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MARCH 2022

The Teachers' Resource Unit and the Regional Inspectorate of Pedagogy, in collaboration with MTA	SUBJECT CODE NUMBER 0765	PAPER NUMBER 1
	GENERAL CERTIFICATE OF EDUCATION REGIONAL MOCK EXAMINATION	
CANDIDATE NAME:	SUBJECT TITLE MATHEMATICS WITH MECHANICS	
CANDIDATE NUMBER:		
CENTRE NUMBER:		
ADVANCED LEVEL		

Time Allowed: One and a half hours
INSTRUCTIONS TO CANDIDATES:

Mobile phones are **NOT ALLOWED** in the examination room.

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 -0765 code and subject title—Maths With Mechanics Paper 1".
4. Insert the information required in the spaces 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 below:
[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. 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.

TURN OVER 1

1. Expressed in partial fractions, $\frac{5x^2+3}{(x-1)(x^2+1)}$

becomes:

A. $\frac{4}{x-1} + \frac{1}{x^2+1}$

B. $\frac{4}{x-1} + \frac{x+1}{x^2+1}$

C. $\frac{4}{x-1} - \frac{x+1}{x^2+1}$

D. $\frac{4}{x-1} + \frac{x-1}{x^2+1}$

2. Given that the polynomials $x^3 + 4x^2 + 2x + 1$ and $x^3 + 3x^2 - x - 1$ leave the same remainder when divided by $x - m$ the possible values of m are:

A 1, 2

B -1, 2

C -2, 1

D -2, -1

3. The range of values of the expression

$$\frac{2x}{1+x^2}, x \in \mathbb{R} \text{ is:}$$

A $[-1, 1]$

B $] -1, 1[$

C $] -\infty, -1] \cup [1, +\infty[$

D $] -\infty, 1[$

4. If the roots of $-x^2 + kx - 2 = 0$ differ by 1 then:

A $k^2 - 4 = 0$

B $k^2 - 12 = 0$

C $k^2 + 4 = 0$

D $k^2 + 12 = 0$

5. The value of x for which $e^{3x} - 3e^x - 4e^{-x} = 0$ is:

A $0.5 \ln 2$

B $0.5 \ln 4$

C $\ln 4$

D $0.25 \ln 2$

6. If $\log_6 2 = a$ then $\log_6 3 =$:

A $\frac{1-a}{3a}$

B $\frac{1-a}{2a}$

C $\frac{1-a}{a}$

D $\frac{3-3a}{a}$

7. The solution set of the inequality $x + |x| - 2x|x| - 8 > 0, x \in \mathbb{R}$ is:

A $\{x: x < -2\} \cup \{x: x \geq 2\}$

B $\{x: -2 < x < 2\}$

C $\{x: x < -2\}$

D $\{x: x > 2\}$

8. The graph of $y = x^2 - x + 5, x \in \mathbb{R}$ is first reflected in the y -axis and then translated 3 units parallel to the x -axis. The equation of the graph obtained is:

A $y = x^2 + x + 8$

B $y = x^2 + 7x - 17$

C $y = x^2 + 7x + 17$

D $y = x^2 - 5x + 11$

9. The sum of the first n terms of an arithmetic sequence is 187. Given that the first term is 2 and the n^{th} term is 32, the value of n is:

A 6

B 11

C 66

D 67

10. For odd values of $n, \sum_{r=1}^n (-1)^r (2r+1) =$:

A $2 - n$

B $n + 2$

C $n - 2$

D $-(n+2)$

11. The number of permutations of the letters of the word **CONTEMPLATE** in which the vowels are together is:

A $\frac{4! \times 8!}{2!}$

B $\frac{11!}{2! \times 2!}$

C $3! \times 8!$

D $3! \times 7!$

12. In an examination a candidate has to answer 8 questions out of 10. If he must answer the first two questions then he can choose the 8 questions in:

- A 56 ways
- B 45 ways
- C 28 ways
- D 90 ways

13. An interval within which a root of $x^3 + x^2 - 16 = 0$ lies is:

- A $-2 \leq x \leq -1$
- B $0 \leq x \leq 1$
- C $1 \leq x \leq 2$
- D $2 \leq x \leq 3$

