**There are 30 questions in Section A and 15 questions in Section B.**
**The diagrams in this paper are not necessarily drawn to scale.**
**Choose the best answer for each question.**

**Section A**

1. $\dfrac{2}{a-5}+\dfrac{1}{2-a}=$

   A. $\dfrac{-a-1}{(a-5)(a-2)}$ .

   B. $\dfrac{a+1}{(a-5)(a-2)}$ .

   C. $\dfrac{3(3-a)}{(a-5)(a-2)}$ .

   D. $\dfrac{3(a-3)}{(a-5)(a-2)}$ .

2. If $a, b$ and $c$ are non-zero constants such that $x(ax+3b)+5b \equiv a(x^2+2x)+3c$ , then $a:b:c=$

   A. $2:3:5$ .

   B. $3:2:5$ .

   C. $9:6:10$ .

   D. $10:15:9$ .

3. There are 782 students in a secondary school. If the number of boys is 30% less than that of girls, then the number of boys is

   A. 322 .

   B. 340 .

   C. 442 .

   D. 460 .

4. If the price of a flat is decreased by 30% and then increased by 40%, then its price is

   A. decreased by 88% .

   B. decreased by 58% .

   C. decreased by 2% .

   D. increased by 10% .

5. The simple interest on a sum of money at an interest rate of $r\%$ per annum for 3 years is equal to the compound interest on the same amount of money at an interest rate of 6% per annum for 3 years compounded half-yearly. Find $r$, correct to 2 significant figures.

   A. 3.2

   B. 6.4

   C. 6.5

   D. 14

6. The costs of candy of brand $A$ and brand $B$ are \$120/kg and \$288/kg respectively. If $x$ kg of candy of brand $A$ and $y$ kg of candy of brand $B$ are mixed so that the cost of the mixture is \$216/kg, then $x : y =$

   A. $3 : 7$ .

   B. $3 : 4$ .

   C. $4 : 3$ .

   D. $7 : 3$ .

7. If $z$ varies directly as $x$ and inversely as the cube root of $y$ , which of the following must be constant?

   A. $\dfrac{xz}{\sqrt[3]{y}}$

   B. $\dfrac{x^3}{yz^3}$

   C. $\dfrac{x}{y^3z}$

   D. $\dfrac{x^3z^3}{y}$

8. A piece of work can be completed by Alan alone in $m$ days. If Alan and Benny work together, the piece of work can be completed in $n$ days. If Benny works alone, how long will he take to complete the piece of work?

   A. $\dfrac{m-n}{mn}$ days

   B. $\dfrac{mn}{m-n}$ days

   C. $\dfrac{m+n}{mn}$ days

   D. $\dfrac{mn}{m+n}$ days

9. If $2u - v - 7 = \log u + \log v = 3$, then $u =$

A. 25 .

B. 25 or $-20$ .

C. $\dfrac{5+\sqrt{85}}{2}$ .

D. $\dfrac{5+\sqrt{85}}{2}$ or $\dfrac{5-\sqrt{85}}{2}$ .

10. If $a > 0 > b > c$, which of the following may NOT be true?

I. $ac > bc$

II. $a^2 > b^2$

III. $b^2 < c^2$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

11. Solve $2x - 1 \leq x < 6 - 2x$ .

A. $x \leq 1$

B. $x < 2$

C. $1 \leq x < 2$

D. No real solutions

12. It is given that the H.C.F. and the L.C.M. of three polynomials are $a^2b^4$ and $6a^3b^5c^7$ respectively. If two of the polynomials are $3a^2b^5$ and $6a^2b^4c^3$, then the third one is

A. $a^2b^5c^7$ .

B. $a^3b^4c^7$ .

C. $2a^2b^4c^4$ .

D. $2a^3b^5c^4$ .

13. $0.0024735689 =$

A. 0.00247 (correct to 3 decimal places).

B. 0.002473 (correct to 4 significant figures).

C. 0.0024736 (correct to 5 decimal places).

D. 0.00247357 (correct to 6 significant figures).

14. In the figure, the 1st pattern consists of 6 dots. For any positive integer $n$ , the $(n+1)$th pattern is formed by adding $(n+3)$ dots to the $n$th pattern. Find the number of dots in the 7th pattern.

