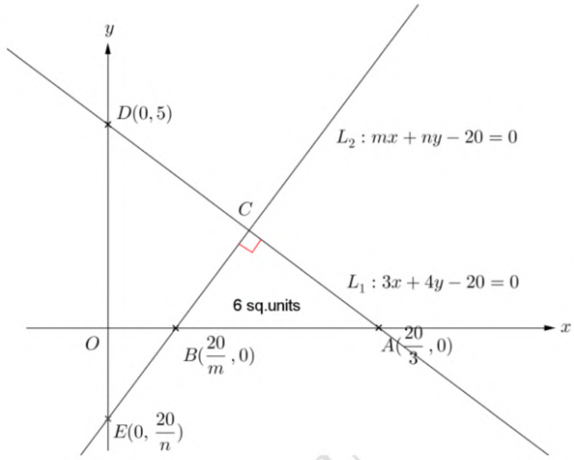
25. B



26. B

Let L_1 intersects the y-axis at point D.

Note that $\Delta AOD \sim \Delta ACB$ (AAA) .



$$\left(\frac{AD}{AB}\right)^2=\frac{\text{The area of }\Delta AOD}{\text{The area of }\Delta ACB}$$

$$\left(\frac{\sqrt{\left(\frac{20}{3}-0\right)^2+(0-5)^2}}{\frac{20}{3}-\frac{20}{m}}\right)^2=\frac{\frac{1}{2}\times5\times\frac{20}{3}}{6}$$

$$\frac{\frac{25}{3}}{\frac{20}{3}-\frac{20}{m}}=\frac{5}{3}$$

$$\frac{25m}{20m-60}=\frac{5}{3}$$

$$100m-300=75m$$

$$m=12$$

Slope of $L_2\times$slope of $L_1=-1$

$$-\frac{m}{n}\times\left(-\frac{3}{4}\right)=-1$$

$$-\frac{m}{n}=\frac{4}{3}$$

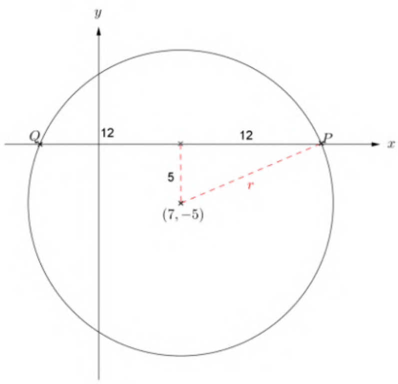
$$-\frac{12}{n}=\frac{4}{3}$$

$$n=-9$$

27. A

$$r^2=5^2+\left(\frac{24}{2}\right)^2 \text{ (Pyth. thm.)}$$

$$r=13$$



$$(x-7)^2+(y+5)^2=13^2$$

$$x^2+y^2-14x+10y-95=0$$

28. C

The expected number of tokens got in the game

$$=\frac{3}{6}\times 10+\frac{1}{6}\times 15+\frac{1}{6}\times 25+\frac{1}{6}\times 50$$
$$=20$$

29. A

The total number of teachers = 22 .

The lower quartile and the upper quartile are 6th datum and the 17th datum respectively.

Thus, the inter-quartile range = 5 – 4 = 1 .

30. B

Consider the mean of the above data,

$$\frac{\alpha+\beta+(-4)+(-3)+1+1+1+4}{8}=0$$
$$\alpha+\beta=0$$

$\therefore$ III is true.

Since the range of the above data is 10 ,

$\therefore$ α and β must be either 5 or -5.

Therefore, the above data become

–5 –4 –3 1 1 1 4 5

The mode is 1 . (s = 1)

$\therefore$ I is true.

The median is 1 . (t = 1)

$\therefore$ II is not true.

