SOUTH WEST REGIONAL MOCK EXAMINATION
GENERAL EDUCATION

<table>
<tr><td>The Teachers' Resource Unit (TRU) in collaboration with the Regional Pedagogic Inspectorate for Science Education and the South-West Association of Mathematics Teachers (SWAMT)</td><td>Subject Code
0775</td><td>Paper Number
1</td></tr>
<tr><td>CANDIDATE NAME
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CANDIDATE NUMBER
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CENTRE NUMBER
....</td><td colspan="2">Subject Title
FURTHER MATHEMATICS</td></tr>
<tr><td>ADVANCED LEVEL</td><td colspan="2">DATE: FRIDAY AFTERNOON
22/03/2024</td></tr>
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Time Allowed: One Hour Thirty Minutes

INSTRUCTIONS TO CANDIDATES:

1. USE A SOFT HB PENCIL THROUGHOUT THIS EXAMINATION.
2. DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

Before the Examination begins:

3. Check that this question booklet is headed **"Advanced Level – 0775 Further Mathematics, Paper 1".**
4. Insert the information required in the spaces provided above.
5. Without opening the booklet, pull out the answer sheet carefully from inside the front cover of this booklet. Take care that you do not crease or fold the answer sheet or make any marks on it other than those asked for in these instructions.
6. Insert the information required in the spaces provided on the answer sheet using your HB pencil: **Candidate Name, Centre Number, Candidate Number, Subject Code Number and Paper Number.**

How to answer questions in this examination:

7. Answer ALL the 50 questions in this examination. All questions carry equal marks.
8. Non-programmable calculators are allowed.
9. For each question there are four suggested answers, A, B, C, and D. Decide which answer is correct. Find the number of the question on the Answer sheet and draw a horizontal line across the letter to join the square brackets for the answer you have chosen. For example, if C is your correct answer, mark C as shown [A] [B] [-C-] [D]
10. Mark only one answer for each question. If you mark more than one answer, you will score zero for that question. If you change your mind about an answer, erase the first mark carefully, and then mark your new answer.
11. Avoid spending much time on any question. If you find a question difficult, move to the next question. You can come back to this question later.
12. Do all rough work in this booklet using, where necessary, the blank spaces in the question booklet.
13. Mobile phones are **NOT ALLOWED** in the examination room.
14. **You must not take this booklet and answer sheet out of the examination room. All question booklets and answer Sheets will be collected at the end of the examination.**

1. Given that $3x \equiv 4 \pmod 7$, then $x =$

A 2
B 4
C 8
D 6

2. Given that p and q are mathematical statements, then the statement $\sim q \Rightarrow p \equiv$

A $\sim p \Rightarrow q$
B $q \Rightarrow \sim p$
C $\sim q \Rightarrow \sim p$
D $q \Rightarrow p$

3. Given the statements p and q,

$\sim(p \Rightarrow \sim q) \equiv$

A $\sim p \wedge q$
B $p \wedge \sim q$
C $p \wedge q$
D $\sim p \wedge \sim q$

4. The inverse of the permutation

$P = \begin{pmatrix} a & b & c & d \\ b & d & a & c \end{pmatrix}$ is

A $\begin{pmatrix} a & b & c & d \\ c & d & a & b \end{pmatrix}$

B $\begin{pmatrix} a & b & c & d \\ c & a & d & b \end{pmatrix}$

C $\begin{pmatrix} a & b & c & d \\ b & c & a & d \end{pmatrix}$

D $\begin{pmatrix} a & b & c & d \\ a & c & b & d \end{pmatrix}$

5. The congruence equation which has no solution, from the equations given below, is

A $7x \equiv 3 \pmod 5$
B $8x \equiv 3 \pmod{10}$
C $15x \equiv 6 \pmod{36}$
D $24x \equiv 18 \pmod{39}$

6. A function f is defined by

$$f(x) = \begin{cases} \dfrac{\sin 2x}{x}, & for\ x < 0 \\ \dfrac{k+3x^2}{2-x}, & for\ 0 \le x \le 4 \end{cases}$$

