SSC-JE

Staff Selection Commission

Junior Engineer

Civil Engineering

Topicwise Objective Solved Questions

Volume-II

Previous Years Solved Papers : 2007-2024

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Preface


B. Singh (Ex. IES)

Staff Selection Commission-Junior Engineer has always been preferred by Engineers due to job stability. SSC-Junior Engineer examination is conducted every year. MADE EASY team has deeply analyzed the previous exam papers and observed that a good percentage of questions are repetitive in nature, therefore it is advisable to solve previous years papers before a candidate takes the exam.

The SSC JE exam is conducted in two stages as shown in table given below.

Papers	Subject	Maximum Marks	Duration
Stage 1: Paper-I : Objective type	(i) General Intelligence & Reasoning (ii) General Awareness (iii) General Engineering : Civil	50 Marks 50 Marks 100 Marks	2 hours
Stage 2: Paper-II : Objective Type	General Engineering : Civil	300 Marks	2 hours
Note: In Paper-I, every question carry one mark and there is negative marking of ¼ marks for every wrong answer. Candidates shortlisted in Stage 1 are called for Stage 2. On the basis of combined score in Stage 1 and Stage 2, final merit list gets prepared.			

MADE EASY has taken due care to provide complete solution with accuracy. Apart from Staff Selection Commission-Junior Engineer, this book is also useful for Public Sector Examinations and other competitive examinations for engineering graduates.

I have true desire to serve student community by providing good source of study and quality guidance. Any suggestion from the readers for improvement of this book is most welcome.

B. Singh (Ex. IES)
Chairman and Managing Director
MADE EASY Group

Syllabus of Engineering Subjects

(For both Objective and Conventional Type Papers)

Civil Engineering

Building Materials : Physical and Chemical properties, Classification, Standard Tests, Uses and manufacture/ quarrying of materials e.g. building stones, silicate based materials, Cement (Portland), Asbestos products, Timber and Wood based Products, Laminates, bituminous materials, Paints, Varnishes.

Estimating, Costing and Valuation : Estimate, Glossary of technical terms, Analysis of rates, Methods and unit of measurement, Items of work – Earthwork, Brick work (Modular & Traditional bricks), RCC work, Shuttering, Timber work, Painting, Flooring, Plastering. Boundary wall, Brick building, Water Tank, Septic tank, Bar bending schedule. Centre line method, Mid-section formula, Trapezodial formula, Simpson's rule. Cost estimate of Septic tank, flexible pavements, Tube well, isolated and combined footings, Steel Truss, Piles and pile-caps. Valuation – Value and cost, scrap value, salvage value, assessed value, sinking fund, depreciation and obsolescence, methods of valuation.

Surveying: Principles of surveying, measurement of distance, chain surveying, working of prismatic compass, compass traversing, bearings, local attraction, plane table surveying, theodolite traversing, adjustment of theodolite, Levelling, Definition of terms used in levelling, contouring, curvature and refraction corrections, temporary and permanent adjustments of dumpy level, methods of contouring, uses of contour map, tachometric survey, curve setting, earth work calculation, advanced surveying equipment.

Soil Mechanics: Origin of soil, phase diagram, Definitions- void ratio, porosity, degree of saturation, water content, specific gravity of soil grains, unit weights, density index and interrelationship of different parameters, Grain size distribution curves and their uses. Index properties of soils, Atterberg's limits, ISI soil classification and plasticity chart. Permeability of soil, coefficient of permeability, determination of coefficient of permeability, Unconfined and confined aquifers, effective stress, quick sand, consolidation of soils, Principles of consolidation, degree of consolidation, pre-consolidation pressure, normally consolidated soil, e-log p curve, computation of ultimate settlement. Shear strength of soils, direct shear test, Vane shear test, Triaxial test. Soil compaction, Laboratory compaction test, Maximum dry density and optimum moisture content, earth pressure theories, active and passive earth pressures, Bearing capacity of soils, plate load test, standard penetration test.

Hydraulics: Fluid properties, hydrostatics, measurements of flow, Bernoulli's theorem and its application, flow through pipes, flow in open channels, weirs, flumes, spillways, pumps and turbines.

Irrigation Engineering : Definition, Necessity, Benefits, III effects of irrigation, types and methods of irrigation. Hydrology – Measurement of rainfall, run off coefficient, rain gauge, losses from precipitation – evaporation, infiltration, etc. Water requirement of crops, duty, delta and base period, Kharif and Rabi Crops, Command area, Time factor, Crop ratio, Overlap allowance, Irrigation efficiencies. Different type of canals, types of canal irrigation, loss of water in canals. Canal lining – types and advantages. Shallow and deep to wells, yield from a well. Weir and barrage, Failure of weirs and permeable foundation, Slit and Scour, Kennedy's theory of critical velocity. Lacey's theory of uniform flow. Definition of flood, causes and effects, methods of flood control, water logging, preventive measures. Land reclamation, Characteristics of affecting fertility of soils, purposes, methods, description of land and reclamation processes. Major irrigation projects in India.

Transportation Engineering : Highway Engineering – cross sectional elements, geometric design, types of pavements, pavement materials – aggregates and bitumen, different tests, Design of flexible and rigid pavements – Water Bound Macadam (WBM) and Wet Mix Macadam (WMM), Gravel Road, Bituminous construction, Rigid pavement joint, pavement maintenance, Highway drainage. Railway Engineering – Components of permanent way – sleepers, ballast, fixtures and fastening, track geometry, points and crossings, track junction, stations and yards. Traffic Engineering – Different traffic survey, speed-flow-density and their interrelationships, intersections and interchanges, traffic signals, traffic operation, traffic signs and markings, road safety.

Environmental Engineering: Quality of water, source of water supply, purification of water, distribution of water, need of sanitation, sewerage systems, circular sewer, oval sewer, sewer appurtenances, sewage treatments. Surface water drainage. Solid waste management – types, effects, engineered management system. Air pollution – pollutants, causes, effects, control. Noise pollution – causes, health effects, control.

