

WEST MATHEMATICS TEACHERS' PEDAGOGIC GROUP  
GENERAL CERTIFICATE OF EDUCATION MOCK EXAMINATION

0765 Maths With Mechanics 1

27<sup>th</sup> MARCH, 2023

ADVANCED LEVEL

Centre Number	
Centre Name	
Candidate Identification No.	
Candidate Name	

Mobile phones are NOT allowed in the examination room.

**MULTIPLE CHOICE QUESTION PAPER**

One and a half hours

**INSTRUCTIONS TO CANDIDATES**

*Read the following instructions carefully before you start answering the questions in this paper. Make sure you have a soft HB pencil and an eraser for this examination.*

1. USE A SOFT HB PENCIL THROUGHOUT THE 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 Maths with Mechanics 1**.
4. Fill in the information required in the spaces above.
5. Fill in the information required in the spaces provided on the answer sheet using your HB pencil:  
**Candidate Name, Exam Session, Subject Code and Candidate Identification Number.**  
Take care that you do not erase or fold the answer sheet or make any marks on it other than those asked for in these instructions.
6. **Answer All questions.**
7. **Mathematical tables (Formulae booklets) and calculators are allowed.**
8. Each question has FOUR suggested answers: **A, B, C** and **D**. Decide which answer is appropriate. 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]
9. Mark only one answer for each question. If you mark more than one answer, you will score a zero for that question. If you change your mind about an answer, erase the first mark carefully, and then mark your new answer.
10. Avoid spending too much time on any one question. If you find a question difficult, move on to the next question. You can come back to this question later.
11. Do all rough work in this booklet using the blank spaces in the question booklet.
12. **At the end of the examination, the invigilator shall collect the answer sheet first then the question booklet. DO NOT ATTEMPT TO LEAVE THE EXAMINATION HALL WITH IT.**

**MARCH 2023 / MTPG / 0765 / 1 / C**

**SECTION A: PURE MATHEMATICS**

1. Given that one of the roots of the equation  $ax^2 + bx + c = 0$ ,  $a, b, c \in \mathbb{R}$ ; are equal, which of the following is true?

- A  $c$  and  $b$  have opposite signs
- B  $c$  and  $a$  have opposite signs
- C  $c$  and  $b$  have the same signs
- D  $c$  and  $a$  have the same signs

2. Given that  $|x + 3| \geq 10$ , then

- A  $x \in (-\infty, -13] \cup [7, +\infty)$
- B  $x \in (-\infty, -13) \cup [7, +\infty)$
- C  $x \in (-\infty, -13] \cup (7, +\infty)$
- D  $x \in (-\infty, -13) \cup (7, +\infty)$

3. The range of values of  $x$  for which  $\frac{2-x}{x+5} > 0$  is

- A  $-5 < x < 2$
- B  $-2 < x < 5$
- C  $x < -2$  or  $x > 5$
- D  $x < -5$  or  $x > 2$

4. If  $\log_5 x = 16 \log_x 5$ , then the value of  $x$  is

- A 625
- B 100
- C 16
- D 20

5. If  $(x - 1)$  is a repeated factor of the polynomial  $P(x) = x^3 + bx + c$ , then the values of  $b$  and  $c$  are

- A  $b = -3, c = -2$
- B  $b = -3, c = 2$
- C  $b = 3, c = 2$
- D  $b = 3, c = -2$

6. Given that

$$\frac{2x - 1}{(x + 1)(2 - 3x)} \equiv \frac{1}{5(2 - 3x)} - \frac{k}{x + 1}$$

, then the value of  $k$  is

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

7. Given that  $P(x + 2) + Q(x + 1) \equiv x$ , the values of  $P$  and  $Q$  respectively are

- A  $-1$  and  $-2$
- B  $-1$  and  $2$
- C  $1$  and  $2$
- D  $1$  and  $-2$

8. The number of different ways in which 2 boys and 2 girls can be chosen from 10 boys and 8 girls is

- A 20
- B 73
- C 1260
- D 5040

9. Thirty government ministers are invited to the presidency of the Republic for presentation of New year wishes. If all of them shake hands once with each other, then the possible number of handshakes is

- A  $30!$
- B 870
- C  $29! + 1$
- D 435

10. The range of values of  $x$  for which the expansion

$$\frac{3x}{(x - 4)(x - 1)}$$
 is valid is

- A  $-4 < x < 1$
- B  $-\frac{1}{4} < x < \frac{1}{4}$
- C  $-1 < x < 4$
- D  $-1 < x < 1$

