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MECHANICAL ENGINEERING

Objective Practice Sets

Theory of Machines

1 CHAPTER

Planer Mechanisms

MCQ and NAT Questions

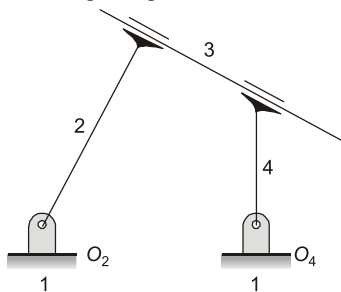**Q.1** Refer to the figure given below

If 2 and 4 are given rotatory motion the motion of link 3 is
- (a) pure translation
- (b) pure rotation
- (c) translation and rotation
- (d) Not defined

Q.2 A higher pair can be replaced by a
- (a) two revolute pair and two additional linkages
- (b) two revolute pair and one additional linkage
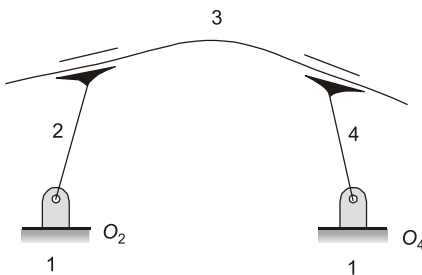- (c) one revolute pair and one additional linkage
- (d) None of these

Q.3 Refer to the figure given below

The effective degree of freedom of the given figure is
- (a) one
- (b) zero
- (c) three
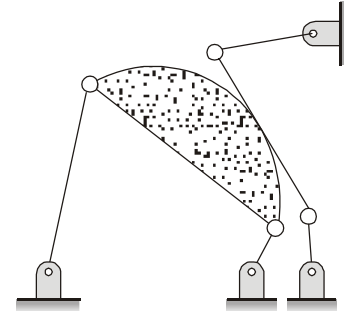- (d) indefinite

Q.4 Refer to the figure given below

The degree of freedom of the given figure is
- (a) one
- (b) two
- (c) zero
- (d) three

Q.5 The degree of freedom of the given mechanism is
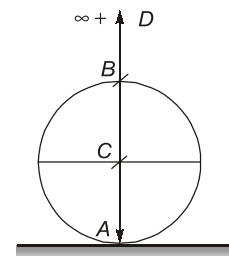

- (a) 1
- (b) 2
- (c) 3
- (d) ∞

Q.6 Which of the following is an exact straight line mechanism?
- (a) Watt's Mechanism
- (b) Grasshopper's Mechanism
- (c) Peaucellier Mechanism
- (d) Robert's Mechanism

Q.7 Which one of following is an Open Pair?
- (a) Ball and socket joint
- (b) Journal bearing
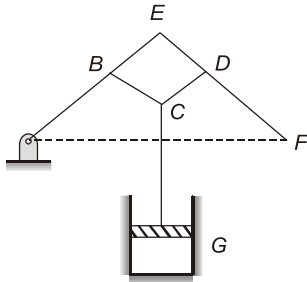- (c) Lead screw and nut
- (d) Cam and follower

Q.8 The instantaneous centre of motion of rigid-thin disc-wheel rolling on plane rigid surface shown in the figure, is located at the point

- (a) *A*
- (b) *B*
- (c) *C*
- (d) *D*

Q.9 A linkage is shown below in the figure in which links *ABC* and *DEF* are ternary links whereas *AF*, *BE* and *CD* are binary links

Q.53 Statement (I): The given line diagram of Watt's indicator mechanism is a type of crank and lever mechanism.

Statement (II): BCD acts as a lever.

Q.54 Statement (I): An inversion is obtained by fixing in turn different links in a kinematic chain.

Statement (II): Quick return mechanism is derived from a single slider crank chain by fixing the ram of a shaper with the slotted lever through a link.

Q.55 Statement (I): In a kinematic chain we obtain a definite output for an input.

Statement (II): In a kinematic chain the first link is connected to the last link and all the relative motions in the chain are constrained.

Multiple Select Questions (MSQ)

Q.56 In a crank and slotted lever quick return motion mechanism, the distance between the fixed centers is 240 mm and the length of the driving crank is 120 mm. The length of the slotted bar is 450 mm. Which of the following statements is(are) correct, if the line of stroke passes through the extreme positions of the free end of the lever?
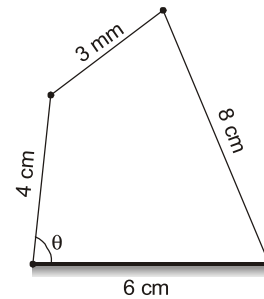
(a) Inclination of the slotted bar with the vertical is 60°.
(b) Inclination of the slotted bar with the vertical is 30°.
(c) Time ratio of cutting stroke to the return stroke is 2.
(d) The length of the stroke is 450 mm.

