ST. PAUL'S COLLEGE
FORM 6 INTERNAL EXAMINATION 2021 - 2022

MATHEMATICS Compulsory Part
PAPER 2

1¼ hours

Name				
Class				( )
Group	G1 FBL	G2 LMW	G3 WHP	G4 TH
	G5 PSK	G6 LTN	G7 HL	

INSTRUCTIONS

1. Read carefully the instructions on the Answer Sheet. Write down the subject, your name, class and class number in the spaces provided and mark the corresponding boxes with an HB pencil.

2. Write your group number on the top right corner of the answer sheet.

3. All questions carry equal marks.

4. ANSWER ALL QUESTIONS. You are advised to use an HB pencil to mark all the answers on the Answer Sheet, so that wrong marks can be completely erased with a clean rubber. You must mark the answers clearly; otherwise you lose marks if the answers cannot be captured.

5. You should marked only ONE answer for each question. If you mark more than one answer, you will receive NO MARKS for that question.

6. No marks will be deducted for wrong answers.

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. $\dfrac{(9\cdot 27^{n+1})^3}{81^n} =$

   A. 3^{n+3}.
   B. 3^{n+5}.
   C. 3^{5n+9}.
   D. 3^{5n+15}.

2. If $a(b-1)=2(1+b)$, then $b=$

   A. -1.
   B. $\dfrac{2+a}{a-2}$.
   C. $\dfrac{2+a}{2-a}$.
   D. $\dfrac{2-a}{2+a}$.

3. $4+2mn-m^2-n^2 =$

   A. $(2-m-n)(2-m+n)$.
   B. $(2-m-n)(2+m+n)$.
   C. $(2+m-n)(2-m+n)$.
   D. $(2+m+n)(2-m+n)$.

4. $\dfrac{2}{k+2}-\dfrac{3}{k-3} =$

   A. $\dfrac{k}{(k+2)(k-3)}$.
   B. $\dfrac{k}{(k+2)(3-k)}$.
   C. $\dfrac{k+12}{(k+2)(3-k)}$.
   D. $\dfrac{k+12}{(k+2)(k-3)}$.

5. $0.09876543 =$

A. 0.10 (correct to 2 significant figures).
B. 0.099 (correct to 3 decimal places).
C. 0.09876 (correct to 4 significant figures).
D. 0.098765 (correct to 5 decimal places).

6. If p and q are constants such that $6x^2 - 2q(x-1) + 20 \equiv px(x+2) + q(x-3)$, then $q =$

A. -4.
B. 4.
C. 6.
D. 8.

7. Let k be a constant. If $f(x) = x^2 - kx + k$, then $f(k) - f(-k) =$

A. $-2k^2$.
B. 0.
C. $2k$.
D. $2k^2$.

8. Let $g(x) = x^{2022} + px^{21} + q$, where p and q are constants. If $g(x)$ is divisible by $x+1$, find the remainder when $g(x)$ is divided by $x-1$.

A. 0
B. $2p$
C. $-2p$
D. $-2p-2$

9. In a school, the number of senior students is 15% less than that of junior students. If 80% of the senior students and 65.2% of the junior students have received the vaccine for more than 14 days, then the percentage of vaccination in the school is

A. 69.5%.
B. 72%.
C. 72.6%
D. 77.8%

10. The solution of $\frac{x-2}{3} \le x-4$ or $3x-4>5$ is

A. $x<3$.
B. $x>3$.
C. $x\le 5$.
D. $x\ge 5$.

11. The scale of a map is $1:25000$. If the area of a carpark on the map is $2\,\text{cm}^2$, then the actual area of the carpark is

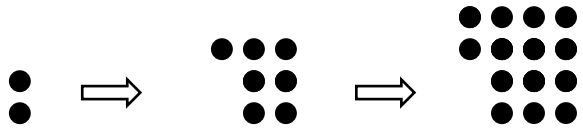
A. $5\times10^4\ \text{m}^2$.
B. $1.25\times10^5\,\text{m}^2$.
C. $6.25\times10^5\ \text{m}^2$.
D. $1\times10^6\ \text{m}^2$.