11. The distance of the point  $P(-3, -4)$  from the  $x$ -axis is
- A 4 units  
B 3 units  
C -3 units  
D 5 units
- 
12. The circles  $S_1$  and  $S_2$  have equations  $x^2 + y^2 = 4x$  and  $x^2 + y^2 = 4y$  respectively. The point  $(1, 1)$  lies
- A outside both circles  
B inside both circles  
C inside  $S_1$  but outside  $S_2$   
D inside  $S_2$  but outside  $S_1$
- 
13. Given that  $X$  and  $Y$  are two variables related by the equation  $Y = aX^2 + bX$ , where  $a$  and  $b$  are constants. A suitable linear transformation for this non-linear equation is
- A  $\frac{Y}{X} = aX + b$   
B  $Y = X(aX + b)$   
C  $\ln Y = \ln X + \ln(aX + b)$   
D  $\ln Y = \ln(aX^2) + \ln(bX)$
- 
14. The direction cosines of the vector  $\mathbf{a} = 3\mathbf{i} + 4\mathbf{j} + 5\mathbf{k}$  in the direction of positive axis of  $X$ , is
- A  $\pm \frac{3}{\sqrt{50}}$   
B  $\frac{4}{\sqrt{50}}$   
C  $\frac{3}{\sqrt{50}}$   
D  $-\frac{4}{\sqrt{50}}$
- 
15. Given the lines  $l_1: \frac{x-1}{-3} = \frac{y-2}{2k} = \frac{z-3}{2}$  and  $l_2: \frac{x-1}{3k} = \frac{y-5}{1} = \frac{z-6}{-5}$ . Then the value of the constant  $k$  for which the lines are perpendicular is
- A  $-\frac{10}{7}$   
B 1  
C  $-\frac{7}{10}$   
D  $-\frac{8}{7}$
- 
16. Consider three vectors  $\mathbf{p} = \mathbf{i} + \mathbf{j} + \mathbf{k}$ ,  $\mathbf{q} = 2\mathbf{i} + 4\mathbf{j} - \mathbf{k}$  and  $\mathbf{r} = \mathbf{i} + \mathbf{j} + 3\mathbf{k}$ . If  $p, q$  and  $r$  denote the position vectors of three non-collinear points, then the equation of the plane containing the points is
- A  $2x - 3y + 1 = 0$   
B  $x - 3y + 2z = 0$   
C  $3x - y + z - 3 = 0$   
D  $3x - y - 2 = 0$
- 
17. Given that  $\begin{vmatrix} 3 & 2 & -2 \\ 2 & 1 & 3 \\ 4 & 2 & -4 \end{vmatrix} = d$  then  $\begin{vmatrix} 3 & 8 & -6 \\ 2 & 4 & 9 \\ 4 & 8 & -12 \end{vmatrix} =$
- A  $7d$   
B  $72d$   
C  $12d$   
D  $12d^2$
- 
18. The image of the line  $y = 2x$  under the transformation with matrix  $\begin{pmatrix} 2 & 1 \\ 1 & 3 \end{pmatrix}$  is the line
- A  $4x + 4y = 0$   
B  $7x + 4y = 0$   
C  $4x - 7y = 0$   
D  $7x - 4y = 0$
-

19. An arithmetic progression with common difference 2 has  $(3p + 5)$  as the first term and has  $(17p + 17)$  as the last term. The number of terms in the sequence in terms of  $p$  is

- A  $7p + 9$
- B  $7p + 5$
- C  $7p + 7$
- D  $14p + 12$

20. The set of values of  $x$  for which the series  $\sum_{r=0}^{\infty} \left(\frac{x-2}{x-3}\right)^r$  converges is

- A  $\{x : x < -\frac{5}{2}\}$
- B  $\{x : x > -\frac{5}{2}\}$
- C  $\{x : x > -\frac{2}{5}\}$
- D  $\{x : x < \frac{5}{2}\}$

21. Given the statements  $p : y = x^3$ ,  $q : \frac{dy}{dx} = 3x^2$ . Which of the following is correct?

- A  $p$  is a necessary condition for  $q$
- B  $q$  is a necessary condition for  $p$
- C  $\sim p$  is a sufficient condition for  $\sim q$
- D  $\sim q$  is a necessary condition for  $\sim p$

22. Define a set  $A = \{1, 2, 3\}$  and a relation  $R$  on  $A$  by  $R = \{(1, 1), (2, 2), (3, 3), (1, 2), (2, 1), (2, 3), (3, 2)\}$ . The relation  $R$  is

- A An equivalence relation
- B Reflexive, symmetric but not transitive
- C Symmetric, transitive but not reflexive
- D Reflexive and transitive but not symmetric

23. The domain of definition of the function  $f(x) = \frac{\sqrt{x-4}}{x-5}$  is

- A  $(-\infty, 5] \cup [4, +\infty)$
- B  $[4, 5) \cup (5, +\infty)$
- C  $(-\infty, 5] \cup (4, +\infty)$
- D  $(4, +\infty)$

