Topicwise Segregated
Previous Years Questions of

RRB-JE

CBT II

RAILWAY RECRUITMENT BOARD - JUNIOR ENGINEER

alongwith various Metro Corporations Papers :

- DMRC
- LMRC
- JMRC
- NMRC
- BMRCL
- UPMRC

Detailed Solutions of

1300+ PYQs

Of Exams held between : 2014 - 2026

MECHANICAL ENGINEERING

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RRB-JE (CBT-II)

alongwith various Metro Corporations Papers:

DMRC, LMRC, JMRC, NMRC, BMRCL, UPMRC

Topicwise Segregated Previous Years Questions

Editions

First Edition : 2026

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PREFACE



B. Singh (Ex. IES)

Railway Recruitment Board - Junior Engineer is a sought-after examination among engineering graduates aspiring to build a career in the Indian Railways. Previous year questions play an important role in preparation, as they help candidates understand the examination pattern, assess the level of difficulty, and identify important concepts.

This book presents a systematically compiled collection of RRB JE and Metro Corporations (DMRC, LMRC, JMRC, NMRC, BMRCL, UPMRC) previous year questions with clear and accurate solutions. The aim is to provide aspirants with a reliable resource for practice and revision while strengthening their conceptual understanding.

MADE EASY has taken due care to maintain the accuracy and clarity of the solutions. This book may also prove useful for other competitive engineering examinations. Suggestions from readers for further improvement are always welcome.

We hope this book serves as a valuable resource in your preparation and wish you success in your endeavours.

With Best Wishes

B. Singh (Ex. IES)

CMD, MADE EASY Group

Detailed Syllabus : RRB-JE

CBT-1 (STAGE-I) : Common for All

(a) **Mathematics:** Number systems, BODMAS, Decimals, Fractions, LCM and HCF, Ratio and Proportion, Percentages, Mensuration, Time and Work, Time and Distance, Simple and Compound Interest, Profit and Loss, Algebra, Geometry, Trigonometry, Elementary Statistics, Square Root, Age Calculations, Calendar & Clock, Pipes & Cistern.

(b) **General Intelligence and Reasoning:** Analogies, Alphabetical and Number Series, Coding and Decoding, Mathematical operations, Relationships, Syllogism, Jumbling, Venn Diagram, Data Interpretation and Sufficiency, Conclusions and Decision Making, Similarities and Differences, Analytical reasoning, Classification, Directions, Statement – Arguments and Assumptions etc.

(c) **General Awareness:** Knowledge of Current affairs, Indian geography, culture and history of India including freedom struggle, Indian Polity and constitution, Indian Economy, Environmental issues concerning India and the World, Sports, General Scientific and technological developments etc.

(d) **General Science:** Physics, Chemistry and Life Sciences (up to 10th Standard CBSE syllabus).

RRB-JE Exam Pattern : CBT-I		
Subjects	**No. of Questions**	**Marks for each Section**
	CBT-I	**CBT-I**
Mathematics	30	30
General Intelligence & Reasoning	25	25
General Awareness	15	15
General Science	30	30
Total	100	100
Time in Minutes	**90**	

- The section wise distribution given in the above table is only indicative and there may be some variations in the actual question papers.
- **Minimum percentage of marks for eligibility in various categories:** UR-40%, EWS-40%, OBC(NCL)-30%, SC-30%, ST -25%. This is also applicable to Ex-servicemen candidates, as per their community. These percentage of marks for eligibility may be relaxed by 2 marks for PwBD candidates in case of shortage of PwBD candidates against vacancies reserved for them.

Detailed Syllabus : RRB-JE

CBT-2 (STAGE-II)

(a) **General Awareness:** Knowledge of Current affairs, Indian geography, culture and history of India including freedom struggle, Indian Polity and Constitution, Indian Economy, Environmental issues concerning India and the World, Sports, General Scientific and Technological Developments etc.

(b) **Physics and Chemistry:** Up to 10th standard CBSE syllabus.

(c) **Basics of Computers and Applications:** Architecture of Computers; input and Output devices; Storage devices, Networking, Operating System like Windows, Unix, Linux; MS Office; Various data representation; Internet and Email; Websites & Web Browsers; Computer Virus.

(d) **Basics of Environment and Pollution Control:** Basics of Environment; Adverse effect of environmental pollution and control strategies; Air, water and Noise pollution, their effect and control; Waste Management, Global warming; Acid rain; Ozone depletion.