12. It is given that z varies as the square of x and inversely as the cube root of y. When $x = 4$ and $y = 8$, $z = 12$. When $x = 2$ and $y = 1$, $z =$

A. 6.
B. 24.
C. 384.
D. 1536.

13. In the figure, the 1st pattern consists of 2 dots. For any positive integer n, the $(n + 1)$th pattern is formed by adding $(2n + 3)$ dots to the nth pattern. Find the number of dots in the 8th pattern.

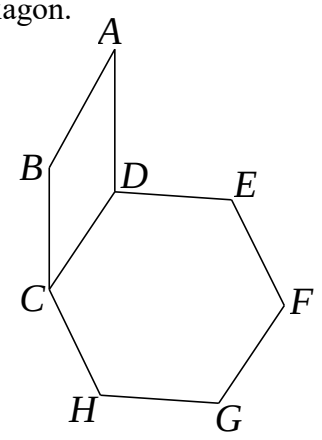
A. 62
B. 74
C. 79
D. 98



14. Let c be a non-zero constant. Which of the following statements about the graph of $y=c-(cx+1)^2$ must be true?

A. The graph cuts the x-axis.
B. The y-intercept of the graph is c.
C. The graph passes through the point $(c, 0)$.
D. The graph opens downwards.

15. In the figure, $ABCD$ is a rhombus and $CDEFGH$ is a regular hexagon. If $\angle BCD = 20°$, then $\angle AED =$



A. $40°$.
B. $45°$.
C. $50°$.
D. $60°$.

16. The height of a circular cylinder is the same as its base diameter. If the volume of the circular cylinder is 432π cm^3, then the total surface area of the circular cylinder is

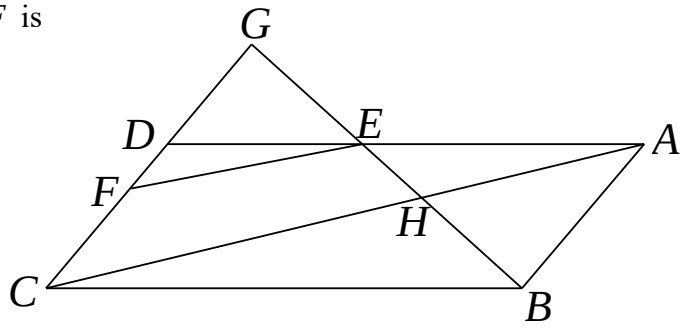
A. 144π cm^2.
B. 180π cm^2.
C. 216π cm^2.
D. 432π cm^2.

17. The arc length of a sector is equal to half of its perimeter. Which of the following must be true?

I. The perimeter of the sector is 4 times the radius of the sector.
II. The angle of the sector is $60°$.
III. The area of the sector is 8π cm^2.

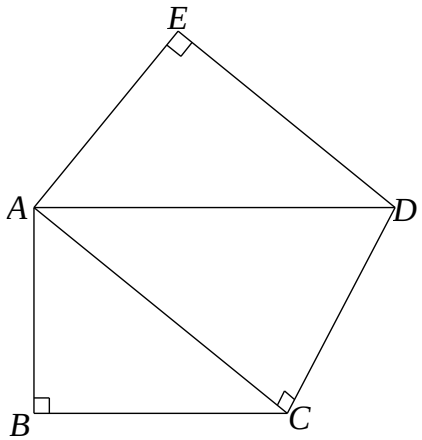
A. I only
B. II only
C. I and II only
D. II and III only

18. In the figure, $ABCD$ is a parallelogram. Let E and F be points lying on AD and CD respectively such that $AE : ED = 4 : 3$. CF produced and BE produced meet at the point G such that $GF = AB$. Denote the point of intersection of AC and BG by H. If the area of ΔCBH is 98 cm^2, then the area of $CHEF$ is