14. Starting with the initial value $x = 1.5$ and using Newton-Raphson procedure once, an approximation to the root of $x^2 - 2 = 0$ is:

- A 0.083
- B 1.417
- C 1.583
- D 1.375

15. The domain of definition of the function $f(x) = \ln(5x - 2)$, $x \in \mathbb{R}$ is:

- A \mathbb{R}^+
- B $\mathbb{R} - \left\{\frac{2}{5}\right\}$
- C $\left\{x: x > \frac{2}{5}, x \in \mathbb{R}\right\}$
- D $\left\{x: x < \frac{2}{5}, x \in \mathbb{R}\right\}$

16. An odd and periodic function g , with period 1 is defined by $g(x) = 2x^2 - x$ for $0 \leq x \leq 0.5$.

$g(0.75) =$:

- A 0.375
- B -0.375
- C -0.125
- D 0.125

17. The relation R on \mathbb{Z} , the set of integers, defined by aRb means $b = a^n$, $n \in \mathbb{Z}$ is:

- A an equivalence relation.
- B a partial order.
- C a total order.
- D a strict order.

18. The argument of the complex number $-\frac{\sqrt{3}}{2} + \frac{1}{2}i$ is:

- A $\frac{5\pi}{6}$
- B $\frac{2\pi}{3}$
- C $\frac{\pi}{3}$
- D $\frac{\pi}{6}$

19. The angle θ , between the line $\frac{x-1}{2} = \frac{1-y}{1} = \frac{z+3}{2}$ and the plane $x - 2y + z = 10$ is given by:

- A $\cos\theta = \frac{\sqrt{6}}{9}$
- B $\cos\theta = \frac{4\sqrt{3}}{9}$
- C $\sin\theta = \frac{2\sqrt{3}}{3}$
- D $\sin\theta = \frac{4\sqrt{6}}{9}$

20. A vector perpendicular to both $i - 3j + 2k$ and $3i + 2j$ is:

- A $4i + 6j - 11k$
- B $4i - 11j + 2k$
- C $-11i - 4j + 6k$
- D $11i - 4j - 6k$

21. Given that the line $y = 3x - 5$ is a tangent to the circle $x^2 + y^2 - 2ax = 0$ the possible values of a are given by the equation:

- A $10a^2 - 3a + 5 = 0$
- B $91a^2 + 30a - 25 = 0$
- C $a^2 + 30a + 25 = 0$
- D $a^2 + 30a - 25 = 0$

22. The equation of a circle with the points $(2, 1)$ and $(-3, 2)$ as ends of a diameter is:

- A $x^2 + y^2 + x - 3y - 4 = 0$
- B $x^2 + y^2 + x - y + 1 = 0$
- C $x^2 + y^2 - x - 3y - 4 = 0$
- D $x^2 + y^2 - 5x - 3y + 8 = 0$

23. The tangent of the acute angle between the lines $2y + 3x = 6$ and $y + 6x = 3$ is:

- A $\frac{20}{9}$
- B $\frac{9}{20}$
- C $\frac{9}{16}$
- D $\frac{5}{4}$

24. The distance of the point $(5, -3)$ from the line $2x - y - 3 = 0$ is:

- A $10\sqrt{5}$ units
- B $4\sqrt{5}$ units
- C $2\sqrt{5}$ units
- D $\sqrt{5}$ units

25. When the relation $\frac{a}{x} + \frac{b}{y} = k$ is reduced to a linear form the gradient of the straight line obtained is:

- A $\frac{k}{b}$
- B $\frac{a}{b}$
- C $-\frac{a}{b}$
- D $-\frac{b}{a}$

26. The area of the region defined by the inequalities $0 \leq y \leq x^2$, $-2 \leq x \leq 2$ is rotated completely about the x -axis. The volume generated is:

- A 64π
- B 12π
- C 3.2π
- D 12.8π

27. The general solution of the differential equation $\frac{dy}{dx} = \frac{1-y}{1-x}$ where k is a positive constant is:

- A $y = 1 - k(1 + x)$
- B $y = 1 + k(1 - x)$
- C $y = 1 + k(1 + x)$
- D $y = 1 - k(1 - x)$

28. $\int_1^3 \frac{x+2}{x+1} dx =$

- A $2 + \ln 2$
- B $2 - \ln 2$
- C $\ln 2$

D $2\ln 2$

29. If $x = 3t + 1$ and $y = t^2 - 5$ then $\frac{d^2y}{dx^2} =$

- A $\frac{2t}{3}$
- B $\frac{2}{3}$
- C $\frac{2}{9}$
- D $\frac{2t}{9}$

30. The equations of the asymptotes to the curve $y = x + \frac{2x^2-1}{3-2x}$ are:

- A $2x + 3 = 0$, $2y + 3 = 0$
- B $2x + 3 = 0$, $2y - 3 = 0$
- C $2x - 3 = 0$, $2y + 3 = 0$
- D $2x - 3 = 0$, $2y - 3 = 0$

31. The Cartesian equation of a curve defined parametrically by $x = e^{2t}$, $y = e^{4t+3}$ is:

- A $y = xe^{-1}$
- B $y = x^2e^{-3}$
- C $y = x^2e^3$
- D $y = x^2e^2$

32. The coefficient of x^7 in the binomial expansion of $\left(\frac{2}{x} + \frac{x^2}{2}\right)^8$ is:

- A 56
- B 28
- C 14
- D 7

33. Given that $x \neq 2n\pi$, $\frac{1+\cos x}{1-\cos x} =$

- A $\cot \frac{x}{2}$
- B $\tan^2 \frac{x}{2}$
- C $\tan \frac{x}{2}$
- D $\cot^2 \frac{x}{2}$

34. All solutions of the equation

$\sqrt{3}\cos x = \cos\left(\frac{\pi}{6} - x\right)$ in the interval $0 \leq x \leq 2\pi$ are:

- A $\frac{\pi}{3}, \frac{4\pi}{3}$
 B $0, \frac{\pi}{3}, \frac{4\pi}{3}$
 C $\frac{\pi}{6}, \frac{7\pi}{6}$
 D $0, \frac{\pi}{6}, \frac{7\pi}{6}$

35. Given the function $h(x) = 1 - x^{2/3}$. Which of the following is true?

- A $h(-1) = h(1)$ and there is a number c in the interval $(-1, 1)$ such that $h'(c) = 0$ confirming Rolle's theorem.
 B $h(-1) = h(1)$ and there is no number c in the interval $(-1, 1)$ for which $h'(c) = 0$. But this does not contradict Rolle's theorem.
 C $h(-1) = h(1)$ and there is no number c in the interval $(-1, 1)$ for which $h'(c) = 0$ contradicting Rolle's theorem.
 D $h(-1) = h(1)$ and there is a number c in the interval $(-1, 1)$ for which $h'(c) = 0$ contradicting Rolle's theorem.

36. The position vector of a particle P at time t is given by $\vec{r} = [2t\mathbf{i} + (t - t^2)\mathbf{j}]m$. The speed of P when $t = 1s$ is:

- A $1m/s$
 B $\sqrt{3}m/s$
 C $\sqrt{5}m/s$
 D $5m/s$

37. The maximum velocity of a particle which moves such that at time t the velocity is given by

$$\vec{v} = [(3t^2 - 4t - 3)\mathbf{i} + (t^3 - t^2 + 4)\mathbf{j}]m/s,$$

occurs when $t = :$

- A 0
 B $\frac{2}{3}$
 C 1
 D 4

38. A particle moves in a straight line with constant acceleration $2m/s^2$. Initially it is at rest. The distance it covers during the fourth second of its motion is:

- A $16m$
 B $7m$
 C $9m$

D $25m$

39. A ball is projected vertically upwards from ground level with speed $15m/s$, to move under gravity with $g = 10m/s^2$. The maximum height it can reach is:

- A $\frac{45}{4}m$
 B $\frac{3}{2}m$
 C $\frac{9}{4}m$
 D $45m$

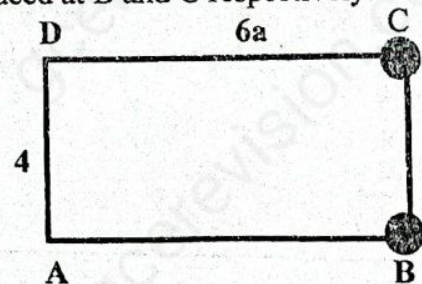
40. A particle P moves with deceleration $(4 + v^2)m/s^2$, where v is the velocity. The motion is considered from a point A, at which the speed is $2m/s$. P comes to instantaneous rest at a point B. The distance AB is:

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

41. A particle is projected with speed $20m/s$ at an angle α to the horizontal. Given that the time of flight is $\frac{2}{3}s$ and that $g = 10m/s^2$ then the angle of projection is given by

- A $\sin^{-1}(\frac{1}{5})$
 B $\sin^{-1}(\frac{2}{3})$
 C $\sin^{-1}(\frac{1}{3})$
 D $\sin^{-1}(\frac{1}{6})$

42. ABCD is a rectangular plate of mass $4mkg$. Particles of masses $5mkg$ and $3mkg$ are placed at B and C respectively.



TURN OVER 5

The distance of the centre of mass of the system from AB is:

- A $\frac{20}{7}a$
- B $\frac{10}{3}a$
- C $\frac{5}{3}a$
- D a

43. A solid is formed by rotating the region bounded by the curve $y = x^2$, the x -axis and the line $x = 2$, once about the x -axis. The x coordinate of the centroid of the solid thus formed is:

- A $\frac{6}{5}$
- B $\frac{32}{3}$
- C $\frac{3}{2}$
- D $\frac{5}{3}$

44. The force $F = (2i - 4j)N$ acts on a mass, displacing it from the point $i + j$ to the point $-2i + 3j$. The work done by F on the mass is

- A $-14Nm$
- B $14Nm$
- C $-10Nm$
- D $10Nm$

45. A elastic spring is of natural length a and modulus of elasticity λ . The length of the spring when the thrust in it is $\frac{1}{4}\lambda$ is

- A $\frac{5}{4}a$
- B $\frac{3}{4}a$
- C $\frac{4}{3}a$
- D $\frac{4}{5}a$

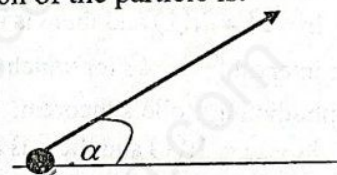
46. A smooth sphere of mass $4kg$ moving with speed $5m/s$ strikes a wall normally and rebounds from it with speed $3m/s$. The loss in Kinetic energy due to the impact is

- A $50J$
- B $18J$
- C $32J$
- D $68J$

47. A car of mass $1000kg$ is moving along a horizontal road against a resistance of $400N$. The power of the engine is $16kW$ when the speed is v . The value of v is

- A $\frac{1}{40}m/s$
- B $\frac{1}{25}m/s$
- C $40m/s$
- D $\sqrt{40}m/s$

48. The figure shows a particle of weight $30N$ pulled across a rough floor by a force of $30N$ applied at an angle α to the horizontal. Given that $\tan \alpha = \frac{3}{4}$, $\mu = \frac{1}{5}$, $g = 10m/s^2$, the acceleration of the particle is:



- A $8m/s^2$
- B $78m/s^2$
- C $\frac{3}{5}m/s^2$
- D $6m/s^2$

49. The events A and B are such that $p(A) = \frac{3}{5}$, $p(B) = \frac{1}{4}$, $p(A \cup B) = \frac{3}{4}$. $p(A/B) = :$

- A $\frac{1}{10}$
- B $\frac{3}{5}$
- C $\frac{3}{20}$
- D $\frac{2}{5}$

50. Which of the following is equivalent to $p(A' \cap B)$?

- A $p(A) + p(A \cap B)$
- B $p(A \cup B) - p(B)$
- C $p(B) - p(A \cap B)$
- D $p(B) + p(A \cup B)$

END

GO BACK AND CHECK YOUR WORK