GATE AE Practice Paper 2024 (CollegeDekho)

Q1) The region of highest static temperature in a rocket engine and the region of highest heat flux are ____________, respectively.
(A) Nozzle throat and nozzle entry
(B) Combustion chamber and nozzle throat
(C) Nozzle exit and nozzle throat
(D) Nozzle throat and combustion chamber

Q2) Q.26 NACA 2412 airfoil has
(A) 4% maximum camber with respect to chord
(B) Maximum camber at 40% chord
(C) 12% maximum thickness to chord ratio
(D) Maximum camber at 20% chord

Q3) Q.30 A high-pressure-ratio multistage axial compressor encounters an extreme loading mismatch during starting. Which of the following technique(s) can be used to alleviate this problem?
(A) Blade cooling
(B) Variable angle stator vanes
(C) Blow-off valves
(D) Multi-spool shaft

Q4) For a given chamber pressure, the thrust of a rocket engine is highest when
(A) the rocket is operating at its design altitude.
(B) the rocket is operating in vacuum.
(C) the rocket is operating at sea-level.
(D) there is a normal shock in the rocket nozzle

Q5) The load factor of an aircraft turning at a constant altitude is 2. The coefficient of lift required for turning flight as compared to level flight at the same speed will be

(A) Same
(B) Half
(C) Double
(D) Four times

Q6) Consider the following system of linear equations:
$2x - y + z = 1$
$3x - 3y + 4z = 6$
$x - 2y + 3z = 4$
This system of linear equations has
(A) No solution.
(B) One solution.
(C) Two solutions.
(D) Three solution

Q7) Q.45 A wall of thickness 5 mm is heated by a hot gas flowing along the wall. The gas is at a temperature of 3000 K, and the convective heat transfer coefficient is 160 W/m^2K. The wall thermal conductivity is 40 W/mK. If the colder side of the wall is held at 500 K, the temperature of the side exposed to the hot gas is _______ K

Q8) An aircraft weighing 10000 N is flying level at 100 m/s and it is powered by a jet engine. The thrust required for level flight is 1000 N. The maximum possible thrust produced by the jet engine is 5000 N. The minimum time required to climb 1000 m, when flight speed is 100 m/s, is ________s.

Q9) A jet engine is operating at a Mach number of 0.8 at an altitude of 10 km. The efficiency of the air intake is 0.8 and that of the compressor is 0.87. The total temperatures (in K) at the exits of the air intake and the compressor respectively are (Ambient pressure = 26.5 kPa; Ambient temperature = 223.3 K; Gas constant, y = 1.4; P_{rc} = 8)
(A) 251.9 and 458.2
(B) 234.9 and 486.8
(C) 251.9 and 486.8

(D) 234.9 and 458.2

Q10) An aircraft in a steady level flight at forward speed of 50 m/s suddenly rolls by 180^{o} and becomes inverted. If no other changes are made to the configuration or controls of the aircraft, the nature of the subsequent flight path taken by the aircraft and its characteristic parameter(s) (assume g = 9.81 ms^{-2}) are

(A) Straight line path with a speed of 50 m/s

(B) Upward circular path with a speed of 50 m/s and radius of 127.4 m

(C) Downward circular path with a speed of 50 m/s and radius of 127.4 m/s

(D) Downward circular path with a speed of 25 m/s and radius of 254.8 m/s

Q11) An aircraft with a mass of 5000 kg takes off from sea level with a forward speed of 50 m/s and starts to climb with a climb angle of 15^{o}. The rate of climb and excess thrust available at the start of the climb respectively (assume g = 9.81 ms^{-2}) are

(A) 13.40 m/s and 13146.0 N

(B) 12.94 m/s and 12694.1 N

(C) 13.40 m/s and 12694.1 N

(D) 12.94 m/s and 13146.0 N

Q12) An elliptic orbit has its perigee at 400 km above the Earth's surface and apogee at 3400 km above the Earth's surface. For this orbit, the eccentricity and semi-major axis respectively are (assume radius of Earth = 6400 km)

(A) 0.18 and 8300 km

(B) 0.18 and 1900 km

(C) 0.22 and 8300 km

(D) 0.22 and 1900 km

Q13) In the context of Prandtl's lifting line theory for a finite wing, which of the following combinations of statements is TRUE?

P: The bound vortex is responsible for the lift force

Q: The trailing vortices are responsible for the induced drag

R: The bound vortex is responsible for the induced drag

S: The trailing vortices are responsible for the lift force

(A) P,Q

(B) Q,R
(C) R,S
(D) P,S

Q14) Which of the following functions is periodic?
(A) $f(x) = x^2$
(B) $f(x) = \log(x)$
(C) $f(x) = e^x$
(D) $f(x) = const$

Q15) An Euler-Bernoulli beam in bending is assumed to satisfy
(A) Both plane stress as well as plane strain conditions
(B) Plane strain condition but not plane stress condition
(C) Plane stress condition but not plane strain condition
(D) Neither plane strain condition nor plane stress condition

Q16) Consider a single degree of freedom spring-mass system of spring stiffness and mass which has a natural frequency of 10 rad/s. Consider another single degree of freedom spring-mass system of spring stiffness and mass which has a natural frequency of 20 rad/s. The spring stiffness is equal to
(A) k_1
(B) $2k_1$
(C) $k_1/4$
(D) $4k_1$

Q17) A statically indeterminate frame structure has
(A) Same number of joint degrees of freedom as the number of equilibrium equations
(B) Number of joint degrees of freedom greater than the number of equilibrium equations
(C) Number of joint degrees of freedom less than the number of equilibrium equations
(D) Unknown number of joint degrees of freedom, which cannot be solved using laws of mechanics

