

✈ ETIHAD AIRWAYS PILOT APTITUDE TEST

PHYSICS & SCIENCE — PRACTICE PAPER

COMPASS System | 50 Questions | Time Allowed: 40 Minutes | No Calculator Permitted

INSTRUCTIONS

- 1. This paper contains 50 questions across 10 physics and science topics tested in the Etihad Airways COMPASS pilot aptitude assessment.
- 2. Select the one best answer from the four options (A, B, C, D) for each question.
- 3. No calculator is permitted. All calculations must be performed mentally or on rough paper.
- 4. Time allowed is 40 minutes. Aim to spend no more than 48 seconds per question.
- 5. Attempt all questions. There is no negative marking.
- 6. A full Answer Key with Explanations is provided at the end of this paper.

SECTION 1: Mechanics & Newton's Laws

Q1. Which of Newton's laws states that for every action, there is an equal and opposite reaction?

- A) Newton's First Law
- B) Newton's Second Law
- C) Newton's Third Law
- D) Law of Universal Gravitation

Q2. An aircraft of mass 60,000 kg accelerates at 2 m/s^2 . What is the net force acting on it?

- A) 30,000 N
- B) 60,000 N
- C) 120,000 N
- D) 240,000 N

Q3. What is the SI unit of force?

- A) Joule
- B) Watt
- C) Newton
- D) Pascal



Q4. Which force opposes the forward motion of an aircraft through the air?

- A) Lift
- B) Thrust
- C) Weight
- D) Drag

Q5. If an object is moving at a constant velocity in a straight line, what is the net force acting on it?

- A) Zero
- B) Equal to its weight
- C) Equal to its mass
- D) Increasing

SECTION 2: Work, Energy & Power

Q6. What type of energy does an aircraft possess due to its altitude?

- A) Kinetic Energy
- B) Potential Energy
- C) Thermal Energy
- D) Chemical Energy

Q7. Calculate the work done when a force of 500 N moves an object 10 metres in the direction of the force.

- A) 50 J
- B) 500 J
- C) 5,000 J
- D) 50,000 J

Q8. Power is defined as:

- A) Force $\times$ Distance
- B) Mass $\times$ Acceleration
- C) Work done $\div$ Time
- D) Energy $\times$ Time



Q9. If the velocity of an aircraft is doubled, its kinetic energy will:

- A) Double
- B) Halve
- C) Quadruple
- D) Remain the same

Q10. The First Law of Thermodynamics states that:

- A) Entropy always increases
- B) Energy cannot be created or destroyed
- C) Heat flows from cold to hot
- D) Absolute zero is unattainable

SECTION 3: Fluid Dynamics & Aerodynamics

Q11. According to Bernoulli's principle, as the velocity of a fluid increases, its pressure:

- A) Increases
- B) Decreases
- C) Remains constant
- D) Fluctuates

Q12. The shape of an aircraft wing, designed to generate lift, is called an:

- A) Airfoil (Aerofoil)
- B) Empennage
- C) Fuselage
- D) Aileron

Q13. What happens to atmospheric pressure as altitude increases?

- A) It increases linearly
- B) It increases exponentially
- C) It decreases
- D) It remains constant



Q14. Which of the following is NOT a type of aerodynamic drag?

- A) Parasitic drag
- B) Induced drag
- C) Wave drag
- D) Magnetic drag

Q15. Archimedes' principle applies to:

- A) Buoyancy
- B) Electricity
- C) Magnetism
- D) Optics

SECTION 4: Gas Laws & Thermodynamics

Q16. Boyle's Law states that for a fixed mass of gas at a constant temperature:

- A) Volume is directly proportional to pressure
- B) Volume is inversely proportional to pressure
- C) Pressure is directly proportional to temperature
- D) Volume is directly proportional to temperature

Q17. Which law explains why aircraft tyre pressure increases after landing due to heat?

- A) Boyle's Law
- B) Charles's Law
- C) Gay-Lussac's Law
- D) Dalton's Law

Q18. Dalton's Law relates to:

- A) Partial pressures of gas mixtures
- B) Thermal expansion of solids
- C) Electrical resistance
- D) Refraction of light



Q19. Heat transfer through a solid material is called:

- A) Convection
- B) Radiation
- C) Conduction
- D) Insulation

Q20. Absolute zero is equivalent to:

- A) 0°C
- B) -100°C
- C) -273.15°C
- D) -459.67°C

SECTION 5: Electricity & Magnetism

Q21. Ohm's Law is expressed by the formula:

- A) $V = I / R$
- B) $V = I \times R$
- C) $P = V \times I$
- D) $R = V \times I$

Q22. In a parallel electrical circuit, if one component fails:

- A) The entire circuit stops working
- B) The voltage across other components increases
- C) The other components continue to work
- D) The resistance of the circuit becomes zero

Q23. What is the unit of electrical resistance?