RRB-JE Exam Pattern : CBT-II		
Subjects	**No. of Questions**	**Marks for each Section**
	CBT-II	**CBT-II**
General Awareness	15	15
Physics & Chemistry	15	15
Basics of Computers and Applications	10	10
Basics of Environment and Pollution Control	10	10
Technical Abilities	100	100
Total	150	150
Time in Minutes	**120**	

- The section wise distribution given in the above table is only indicative and there may be some variations in the actual question papers.

Mechanical & Allied Engineering Exam Group– JE

1. **Engineering Mechanics:** Resolution of forces, Equilibrium and Equilibrant, parallelogram law of forces, triangle law of forces, polygon law of forces and Lami's theorem, couple and moment of a couple, condition for equilibrium of rigid body subjected to number of coplanar non-concurrent forces, definition of static friction, dynamic friction, derivation of limiting angle of friction and angle of repose, resolution of forces considering friction when a body moves on horizontal plane and inclined plane, calculation of moment of inertia and radius of gyration of : (a) I-Section (b) channel section (c) T-Section (d) L-Section (Equal & unequal lengths) (e) Z-Section (f) Built up sections (simple cases only), Newton's laws of motion (without derivation), motion of projectile, D'Alembert's principle, definition law of conservation of energy, law of conservation of momentum.

2. **Material Science:** Mechanical properties of engineering materials – tensile strength, compressive strength, ductility, malleability, hardness, toughness, brittleness, impact strength, fatigue, creep resistance. Classification of steels, mild steel and alloy steels. Importance of heat treatment. Heat treatment processes – annealing, normalizing, hardening, tempering, carburizing, nitriding and cyaniding.

3. **Strength of Materials:** Stress, strain, stress strain diagram, factor of safety, thermal stresses, strain energy, proof resilience and modules of resilience. Shear force and bending moment diagram – cantilever beam, simply supported beam, continuous beam, fixed beam. Torsion in shafts and springs, thin cylinder shells.

4. **Machining:** Working principle of lathe. Types of lathes – Engine lathe – construction details and specifications. Nomenclature of single point cutting tool, geometry, tool signature, functions of tool angles. General and special operations – (Turning, facing, taper turning, thread cutting, knurling, forming, drilling, boring, reaming, key way cutting), cutting fluids, coolants and lubricants. Introduction to shaper, slotter, plainer, broaching, milling and manufacture of gears, heat treatment process applied to gears.

5. **Welding:** Introduction, classification of welding processes, advantages and limitations of welding, principles of arc welding, arc welding equipment, choice of electrodes for different metals, principle of gas (oxy-acetylene) welding, equipment of gas welding, welding procedures (arc & gas), soldering and brazing techniques, types and applications of solders and fluxes, various flame cutting processes, advantages and limitations of flame cutting, defects in welding, testing and inspection modern welding methods, (submerged, CO_2, atomic – hydrogen, ultrasonic welding), brief description of MIG & TIG welding.

6. **Grinding & Finishing Process:** Principles of metal removal by grinding, abrasives, natural and artificial, bonds and binding processes, vitrified, silicate, shellac rubber, grinding machines, classification: cylindrical, surface, tool & cutter grinding machine, construction details, relative merits, principles of centreless grinding, advantages & limitations of centreless grinding work, holding devices, wheel maintenance, balancing of wheels, coolants used, finishing by grinding, honing, lapping, super finishing, electroplating, basic principles – plating metals, applications, hot dipping, galvanizing tin coating, parkerising, anodizing, metal spraying, wire process, powder process and applications, organic coatings, oil base paint, lacquer base enamels, bituminous paints, rubber base coating.

7. **Metrology:** Linear measurement – Slip gauges and dial indicators, angle measurements, bevel protractor, sine bar, angle slip gauges, comparators (a) mechanical (b) electrical (c) optical (d) pneumatic. Measurement of surface roughness; methods of measurements by comparison, tracer instruments and by interferometry, collimators, measuring microscope, interferometer, inspection of machine parts using the concepts of shadow projection and profile projection.