Given that f is continuous at $x = 0$, then the value of k is

A 0
B 9
C 4
D 6

7. The function $f(x) = \sqrt{\dfrac{x-1}{x+1}}$ is continuous on

A $]-\infty, 1]$
B $[-1, 1]$
C $]-1, 1[$
D $]\infty, 1[$

8. The series $\sum_{r=1}^{\infty} \dfrac{1}{4^r}$ is

A divergent
B convergent
C telescopic
D oscillating

9. The point of intersection of the polar curves $r = 2 + \cos\theta$ and $r\cos\theta = 3$ is

A $(0, 2)$
B $(3, 0)$
C $(2, \pi)$
D $(\pi, 2)$

10. The number $\dfrac{2}{7}$ can be expressed as a decimal as 0.28571428571428571.... The 307[th] digit is

A 7
B 8
C 4
D 2

11. The eccentricity of the ellipse $3x^2 + 4y^2 = 12$ is

A $\frac{1}{2}$
B $\frac{\sqrt{7}}{2}$
C $\frac{\sqrt{7}}{3}$
D 2

12. Given the matrix $A = \begin{bmatrix} 2 & 1 & -1 \\ 1 & -1 & 2 \\ a & b & c \end{bmatrix}$ and that

$|A| = \lambda$, then $\begin{vmatrix} 2a & a & -a \\ a & -a & 2a \\ a & b & c \end{vmatrix} =$

A $a\lambda$

B $\frac{\lambda}{a}$

C $a^2\lambda$

D $\frac{\lambda}{a^2}$

---

13. Given the non-singular matrices N and M, and non-zero column vectors x, y, such that $(NM^{-1})x = y$, then $x =$

A $MN^{-1}y$

B $N^{-1}My$

C $M^{-1}Ny$

D $NM^{-1}y$

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14. The series $\sum_{r=1}^{\infty} \frac{1}{r^n}$ converges when

A $n > 0$

B $n < 1$

C $n = 1$

D $n > 1$

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15. If a force F acts through a point with position vector $\boldsymbol{a}$, then its moment about a point with position vector $\boldsymbol{b}$ is

A $a \times F$

B $(b - a)F$

C 0

D $(a - b) \times F$

---

16. One of the tangents at the pole to the polar curve $r = a\left(1 - 2\cos\frac{\theta}{2}\right)$ where $a > 0$ is

A $\frac{\pi}{6}$

B $\frac{2\pi}{3}$

C $\frac{\pi}{3}$

D 0

---

17. Given that $y = \sec h 3x$, then $\frac{dy}{dx} =$

A $\tanh(3x)\sec h(3x)$

B $3\tanh(3x)\sec h(3x)$

C $-\tanh(3x)\sec h(3x)$

D $-3\tanh(3x)\sec h(3x)$

---

18. Given that $|Z| = 6$, then the greatest value of $|Z - 3|$ is

A 6

B 3

C 9

D 3

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19. If $\frac{dy}{dx} - 2xy = 1$ and $y = 0$ when $x = 0$, then the first two non zero terms in the series solution for y are

A $1 + x$

B $x - \frac{x^2}{2}$

C $x - x^2$

D $x + \frac{2x^3}{3}$

---

20. A recursive sequence $(x)_n, n \geq 1$ is defined by $x_{n+1} = (-x_n + 4)$ and $x_1 = 2$. The sequence is

A decreasing

B constant

C increasing

D alternating

---

21. A particle moves round the polar curve $r = a(1 + \cos\theta)$ with constant angular velocity ω. The transverse component of its velocity is

A ω

B $a\omega(1 + \cos\theta)$

C $-a\omega\sin\theta$

D $a\omega(1 - \sin\theta)$

---

22. $\left(\frac{1}{e^{2i\theta}}\right)^2 =$

A $\cos 2\theta - i\sin 2\theta$

B $\cos 4\theta - i\sin 4\theta$

C $\cos 2\theta + i\sin 2\theta$

D $\cos 4\theta + i\sin 4\theta$

23. Given that kx^2e^{2x} is the particular integral for the differential equation $\frac{d^2y}{dx^2}-4\frac{dy}{dx}+4y=e^{2x}$ where k is a constant, then the value of k is