A. 36

B. 44

C. 45

D. 55

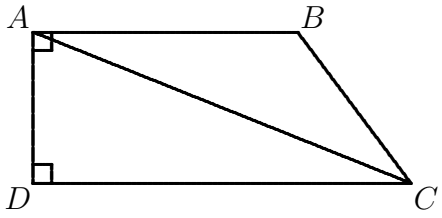
15. In the figure, $\angle ADC = \angle BAD = 90°$. If $AB = 9$ cm, $AD = 8$ cm and $BC = 10$ cm, then $AC =$

A. 13 cm .

B. 15 cm .

C. 17 cm .

D. 23 cm .



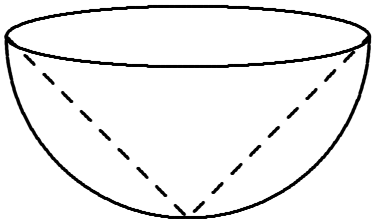
16. In the figure, a wooden container is made from drilling a right conical hole in the middle of a hemisphere. If the volume of the wood of the container is $128\pi$ cm$^3$, find the radius of the hemisphere correct to the nearest 0.1 cm.

A. 4.3 cm

B. 4.6 cm

C. 5.0 cm

D. 7.3 cm



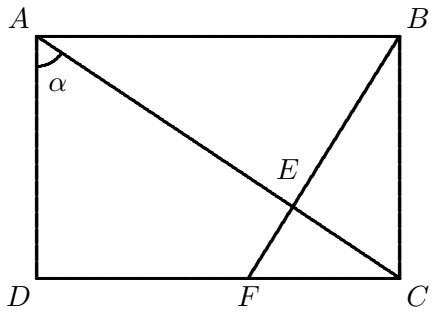
17. In the figure, $ABCD$ is a rectangle. Let $F$ be a point lying on $CD$ such that $AC$ and $BF$ are perpendicular to each other and intersect at point $E$. Find $\dfrac{BE}{EF}$ .

A. 1

B. $\cos^2\alpha$

C. $\sin^2\alpha\cos^2\alpha$

D. $\tan^2\alpha$



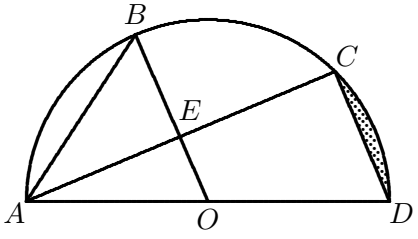

18. In the figure, $O$ is the centre of the semi-circle $OABCD$. $OB$ and $CD$ are parallel to each other and $OB$ intersects $AC$ at point $E$. If $AB = 10$ cm and $BE = 6$ cm, find the area of the shaded region correct to the nearest 0.01 cm$^2$.

A. 0.13 cm$^2$

B. 0.66 cm$^2$

C. 1.04 cm$^2$

D. 5.09 cm$^2$



19. $\dfrac{1}{(1+\sin(90^\circ+\theta))\,(1+\sin(270^\circ-\theta))}+\dfrac{1}{\cos^2(180^\circ-\theta)}=$

A. $0$ .

B. $\dfrac{1}{\tan^2\theta}$ .

C. $\dfrac{\tan^2\theta}{\sin^4\theta}$ .

D. $\dfrac{1-2\sin^2\theta}{\sin^2\theta\cos^2\theta}$ .

20. Let $f(x)=3x^2+mx+2m$, where $m$ is a constant. If the axis of symmetry of the graph of $y=f(x)$ is $x=-1$, find the $y$-coordinate of the vertex of the graph of $y=f(x)$.