A. 39.5 cm^2.
B. 49.5 cm^2.
C. 105.5 cm^2.
D. 115.5 cm^2.

19. In the figure, ABC, ACD and ADE are right-angled isosceles triangles. Which of the following must be true?



I. $AD = 2BC$

II. $AC^2 = AB \cdot AD$.

III. $AD \perp CE$.

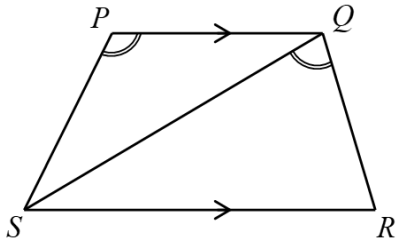
A. I and II only

B. I and III only

C. II and III only

D. I, II and III

20. In the figure, $PQ // SR$ and $\angle SPQ = \angle SQR$. Which of the following is/are true?



I. $\dfrac{PQ}{QS} = \dfrac{QS}{SR}$

II. $\dfrac{PQ}{PS} = \dfrac{QS}{QR}$

III. $\dfrac{PS}{QS} = \dfrac{QS}{RS}$

A. I only

B. II only

C. I and II only

D. II and III only

21. If an interior angle of a regular polygon is 7 times an exterior angle of the polygon, which of the following must be true?

I. Each exterior angle is $15°$.

II. The number of diagonals of the polygon is 14.

III. The number of folds of rotational symmetry of the polygon is 16.

A. I only

B. III only

C. I and II only

D. II and III only

22. The rectangular coordinates of the point P are $(3\sqrt{3}, -3)$. P is reflected with respect to the x-axis to the point Q. Q is then rotated anticlockwise about the origin through $60°$ to the point R. Find the polar coordinates of R.

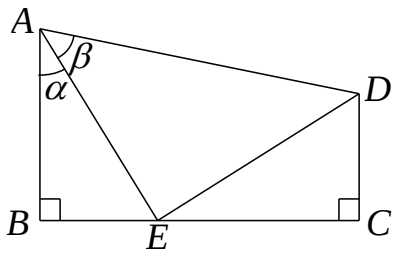
A. $(6, 90°)$
B. $(6, 120°)$
C. $(6, 150°)$
D. $(6, 330°)$

23. Two numbers are randomly drawn at the same time from six cards numbered 1, 2, 3, 5, 6 and 7 respectively. Find the probability that the sum of the numbers drawn is an odd number.

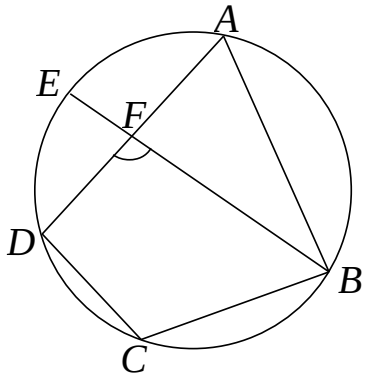
A. $\frac{1}{2}$
B. $\frac{2}{3}$
C. $\frac{3}{5}$
D. $\frac{8}{15}$

24. In the figure, $ABCD$ is a trapezium with $\angle ABC = \angle BCD = 90°$. If E is a point lying on BC such that $\angle AED = 90°$, then $\frac{AB}{CD} =$

A. $\tan\alpha \tan\beta$.
B. $\frac{1}{\tan\alpha \tan\beta}$.
C. $\frac{\tan\alpha}{\tan\beta}$.
D. $\frac{\tan\beta}{\tan\alpha}$.



25. In the figure, $ABCDE$ is a circle. AD and BE intersect at F. If $AB = BC = 2CD = 2DE$ and $\angle BCD = 126°$, then $\angle BFD =$

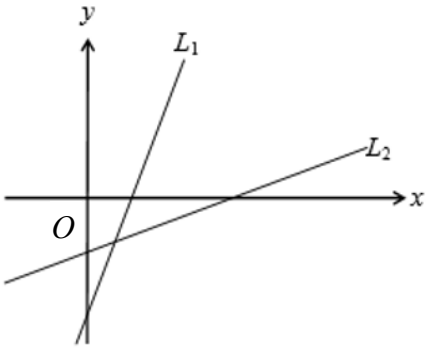


A. $54°$.
B. $63°$.
C. $108°$.
D. $126°$.

26. The coordinates of the points A and B are $(17,17)$ and $(20,21)$ respectively. If P is a moving point in the rectangular coordinate plane P is equidistant from A and B, then the locus of P is

A. the perpendicular bisector of AB.
B. the straight line which passes through A and B.
C. the angle bisector of $\angle AOB$, where O is the origin.
D. the circle with AB as a diameter.

