POSTAL Book Package 2023

Mechanical Engineering

Objective Practice Sets

Theory of Machines

Contents

MADE EASY Publications

2 CHAPTER Displacements, Velocity and Acceleration

MCQ and NAT Questions

Q.1

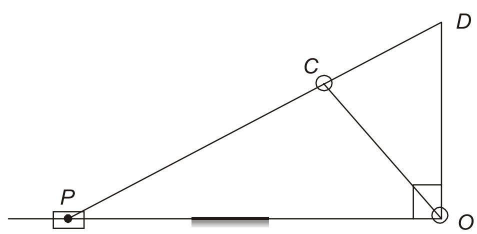


Figure shows Klein's construction for slider-crank mechanism *OCP* drawn to full scale. What velocity does *CD* represent?
(a) Velocity of the crank pin
(b) Velocity of the piston
(c) Velocity of the piston with respect to crank pin
(d) Angular velocity of the connecting rod

Q.2 Klein's construction can be used when
(a) Crank has a uniform angular velocity
(b) Crank has a non-uniform velocity
(c) Crank has uniform angular acceleration
(d) Crank has a uniform angular velocity and angular acceleration

Q.3 The centre of gravity of the coupler link in a 4-bar mechanism would experience
(a) no acceleration
(b) only linear acceleration
(c) only angular acceleration
(d) both linear & angular accelerations

Q.4 In order to draw the acceleration diagram, it is necessary to determine the Coriolis component of acceleration in the case of
(a) crank and slotted lever quick return mechanism
(b) slider-crank mechanism
(c) four bar mechanism
(d) pantograph

Q.5 The Coriolis acceleration component is taken into account for
(a) double slider crank mechanism
(b) four link mechanism
(c) scotch yoke mechanism
(d) quick-return mechanism

Q.6 When a slider moves with a velocity 'V' on a link rotating at an angular speed of ω, the Coriolis component of acceleration is given by
(a) $\sqrt{2V\omega}$
(b) $V\omega$
(c) $\frac{V\omega}{2}$
(d) $2\,V\omega$

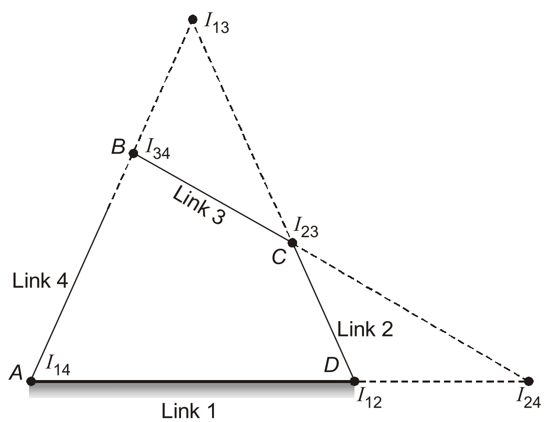
Q.7 The relative acceleration of two points which are at variable distance apart on a moving link can be determined by using the
(a) Three centres in line theorem
(b) Instantaneous centre of rotation method
(c) Coriolis component of acceleration method
(d) Klein's construction

Q.8 In a slider-crank mechanism, the maximum acceleration of slider is obtained when the crank is
(a) at the inner dead centre position
(b) at the outer dead centre position
(c) exactly midway position between the two dead centres
(d) slightly in advance of the midway position between the two dead centres

Q.9 In a slider-crank mechanism, the velocity of piston becomes maximum when
(a) Crank and connecting rod are in line with each other
(b) Crank is perpendicular to the line of stroke of the piston
(c) Crank and connecting rod are mutually perpendicular
(d) Crank is 120° with the line of stroke

Multiple Select Questions (MSQ)

Q.49 Which of the following statements is(are) correct for figure given below?



(a) The instantaneous centres I_{12} and I_{14} are called fixed instantaneous centres.

(b) The instantaneous centres I_{23} and I_{34} are called permanent instantaneous centres.

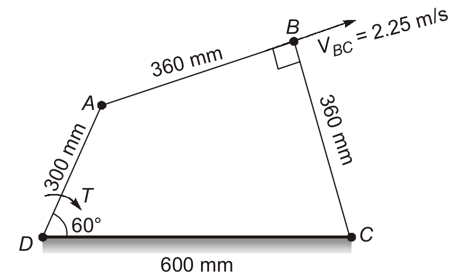
(c) I_{13} and I_{24} are called secondary instantaneous centres.

(d) I_{12}, I_{23}, I_{14} and I_{34} are called primary instantaneous centres.

Q.50 A four bar mechanism has the following dimensions:

AD = 300 mm; CB = AB = 360 mm; DC = 600 mm. The link DC is fixed and the angle ADC is 60°. The driving link DA rotates uniformly at a speed of 100 rpm clockwise and the constant driving torque has the magnitude of 50 N-m. The velocity of point B is 2.25 m/s. The efficiency of the mechanism is 70%.