- A) Ampere
- B) Volt
- C) Ohm
- D) Watt



Q24. A device that converts mechanical energy into electrical energy is a:

- A) Motor
- B) Generator
- C) Transformer
- D) Battery

Q25. The magnetic compass in an aircraft points to:

- A) True North
- B) Magnetic North
- C) Grid North
- D) Relative North

SECTION 6: Waves, Sound & Optics

Q26. Sound travels fastest in which of the following mediums?

- A) Air
- B) Water
- C) Steel
- D) Vacuum

Q27. The change in frequency of a wave in relation to an observer who is moving relative to the wave source is called:

- A) The Bernoulli Effect
- B) The Doppler Effect
- C) The Coriolis Effect
- D) The Faraday Effect

Q28. Which electromagnetic waves have the longest wavelength?

- A) Gamma rays
- B) X-rays
- C) Visible light
- D) Radio waves



Q29. The bending of light as it passes from one medium to another of different density is called:

- A) Reflection
- B) Refraction
- C) Diffraction
- D) Dispersion

Q30. What is the speed of light in a vacuum?

- A) 300,000 km/s
- B) 340 m/s
- C) 150,000 km/s
- D) 1,000,000 km/s

SECTION 7: Mechanics & Circular Motion

Q31. The force that keeps an object moving in a circular path and is directed towards the centre of the circle is:

- A) Centrifugal force
- B) Centripetal force
- C) Gravitational force
- D) Frictional force

Q32. Momentum is defined as:

- A) Mass $\times$ Velocity
- B) Mass $\times$ Acceleration
- C) Force $\times$ Time
- D) Work $\div$ Time

Q33. In an elastic collision between two objects:

- A) Only momentum is conserved
- B) Only kinetic energy is conserved
- C) Both momentum and kinetic energy are conserved
- D) Neither is conserved



Q34. Torque is best described as:

- A) Linear force
- B) Rotational force
- C) Centripetal acceleration
- D) Angular momentum

Q35. The tendency of an object to resist changes in its state of motion is called:

- A) Gravity
- B) Friction
- C) Inertia
- D) Acceleration

SECTION 8: Properties of Matter

Q36. Density is defined as:

- A) $\text{Mass} \times \text{Volume}$
- B) $\text{Weight} \div \text{Volume}$
- C) $\text{Mass} \div \text{Volume}$
- D) $\text{Volume} \div \text{Mass}$

Q37. Hooke's Law relates to:

- A) Fluid pressure
- B) Electrical circuits
- C) Elasticity of springs
- D) Gas expansion

Q38. Pascal's principle states that pressure applied to an enclosed fluid is:

- A) Diminished as it travels
- B) Transmitted undiminished to every part of the fluid
- C) Converted into heat
- D) Dependent on the shape of the container



Q39. The temperature at which a liquid turns into a gas is its:

- A) Melting point
- B) Freezing point
- C) Boiling point
- D) Dew point

Q40. Which state of matter has a definite volume but no definite shape?

- A) Solid
- B) Liquid
- C) Gas
- D) Plasma

SECTION 9: Aviation Science Applications

Q41. Why do high-altitude runways require longer takeoff distances?

- A) Gravity is stronger
- B) Air density is lower
- C) Air temperature is higher
- D) Engine thrust increases

Q42. The Pitot-static system on an aircraft measures:

- A) Engine temperature
- B) Fuel flow
- C) Dynamic and static air pressure
- D) Electrical voltage

Q43. What is the primary purpose of an aircraft's flaps?

- A) To increase lift and drag during takeoff and landing
- B) To steer the aircraft left or right
- C) To slow the aircraft down in flight
- D) To increase fuel efficiency



Q44. In a jet engine, what is the function of the compressor?

- A) To ignite the fuel
- B) To mix fuel and air
- C) To increase the pressure of incoming air
- D) To extract energy from the exhaust

Q45. The Mach number is the ratio of the aircraft's speed to:

- A) The speed of light
- B) The speed of sound in the surrounding air
- C) The stall speed
- D) The speed of the wind

SECTION 10: General Science & Calculations

Q46. If a 12V battery is connected to a 4Ω resistor, what is the current flowing through the circuit?