27. In the figure, the equations of the straight lines L_1 and L_2 are $x + ay = b$ and $x + cy = d$ respectively. Which of the following are true?



I. $a > c$
II. $b > d$
III. $ad > bc$

A. I and II only
B. I and III only
C. II and III only
D. I, II and III

28. The equations of the circles C_1 and C_2 are $3x^2 + 3y^2 - 6x + 12y + 14 = 0$ and $x^2 + y^2 - 2x + 2y + 1 = 0$ respectively. Which of the following is/are true?

I. The centre of C_1 lies on C_2.
II. The area of C_2 is 3 times that of C_1.
III. The distance between the two centres is greater than 5.

A. I only
B. II only
C. I and II only
D. I, II and III

29. The table below shows the distribution of the numbers of books read by some students in a month.

Number of books read	5	6	7	8	9
Number of students	34	36	30	16	4

Which of the following is true?

A. The mode of the distribution is 36.
B. The median of the distribution is 7.
C. The lower quartile of the distribution is 5.
D. The upper quartile of the distribution is 8.

30. Consider the following integers.

24 36 42 68 86 90 90 a b c

If the mean and the mode of the above data are 58 and 42 respectively, then the median of the above data is

A. 51.
B. 55.
C. 77.
D. 88.

Section B

31. The L.C.M. of a^2-2a+1, a^3-a and a^3-1 is

A. $a-1$.
B. $a(a-1)^2(a^2+a+1)$.
C. $a(a+1)(a-1)^2(a^2+a+1)$.
D. $a(a-1)^4(a^2+a+1)$.

32. $\text{F}00000000000011_{16} =$

A. $15\times 2^{56}+17$.
B. $1\times 2^{60}+17$.
C. $15\times 2^{60}+272$.
D. $1\times 2^{64}+272$.

33. If k is a real number, then the imaginary part of $\dfrac{2+i^{33}}{k+i}-i^{34}=$

A. $\dfrac{k-2}{k^2+1}$.

B. $\dfrac{k-2}{k^2-1}$.

C. $\dfrac{k^2+2k+2}{k^2+1}$.

D. $\dfrac{k^2+2k+2}{k^2-1}$.

34. It is given that $\log_8 y$ is a linear function of $\log_4 x$. The intercepts on the vertical axis and on the horizontal axis of the graph of the linear function are 10 and 9 respectively. Which of the following must be true?