A. $-3$

B. $6$

C. $9$

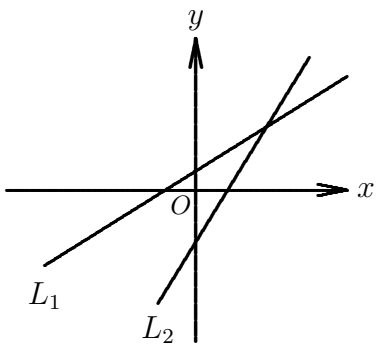
D. $12$

21. In the figure, the equations of the straight lines $L_1$ and $L_2$ are $ax+y=b$ and $x+cy=1$ respectively. Which of the following must be true?

I. $a<0$

II. $b>0$

III. $ac<1$




A. I and II only

B. I and III only

C. II and III only

D. I, II and III

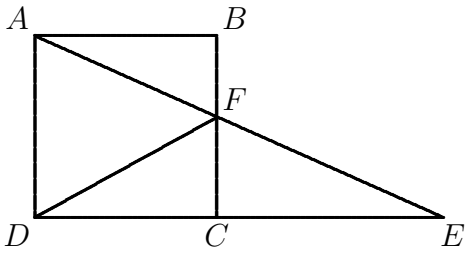
22. In the figure, $ABCD$ is a square. $DC$ is produced to $E$. $AE$ and $BC$ intersect at $F$. If $\angle CEF = 36°$ , find $\angle CDF$ correct to the nearest degree.

A. $15°$

B. $22°$

C. $24°$

D. $32°$



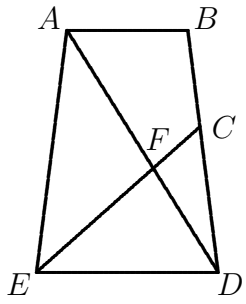

23. In the figure, $AFD, BCD$ and $CFE$ are straight lines. It is given that $AB//ED$ , $AB : ED = 5 : 7$ and $BC : CD = 2 : 3$. If the area of $\triangle CDF$ is 63 cm$^2$, find the area of $\triangle AEF$.

A. 187 cm$^2$

B. 203 cm$^2$

C. 210 cm$^2$

D. 250 cm$^2$




24. $ABCD$ is a rhombus. $E$ and $F$ are the points on $AB$ and $BC$ respectively. $DE$ and $DF$ cut $AC$ at $G$ and $H$ respectively. If $AG = GH = HC$ and $\angle ADC = 135°$, which of the following must be true?

I. $\angle GDH = 45°$

II. $\triangle AGD \cong \triangle CHD$

III. $E$ is the mid-point of $AB$.

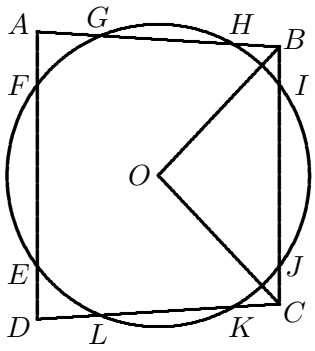
A. I only

B. II only

C. I and III only

D. II and III only

25. In the figure, $O$ is the centre of the circle $EFGHIJKL$. The quadrilateral $ABCD$ intersects the circle at $E, F, G, H, I, J, K$ and $L$ . If $\angle EDL = 84°$, $\angle BOC = 74°$ and $EF = GH = IJ = KL$, then $\angle FAG =$




A. $64°$ .

B. $78°$ .

C. $80°$ .

D. $82°$ .

26. The coordinates of the points $A$ and $B$ are $(2, 4)$ and $(-1, 3)$ respectively. If $P$ is a moving point in the rectangular coordinate plane such that $PA = AB$, then the locus of $P$ is a

A. straight line .

B. circle .

C. parabola .

D. square .

27. Let $O$ be the origin. The straight line $3x - 4y - 24 = 0$ cuts the $x$-axis and $y$-axis at $A$ and $B$ respectively. Find the equation of the inscribed circle of $\triangle OAB$.