Structural Engineering

Theory of structures: Elasticity constants, types of beams - determinate and indeterminate, bending moment and shear force diagrams of simply supported, cantilever and over hanging beams. Moment of area and moment of inertia for rectangular & circular sections, bending moment and shear stress for tee, channel and compound sections, chimneys, dams and retaining walls, eccentric loads, slope deflection of simply supported and cantilever beams, critical load and columns, Torsion of circular section.

Concrete Technology: Properties, Advantages and uses of concrete, cement aggregates, importance of water quality, water cement ratio, workability, mix design, storage, batching, mixing, placement, compaction, finishing and curing of concrete, quality control of concrete, hot weather and cold weather concreting, repair and maintenance of concrete structures.

RCC Design: RCC beams-flexural strength, shear strength, bond strength, design of singly reinforced and doubly reinforced beams, cantilever beams. T-beams, lintels. One way and two way slabs, isolated footings. Reinforced brick works, columns, staircases, retaining walls, water tanks (RCC design questions may be based on both Limit State and Working Stress methods).

Steel Design: Steel design and construction of steel columns, beams roof trusses plate girders.

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SSC-JE : Paper-I

Contents

Civil Engineering : Volume-II

Previous Years Objective Solved Papers

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CHAPTER 1

Hydraulics

1. Fluid Properties, Hydrostatic Forces

1.1 For a fluid, the shear stress was found to be directly proportional to the rate of angular deformation. The fluid is classified as
(a) non-Newtonian fluid
(b) Ideal fluid
(c) Newtonian fluid
(d) Thixotropic fluid
[SSC-JE : 2007]

1.2 A U-tube manometer measures
(a) local atmosphere pressure
(b) difference in pressure between two points
(c) difference in total energy between two points
(d) absolute pressure at a point
[SSC-JE : 2007]

1.3 Poise is the unit of
(a) mass density (b) kinematic viscosity
(c) viscosity (d) velocity gradient
[SSC-JE : 2008]

1.4 Gauge pressure at a point is equal to
(a) absolute pressure plus atmospheric pressure
(b) absolute pressure minus atmospheric pressure
(c) vacuum pressure plus absolute pressure
(d) None of the above
[SSC-JE : 2008]

1.5 The difference in pressure head, measured by a mercury water differential manometer for a 20 cm difference of mercury level will be
(a) 2.72 m (b) 2.52 m
(c) 2.0 m (d) 0.2 m
[SSC-JE : 2008]

1.6 Manometer is used to determine
(a) water content and voids ratio
(b) specific gravity and dry density
(c) water content and specific gravity
(d) None of the above
[SSC-JE : 2009]

1.7 Pascal's law states that pressure at any point in a fluid at rest has
(a) different magnitude in all directions
(b) same magnitude, in all directions
(c) zero magnitude in all directions
(d) None of the above
[SSC-JE : 2009]

1.8 The property of a fluid which determines its resistance to shearing stresses is called
(a) viscosity (b) surface tension
(c) adhesion (d) None of the above
[SSC-JE : 2009]

1.9 If the diameter of a capillary tube is doubled, the capillary rise will be :
(a) unaffected (b) doubled
(c) halfed (d) none of the above
[SSC-JE : 2010]

1.10 The magnitude of the buoyant force can be determined by:
(a) Newton's law of viscosity
(b) Archimede's principle.
(c) Principles of moments
(d) none of the above
[SSC-JE : 2010]

1.11 Flow of fluid takes place due to its :
(a) Viscosity
(b) compressibility
(c) Surface tension
(d) Deformation under shear force
[SSC-JE : 2010]

1.12 The pressure intensity in kg/cm^2 at any point in a liquid is
(a) w (b) w/h
(c) h/w (d) wh
where w is unit weight of liquid in kg/cm^3, h is the depth of the point from liquid surface.
[SSC : JE : 2011]

1.13 The characteristic of an ideal fluid is
(a) one which satisfies continuity equation
(b) one which flows with least friction
(c) one which obeys Newton's law of Viscosity
(d) frictionless and incompressible
[SSC - JE : 2012]

1.14 A rectangular plate 1.25 m × 2.4 m is immersed in a liquid of relative density 0.85 with its 1.25 m side horizontal and just at the water surface. If the plane of the plate makes an angle of 60° with the horizontal, the pressure force on one side of the plate of
(a) 30.6 kN (b) 26.0 kN
(c) 15.0 kN (d) 30.0 kN
[SSC - JE : 2012]

1.15 The ratio of specific weight of a liquid to the specific weight of pure water at a standard temperature is called
(a) Compressibility of liquid
(b) Surface tension of liquid
(c) Density of liquid
(d) Specific gravity of liquid
[SSC - JE : 2012]

1.16 Bulk modulus of fluid is the ratio of
(a) shear stress to shear strain
(b) increase in volume to the viscosity of fluid
(c) increase in pressure to the volumetric strain
(d) critical velocity to the velocity of fluid
[SSC : JE : 2013]

1.17 The buoyancy depends upon the
(a) pressure with which the liquid is displaced
(b) weight of the liquid displaced
(c) viscosity of the liquid
(d) compressibility of the liquid
[SSC : JE : 2013]

1.18 Manometer is a device used for measuring
(a) Velocity (b) Pressure
(c) Density (d) Discharge
[SSC - JE (Forenoon) : 2014]

1.19 Capillarity is due to
I. surface tension
II. cohesion
III. viscosity
IV. weight density of liquid
(a) II, III (b) III
(c) I (d) II, III, V
[SSC - JE (Forenoon) : 2014]

1.20 Pressure in terms of metres of oil (specific gravity = 0.9) equivalent to 4.5 m of water is
(a) 4.05 (b) 5.0
(c) 3.6 (d) 0.298
[SSC - JE (Forenoon) : 2014]

1.21 Capillary rise is a phenomenon that is attributed to the following property of fluid
(a) vapour pressure (b) viscosity
(c) density (d) surface tension
[SSC - JE (Afternoon) : 2014]

1.22 Specific gravity has a unit :
(a) g/cc
(b) kg/m^3
(c) N/m^3
(d) No unit i.e., dimensionless
[SSC - JE (Afternoon) : 2014]