A. $x^5y^3=2^{90}$

B. $x^3y^5=2^{90}$

C. $x^{10}y^9=2^{90}$

D. $x^9y^{10}=2^{90}$

35. Let $a>1$. If the roots of the equation $(\log_a x)^2-4\log_a x+4=\log_a a$ are α and β, then $\alpha+\beta=$

A. 4.

B. $2a^2$.

C. a^3+a.

D. a^4.

36. If a, b, c, d is an arithmetic sequence, which of the following must be true?

I. $a+d=b+c$

II. $a-d=3(b-c)$

III. $a<b<c<d$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

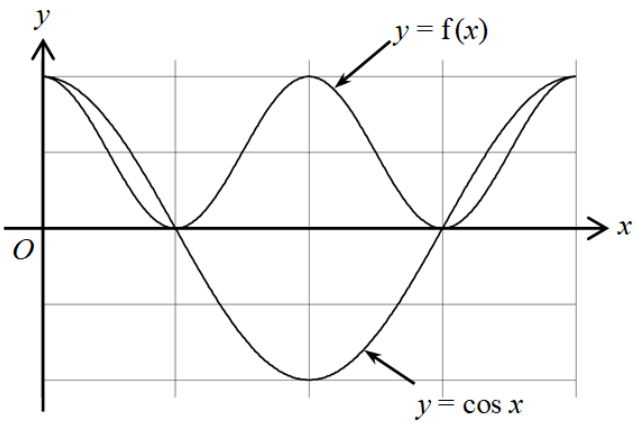
37. In the figure, $\mathrm{f}(x)=$

A. $\frac{1}{2}\cos\frac{x}{2}+\frac{1}{2}$.

B. $\frac{1}{2}\cos 2x+\frac{1}{2}$.

C. $\cos\frac{x}{2}+\frac{1}{2}$.

D. $\cos 2x+\frac{1}{2}$.



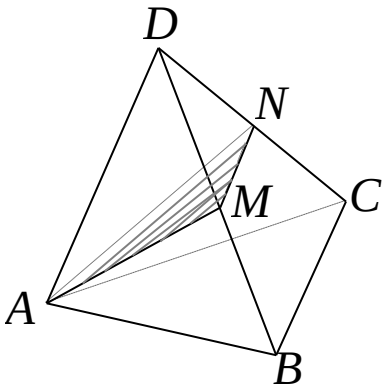
38. In the figure, $ABCD$ is a tetrahedron. M and N are the mid-points of BD and CD respectively. If $AB=AC=AD=25\,\text{cm}$, $BD=14\,\text{cm}$, $CD=30\,\text{cm}$ and $BC=4k\,\text{cm}$, then the area of ΔAMN is

A. $\sqrt{(k^2-4)(484-k^2)}\ \text{cm}^2$.

B. $\sqrt{(k^2-4)(484+k^2)}\ \text{cm}^2$.

C. $\sqrt{(k^2+4)(484-k^2)}\ \text{cm}^2$.

D. $\sqrt{(k^2+4)(484+k^2)}\ \text{cm}^2$.



39. In the figure, BF is the tangent to the circle $ABCD$ at B such that $BF//CD$. Chords CD and BA are produced to meet at E such that $DE=BC$. Which of the following statements are true?

I. $\Delta ABC\cong\Delta ADE$.

II. AC is the angle bisector of $\angle BCD$.

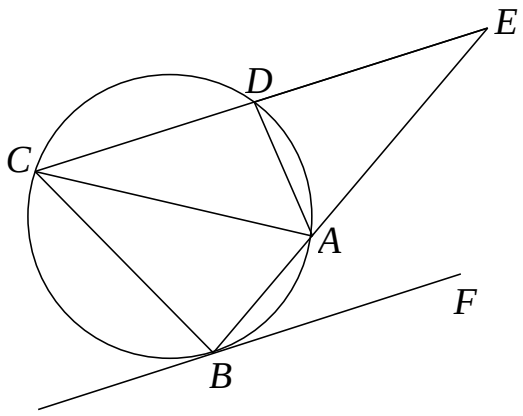
III. $\Delta ABC\sim\Delta CBE$.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III



40. Find the range of values of k such that the circle $x^2+y^2+kx-10y-14=0$ and the straight line $3x-y-18=0$ intersect.

A. $-2 \le k \le 278$
B. $-278 \le k \le 2$
C. $k \le -2$ or $k \ge 278$
D. $k \le -278$ or $k \ge 2$

41. Let O be the origin. If the coordinates of the point A are (0, 8) and the x-coordinate of the circumcentre of ΔOAB is 5, then which of the following must not be the x-coordinate of B?

A. 3
B. 6
C. 9
D. 12

42. The 170th Anniversary Concert Committee is formed by 30 students and 10 teachers. If 8 members are selected from the committee to form a production team for the opera consisting of at most 5 students, how many different production teams can be formed?

A. 17100720
B. 23437965
C. 23973885
D. 47077875

43. A bag contains 4 blue balls and 3 white balls. David keeps drawing one ball at a time randomly from the bag without replacement until a white ball appears. Find the probability that David gets the first white ball on the third draw given that David needs at least 3 draws to get the first white ball.

A. $\frac{2}{7}$
B. $\frac{3}{5}$
C. $\frac{6}{35}$
D. $\frac{8}{35}$

44. In an examination, the standard deviation of the examination is 6 marks. The examination score of a girl is 59 marks and her standard score is -2. If the standard score of a boy in the examination is 0.5, then his examination score is

A. 47 marks.
B. 50 marks.
C. 71 marks.
D. 74 marks.

45. If the variance of five numbers are *a, b*, *c*, *d* and *e* is 20, then the variance of the five numbers $21-22a$, $21-22b$, $21-22c$, $21-22d$ and $21-22e$ is

A. 419.
B. 420.
C. 440.
D. 9680.

End of Paper