A. $x^2 + y^2 - 4x + 3y = 0$

B. $x^2 + y^2 + 4x - 3y = 0$

C. $x^2 + y^2 - 4x + 4y + 4 = 0$

D. $x^2 + y^2 + 4x - 4y + 4 = 0$

28. There are 4 cards numbered 1, 3, 5, 7 in bag $A$ and 3 balls numbered 1, 2, 4 in bag $B$. If one card is drawn from bag $A$ and one ball is drawn from bag $B$ at random, find the probability that the sum of the numbers drawn is a prime number.

A. $\frac{5}{12}$

B. $\frac{3}{7}$

C. $\frac{1}{2}$

D. $\frac{7}{12}$

29. Consider the following set of data.

$$20 \quad 25 \quad 28 \quad 28 \quad 30 \quad 33 \quad 34 \quad 35 \quad 36 \quad m \quad n$$

The mean and the median of the above data are 32 and 33 respectively. Which of the following must be true?

I. $m + n = 83$

II. $m \geq 36$

III. $n \leq 50$

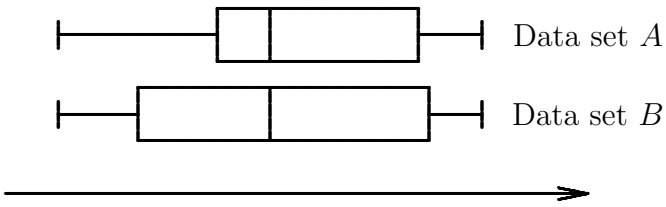
A. I and II only

B. I and III only

C. II and III only

D. I, II and III

30. Consider the following box-and-whisker diagrams.




Which of the following must be true?

I. The upper quartile of the data set $A$ is less than that of the data set $B$.

II. The inter-quartile range of the data set $A$ is less than that of the data set $B$.

III. The variance of the data set $A$ is less than that of the data set $B$.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

**Section B**

31. $20 + 11 \times 16^4 + 4102 \times 16^6 =$

A. $10060A014_{16}$ .

B. $10060B014_{16}$ .

C. $10060A0014_{16}$ .

D. $10060B0014_{16}$ .

32. Which of the following is/are NOT true?

I. The real part of $\dfrac{1}{3+2i}$ is $\dfrac{3}{13}$ .

II. The imaginary part of $2 - 5i$ is $-5i$ .

III. $i^{2n} = -1$ for all positive integers $n$ .

A. I only

B. II only

C. I and III only

D. II and III only

33. Which of the following are true?

I. $12345^{6789} < 6789^{12345}$

II. If $b > c$, then $\log_{\frac{1}{2}} b > \log_{\frac{1}{2}} c$ .

III. $\log_a b = (\log_a c)\ \ (\log_c b)$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

34. Let $x_n$ be the $n$th term of an arithmetic sequence. If $x_{15} = -20$ and $x_{24} = -56$, which of the following must be true?

I. The common difference is less than $-1$.

II. The 10th term is a natural number.

III. The sum of the first 19 terms is positive.

A. I only

B. II only

C. I and III only

D. II and III only

35. Consider the following system of inequalities: $\begin{cases} y - x \geq -5 \\ 2x + y \leq 16 \\ x \geq 1 \\ y \leq 4 \end{cases}$ .