- A) 2 A
- B) 3 A
- C) 4 A
- D) 48 A

Q47. A lever has a load of 100 N at a distance of 2 m from the fulcrum. What effort force must be applied at a distance of 4 m on the other side to balance it?

- A) 25 N
- B) 50 N
- C) 100 N
- D) 200 N

Q48. What is the mechanical advantage of a pulley system that lifts a 600 N load using an effort of 150 N?

- A) 2
- B) 3
- C) 4
- D) 5

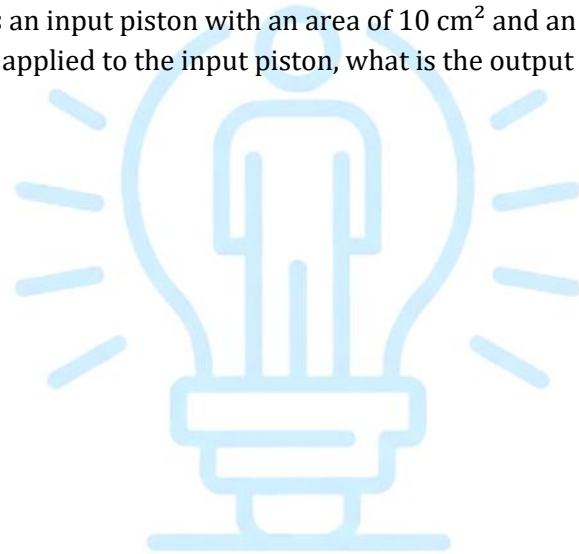


Q49. An object falls freely from rest. Ignoring air resistance, what is its velocity after 3 seconds? ($g \approx 9.8 \text{ m/s}^2$)

- A) 9.8 m/s
- B) 19.6 m/s
- C) 29.4 m/s
- D) 44.1 m/s

Q50. A hydraulic system has an input piston with an area of 10 cm^2 and an output piston with an area of 100 cm^2 . If a force of 50 N is applied to the input piston, what is the output force?

- A) 5 N
- B) 50 N
- C) 500 N
- D) 5,000 N



AURA

Tutorial



ANSWER KEY & EXPLANATIONS

SECTION 1: Mechanics & Newton's Laws

Q1. Which of Newton's laws states that for every action, there is an equal and opposite reaction?

✓ **Correct Answer: C) Newton's Third Law**

Explanation: Newton's Third Law of Motion states that for every action, there is an equal and opposite reaction. This is the fundamental principle behind jet propulsion.

Q2. An aircraft of mass 60,000 kg accelerates at 2 m/s^2 . What is the net force acting on it?

✓ **Correct Answer: C) 120,000 N**

Explanation: Force = mass $\times$ acceleration ($F = ma$). $F = 60,000 \text{ kg} \times 2 \text{ m/s}^2 = 120,000 \text{ N}$.

Q3. What is the SI unit of force?

✓ **Correct Answer: C) Newton**

Explanation: The SI unit of force is the Newton (N), defined as the force required to accelerate a 1 kg mass by 1 m/s^2 .

Q4. Which force opposes the forward motion of an aircraft through the air?

✓ **Correct Answer: D) Drag**

Explanation: Drag is the aerodynamic force that opposes an aircraft's motion through the air. Thrust opposes drag.

Q5. If an object is moving at a constant velocity in a straight line, what is the net force acting on it?

✓ **Correct Answer: A) Zero**

Explanation: According to Newton's First Law, an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force. Constant velocity means zero acceleration, hence zero net force.

SECTION 2: Work, Energy & Power

Q6. What type of energy does an aircraft possess due to its altitude?

✓ Correct Answer: B) Potential Energy

Explanation: Gravitational potential energy is the energy an object possesses due to its position in a gravitational field (altitude).

Q7. Calculate the work done when a force of 500 N moves an object 10 metres in the direction of the force.

✓ Correct Answer: C) 5,000 J

Explanation: Work = Force $\times$ Distance. $W = 500 \text{ N} \times 10 \text{ m} = 5,000 \text{ Joules (J)}$.

Q8. Power is defined as:

✓ Correct Answer: C) Work done $\div$ Time

Explanation: Power is the rate at which work is done or energy is transferred. $P = W/t$.

Q9. If the velocity of an aircraft is doubled, its kinetic energy will:

✓ Correct Answer: C) Quadruple

Explanation: Kinetic Energy = $\frac{1}{2}mv^2$. Since velocity (v) is squared, doubling the velocity increases the kinetic energy by a factor of $2^2 = 4$.