8. **Fluid Mechanics & Hydraulic Machinery:** Properties of fluid, density, specific weight, specific gravity, viscosity, surface tension, compressibility, capillarity, Pascal's law, measurement of pressures, concept of buoyancy. Concept of Reynold's number, pressure, potential and kinetic energy of liquids, total energy, laws of conservation, mass, energy and momentum, velocity of liquids and discharge, Bernoulli's equation and assumptions, venturi meters, pitot-tube, current meters. Working principle & constructional details of centrifugal pump, efficiencies – manometric efficiency, volumetric efficiency, mechanical efficiency and overall efficiency, cavitation and its effect, working principle of jet & submersible pumps with line diagrams.

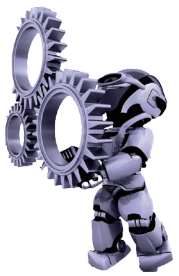
9. **Industrial Management:** Job analysis, motivation, different theories, satisfaction, performance reward systems, production, planning and control, relation with other departments, routing, scheduling, dispatching, PERT and CPM, simplex problems.

   Materials in industry, inventory control model, ABC Analysis, Safety stock, re-order, level, economic ordering quantity, break even analysis, stores layout, stores equipment, stores records, purchasing procedures, purchase records, Bin card, Cardex, Material handling, Manual lifting, hoist, cranes, conveyors, trucks, fork trucks.

10. **Thermal Engineering:** Laws of thermodynamics, conversion of heat into work vice versa , laws of perfect gases, thermodynamic processes – isochoric, isobaric, isothermal hyperbolic, isentropic, polytrophic and throttling, modes of heat transfer, thermal conductivity, convective heat transfer coefficient, Stefan Boltzman law by radiation and overall heat transfer coefficient.

    Air standards cycles – Carnot cycle, Otto cycle, Diesel cycle, construction and working of internal combustion engines, comparison of diesel engine and petrol engine. Systems of internal combustion engine, performance of internal combustion engines.

    Air compressors their cycles, refrigeration cycles, principle of a refrigeration plant.



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1 CHAPTER

MECHANICS

1 • Laws of Force system

1.1 If 'α' is the angle between two forces P and Q, then the angle made by the direction of the resultant 'θ' relative to the force P is given by

(a) $\theta = \tan^{-1}\left(\frac{Q\sin\alpha}{P+Q\cos\alpha}\right)$

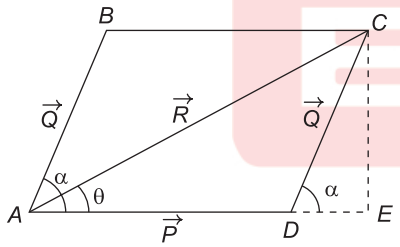
(b) $\theta = \cos^{-1}\left(\frac{P\sin\alpha}{Q+P\cos\alpha}\right)$

(c) $\theta = \sin^{-1}\left(\frac{Q\sin\alpha}{Q+P\cos\alpha}\right)$

(d) $\theta = \sin^{-1}\left(\frac{P\sin\alpha}{P+Q\cos\alpha}\right)$

[RRB-JE • 30-08-2019]

Sol. (a)



Resolving Q into components along and perpendicular to P:

Horizontal component = $Q\cos\alpha = DE$

Vertical component = $Q\sin\alpha = CE$

Therefore in ΔACE

$$\tan\theta = \frac{CE}{AD+DE}$$

$$\tan\theta = \frac{Q\sin\alpha}{P+Q\cos\alpha}$$

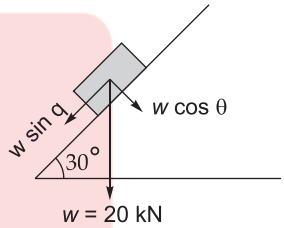
1.2 A block weighing W = 20 kN is resting on an inclined plane which makes an angle of 30° to the horizontal. The component of gravity force parallel to inclined plane is

(a) 17.32 kN (b) 10 kN

(c) 5 kN (d) 14.14 kN

[RRB-JE • 29-08-2019]

Sol. (b)



$F_{parallel} = W\sin30°$

$F_{parallel} = 20 \times 0.5$

$F_{parallel} = 10$ kN

1.3 The algebraic sum of the resolved parts of a number of forces in a given direction is equal to the resolved part of their resultant in the same direction. This is known as

(a) Principle of resolution of forces

(b) All of the options

(c) Principle of transmissibility of forces

(d) Principle of independence of forces

[RRB-JE • 29-08-2019]

Sol. (a)

According to the principle of resolution:

$$R_x = \Sigma F_x$$

Thus, the algebraic sum of components of individual forces in a given direction equals the component of their resultant in that direction.