A $\frac{1}{2}$
B 2
C $-\frac{1}{2}$
D 3

24. A smooth sphere travelling with a speed of $2m/s$ on a smooth horizontal floor hits a vertical wall at an angle of 45^0. Given that the coefficient of restitution is $\frac{1}{4}$, then its speed after impact is

A $\frac{1}{4}\sqrt{34}$
B $\frac{1}{2}\sqrt{2}$
C $\frac{3}{4}\sqrt{2}$
D $\frac{1}{4}\sqrt{3}$

25. $\int\frac{1}{\sqrt{x^2+4}}dx=$

A $cosh^{-1}\left(\frac{x}{4}\right)+c$
B $sinh^{-1}\left(\frac{x}{4}\right)+c$
C $cosh^{-1}\left(\frac{x}{2}\right)+c$
D $sinh^{-1}\left(\frac{x}{2}\right)+c$

26. Given that $|a|<\pi$, then $\int_{-a}^{a}\cos|x|dx=$

A $2\int_{-a}^{a}\cos xdx$
B 0
C $\int_{0}^{a}\cos xdx$
D $2\int_{0}^{a}\cos xdx$

27. A particle P describes simple harmonic motion with O as the centre and has a speed of 6 m/s at a distance of 1 m from O and a speed of 2 m/s at a distance of 3 m from O. Its amplitude is

A $2\sqrt{2}\ m$
B $\sqrt{10}\ m$
C $10\ m$
D $\sqrt{5}\ m$

28. A particle P describes simple harmonic motion of amplitude $2\ m$. In performing one complete oscillation, its displacement is

A $0\ m$
B $2\ m$
C $8\ m$
D $4\ m$

29. The general solution of the differential equation $2\frac{d^2y}{dx^2}+3\frac{dy}{dx}-2y=0$, where P and Q are real constants is

A $Pe^{2x}\cos\left(\frac{x}{2}+\theta\right)$
B $Pe^{2x}+Qe^{\frac{x}{2}}$
C $P\cos 2x+Q\sin\left(-\frac{x}{2}\right)$
D $(P+Qx)e^{2x}$

30. The moment of inertia of an object of mass $2m$ is $\frac{8ma^2}{3}$. Its radius of gyration is

A $\frac{2a}{3}\sqrt{3}$
B $\frac{a}{3}\sqrt{3}$
C $\frac{4a^2}{3}$
D $\frac{1}{2a}\sqrt{3}$

31. The work done by a force F in moving a particle of mass m from a point A with position vector $\boldsymbol{a}$ to a point B with position vector $\boldsymbol{b}$ is

A $mF\cdot(\boldsymbol{b}-\boldsymbol{a})$
B $F\cdot(\boldsymbol{b}-\boldsymbol{a})$
C $F\times(\boldsymbol{b}-\boldsymbol{a})$
D $mF\times(\boldsymbol{b}-\boldsymbol{a})$

32. One of the asymptotes to the curve $y+x=xy$ is

A $y=1$
B $x=-1$
C $x=0$
D $y=-1$

33. The centre of symmetry of the curve $y=\frac{1}{x+3}$ is at the point

A (3, 0)
B (−3, 0)
C (0, 0)
D (0, 3)

34. Given that $g(x)=\begin{cases}\frac{x^2-a^2}{x-a}, & for\ x\neq a\\ a, & for\ x=a\end{cases}$, then

A $g(x)$ is defined on $\mathbb{R}$
B $g(x)$ is not defined on all of $\mathbb{R}$
C $\lim_{x\to a} g(x)=a$
D $g(x)$ is continuous at $x=a$