Let $R$ be the region which represents the solution of the above system of inequalities. If $(x, y)$ is a point lying in $R$, then the difference in the greatest value and the smallest value of $8x - y - 2019$ is

A. 40 .

B. 42 .

C. 50 .

D. 54 .

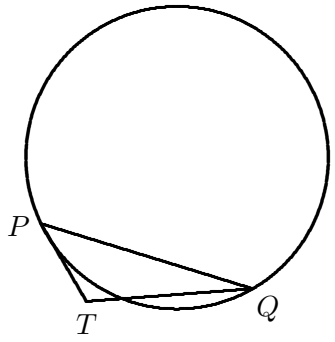
36. In the figure, $P$ and $Q$ are points on the circle. $TP$ is the tangent to the circle at $P$. $TQ$ is a straight line. If $\angle PTQ = 105°$ , $TQ = 7$ cm and $PQ = 9$ cm, find the radius of the circle.

A. 5.99 cm

B. 6.10 cm

C. 6.36 cm

D. 7.39 cm




37. Let $O$ be the origin. The coordinates of $P$ are $(8, 24)$ and $Q$ lies on the positive $x$-axis. If the coordinates of the circumcenter of $\triangle OPQ$ are $(19, 7)$, then the $y$-coordinate of the orthocenter of $\triangle OPQ$ is

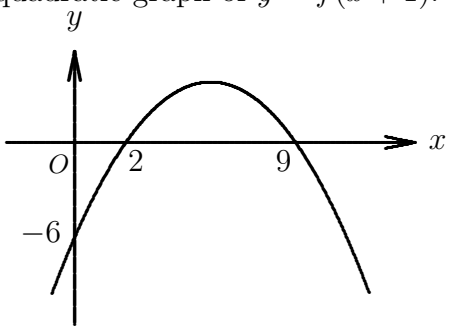
A. 2 .

B. 7 .

C. 8 .

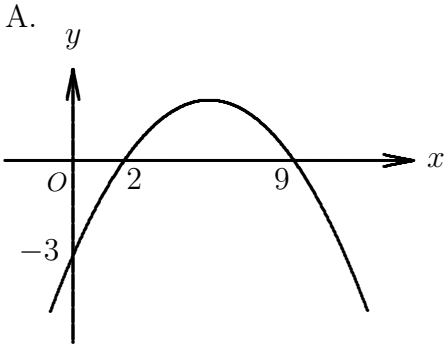
D. 10 .

38. The figure shows the quadratic graph of $y = f(x+1)$.

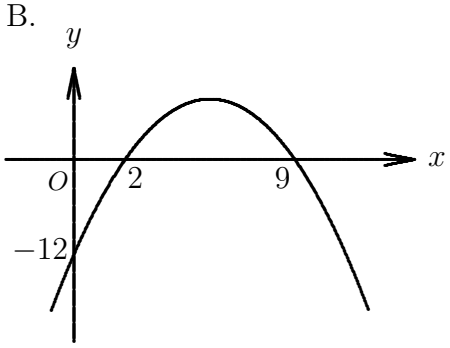



If $g(x) = 2f(x)$, which of the following may represent the graph of $y = g(x)$?

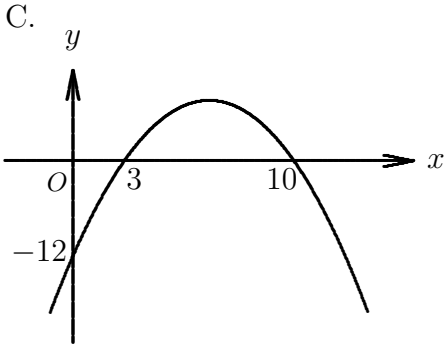
A.



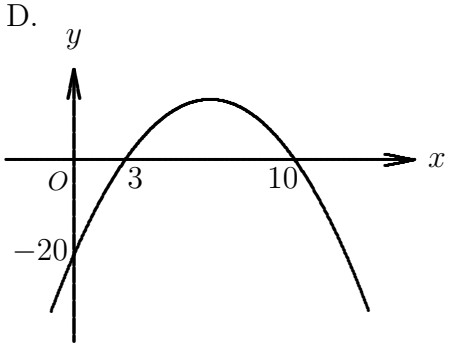

B.




C.




D.