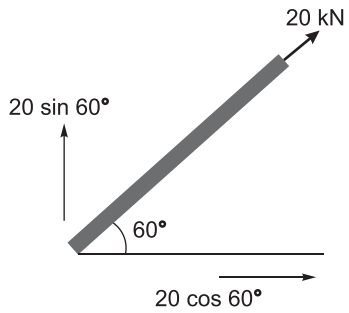
1.4 The horizontal component of tensile force in a wire that makes 60° with horizontal and is carrying a force of 20 kN is

(a) 30 kN (b) 18 kN

(c) 10 kN (d) 25 kN

[RRB-JE • 31-08-2019]

Sol. **(c)**



$T_H = T\cos 60°$
$T_H = 20 \times 0.5$
$T_H = 10\ kN$

1.5 In the analytical method, how is the resultant force determined when all forces act in the same direction?
(a) By adding all the forces together
(b) By subtracting the smallest force from the largest
(c) By dividing the total force by the number of forces
(d) By multiplying all the forces together

[RRB-JE • (Re-Exam) 04.06.2025]

Sol. **(a)**
When all forces act in the same direction:

$$R = F_1 + F_2 + F_3 + \ldots$$

1.6 In the resolution of a force, along which of the following directions is a force generally resolved?
(a) Two mutually perpendicular directions
(b) Any three random directions
(c) A single fixed direction
(d) Two parallel directions

[RRB-JE • (Re-Exam) 04.06.2025]

Sol. **(a)**
A force is generally resolved into two mutually perpendicular components along Cartesian coordinate axes.

1.7 According to the Principle of Resolution, the algebraic sum of the resolved parts of multiple forces in a given direction is equal to
(a) the total magnitude of all forces combined
(b) the resolved part of their resultant in the same direction
(c) the sum of all forces acting in that direction
(d) the difference between the largest and smallest force

[RRB-JE • 22.04.2025 (9:00 AM - 11:00 AM)]

Sol. **(b)**
The component of the resultant in any given direction equals the algebraic sum of the components of the individual forces in that direction.

1.8 What does the Polygon Law of Forces describe?
(a) The equilibrium condition of multiple forces
(b) The force required to balance a single force
(c) The interaction between two perpendicular forces
(d) The method to find the resultant of multiple forces

[RRB-JE • 22.04.2025 (9:00 AM - 11:00 AM)]

Sol. **(d)**
The polygon law provides a graphical method for determining the resultant of more than two coplanar concurrent forces.

1.9 If two forces act at a right angle (90°), what will be the magnitude of their resultant force?
(a) $R = F_1 + F_2$
(b) $R = \sqrt{F_1^2 + F_2^2}$
(c) $R = 2F_1F_2\cos\theta$
(d) $R = F_1 - F_2$

[RRB-JE • 22.04.2025 (9:00 AM - 11:00 AM)]

Sol. **(b)**
For $\theta = 90°$

$$R = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos 90^\circ}$$

$$\therefore \quad R = \sqrt{F_1^2 + F_2^2}$$

1.10 What is meant by the resolution of a force?
(a) Reducing the magnitude of a force in a given direction
(b) Splitting a force into components without changing its effect
(c) Changing the direction of a force without altering magnitude
(d) Combining multiple forces to form a single resultant

[RRB-JE • 22.04.2025 (9:00 AM - 11:00 AM)]

Sol. **(b)**

Resolution of a force is the process of replacing a single force by components that together produce the same mechanical effect.

1.11 Why is the concept of transmissibility of forces valid for a rigid body?

(a) Because a rigid body does not deform under applied forces

(b) Because forces always act in the direction of motion

(c) Because internal forces in a rigid body do not exist

(d) Because a rigid body always has an infinite number of forces acting on it

[RRB-JE • 22.04.2025 (9:00 AM - 11:00 AM)]

Sol. **(a)**

For an ideal rigid body, deformation is neglected. Therefore, shifting a force along its line of action does not change the external effect on the body.