24. The value of  $k$  for which the function

$$g(x) = \begin{cases} 3x + 4, & 0 < x \leq 4 \\ k + 3, & 4 < x \leq 5 \end{cases} \text{ is continuous at } x = 4 \text{ is}$$

- A  $-3$
- B  $1$
- C  $13$
- D  $16$

25. The period of the function  $f(x) = 3 \cos 5x$  is

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

26. Given that  $\cos(\alpha + \beta) = 0$ , then  $\sin(\alpha - \beta)$  can be reduced to

- A  $\cos \beta$
- B  $\sin \alpha$
- C  $\sin 2\alpha$
- D  $\cos 2\beta$

27. The principal argument of  $i(1 + i)$  is

- A  $\frac{3}{4}\pi$
- B  $\frac{1}{4}\pi$
- C  $-\frac{3}{4}\pi$
- D  $\frac{5}{4}\pi$

28. The complex number  $(\cos \frac{1}{27}\pi + i \sin \frac{1}{27}\pi)^9$ , expressed in the form  $a + bi$ ,  $a, b \in \mathbb{R}$  is

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

29. The value of  $K$  for which  $\lim_{x \rightarrow 0} \frac{3kx - 4x^2}{2x - 3x^2} = 6$  is

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

30. Given that  $y = (\ln x)^2$ , the  $\frac{dy}{dx} =$

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

31. The function  $f(x) = x^3 + 1$  is continuous on the interval  $[-2, 4]$  and differentiable on the interval  $(-2, 4)$ . The value of the constant  $c$  such that  $-2 < c < 4$  for which  $f'(c) = \frac{f(4) - f(-2)}{4 - (-2)}$  is

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

32.  $\int \frac{2x+1}{2x} dx$  is equal to

- A  $x + 2 \ln |x| + k$
- B  $x + \ln |2x| + k$
- C  $x + \frac{1}{2} \ln |x| + k$
- D  $1 + \frac{1}{2} x^{-1} + k$

33. Using the substitution  $u = 1 + x^2$ ,

$$\int_0^1 2x(1+x^2)^3 dx =$$

- A  $\frac{15}{4}$
- B  $\frac{7}{4}$
- C 1
- D  $\frac{17}{4}$

34. The solution of the differential equation

$$\frac{dy}{dx} = 1 + y^2$$
 is

- A  $\tan^{-1}(y+c) = x$
- B  $y = \tan(x+c)$
- C  $y = \tan x + c$
- D  $\tan^{-1}(y+x) = c$

35. An iteration formula is given by  $x_{n+1} = \frac{x_n^2 + 1}{3}$ .

Given that  $x_1 = 0$  then  $x_3 =$

- A 0.370
- B 0.307
- C 0.3
- D 0.208

### SECTION B: MECHANICS

36. The position vector of a particle of mass 4 kg is  $\mathbf{r} = [t^2\mathbf{i} - 3t\mathbf{j} + (1-t^2)\mathbf{k}]$  m. Its momentum when  $t = 1$  is

- A  $(8\mathbf{i} - 8\mathbf{j})$  Ns
- B  $(2\mathbf{i} - 3\mathbf{j} - 2\mathbf{k})$  Ns
- C  $(4\mathbf{i} - 3\mathbf{j})$  Ns
- D  $(8\mathbf{i} - 12\mathbf{j} - 8\mathbf{k})$  Ns

37. A particle is projected horizontally from a height of 78.4 m with a velocity of  $10 \text{ ms}^{-1}$ . The angle made by the velocity vector and the  $x$ -axis after 4 seconds is

- A  $\tan^{-1} 3$
- B  $\tan^{-1} 4$
- C  $\tan^{-1} 5$
- D  $\tan^{-1} 6$

38. A spring is compressed to one-third of its natural length by a force of 6 N. Its modulus of elasticity is

- A 18 N
- B 12 N
- C 15 N
- D 9 N

39. A compact disc (CD) on a DVD player makes 30 revolutions in a half minute. The angular velocity of the CD is

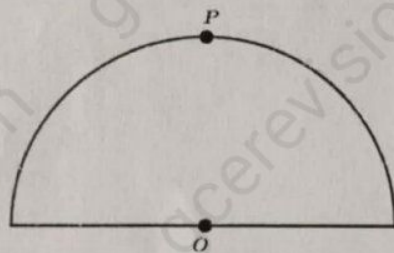
- A  $15\pi \text{ rads}^{-1}$
- B  $120\pi \text{ rads}^{-1}$
- C  $2\pi \text{ rads}^{-1}$
- D  $\pi \text{ rads}^{-1}$

40. Particles of masses 2 kg and 3 kg are placed at the points with position vectors  $(6\mathbf{i} - \mathbf{j}) \text{ m}$  and  $(\mathbf{i} + 4\mathbf{j}) \text{ m}$  respectively. The position vector of their centre of mass is