1.23 The total energy line lies above the hydraulic gradient line by an amount equal to :
(a) sum of pressure, velocity and datum heads
(b) Pressure head, $\frac{P}{\gamma}$
(c) Velocity head, $\frac{V^2}{2g}$
(d) datum head, z
[SSC - JE (Afternoon) : 2014]

1.24 A fluid, which is incompressible and is having no viscosity is
(a) Ideal fluid (b) Real fluid
(c) Newtonian fluid (d) Non Newtonian fluid
[SSC - JE (Afternoon) : 2014]

1.25 The relationship between atmospheric pressure (P_{atm}), gauge pressure (P_{gauge}) and absolute pressure (P_{abs}) is given by :
(a) $P_{atm} = P_{abs} - P_{gauge}$
(b) $P_{abs} = P_{atm} + P_{gauge}$
(c) $P_{abs} = P_{atm} - P_{gauge}$
(d) $P_{atm} = P_{abs} + P_{gauge}$
[SSC - JE (Afternoon) : 2014]

1.26 With increase in temperature the viscosity of air and water varies as
(a) viscosity' of air increases and viscosity of water decreases
(b) viscosity of air increases and viscosity of water increases

(c) viscosity of air decreases and viscosity of water decreases
(d) viscosity of air decreases and viscosity of water increases

[SSC-JE : 2015]

1.27 For stability of floating bodies, the metacentre should be
(a) above the centre of gravity
(b) below the centre of gravity
(c) above the centre of buoyancy
(d) below the centre of buoyancy

[SSC-JE : 2015]

1.28 A vessel containing water of depth h is accelerated upward with an acceleration of $\frac{g}{2}$. The pressure at the bottom of the vessel is
(a) γh (b) $\frac{\gamma h}{2}$
(c) $2\gamma h$ (d) $\frac{3}{2}\gamma h$

[SSC-JE : 2015]

1.29 The point in the immersed body through which the resultant pressure of the liquid may be taken to act is known as
(a) Metacentre
(b) Centre of pressure
(c) Centre of buoyancy
(d) Centre of gravity

[SSC - JE (Forenoon) 1.3.2017]

1.30 Surface tension
(a) Acts in the plane of interface normal to any line in the surface
(b) Is also known as capillarity
(c) Is a function of the curvature of the interface
(d) Decreases with fall in temperature

[SSC - JE (Forenoon) 1.3.2017]

1.31 The pressure in meters of oil (specific gravity 0.85) equivalent to 42.5 m of water is
(a) 42.5 m (b) 50 m
(c) 52.5 m (d) 85 m

[SSC - JE (Forenoon) 1.3.2017]

1.32 Viscosity of a fluid with specific gravity 1.3 is measured to be 0.0034 Ns/m^2. Its kinematic viscosity, in m^2/s, is
(a) 2.6×10^{-6} (b) 4.4×10^{-6}
(c) 5.8×10^{-6} (d) 7.2×10^{-6}

[SSC - JE (Forenoon) 1.3.2017]

1.33 The resultant upward pressure of the fluid on an immersed body is called
(a) Upthrust
(b) Buoyancy
(c) Centre of pressure
(d) All options are correct

[SSC - JE (Forenoon) 1.3.2017]

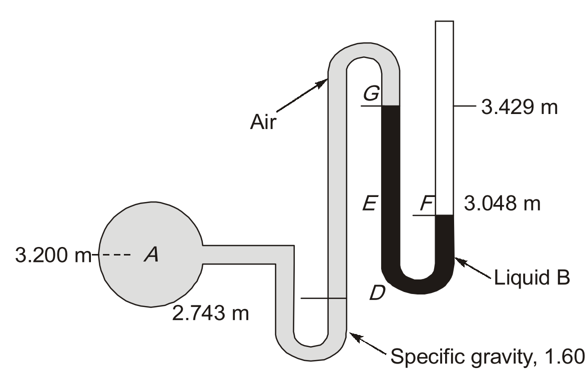
1.34 Center of pressure on an inclined plane is_______.
(a) At the centroid
(b) Above the centroid
(c) Below the centroid
(d) At metacentre

[SSC - JE (Afternoon) 1.3.2017]

1.35 A body floats in stable equilibrium_______.
(a) When its metacentric height is zero
(b) When metacentre is above centre of gravity
(c) When its center of gravity is below the center of buoyancy.
(d) None of these

[SSC - JE (Afternoon) 1.3.2017]

1.36 For a gauge pressure of A of –10.89 kPa, what is the specific gravity of the gauge liquid B in the figure below?



(a) 1 (b) 2
(c) 3 (d) None of these

[SSC - JE (Afternoon) 1.3.2017]

1.37 When the adhesion between molecules of a fluid is greater than adhesion between fluid and the glass, then the free level of fluid in glass tube dipped in the glass vessel will be_______.

(a) Same as the surface of the fluid
(b) Lower than the surface of the fluid
(c) Higher than the surface of the fluid
(d) Dependent on atmospheric pressure

[SSC - JE (Afternoon) 1.3.2017]

1.38 An odd shaped body weighing 7.5 kg and occupying 0.01 cubic metre volume will be completely submerged in a fluid having specific gravity of

(a) 1 (b) 1.2
(c) 0.8 (d) 0.75

[SSC - JE (Forenoon) : 2.3.2017]

1.39 If the capillary rise of water in a 1 mm diameter tube is 3 cm, the height of capillary rise of water in a 0.2 mm diameter tube in centimeter will be

(a) 1.5 (b) 7.5
(c) 15 (d) 75

[SSC - JE (Forenoon) : 2.3.2017]

1.40 The pressure intensity is same in all directions at a point in a fluid

(a) only when fluid is frictionless and incompressible
(b) only when fluid is frictionless and is at rest
(c) only when fluid is frictionless
(d) when there is no relative motion of one fluid layer relative to other

[SSC - JE (Forenoon) : 2.3.2017]

1.41 Which of the following fluids can be classified as non-Newtonian?

(a) Kerosene oil and Diesel oil
(b) Human blood and Toothpaste
(c) Diesel oil and Water
(d) Kerosene and Water

[SSC - JE (Forenoon) : 2.3.2017]