1.12 How is the resultant force calculated if two forces act along the same straight line but in opposite directions?

(a) $R = 2F_1F_2 \cos\theta$

(b) $R = F_1 + F_2$

(c) $R = F_1 - F_2$

(d) $R = \sqrt{F_1^2 + F_2^2}$

[RRB-JE • 22.04.2025 (2:30 PM - 4:30 PM)]

Sol. **(c)**

For $\theta = 180°$

$$R = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos 180^\circ}$$

$$R = \sqrt{F_1^2 + F_2^2 - 2F_1F_2}$$

$$R = |F_1 - F_2|$$

1.13 When two equal forces F act at an angle θ, the resultant force is given by which of the following expressions?

(a) $R = F_1 - F_2$

(b) $R = F_1 + F_2$

(c) $R = 2F\cos\left(\frac{\theta}{2}\right)$

(d) $R = 2F\sin\left(\frac{\theta}{2}\right)$

[RRB-JE • 22.04.2025 (2:30-4:30 PM)]

Sol. **(c)**

$$R = \sqrt{F^2 + F^2 + 2F^2\cos\theta}$$

$$R = \sqrt{2F^2(1+\cos\theta)}$$

Using:

$$1 + \cos\theta = 2\cos^2\left(\frac{\theta}{2}\right)$$

$$\therefore \quad R = 2F\cos\left(\frac{\theta}{2}\right)$$

1.14 A force of 100 N acting on a rigid body is moved to another point along the same line of action. What is the effect on the external equilibrium of the body?

(a) The effect depends on the material

(b) The external equilibrium remains unchanged

(c) The force magnitude becomes zero

(d) The external equilibrium changes

[RRB-JE • Shift-1, 02.07.2026 :09 AM to 11 AM]

Sol. **(b)**

According to the Principle of Transmissibility of Forces, the external effect of a force on a rigid body remains unchanged when its point of application is moved anywhere along its line of action.

1.15 A force of 10 N acts along a line OB, which makes an angle of 60° with the horizontal line OA. What is the component of the force along the direction of the acute angle bisector of angle $\angle AOB$?

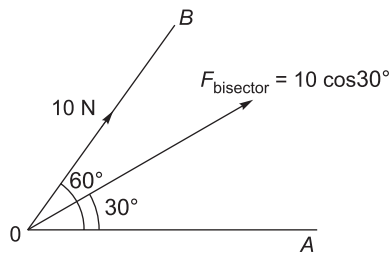
(a) 10 cos 30° N (b) 10 N

(c) 10 cos 60° N (d) 10 sin 30° N

[RRB-JE • Shift-1, 02.07.2026 :09 AM to 11 AM]

Sol. **(a)**

Given: F = 10 N along OB, $\angle AOB = 60°$



The acute angle bisector of $\angle AOB$ lies at an angle of $\alpha = \frac{60^\circ}{2} = 30^\circ$ with the line OB.

Component along the bisector: $F_{bisector} = F \times \cos 30° = 10 \cos 30°$ N

1.16 The horizontal and vertical components of a 100 N force inclined at 37° with the horizontal are: (consider the approximation of sin 37°=0.6, cos 37°=0.8 and tan 37°=0.75)
(a) 70 N and 70 N (b) 80 N and 60 N
(c) 60 N and 80 N (d) 100 N and 0 N
[RRB-JE • Shift-1, 02.07.2026 :09 AM to 11 AM]

Sol. (b)
Given: F = 100 N, $\theta = 37°$, cos 37° = 0.8, sin 37° = 0.6
Horizontal component:
$F_x = F\cos 37° = 100 \times 0.8 = 80$ N
Vertical component:
$F_y = F \sin 37° = 100 \times 0.6 = 60$ N

1.17 The law of parallelogram of forces gives the resultant of
(a) Parallel forces
(b) Two coplanar concurrent forces
(c) Like parallel forces
(d) Non Coplanar concurrent forces
[DMRC-JE • 22.09.2017]

Sol. (b)
- The parallelogram law of forces explicitly defines the resultant of two concurrent forces acting simultaneously at a single point in the same plane.
- The magnitude and direction of their resultant are represented by the diagonal of the parallelogram whose adjacent sides represent the two given forces in magnitude and direction.

1.18 What is the SI unit of force?
(a) Dyne (b) Newton
(c) Kilogram (d) Watt
[DMRC-JE • 18.02.2017, 8.30 a.m]

Sol. (b)
- In the International System of Units (SI), force is defined from Newton's second law as the product of mass (in kg) and acceleration (in m/s^2), giving the derived unit 1 $kg \cdot m/s^2$.
- This SI derived unit is formally designated as the Newton (N), whereas Dyne is the CGS unit and Kilogram is the unit of mass.