35. A discrete random variable X, for $x=0,1,2,3$ has distribution table

x_i	0	1	2	3
$P(X=x_i)$	$\frac{1}{64}$	$\frac{18}{64}$	d	$\frac{26}{64}$

The value of d is

A $\frac{18}{64}$
B $\frac{19}{64}$
C 1
D $\frac{27}{64}$

36. A group G has subgroups $\{a,d\}$, $\{b,c,d,f\}$, $\{c,d,f\}$. The identity element of G is

A c
B f
C d
D a

37. When x is largely negative, $\cosh x \approx$

A $\frac{1}{2}(e^x+e^{-x})$
B e^x
C $\frac{1}{2}e^{-x}$
D $\frac{1}{2}e^x$

38. The velocities of a sphere before and after an impact are $\vec{i}+2\vec{j}$ and $3\vec{i}+\vec{j}$ respectively. The angle of deflection due to the collision is

A $\frac{\pi}{3}$
B $\frac{\pi}{4}$
C $\frac{\pi}{5}$
D $\frac{\pi}{6}$

39. $\int_0^{\ln 2} e^{\sinh x}\cosh x\,dx=$

A $e^{\frac{3}{4}}-1$
B $e^{\frac{5}{4}}-e$
C $e^{\frac{3}{2}}-1$
D $e^{\frac{1}{4}}-1$

40. $(i-j-k)\times(j-2k)=$

A $3i+2j+k$
B $3i-2j+k$
C $-3i-2j+k$
D $-3i+2j-k$

41. The integrating factor of the differential equation $x\frac{dy}{dx}+2y=x^3$ is

A $2\ln x$
B x
C x^2
D $2x$

42. The root mean square value of $y = x^2 + x$ in the interval $0 \le x \le 2$ is

A $\frac{64}{15}$

B $\frac{8\sqrt{30}}{15}$

C $\frac{2\sqrt{15}}{15}$

D $\frac{8\sqrt{15}}{15}$

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43. An estimate for $\int_2^4 \frac{1}{x}dx$, using Simpson's Rule with 3 ordinates is

A $\frac{25}{36}$

B $\frac{17}{36}$

C $\frac{25}{24}$

D $\frac{17}{24}$

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44. Given that $\tanh^{-1} x = \ln 3$, then the value of x is

A $\frac{3}{5}$

B $\frac{5}{4}$

C $\frac{4}{5}$

D $\frac{5}{3}$

---

45. The forces F_1, F_2 and F_3 act at points with position vectors r_1, r_2 and r_3 respectively. Given that $\sum_{i=1}^{3} F_i \ne 0$ and $\sum_{i=1}^{3} r_i \times F_i = 0$, then this system of forces

A is in equilibrium

B reduces to a couple

C reduces to a single force through O

D reduces to a single force and a couple

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46. The normal approximation to the Poisson distribution of the random variable X with variance $\frac{1}{4}$ is

A $X \sim N\left(\frac{1}{2}, \frac{3}{4}\right)$

B $X \sim N\left(\frac{1}{2}, \frac{1}{2}\right)$

C $X \sim N\left(\frac{3}{4}, \frac{3}{4}\right)$

D $X \sim N\left(\frac{1}{4}, \frac{1}{4}\right)$

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47. A particle of mass m falls against a resistance of magnitude kv, where v is the velocity and k is a positive constant. The equation of motion is given by

A $\frac{dv}{dt} = -kv$

B $\frac{dv}{dt} = mg - \frac{kv}{m}$

C $\frac{dv}{dt} = g + kv$

D $\frac{dv}{dt} = -mg - kv$

---

48. If x is the displacement of a particle from a fixed point O at time t, then an oscillatory motion is represented by

A $\frac{d^2x}{dt^2} + 4\frac{dx}{dt} + 4x = 0$

B $\frac{d^2x}{dt^2} - 4\frac{dx}{dt} - 5x = 0$

C $\frac{d^2x}{dt^2} + 4x = 0$

D $\frac{d^2x}{dt^2} - 4x = 0$

---

49. The moment of momentum about O of a particle of mass m with velocity v through a point with position vector r is

A $r \times mv$

B $mv \times r$

C $r \cdot mv$

D $mv \cdot r$

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50. A continuous random variable X is uniformly distributed in the interval $23 \le x \le 31$. The median of this variable is

A 4

B 8

C 27

D 54

END.

GO BACK AND CHECK YOUR WORK.