1.42 Alcohol is used in manometer, because_______.

(a) its vapor pressure is low
(b) it provides suitable meniscus
(c) its density is less
(d) it provides longer length for a given pressure difference

[SSC - JE (Afternoon) 2.3.2017]

1.43 The property of fluid by virtue of which it offers resistance to shear is called_______.

(a) surface tension (b) adhesion
(c) cohesion (d) viscosity

[SSC - JE (Afternoon) 2.3.2017]

1.44 The unit of kinematic viscosity is_______.

(a) m^2/sec (b) kg-sec/m^2
(c) newton-sec/m^2 (d) newton-sec^2/m

[SSC - JE (Afternoon) 2.3.2017]

1.45 The total pressure on the surface of a vertical sluice gate 2 m x 1 m with its top 2 m surface being 0.5 m below the water level will be_______

(a) 500 kg (b) 1000 kg
(c) 1500 kg (d) 2000 kg

[SSC - JE (Afternoon) 2.3.2017]

1.46 Metacentric height is given as the distance between_______.

(a) the centre of gravity of the body and the metacentre
(b) the centre of gravity of the body and the centre of buoyancy
(c) the centre of gravity of the body and the centre of pressure
(d) centre of buoyancy and metacentre

[SSC - JE (Afternoon) 2.3.2017]

1.47 The difference of pressure between the inside and outside of a liquid drop is_______.

(a) $p = T \times r$ (b) $p = \dfrac{T}{r}$
(c) $p = \dfrac{T}{2r}$ (d) $p = \dfrac{2T}{r}$

[SSC - JE (Afternoon) 2.3.2017]

1.48 The property by which a liquid opposes relative motion between its different layers is called_______.

(a) surface tension
(b) coefficient of viscosity
(c) viscosity
(d) osmosis

[SSC - JE (Afternoon) 2.3.2017]

1.49 The atmospheric pressure with rise in altitude decreases_______.

(a) linearly
(b) first slowly then steeply
(c) first steeply and then gradually
(d) unpredictable

[SSC - JE (Afternoon) 2.3.2017]

1.50 Barometer is used to measure_______.

(a) pressure in pipes, channels etc.
(b) atmospheric pressure

Answers Hydraulics

1. Fluid Properties, Hydrostatic Forces, Buoyancy and Floatation

1.1 (c)	1.2 (b)	1.3 (c)	1.4 (b)	1.5 (a)	1.6 (d)	1.7 (b)	1.8 (a)	1.9 (c)
1.10 (b)	1.11 (d)	1.12 (d)	1.13 (d)	1.14 (b)	1.15 (d)	1.16 (c)	1.17 (b)	1.18 (b)
1.19 (c)	1.20 (b)	1.21 (d)	1.22 (d)	1.23 (c)	1.24 (a)	1.25 (b)	1.26 (a)	1.27 (a)
1.28 (d)	1.29 (b)	1.30 (a)	1.31 (b)	1.32 (a)	1.33 (b)	1.34 (c)	1.35 (b)	1.36 (a)
1.37 (b)	1.38 (d)	1.39 (c)	1.40 (d)	1.41 (b)	1.42 (d)	1.43 (d)	1.44 (a)	1.45 (d)
1.46 (a)	1.47 (d)	1.48 (c)	1.49 (b)	1.50 (b)	1.51 (d)	1.52 (b)	1.53 (b)	1.54 (b)
1.55 (a)	1.56 (d)	1.57 (b)	1.58 (b)	1.59 (d)	1.60 (a)	1.61 (b)	1.62 (c)	1.63 (c)
1.64 (b)	1.65 (c)	1.66 (d)	1.67 (d)	1.68 (b)	1.69 (c)	1.70 (c)	1.71 (b)	1.72 (c)
1.73 (c)	1.74 (c)	1.75 (b)	1.76 (a)	1.77 (b)	1.78 (b)	1.79 (c)	1.80 (d)	1.81 (c)
1.82 (a)	1.83 (d)	1.84 (c)	1.85 (b)	1.86 (d)	1.87 (d)	1.88 (b)	1.89 (b)	1.90 (c)
1.91 (b)	1.92 (d)	1.93 (d)	1.94 (a)	1.95 (a)	1.96 (a)	1.97 (d)	1.98 (c)	1.99 (c)
1.100 (d)	1.101 (c)	1.102 (b)	1.103 (d)	1.104 (c)	1.105 (d)	1.106 (a)	1.107 (d)	1.108 (c)
1.109 (d)	1.110 (b)	1.111 (a)	1.112 (d)	1.113 (d)	1.114 (b)	1.115 (d)	1.116 (d)	1.117 (c)
1.118 (c)	1.119 (b)	1.120 (c)	1.121 (d)	1.122 (b)	1.123 (d)	1.124 (b)	1.125 (d)	1.126 (c)
1.127 (b)	1.128 (b)	1.129 (b)	1.130 (a)	1.1301 (c)	1.132 (a)	1.133 (c)	1.134 (c)	1.135 (a)
1.136 (c)	1.137 (a)	1.138 (d)	1.139 (c)	1.140 (a)	1.141 (*)	1.142 (c)	1.143 (b)	1.144 (c)
1.145 (b)	1.146 (b)	1.147 (a)	1.148 (c)	1.149 (b)	1.150 (a)	1.151 (d)	1.152 (b)	1.153 (d)
1.154 (a)	1.155 (a)	1.156 (a)	1.157 (d)	1.158 (b)	1.159 (a)	1.160 (d)	1.161 (b)	1.162 (a)
1.163 (b)	1.164 (b)	1.165 (b)	1.166 (b)	1.167 (c)	1.168 (c)	1.169 (c)	1.170 (b)	1.171 (c)