1.19 The resultant force of five coplanar forces can be found out by
(a) Law of polygon
(b) Laws of equilibrium
(c) Law of parallelogram
(d) Lami's Theorem
[DMRC-JE • 17.04.2018 12:15-2:30 PM]

Sol. (a)
- The polygon law of forces states that if any number of coplanar concurrent forces acting simultaneously on a particle are represented in magnitude and direction by the sides of an open polygon taken in order, their resultant is represented completely by the closing side of the polygon taken in the reverse order.
- While the parallelogram law is restricted to two concurrent forces, the polygon law directly generalizes vector addition to three or more (e.g., five) coplanar forces.

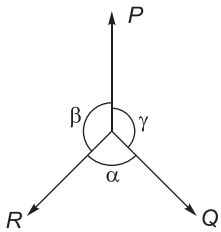
2 • Coplanar concurrent and Non-concurrent Force system

2.1 If the line of action of all the forces are along the same line, then the forces are said to be
(a) Collinear forces
(b) Coplanar concurrent forces
(c) Non-coplanar non-concurrent forces
(d) Coplanar parallel forces
[RRB-JE • 29-08-2019]

Sol. (a)
Forces whose lines of action lie along the same straight line are called collinear forces.

2.2 Which of the following states that, "If a body is in equilibrium, under the action of three concurrent forces, each force is proportional to the sine of the angle between the other two forces"?
(a) Varignon's theorem
(b) Lami's theorem
(c) Parallelogram law of forces
(d) Transmissibility of forces
[RRB-JE • 31-08-2019]

Sol. (b)



Lami's theorem states:

$$\frac{P}{\sin\alpha} = \frac{Q}{\sin\beta} = \frac{R}{\sin\gamma}$$

2.3 What is a coplanar force system?

(a) A system where all forces lie in the same plane
(b) A system where forces act only in one direction
(c) A system where forces do not intersect at a point
(d) A system where all forces lie in different planes

[RRB-JE • (Re-Exam) 04.06.2025]

Sol. (a)

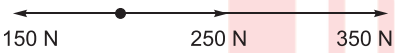
A coplanar force system consists of forces whose lines of action lie in the same plane.

2.4 Three collinear horizontal forces of magnitudes 250 N, 150 N and 350 N are acting on a rigid body. If the 150 N force acts in the opposite direction, determine the resultant force.

(a) 350 N (b) 250 N
(c) 450 N (d) 550 N

[RRB-JE • (Re-Exam) 04.06.2025]

Sol. (c)



Taking the rightward direction as positive:

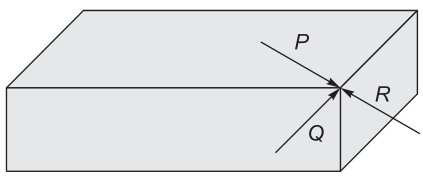
$$R = 250 - 150 + 350$$
$$R = 450\ \text{N}$$

2.5 Which of the following options best describes non-coplanar concurrent forces?

(a) Forces that meet at one point and their lines of action lie on the same plane
(b) Forces that meet at one point but their lines of action do not lie on the same plane
(c) Forces that do not meet at one point but their lines of action lie on different planes
(d) Forces that do not meet at one point and their lines of action lie on the same plane

[RRB-JE • 22.04.2025 (2:30-4:30 PM)]

Sol. (b)



Non-coplanar concurrent forces have lines of action that meet at a common point but do not lie in a single plane.

2.6 Which of the following happens when two equal and opposite forces are applied at a point on a rigid body?

(a) They cancel each other and have no effect.
(b) They produce an additional force on the body.
(c) They create rotational motion in the body.
(d) They change the magnitude of the original force.

[RRB-JE • 22.04.2025 (2:30-4:30 PM)]

Sol. (a)

If equal and opposite forces act at exactly the same point, their resultant force is zero and their moment is also zero.

Hence, they have no net external effect.

2.7 What is a characteristic of a coplanar parallel force system?

(a) Forces act in the same plane but are not parallel.
(b) Forces act in different planes and are parallel.
(c) Forces act in the same plane and are parallel.
(d) Forces act in different planes and are not parallel.