Q.57 Which of the following statements is(are) the inversions of double slider crank chain?
(a) Elliptical trammel.
(b) Whitworth quick return motion mechanism.
(c) Scotch Yoke mechanism
(d) Oldham's coupling

Q.58 A four bar mechanism is shown in figure with the length of different links as shown.
Which of the following statements is(are) correct for this four bar mechanism?

(a) For maximum value of transmission angle $\theta = 180°$.
(b) For minimum value of transmission angle $\theta = 0°$.
(c) Maximum value of transmission angle is 124.23°.
(d) Minimum value of transmission angle is 46.57°.

■■■■

Answers	**Planer Mechanisms**

1. (c)	**2.** (b)	**3.** (b)	**4.** (a)	**5.** (a)	**6.** (c)	**7.** (d)	**8.** (a)	**9.** (a)
10. (a)	**11.** (c)	**12.** (d)	**13.** (d)	**14.** (b)	**15.** (d)	**16.** (a)	**17.** (a)	**18.** (b)
19. (c)	**20.** (d)	**21.** (d)	**22.** (a)	**23.** (b)	**24.** (d)	**25.** (a)	**26.** (c)	**27.** (b)
28. (c)	**29.** (a)	**30.** (b)	**31.** (b)	**32.** (a)	**33.** (d)	**34.** (d)	**35.** (d)	**36.** (a)
37. (d)	**38.** (c)	**39.** (a)	**40.** (c)	**41.** (c)	**42.** (c)	**43.** (b)	**44.** (39.06)	**45.** (1)
46. (4)	**47.** (360)	**48.** (421.8)	**49.** (533.3)	**50.** (120)	**51.** (34.92)	**52.** (c)	**53.** (d)	**54.** (c)
55. (a)	**56.** (b, c, d)		**57.** (a, c, d)		**58.** (a, c, d)			

2 Displacement, Velocity and Acceleration

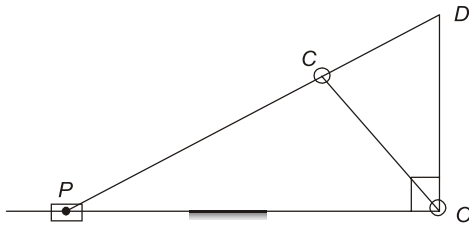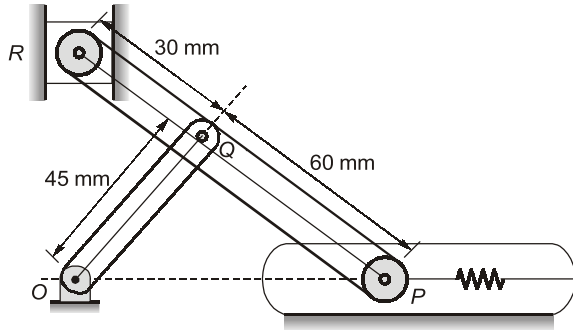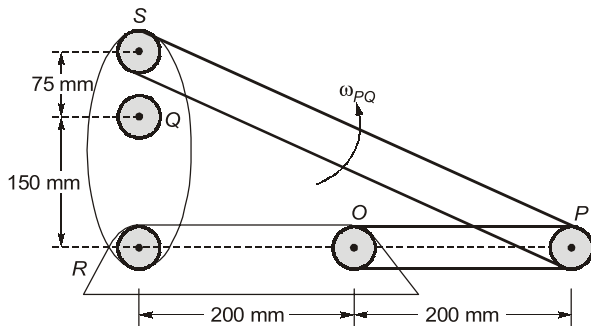## MCQ and NAT Questions

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 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.3 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.4 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.5 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) $\dfrac{V\omega}{2}$
(d) $2\,V\omega$

Q.6 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.7 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.8 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