2. Fluid Kinematics and Dynamics & Flow Measurements

2.1 (a)	2.2 (d)	2.3 (c)	2.4 (b)	2.5 (b)	2.6 (d)	2.7 (b)	2.8 (a)	2.9 (d)
2.10 (c)	2.11 (c)	2.12 (d)	2.13 (a)	2.14 (c)	2.15 (b)	2.16 (c)	2.17 (a)	2.18 (a)
2.19 (c)	2.20 (b)	2.21 (c)	2.22 (b)	2.23 (b)	2.24 (d)	2.25 (d)	2.26 (c)	2.27 (a)
2.28 (a, b, c)		2.29 (b)	2.30 (c)	2.31 (b)	2.32 (c)	2.33 (c)	2.34 (d)	2.35 (d)
2.36 (b)	2.37 (b)	2.38 (a)	2.39 (d)	2.40 (b)	2.41 (a)	2.42 (d)	2.43 (c)	2.44 (c)
2.45 (c)	2.46 (b)	2.47 (a)	2.48 (c)	2.49 (a)	2.50 (a)	2.51 (d)	2.52 (a)	2.53 (b)

2.54 (d)	2.55 (c)	2.56 (a)	2.57 (b)	2.58 (b)	2.59 (a)	2.60 (d)	2.61 (a)	2.62 (b)
2.63 (d)	2.64 (a)	2.65 (a)	2.66 (b)	2.67 (a)	2.68 (d)	2.69 (c)	2.70 (c)	2.71 (a)
2.72 (b)	2.73 (d)	2.74 (d)	2.75 (a)	2.76 (a)	2.77 (a)	2.78 (c)	2.79 (a)	2.80 (a)
2.81 (b)	2.82 (b)	2.83 (d)	2.84 (c)	2.85 (c)	2.86 (a)	2.87 (b)	2.88 (a)	2.89 (c)
2.90 (b)	2.91 (a)	2.92 (c)	2.93 (b)	2.94 (a)	2.95 (c)	2.96 (d)	2.97 (b)	2.98 (a)
2.99 (a)	2.100 (a)	2.101 (c)	2.102 (d)	2.103 (d)	2.104 (b)	2.105 (a)	2.106 (b)	2.107 (d)
2.108 (a)	2.109 (d)	2.110 (b)						

3. Flow Through Pipes and Dimensional Analysis

3.1 (b)	3.2 (b)	3.3 (a)	3.4 (b)	3.5 (a)	3.6 (c)	3.7 (a)	3.8 (b)	3.9 (b)
3.10 (d)	3.11 (c)	3.12 (a)	3.13 (c)	3.14 (d)	3.15 (a)	3.16 (a)	3.17 (b)	3.18 (c)
3.19 (c)	3.20 (c)	3.21 (c)	3.22 (b)	3.23 (a)	3.24 (d)	3.25 (c)	3.26 (c)	3.27 (d)
3.28 (a)	3.29 (d)	3.30 (c)	3.31 (c)	3.32 (c)	3.33 (c)	3.34 (b)	3.35 (d)	3.36 (c)
3.37 (b)	3.38 (b)	3.39 (c)	3.40 (a)	3.41 (a)	3.42 (c)	3.43 (d)	3.44 (b)	3.45 (b)
3.46 (b)	3.47 (c)	3.48 (b)	3.49 (a)	3.50 (b)	3.51 (b)	3.52 (d)	3.53 (b)	3.54 (c)
3.55 (b)	3.56 (c)	3.57 (c)	3.58 (b)	3.59 (b)	3.60 (d)	3.61 (c)	3.62 (b)	3.63 (c)
3.64 (d)	3.65 (a)	3.66 (c)	3.67 (a)	3.68 (d)	3.69 (a)	3.70 (c)	3.71 (c)	3.72 (b)
3.73 (c)	3.74 (b)	3.75 (a)	3.76 (c)	3.77 (a)	3.78 (a)	3.79 (d)	3.80 (d)	3.81 (a)
3.82 (a)	3.83 (c)	3.84 (d)	3.85 (d)	3.86 (a)	3.87 (d)	3.88 (d)	3.89 (b)	3.90 (d)
3.91 (b)	3.92 (c)							

4. Open Channel Flow

4.1 (d)	4.2 (d)	4.3 (b)	4.4 (b)	4.5 (a)	4.6 (c)	4.7 (c)	4.8 (c)	4.9 (c)
4.10 (a)	4.11 (b)	4.12 (a)	4.13 (d)	4.14 (b)	4.15 (b)	4.16 (b)	4.17 (c)	4.18 (a)
4.19 (a)	4.20 (a)	4.21 (b)	4.22 (b)	4.23 (b)	4.24 (a)	4.25 (a)	4.26 (b)	4.27 (b)
4.28 (b)	4.29 (b)	4.30 (d)	4.31 (c)	4.32 (b)	4.33 (*)	4.34 (b)	4.35 (c)	4.36 (c)
4.37 (a)	4.38 (d)	4.39 (a)	4.40 (b)	4.41 (d)	4.42 (d)	4.43 (a)	4.44 (a)	4.45 (c)
4.46 (c)	4.47 (c)	4.48 (c)	4.49 (c)	4.50 (b)	4.51 (b)	4.52 (b)	4.53 (d)	4.54 (b)
4.55 (c)	4.56 (b)	4.57 (c)	4.58 (c)	4.59 (b)	4.60 (d)	4.61 (a)	4.62 (b)	4.63 (c)
4.64 (c)	4.65 (b)	4.66 (a)	4.67 (d)					

5. Hydraulic Machinery

5.1	(a)	5.2	(b)	5.3	(a)	5.4	(a)	5.5	(b)	5.6	(a)	5.7	(c)	5.8	(b)	5.9	(d)
5.10	(a)	5.11	(b)	5.12	(c)	5.13	(b)	5.14	(c)	5.15	(c)	5.16	(d)	5.17	(c)	5.18	(d)
5.19	(c)	5.20	(c)	5.21	(c)	5.22	(b)	5.23	(c)	5.24	(b)	5.25	(c)	5.26	(a)	5.27	(b)
5.28	(c)	5.29	(b)	5.30	(c)	5.31	(c)	5.32	(c)	5.33	(c)	5.34	(a)	5.35	(b)	5.36	(d)
5.37	(d)	5.38	(b)	5.39	(d)	5.40	(a)	5.41	(b)	5.42	(a)	5.43	(b)	5.44	(b)	5.45	(c)
5.46	(a)	5.47	(c)	5.48	(b)	5.49	(a)	5.50	(c)	5.51	(d)	5.52	(a)	5.53	(c)	5.54	(a)
5.55	(a)	5.56	(d)	5.57	(d)	5.58	(b)	5.59	(d)	5.60	(c)	5.61	(d)	5.62	(d)	5.63	(b)
5.64	(c)																