[RRB-JE • 22.04.2025 (2:30-4:30 PM)]

Sol. (c)

A coplanar parallel force system consists of parallel forces whose lines of action all lie in the same plane.

2.8 Under which scenario is a body on an inclined plane most likely to slip when subjected to a parallel force?

(a) Coefficient of friction is less than tangent of inclination
(b) Parallel force is opposite to frictional force
(c) Frictional force equals weight of the body
(d) Normal reaction is greater than weight

[RRB-JE • Shift-1, 02.07.2026 :09 AM to 11 AM]

Sol. (a)

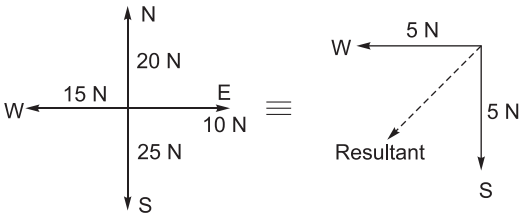
A body on an inclined plane begins self-sliding under gravity when the down-slope component exceeds limiting friction ($mg \sin\theta > \mu\, mg \cos\theta$), which simplifies directly to $\mu < \tan\theta$.

2.9 Given are four concurrent forces: 10 N east, 20 N north, 15 N west, 25 N south. What is the direction of the resultant force?

(a) North-east (b) South-west
(c) South-east (d) North-west

[RRB-JE • Shift-1, 02.07.2026 :09 AM to 11 AM]

Sol. (b)



Given: F_1 = 10 N East, F_2 = 20 N North, F_3 = 15 N West, F_4 = 25 N South

Sum of horizontal forces:

$$\Sigma F_x = 10 - 15 = -5 \text{ N (towards West)}$$

Sum of vertical forces:

$$\Sigma F_y = 20 - 25 = -5 \text{ N (towards South)}$$

Since both horizontal and vertical components are negative, the resultant lies in the South-West direction.

2.10 Point of application of all force in concurrent system is:

(a) one point
(b) two point
(c) perpendicular plane
(d) plane

[DMRC-JE • 18.02.2017, 8.30 a.m]

Sol. (a)

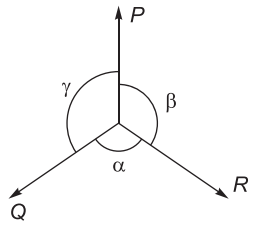
- By classical definition in statics, a concurrent force system consists of two or more forces whose lines of action pass through a single, common point.
- Consequently, the point of intersection or common application for all forces in a concurrent system is exactly one point.

2.11 According to Lami's theorem

(a) the three forces must be equal
(b) the three forces must be at 120° to each other
(c) the three forces must be in equilibrium
(d) if the three forces acting at a point are in equilibrium, then each force is proportional to the sine of the angle between the other two

[JMRC-JE • 10.06.2017]

Sol. (d)



- Lami's theorem is a direct consequence of the sine rule applied to the closed triangle of forces in static equilibrium.
- It formally states that if three coplanar, concurrent forces acting at a point are in static equilibrium, each force is directly proportional to the sine of the angle included between the lines of action of the other two forces:

$$\frac{P}{\sin(\alpha)} = \frac{Q}{\sin(\beta)} = \frac{R}{\sin(\gamma)}$$

2.12 Which equilibrium is used for two forces?

(a) Same line of action
(b) Equal in magnitude
(c) Opposite in direction
(d) All of the above options

[DMRC-JE • 17.04.2018 12:15-2:30 PM]

Sol. (d)

For a rigid body subjected to only two forces to remain in static equilibrium, the resultant force must be zero ($\Sigma F = 0$) and the resultant moment must be zero ($\Sigma M = 0$).

This fundamental two-force equilibrium principle mandates that the two forces must be equal in magnitude, opposite in direction, and share the exact same line of action (collinear).

2.13 Which of the following concurrent forces cannot have a resultant of 4 N

(a) 2N and 4N (b) 2N and 6N
(c) 2N and 8 N (d) All of these

[BMRCL-JE • 24 Feb. 2019]

Sol. (c)

By the triangle inequality of vector addition, the resultant R of two forces F_1 and F_2 must satisfy the closed range $|F_1 - F_2| \le R \le (F_1 + F_2)$.

For 2 N and 8 N,

$$R_{min} = 8 - 2 = 6 \text{ N}$$