- A  $(4\mathbf{i} + \mathbf{j}) \text{ m}$
- B  $(3\mathbf{i} + 2\mathbf{j}) \text{ m}$
- C  $(-4\mathbf{i} + \mathbf{j}) \text{ m}$
- D  $(-3\mathbf{i} - \mathbf{j}) \text{ m}$

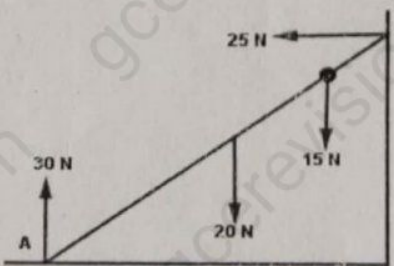
41. The diagram shows a uniform semi-circular lamina of radius  $2a$ , centre  $O$ . The distance of the centre of mass from  $P$ , vertically above  $O$  is

- A  $\frac{60\pi - 8a}{3\pi}$
- B  $\frac{60\pi + 8a}{3\pi}$
- C  $\frac{8a - 60\pi}{3\pi}$
- D  $\frac{60\pi - 4a}{3\pi}$



42. The figure below shows a uniform ladder AB with a load on it. B is leaning against a rough vertical wall. The forces acting on the ladder are as shown. The coefficient of friction between the ladder and the wall is

- A 0.2
- B 0.4
- C 0.2 N
- D 0.4 N



43. At time  $t = 0$ , the position vectors of two particles A and B are  $(5\mathbf{i} + 20\mathbf{j}) \text{ m}$  and  $(-10\mathbf{i} - 5\mathbf{j}) \text{ m}$  respectively. The particles are given constant velocities of  $(-2\mathbf{i} - 5\mathbf{j}) \text{ m/s}$  and  $(3\mathbf{i} + 5\mathbf{j}) \text{ m/s}$  respectively. The position vector of B relative to the position vector of A after 3 seconds is

- A  $5\mathbf{j} \text{ m}$
- B  $-5\mathbf{j} \text{ m}$
- C  $(-15\mathbf{i} - 25\mathbf{j}) \text{ m}$
- D  $(5\mathbf{i} + 10\mathbf{j}) \text{ m}$

44. The speed  $v$  at time  $t$  of a particle of mass 3 kg is given by  $v = 32t - 4t^2$ . The force acting on the particle when  $t = 2$  seconds is

- A 144 N
- B 48 N
- C 16 N
- D 190 N

45. A smooth sphere A of mass 4 kg travelling at 5 m/s collides directly with another smooth sphere B of mass 3 kg travelling at 4 m/s in the opposite direction. Given that the speed of A after impact is 0.5 m/s, the kinetic energy of B after impact is

- A 3 J
- B 6 J
- C 6.5 J
- D 24 J

46. To a lady riding at a velocity of  $(\mathbf{i} + 2\mathbf{j}) \text{ m/s}$ , the wind appears to be blowing at a velocity of  $(-2\mathbf{i} + 3\mathbf{j}) \text{ m/s}$ . The true velocity of the wind is

- A  $(-\mathbf{i} + 4\mathbf{j}) \text{ m/s}$
- B  $(-3\mathbf{i} + \mathbf{j}) \text{ m/s}$
- C  $(3\mathbf{i} - \mathbf{j}) \text{ m/s}$
- D  $(\mathbf{i} - 5\mathbf{j}) \text{ m/s}$

47. A bullet of mass 0.01 kg is fired into a wall of thickness 0.12 m, with a velocity of 400 m/s. If the depth of penetration of the bullet is 0.1 m, then the resistance of the wall is
- A 800 N
  - B 40 000 N
  - C 0.4 N
  - D 8 000 N
- 
48. A particle of mass 2 kg slides down a plane inclined at  $30^\circ$  to the horizontal with an acceleration of  $2.5 \text{ m/s}^2$ . Taking  $g$  as  $10 \text{ m/s}^2$ , the coefficient of friction between the particle and the plane is
- A  $\frac{1}{8}$
  - B  $\frac{1}{2}\sqrt{3}$
  - C  $\frac{1}{6}\sqrt{3}$
  - D  $\frac{1}{8}\sqrt{3}$
- 
49. A car accelerates from 15 m/s to 35 m/s in 5 seconds. The distance covered by the car in this time is
- A 125 m
  - B 110 m
  - C 190 m
  - D 100 m
- 
50. Three fair coins are tossed simultaneously. The probability that they will all land tail up is
- A  $\frac{1}{8}$
  - B  $\frac{1}{2}$
  - C  $\frac{3}{4}$
  - D  $\frac{5}{8}$
- 

STOP

GO BACK AND CHECK YOUR WORK