Explanations Hydraulics

1. Fluid Properties, Hydrostatic Forces, Buoyancy and Floatation

1.1 (c)

As per Newton's law of viscosity, the shear stress at any point in a moving fluid is directly proportional to the rate of shear strain (angular deformation by distance between layers). The fluids obeying this law are called Newtonian fluids.

i.e., $\tau \propto \dfrac{d\theta}{dt}$

Also, $\dfrac{d\theta}{dt} = \dfrac{du}{dy}$

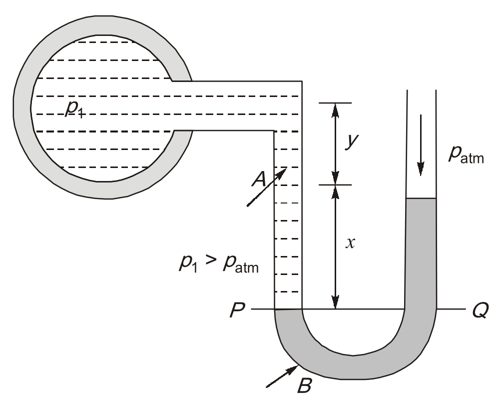
$\therefore \quad \tau \propto \dfrac{du}{dy}$

$\tau = \mu \dfrac{du}{dy}$

μ = Coefficient of viscosity

1.2 (b)

U-tube manometer is used primarily to find the gauge pressure at any point. One end of the U-tube is connected to the fluid while the other end is open to the atmosphere.



1.3 (c)

Poise is the CGS unit of dynamic viscosity(μ).
1 Poise = 10^{-1} Ns/m^2.

Note: Unit of Kinematic viscosity

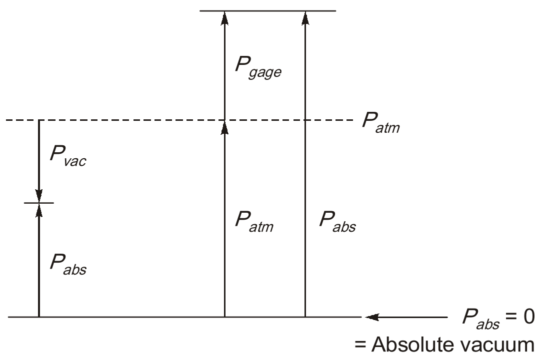
ν = m^2/sec or cm^2/sec or stoke

1 Stoke = 1 cm^2/sec

= 10^{-4} m^2/sec

1.4 (b)

Absolute pressure = Atmospheric pressure + Gauge pressure.



1.5 (a)

Let the difference in pressure in terms of head of water be 'h_w'.

∴ Difference in pressure

$$\Delta P = \gamma_w h_w$$

As per question,

$$\Delta P = \gamma_m \times h_m \ ;$$

γ_m = Unit weight of mercury; h_m = difference of mercury level

$$\Rightarrow \quad \Delta P = 13.6\,\gamma_w \times (20 \times 10^{-2})$$

[Note : Specific gravity of mercury = 13.6]

$$\therefore \quad \gamma_w h_w = 13.6\gamma_w \times 20 \times 10^{-2}$$

$$\Rightarrow \quad h_w = 2.72 \text{ m}$$

1.6 (d)

Manometer is a pressure measuring device basically used to measure the pressure of a flowing fluid.

1.7 (b)

Pascal's Law: It states that the pressure or intensity of pressure at a point in a static fluid is equal in all directions

1.9 (c)

Capillary rise is given by the formula

$$h = \frac{4\sigma\cos\theta}{\gamma d}$$

if σ, γ, θ = constant

$$h \propto \frac{1}{d}$$

Given, $d_2 = 2d_1$

$$\therefore \quad \frac{h_2}{h_1} = \frac{d_1}{d_2}$$

$$\Rightarrow \quad h_2 = \frac{d_1}{2d_2} \times h_1$$

$$\Rightarrow \quad h_2 = \frac{h_1}{2}$$

∴ Capilary rise will be halfed.

1.10 (b)

Archimedes' principle is a physical law of buoyancy stating that any body completely or partially submerged in a fluid at rest is acted upon by an upward, or buoyant, force the magnitude of which is equal to the weight of the fluid displaced by the body.

1.11 (d)

Viscosity, Compressibility and Surface tension are the properties of a static fluid. Deformation under shear force is the reason for the fluid flow to occur.

1.12 (d)

Pressure intensity at any point in liquid

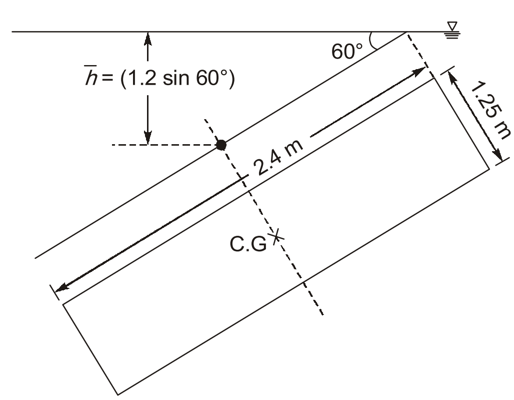
$$p = \rho g h = wh$$

w = weight density of liquid

1.13 (d)

Ideal fluid is the one that is frictionless and incompressible and having zero surface tension.

1.14 (b)



Given, relative density of liquid = 0.85

∴ Density of liquid (ρ) = 0.85 × 1000 = 850 kg/m^3

$$\bar{h} = 1.2 \sin 60° = 1.04 \text{ m}$$

Hydrostatic pressure force on one side of plate

$$F = \text{Pressure at C.G. of plate} \times A_{plate}$$

$$= \rho g\bar{h} \times A$$
$$= 850 \times 9.81 \times 1.04 \times 1.25 \times 2.4$$
$$= 26016.12 \text{ N}$$
$$= 26.01 \text{ kN} \simeq 26 \text{ kN}$$

1.15 (d)

Specific gravity of liquid

$$= \frac{\text{density of liquid}}{\text{density of pure water}}$$

$$= \frac{\text{specific weight of liquid}}{\text{specific weightof pure water}}$$

1.16 (c)

Bulk modulus of liquid (k):

$$k = \frac{\text{change in pressure}}{\text{volumetric strain}}$$

$$= -\frac{dP}{\left(\frac{dV}{V}\right)}$$

–ve sign indicates that volume of liquid decreases as pressure increases.