SECTION B

31. D

$$
\begin{aligned}
&3E000000000000_{16}\\
&=3\times16^{13}+14\times16^{12}\\
&=(2+1)\times(2^4)^{13}+(8+4+2)\times(2^4)^{12}\\
&=2\times2^{52}+1\times2^{52}+2^3\times2^{48}+2^2\times2^{48}+2\times2^{48}\\
&=2^{53}+2^{52}+2^{51}+2^{50}+2^{49}
\end{aligned}
$$

32. C

$$
\begin{array}{lll}
p^2-4q^2 & p^3-8q^3 & (p+2q)(p^2-4q^2)\\
=(p-2q)(p+2q) & =(p-2q)(p^2+2pq+4q^2) & =(p+2q)^2(p-2q)
\end{array}
$$

$$
\begin{aligned}
&\text{L.C.M.}\\
&=(p+2q)^2(p-2q)(p^2+2pq+4q^2)\\
&=(p+2q)^2(p^3-8q^3)
\end{aligned}
$$

33. C

The slope of the linear function

$$
\begin{aligned}
&=\frac{0-12}{2-0}\\
&=-6
\end{aligned}
$$

The equation of the linear function is

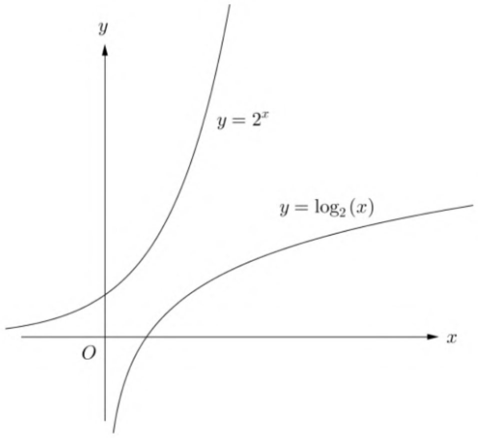
$$
\begin{aligned}
\log_5 y&=-6\log_{25}x+12\\
\log_5 y+6\log_{25}x&=12\\
\log_5 y+\frac{\log_5 x^6}{\log_5 25}&=12\\
\log_5 y+\frac{\log_5 x^6}{2}&=12\\
2\log_5 y+\log_5 x^6&=24\\
\log_5 y^2x^6&=24\\
y^2x^6&=5^{24}\\
y&=5^{12}x^{-3}
\end{aligned}
$$

$\therefore n=-3$

34. D

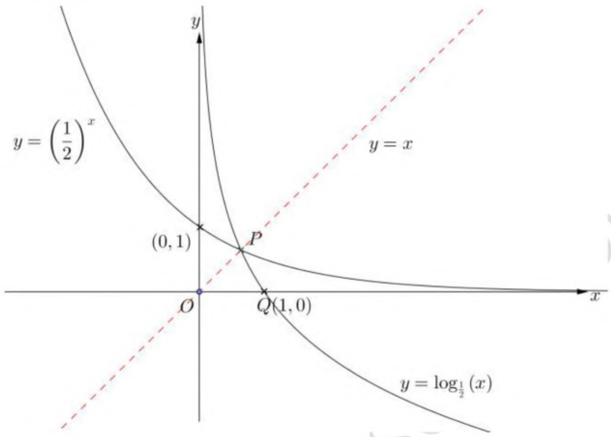
For $a > 1$,

for example $a = 2$,



For $0 < a < 1$,

for example $a = \frac{1}{2}$,



$\therefore$ I is true.

Q is the point of intersection of $y = \log_a x$ and the x-axis.

When $y = 0$, $x = 1$.

$\therefore OQ = 1$

$> a$

$\therefore$ II is true.

Since $y = a^x$ and $y = \log_a x$ are symmetric to each other about the straight line $y = x$,

P is a point lying on $y = x$.

$\tan \angle POQ =$ slope of the straight line $y = x$

$\tan \angle POQ = 1$

$\angle POQ = 45°$

$\therefore$ III is true.

(This question is controversial and may be cancelled.)

35. A

$$\begin{aligned}
& i^9 + i^{10} + i^{11} + \cdots + i^{999} \\
&= (i^9 + i^{10} + i^{11} + i^{12}) + (i^{13} + i^{14} + i^{15} + i^{16}) + \cdots + (i^{993} + i^{994} + i^{995} + i^{996}) + i^{997} + i^{998} + i^{999} \\
&= (i - 1 - i + 1) + (i - 1 - i + 1) + \cdots + (i - 1 - i + 1) + i - 1 - i \\
&= -1
\end{aligned}$$

36. B

The points of intersections of the lines are (1, 3) , $(11, \frac{44}{3})$ and (11, –5) .