Which of the following statements is(are) correct?



(a) Angular velocity of driven link CB is 6.25 rad/s (CW about C).

(b) Actual mechanical advantage is 1.173.

(c) The resisting torque is 58.64 N-m.

(d) The resisting torque is 68.32 N-m.

Q.51 Which of the following statements is(are) correct?

(a) According to Kennedy's theorem, "For the relative motion between the number of links in a mechanism, any three links and their three I-centres must lie in straight line."

(b) Klein's construction is only applicable in basic single slider crank mechanism, in which angular acceleration of the crank is zero.

(c) Coriolis acceleration is associated with the slider, when the slider is sliding on the rotating body.

(d) Magnitude of Coriolis acceleration is $2V\omega$, where V is sliding velocity of slider and ω is angular velocity of body on which slider is sliding.

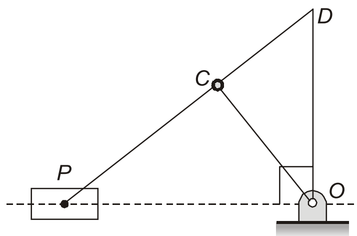
■■■■

Answers — Displacements, Velocity and Acceleration

1. (c)	2. (a)	3. (d)	4. (a)	5. (d)	6. (d)	7. (b)	8. (a)	9. (b)
10. (d)	11. (a)	12. (c)	13. (a)	14. (c)	15. (a)	16. (b)	17. (a)	18. (b)
19. (c)	20. (c)	21. (b)	22. (d)	23. (c)	24. (a)	25. (c)	26. (a)	27. (b)
28. (a)	29. (a)	30. (c)	31. (c)	32. (a)	33. (b)	34. (a)	35. (c)	36. (c)
37. (d)	38. (0.8)	39. (100.53)	40. (3.14)	41. (0.2)	42. (60)	43. (100)	44. (10.34)	
45. (2.25)	46. (6.75)	47. (107.83)	48. (3.38)	49. (a, b, c, d)	50. (a, b, c)		51. (a,b,c,d)	

Explanations Displacements, Velocity and Acceleration

1. (c)



$$\frac{V_P}{OD} = \frac{V_C}{OC} = \frac{V_{PC}}{CD}$$

Thus, *CD* represent velocity of the piston with respect to crank pin.

2. (a)

Klein's construction is used to determine the acceleration of various parts and this method is used when crank has uniform angular velocity.

3. (d)

Since the coupler link in a 4-bar mechanism is in general motion (both translational and rotational motion) so the centre of gravity of the coupler link would experience both linear and angular accelerations.

4. (a)

In case of crank and slotted lever quick return mechanism, the slider will be associated with Coriolis acceleration when it is sliding on the rotating slotted lever. So, here it is necessary to determine the Coriolis component of acceleration.

5. (d)

Coriolis component of acceleration is taken into account for quick-return mechanism.

6. (d)

Coriolis component of acceleration is given by

$$a_c = 2\,v\,\omega$$

where v is sliding velocity of slider

ω is angular speed of link on which slider is sliding.

7. (b)

Using instantaneous centre of rotation method, the relative acceleration of two points which are at variable distance apart on a moving link can be determined.

8. (a)

In a slider-crank mechanism, the maximum acceleration of slider is obtained when the crank is at the inner dead centre position,

i.e. at $\theta = 0°$

$$a = r\omega^2\left[1+\frac{1}{n}\right]$$

9. (b)

In a slider-crank mechanism, the velocity of piston becomes maximum when crank is perpendicular to the line of stroke of the piston.

i.e. $\theta = 90°$

$$V = r\omega\left[\sin\theta + \frac{\sin 2\theta}{2n}\right]$$

$$V = r\omega \qquad \text{(at } \theta = 90°\text{)}$$

10. (d)

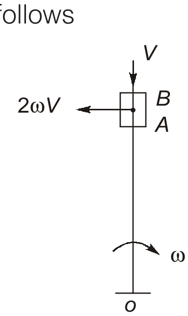
Only 3rd statement is correct, i.e. the direction of the relative velocity of a point *A*, with respect to a point *B* on a rotating link is perpendicular to *AB*.

Tangential acceleration, $a_t = r \cdot \alpha$

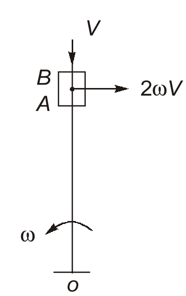
Radial acceleration, $a_r = \dfrac{V^2}{r}$

11. (a)

Figure 2 and 4 are wrong. These should be as follows



Correct form of figure



Correct form of figure.4

12. (c)

In a rigid link *AB*, the point *B* is moving with respect to point *A*, then the acceleration of *B* will be equal to vector sum of acceleration of *A* and acceleration of *B*, relative to *A*.

$$\vec{a}_{B0} = \vec{a}_{BA} + \vec{a}_{A0}$$