1.17 (b)

As per Archimedes principle buoyant force is equal to the weight of liquid displaced.

1.18 (b)

Manometer: Manometer is defined as the devices used for measuring the pressure at a point in a fluid by balancing the column of a fluid by the same or another column of the fluid, they are classified as:

(i) **Simple manometer** used to measure pressure at a point.

(ii) **Differential manometers** used to measure pressure difference between two points.

1.19 (c)

- Capillary effect is a consequence of surface tension and adhesion.
- Capillary is defined as phenomenon of rise or fall of a liquid surface in a small tube relative to the adjacent general level of liquid when the tube is held vertically in the liquid.

1.20 (b)

Pressure is terms of metres of oil $= \frac{4.5}{0.9} = 5$ m

1.21 (d)

- Capillary effect is a consequence of surface tension and adhesion.
- Capillary is defined as phenomenon of rise or fall of a liquid surface in a small tube relative to the adjacent general level of liquid when the tube is held vertically in the liquid.

1.22 (d)

Specific gravity is the ratio of the density of a substance to the density of a reference substance. Therefore it is dimensionless.

1.23 (c)

Total energy line = Pressure head (p/γ) + Velocity head ($v^2/2g$) + Elevation head (h)

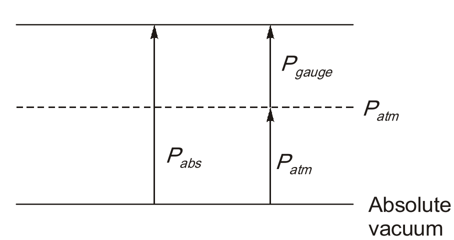
Hydraulic grade line = Pressure head (p/γ) + Elevation head (h)

Velocity head ($v^2/2g$) = Total energy line – Hydraulic grade line

1.24 (a)

Ideal fluid is the one that is frictionless and incompressible and having zero surface tension.

1.25 (b)



$$P_{gauge} = P_{abs} - P_{atm}$$
$$P_{atm} = P_{abs} - P_{gauge}$$

1.26 (a)

With increase in temperature, the viscosity of air increases because the number of collisions increases and the viscosity of water decreases because the cohesion decreases.

1.27 (a)

The stability of a floating body is determined from the position of metacenter.

• M above G • BM > BG • GM = BM – BG > 0	Stable equilibrium
• M below G • BM < BG • GM = BM – BG < 0	Unstable equilibrium
• M at G • GM = 0	Natural equilibrium

1.28 (d)

The pressure at a depth '*h*' in a fluid is given as,

$$P = \rho h(g \pm a)$$

+ → where '*a*' is upward

– → where '*a*' is downward

Given that the vessel is accelerated upward with an acceleration of $a = \frac{g}{2}$.

∴ Pressure at bottom of vessel

$$= \rho h\left(g + \frac{g}{2}\right)$$

$$= \frac{3}{2}\rho gh = \frac{3}{2}\gamma h$$

1.29 (c)

- The resultant force exerted on a body by a static fluid in which the body is submerged or floating is called the buoyant force.
- Point of application of this force is at the C.G. of displaced liquid and it is called as centre of buoyancy.

1.30 (a)

The surface tension of a liquid results from an imbalance of intermolecular attractive forces, the cohesive forces between molecules: A molecule in the bulk liquid experiences cohesive forces with other molecules in all directions. A molecule at the surface of a liquid experiences only net inward cohesive forces.

1.31 (b)

The pressure in meters of oil is given by

$$P_{oil} = P_{water}/\gamma_{oil}$$

$$P_{oil} = 42.5/0.85 = 50 \text{ m}$$

1.32 (a)

Given,

Specific gravity = 1.3

∴ Density of fluid, ρ = 1.3 × Density of water

$= 1.3 \times 1000 \text{ kg/m}^3$

$= 1300 \text{ kg/m}^3$

Dynamic viscosity, $\mu = 0.0034 \text{ Ns/m}^2$

∴ Kinematic viscosity,

$\nu = \mu/\rho = 0.0034/1300$

$= 2.6 \times 10^{-6} \text{ m}^2/\text{s}$

1.33 (b)

- The resultant force exerted on a body by a static fluid in which the body is submerged or floating is called the buoyant force.
- Point of application of this force is at the C.G. of displaced liquid and it is called as centre of buoyancy.

1.34 (c)

$$h_{c.p.} = \bar{h} + \frac{I_{GG}}{A\bar{h}}\sin^2\theta$$

$$h_{c.p.} > \bar{h}$$

1.35 (b)

The stability of a floating body is determined from the position of metacenter.

• M above G • BM > BG • GM = BM – BG > 0	Stable equilibrium
• M below G • BM < BG • GM = BM – BG < 0	Unstable equilibrium
• M at G • GM = 0	Natural equilibrium

1.36 (a)

Consider, specific gravity of air = 1.225

Let specific gravity of liquid *B* is '*G*'.

$$\left(\frac{P_A}{\gamma_\omega} + (3.2-2.743)\times 1.6 - (3.429-2.743) \times 1.225 + (3.429-3.048)\cdot G\right) = 0$$

[∵ Point F is atmospheric]

$$\Rightarrow \quad \frac{-10.89}{9.81} + 0.7312 - 0.84035 + 0.381G = 0$$

$$\Rightarrow \quad G \simeq 1$$

1.37 (b)

If the strength of the adhesive forces (adhesion between fluid and glass) are larger than the strength of the cohesive forces (adhesion between molecules of fluid), this results in the rise and concave formation of water in the capillary tube; this is known as capillary attraction. Alternatively for mercury, the cohesive forces are stronger than the adhesive forces which allows the meniscus to dip and bend away from the walls of the capillary tube. This is known as capillary repulsion.