For $x=1$ and $y=3$,

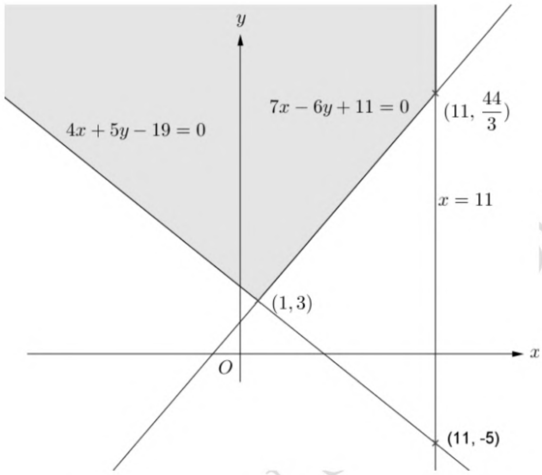
$8(1)-6(3)+11$
$=1$

For $x=11$ and $y=\frac{44}{3}$,

$8(11)-6\left(\frac{44}{3}\right)+11$
$=11$

For $x=11$ and $y=-5$,

$8(11)-6(-5)+11$
$=129$



Since (11, –5) does not lie in D , the greatest value of $8x-6y+11$ is 11 .

37. A

$\frac{3^r}{3^q}=3^{r-q}$ $\quad$ $\frac{3^q}{3^p}=3^{q-p}$

$\because p$, q , r is an arithmetic sequence.

$\therefore r-q=q-p$

$\therefore 3^{r-q}=3^{q-p}$

$\therefore 3^p,\ 3^q,\ 3^r$ is a geometric sequence.

$\therefore$I is true.

For $p=1$, $q=2$ and $r=3$,

$\frac{5}{1}, \frac{5}{2}, \frac{5}{3}$ is not a geometric sequence.

$\therefore$II is not true.

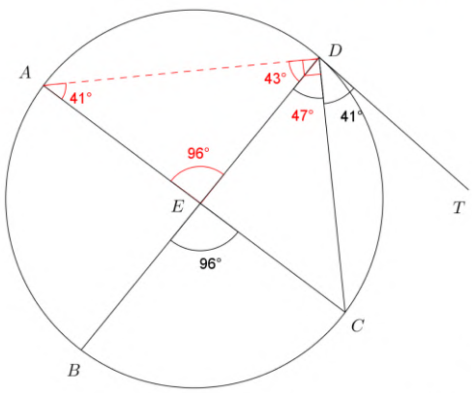
For $p=1$, $q=2$ and $r=3$,

$p-q$	$q-r$	$r-p$
$=1-2$	$=2-3$	$=3-1$
$=-1$	$=-1$	$=2$

$-1,-1,2$ is not an arithmetic sequence.

$\therefore$III is not true.

38. A



$\angle CAD = 41°$ ($\angle$s in alt. segment)

$\angle AED = 96°$ (vert. opp. $\angle$s)

$\angle ADE + 41° + 96° = 180°$ ($\angle$ sum of Δ)

$\angle ADE = 43°$

$\angle ADC = 90°$ ($\angle$ in semi-circle)

$\angle CDE = 90° - 43°$

$= 47°$

39. B

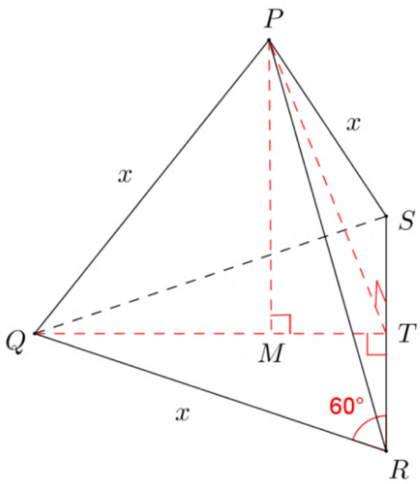
$$\tan^3\theta = 2\tan\theta$$
$$\tan\theta(\tan^2\theta - 2) = 0$$
$$\tan\theta = 0 \text{ or } \tan\theta = \pm\sqrt{2}$$
$$\theta = 0° \text{ (rej.) or } 180° \text{ or } 360° \text{ (rej.) or } 125° \text{ or } 235°$$

40. B

Let T be a point on SR such that $QT \perp SR$.