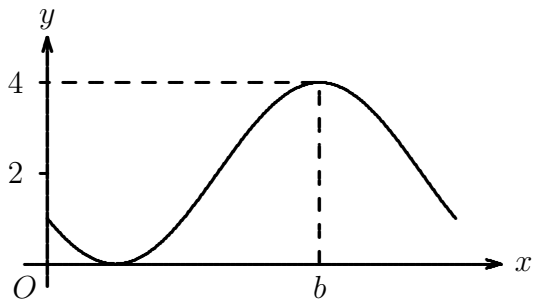

39. Let $a$ and $b$ be constants. If the figure shows the graph of $y = a\cos(2x^\circ - 60^\circ) + 2$, then

A. $a = -2$ and $b = 120$ .

B. $a = -2$ and $b = 210$ .

C. $a = 2$ and $b = 120$ .

D. $a = 2$ and $b = 210$ .



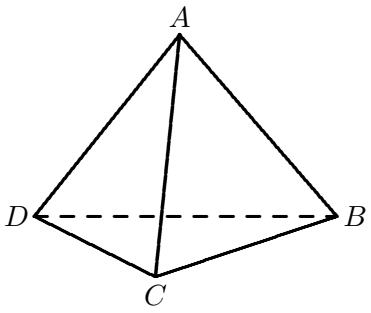
40. The figure shows a tetrahedron $ABCD$ where $3AB = 2AC$. If $ACD$ and $BCD$ are equilateral triangles, find the angle between $AB$ and the plane $BCD$ correct to the nearest degree.

A. $30°$

B. $41°$

C. $67°$

D. $71°$



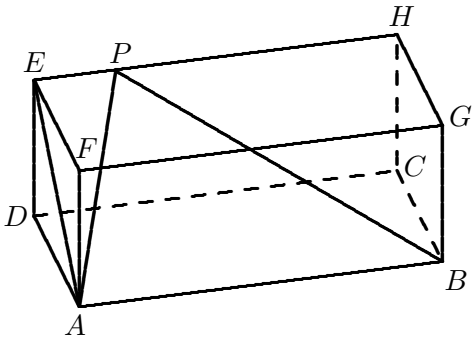

41. In the figure, $ABCDEFGH$ is a rectangular block. Let $P$ be a point lying on $EH$ such that $EP = (6 - 2\sqrt{3})$ cm and $PH = (6 + 2\sqrt{3})$ cm. If $\angle APB = 60°$ and $\angle BAP = 75°$, find $\tan \angle EAP$ .

A. $\dfrac{1}{\sqrt{6}}$

B. $2 - \sqrt{3}$

C. $\dfrac{1}{2}$

D. $\sqrt{\dfrac{5}{6}}$




42. In a seminar, there are 7 teachers from school $A$ and 3 teachers from school $B$. If they are randomly arranged to sit in a row, find the number of ways that no teachers from school $B$ sit next to each other.

A. 604 800

B. 1 058 400

C. 1 693 440

D. 3 386 880

43. Ben and Jason are asked to answer a question. The probabilities that Ben and Jason answer the question correctly are $\frac{1}{3}$ and $\frac{2}{5}$ respectively. Given that at least one of them answers the question wrongly, find the probability that Ben answers the question correctly.

A. $\frac{3}{13}$

B. $\frac{5}{13}$

C. $\frac{5}{11}$

D. $\frac{5}{9}$

44. In a test, the scores of Donald and Elsa are 13 and 31 respectively, and their standard scores are 0.1 and 1.3 respectively. Find the standard deviation of the scores in the test.

A. 11.5

B. 12

C. 15

D. 18

45. There are 10 terms in a geometric sequence, with common ratio $\sqrt{2}$. If the variance of the first 4 terms of the sequence is 3 , then the variance of the last 4 terms of the sequence is

A. 6 .

B. 12 .

C. 24 .

D. 192 .

**END OF PAPER**