Q.9 Consider the following statements regarding motions in machines:
1. Tangential acceleration is a function of angular velocity and the radial acceleration is a function of angular accelerations.
2. The resultant acceleration of a point *A* with respect to a point *B* on a rotating link is perpendicular to *AB*.
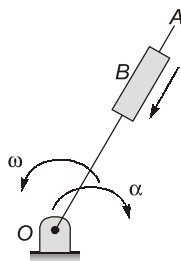
Q.35 Motion of the roller *P* against its restraining spring is controlled by the downward motion of the slider *R*. For an interval of motion the velocity of slider *R* is 3 m/s, then the velocity of *P* when θ becomes 90° is _____ m/s
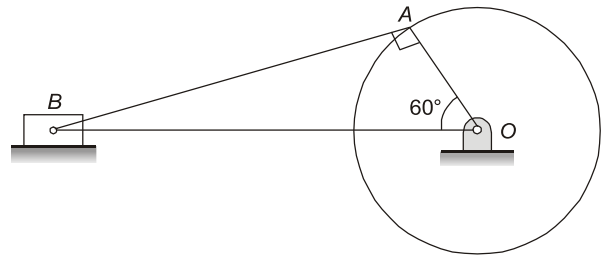

Q.36 The velocity of point *S* which will produce a counterclockwise angular velocity of 30 rad/s for link *PQ* in the position shown in figure below is _____ m/s.

Q.37 A link OA is rotating at an angular velocity of 3 rad/sec in counter clockwise direction at the instant shown in figure and a block *B* is sliding radially inward in it with a uniform velocity of 8 m/s with respect to the link *OA*, if *OB* = 5 m and angular acceleration of link *OA* is 10 rad/s² in clockwise direction, the magnitude of absolute acceleration of the block *B* at the instant shown is

Q.38 In a simple slider-crank mechanism as shown in figure, stroke of piston is 8 cm. Crank of the mechanism is rotating at 1400 rpm (clockwise) uniformly.
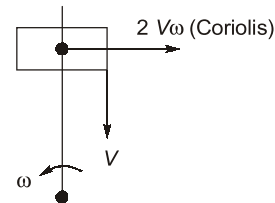

Velocity of slider '*B*' with respect to crank pin '*A*' is equal to _____ m/s.

Direction (Q.39 to Q.40): The following questions consist of two statements, one labelled as '**Statement (I)**' and the other labelled as '**Statement (II)**'. You are to examine these two statements carefully and select the answers to these items using the codes given below.

Codes:
  (a) Both Statement (I) and Statement (II) are true and Statement (II) is the correct explanation of Statement (I).
  (b) Both Statement (I) and Statement (II) are true but Statement (II) is not a correct explanation of Statement (I).
  (c) Statement (I) is true but Statement (II) is false.
  (d) Statement (I) is false but Statement (II) is true.

Q.39 Statement (I): The direction of Coriolis acceleration as shown in the given figure is correct.
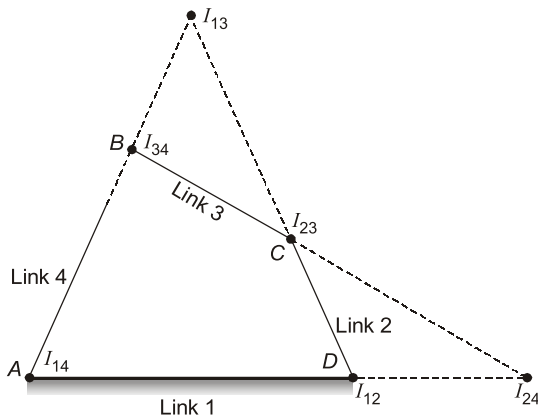

Statement (II): The direction of Coriolis acceleration is such that it will rotate at a velocity *V* about its origin in the direction opposite to ω.

Q.40 Statement (I): Inertia force always acts through the centroid of the body and is directed opposite to the acceleration of the centroid.
Reason (R): It has always a tendency to retard the motion.

Multiple Select Questions (MSQ)

Q.41 Which of the following statements is(are) correct for figure given below?
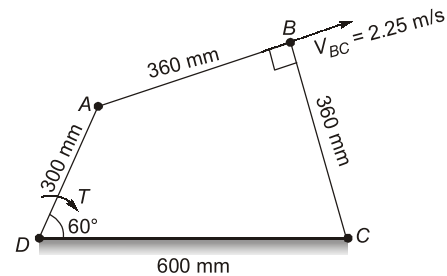

(a) The instantaneous centres I_{12} and I_{14} are called fixed instantaneous centres.

(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.42 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.43 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.

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Answers	**Displacements, Velocity and Acceleration**

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