1.38 (d)

Given,

Weight of body = 7.5 kg

Volume of body = 0.01 m^3

For complete submergence.

Volume of body = Volume of liquid displaced = 0.01 m^3

By law of Buoyancy,

Weight of body = Weight of liquid displaced.

$$\Rightarrow \quad 7.5 \text{ kg} = G\gamma_\omega \times V$$

$$\Rightarrow \quad 7.5 \text{ kg} = G \times 1000 \text{ kg/m}^3 \times 0.01 \text{ m}^3$$

$$\Rightarrow \quad G = 0.75$$

1.39 (c)

Given, $d_1 = 1$ mm, $d_2 = 0.2$ mm

$h_1 = 3$ cm = 30 mm

For capillarity, $h = \dfrac{4\sigma\cos\theta}{\gamma d}$

∵ σ, θ and γ are constant for water.

$$\therefore \quad h \propto \frac{1}{d}$$

$$\Rightarrow \quad \frac{h_2}{h_1} = \frac{d_1}{d_2}$$

$$\Rightarrow \quad \frac{h_2}{30} = \frac{1}{0.2}$$

$$\Rightarrow \quad h_2 = \frac{30}{0.2} \text{ mm} = 150 \text{ mm} = 15 \text{ cm}$$

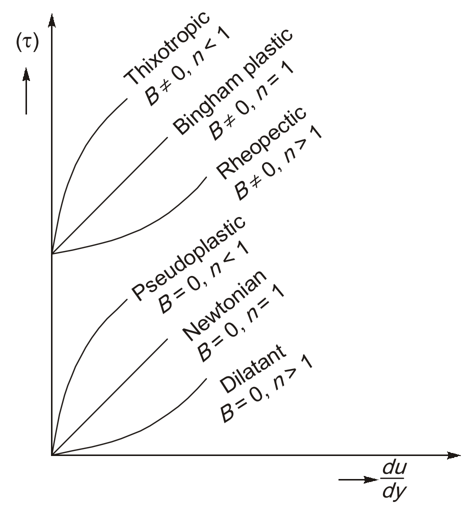
1.40 (d)

The normal stress is the same in all directions at a point in a fluid when the fluid is at rest, regardless of its nature, i.e. there is no relative motion of one layer of fluid relative to the other.

1.41 (b)

General relationship between stress and velocity gradient for a fluid flow is:

$$\tau = A\left(\frac{du}{dy}\right)^n + B$$



Type of fluid	Example
Newtonian fluid	H_2O, Air, Petrol, Hg, Kerosene etc.
Thixotropic	Printer's ink, ketch up, Certain paints & Enamels.
Bingham plastic	Tooth paste, Sewage sludge, Drilling mud
Rheopectic	Gypsum paste, Lubricants
Pseudoplastic	Blood, milk, paper pulp, syrup
Dillatant	Solution with suspended starch or sand saucer in water

1.42 (d)

Alcohol is used in manometer because it can provide longer length for a given pressure difference. So to measure very small pressure difference, alcohol is generally preferred in manometer.

1.43 (d)

Viscosity: When the two adjacent layer of the fluid are in relative motion they resist the motion of each other such a fundamental property of fluid is known as viscosity.

1.44 (a)

$$\text{Kinematic viscosity} = \frac{\text{Dynamic viscosity}}{\text{Density}}$$

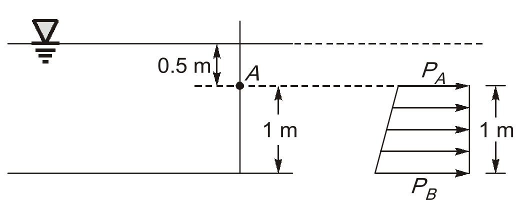
$$\Rightarrow \quad \nu = \frac{\mu}{\rho}$$

$$\therefore \quad \text{Unit of } \nu = \frac{Ns/m^2}{kg/m^3} = \frac{kg.m/s^2 \times s/m^2}{kg/m^3}$$

$[1 \text{ N} = 1 \text{ kgm/s}_2]$

$$= m^2/s$$

1.45 (d)



$$P_A = \gamma_\omega h = 1000 \text{ kg/m}^3 \times 0.5 \text{ m}$$
$$= 500 \text{ kg/m}^2$$
$$P_B = 1000 \text{ kg/m}^3 \times 1.5 \text{ m}$$
$$= 1500 \text{ kg/m}^2$$

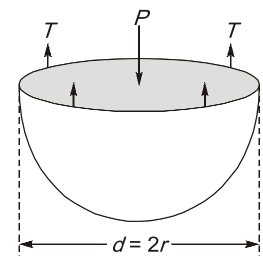
Total pressure force = (Area of pressure diag.) × (inside width)

$$F = \frac{(500 + 1500)}{2} \times (1 \times 2)$$
$$= 2000 \text{ kg}$$

1.46 (a)

Metacentric height is the distance between metacenter and centre of gravity of body.

1.47 (d)



Pressure 'P' acts on the surface at surface tension 'T' acts on the circumference.

∴ By equilibrium of forces.

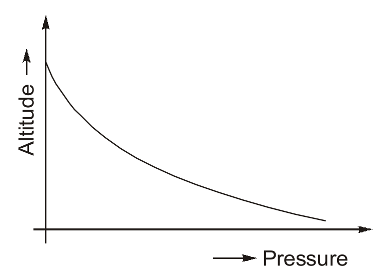
$$P \times \pi r^2 = T \times 2\pi r$$

$$\Rightarrow \quad P = \frac{2T}{r}$$

1.48 (c)

Viscosity: When the two adjacent layer of the fluid are in relative motion they resist the motion of each other such a fundamental property of fluid is known as viscosity.

1.49 (b)



It can be seen that atmospheric pressure with rise in altitude decreases slowly an sleeply.

1.50 (b)

Barometer is used to measure atmospheric pressure.

1.51 (d)

If the combined effect of all the forces acting on a body is zero and the body is in the state of rest then its equilibrium is termed as static equilibrium.

1.52 (b)

According to Newton's law of viscosity, Shear stress of a fluid is directly proportional to the rate of shear strain.