Let M be the projection of P on the plane QRS.

Since $PQRS$ is a regular tetrahedron, M lies on QT.



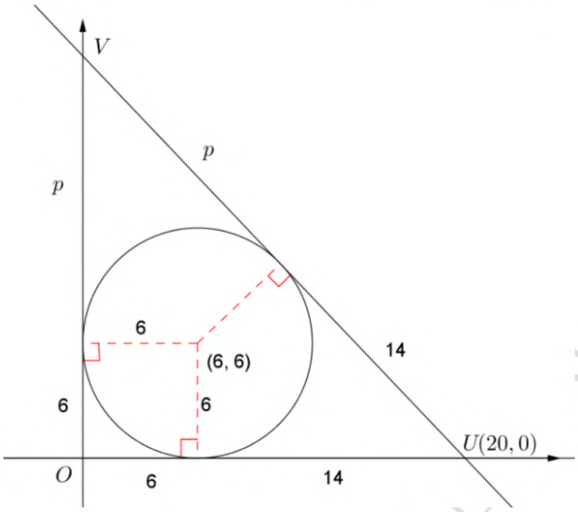
$$\frac{QT}{x} = \sin 60°$$
$$QT = x\sin 60°$$
$$PT = QT$$
$$= x\sin 60°$$

By cosine formula,

$$\cos\angle PQT = \frac{PQ^2 + QT^2 - PT^2}{2(PQ)(QT)}$$
$$\cos\angle PQT = \frac{x^2 + (x\sin 60°)^2 - (x\sin 60°)^2}{2(x)(x\sin 60°)}$$
$$\cos\angle PQT = \frac{x^2}{2x^2\sin 60°}$$
$$\angle PQT = 54.73561032...°$$

41. C

$$(p+6)^2+20^2=(p+14)^2 \quad \text{(Pyth. thm.)}$$
$$p^2+12p+36+400=p^2+28p+196$$
$$240=16p$$
$$p=15$$



The area of ΔOUV

$=\dfrac{20\times(15+6)}{2}$

$=210$

42. B

The required number

$=C_7^{2+4+12}-C_7^{4+12}$

$=20\ 384$

Alternative solution:

The required number

$=C_1^2C_6^{4+12}+C_2^2C_5^{4+12}$

$=20\ 384$

43. C

The required probability

$=1-\dfrac{C_2^9C_4^4}{C_6^{13}}$

$=\dfrac{140}{143}$

44. A

The difference of the standard score of the boy and girl

$=\dfrac{6}{2}$

$=3$

Thus,

$z=-2+3$ or $z=-2-3$

$=1$ $\qquad$ $=-5$

45. D

For $\{a, b, c, d\}$,

mean $= m_1$

range $= r_1$

variance $= v_1$

For $\{2a, 2b, 2c, 2d\}$,

mean $= m_2 = 2m_1$

range $= r_2 = 2r_1$

variance $= v_2 = 4v_1$

For $\{a+3, b+3, c+3, d+3\}$,

mean $= m_3 = m_1 + 3$

range $= r_3 = r_1$

variance $= v_3 = v_1$

$m_1 + m_3$
$= m_1 + m_1 + 3$
$= 2m_1 + 3$
$> m_2$
$\therefore$ I is true.

$r_1 + r_3$
$= r_1 + r_1$
$= 2r_1$
$= r_2$
$\therefore$ II is true.

$v_1 + v_3$
$= v_1 + v_1$
$= 2v_1$
$< v_2$
$\therefore$ III is true.