Q18) In an unpowered glide of an aircraft having weight W, lift L and drag D, the equilibrium glide angle is defined as
(A) $\tan^{-1}(L/D)$
(B) $\tan^{-1}(D/L)$
(C) $\tan^{-1}(L/W)$
(D) $\tan^{-1}(W/L)$

Q19) Thermodynamic cycle on which the jet engine operates can be
(A) Open Rankine cycle only
(B) Either open or closed Rankine cycle
(C) Open Brayton cycle only
(D) Either open or closed Brayton cycle

Q20) It is seen that the drag polar of a certain aerofoil is symmetric about the C_d axis. This drag polar could refer to
(A) NACA 0012
(B) NACA 4415
(C) NACA 23012
(D) None of the above

Q21) Lift on an aircraft climbing vertically up is
(A) Equal to its weight
(B) Zero
(C) Equal to the drag
(D) Equal to the thrust

Q22) Propulsion efficiency of a jet engine is
(A) Directly proportional to both the thrust power and the air mass flow rate
(B) Inversely proportional to both the thrust power and the air mass flow rate
(C) Directly proportional to the thrust power and inversely proportional to the air mass flow rate
(D) Inversely proportional to the thrust power and directly proportional to the air mass flow rate

Q23) The pressure ratio in any one stage of a jet engine compressor is limited by
(A) Entry stagnation temperature in that stage
(B) Entry Mach number in that stage
(C) Pressure gradient induced separation in that stage
(D) Mass flow rate in that stage

Q24) In three-dimensional linear elastic solids, the number of non-trivial stress-strain relations, strain-displacement equations and equations of equilibrium are, respectively,
(A) 3, 3 and 3
(B) 6, 3 and 3
(C) 6, 6 and 3
(D) 6, 3 and 6

Q25) For an aeroplane to be statically stable, its centre of gravity must always be
(A) Ahead of wing aerodynamic centre
(B) aft of the wing aerodynamic centre
(C) Ahead of neutral point
(D) aft of neutral point

Q26) If an aircraft is performing a positive yawing manoeuvre, the side slip angle
(A) Is always zero
(B) Is never zero
(C) Is always negative
(D) Could be any value

Q27) The general solution of the differential equation $d^2y/dt^2 + dy/dt - 2y = 0$ is
(A) $Ae^{-1} + Be^{2t}$
(B) $Ae^{-2t} + Be^{-1}$
(C) $Ae^{-2t} + Be^{1}$
(D) $Ae^{1} + Be^{2t}$

Q28) For a symmetric airfoil, the lift coefficient for zero degree angle of attack is
(A) – 1.0

(B) 0.0
(C) 0.5
(D) 1.0

Q29) The Hohmann ellipse used as earth-Mars transfer orbit has
(A) Apogee at earth and perigee at Mars
(B) Both apogee and perigee at earth
(C) Apogee at Mars and perigee at earth
(D) Both apogee and perigee at Mars

Q30) During the ground roll manoeuvre of an aircraft, the force(s) acting on it parallel to the direction of motion
(A) Is thrust alone
(B) Is drag alone
(C) Are both thrust and drag
(D) Are thrust, drag and a part of both weight and lift

Q31) A rocket is to be launched from the bottom of a very deep crater on Mars for earth return. The specific impulse of the rocket, measured in seconds, is to be normalised by the acceleration due to gravity at
(A) The bottom of the crater on Mars
(B) Mars standard “sea level”
(C) Earth’s standard sea level
(D) The same depth of the crater on earth

Q32) An aircraft has a steady rate of climb of 300 m/s at sea level and 150 m/s at 2500 m altitude. The time taken (in sec) for this aircraft to climb from 500 m altitude to 3000 m altitude is ____.

Q33) In an aircraft, elevator control effectiveness determines
(A) Turn radius
(B) Rate of climb
(C) Forward-most location of the centre of gravity
(D) aft-most location of the centre of gravity

Q34) The Mach angle for a flow at Mach 2.0 is
(A) 30°
(B) 45°
(C) 60°
(D) 90°

Q35) An aircraft in a steady climb suddenly experiences a 10% drop in thrust. After a new equilibrium is
reached at the same speed, the new rate of climb is
(A) lower by exactly 10%
(B) lower by more than 10%.
(C) lower by less than 10%
(D) an unpredictable quantity.

Q36) An aircraft is trimmed straight and level at true air speed (TAS) of 100 m/s at standard sea level (SSL). Further, pull of 5 N holds the speed at 90 m/s without re-trimming at SSL (air density = 1.22 kg/m^3). To fly at 3000 m altitude (air density = 0.91 kg/m^3) and 120 m/s TAS without re-trimming, the aircraft needs
(A) 1.95 N upward force
(B) 1.95 N downward force
(C) 1.85 N upward force
(D) 1.75 N downward force

Q37) Buckling of the fuselage skin can be delayed by
(A) increasing internal pressure
(B) placing stiffeners farther apart
(C) reducing skin thickness
(D) placing stiffeners farther and decreasing internal pressure

Q38) A rocket motor has combustion chamber temperature of 2600 K and the products have molecular weight of 25 g/mol and ratio of specific heats 1.2. The universal gas constant is 8314 J/kg-mole-K. The value of theoretical c* (in m/s) is ____.

Q39) The logarithmic decrement measured for a viscously damped single degree of freedom system is 0.125. The value of the damping factor in % is closest to
(A) 0.5
(B) 1.0
(C) 1.5
(D) 2.0

Q40) The ratio of flight speed to the exhaust velocity for maximum propulsion efficiency is
(A) 0.0
(B) 0.5
(C) 1.0
(D) 2.0