Q10. The First Law of Thermodynamics states that:

✓ Correct Answer: B) Energy cannot be created or destroyed

Explanation: The First Law of Thermodynamics is the law of conservation of energy: energy can be transformed from one form to another, but cannot be created or destroyed.

SECTION 3: Fluid Dynamics & Aerodynamics

Q11. According to Bernoulli's principle, as the velocity of a fluid increases, its pressure:

✓ Correct Answer: B) Decreases

Explanation: Bernoulli's principle states that an increase in the speed of a fluid occurs simultaneously with a decrease in static pressure. This is a key principle in generating lift.

Q12. The shape of an aircraft wing, designed to generate lift, is called an:

✓ **Correct Answer: A) Airfoil (Aerofoil)**

Explanation: An airfoil is a cross-sectional shape designed to generate lift when air flows over it.

Q13. What happens to atmospheric pressure as altitude increases?

✓ **Correct Answer: C) It decreases**

Explanation: Atmospheric pressure decreases with altitude because there is less weight of air above pushing down.

Q14. Which of the following is NOT a type of aerodynamic drag?

✓ **Correct Answer: D) Magnetic drag**

Explanation: Magnetic drag is not an aerodynamic force. The main types of aerodynamic drag are parasitic (form, skin friction, interference), induced (lift-related), and wave drag (supersonic).

Q15. Archimedes' principle applies to:

✓ **Correct Answer: A) Buoyancy**

Explanation: Archimedes' principle states that the upward buoyant force exerted on a body immersed in a fluid is equal to the weight of the fluid that the body displaces.

SECTION 4: Gas Laws & Thermodynamics

Q16. Boyle's Law states that for a fixed mass of gas at a constant temperature:

✓ **Correct Answer: B) Volume is inversely proportional to pressure**

Explanation: Boyle's Law: $P_1V_1 = P_2V_2$. Pressure and volume are inversely proportional when temperature is constant.

Q17. Which law explains why aircraft tyre pressure increases after landing due to heat?

✓ **Correct Answer: C) Gay-Lussac's Law**

Explanation: Gay-Lussac's Law states that the pressure of a fixed mass of gas is directly proportional to its absolute temperature, provided the volume remains constant.

Q18. Dalton's Law relates to:

✓ **Correct Answer: A) Partial pressures of gas mixtures**

Explanation: Dalton's Law states that in a mixture of non-reacting gases, the total pressure exerted is equal to the sum of the partial pressures of the individual gases. This is crucial for understanding oxygen requirements at altitude.

Q19. Heat transfer through a solid material is called:

✓ **Correct Answer: C) Conduction**

Explanation: Conduction is the transfer of heat through a material by direct contact of molecules. Convection is through fluids, and radiation is through electromagnetic waves.

Q20. Absolute zero is equivalent to:

✓ **Correct Answer: C) -273.15°C**

Explanation: Absolute zero is 0 Kelvin, which is exactly -273.15° Celsius.

SECTION 5: Electricity & Magnetism

Q21. Ohm's Law is expressed by the formula:

✓ **Correct Answer: B) $V = I \times R$**

Explanation: Ohm's Law states that Voltage (V) equals Current (I) multiplied by Resistance (R).

Q22. In a parallel electrical circuit, if one component fails:

✓ **Correct Answer: C) The other components continue to work**

Explanation: In a parallel circuit, each component has its own path to the power source. If one path is broken, current can still flow through the other paths.

Q23. What is the unit of electrical resistance?

✓ **Correct Answer: C) Ohm**

Explanation: The Ohm (Ω) is the SI unit of electrical resistance.

Q24. A device that converts mechanical energy into electrical energy is a:

✓ **Correct Answer: B) Generator**

Explanation: A generator (or alternator) converts mechanical energy into electrical energy. A motor does the reverse.

Q25. The magnetic compass in an aircraft points to:

✓ **Correct Answer: B) Magnetic North**

Explanation: A magnetic compass aligns itself with the Earth's magnetic field, pointing to Magnetic North, which differs from True (geographic) North by the magnetic variation.

SECTION 6: Waves, Sound & Optics

Q26. Sound travels fastest in which of the following mediums?

✓ **Correct Answer: C) Steel**

Explanation: Sound waves are mechanical vibrations that travel faster in denser, more elastic mediums. Sound travels fastest in solids (like steel), slower in liquids, and slowest in gases. It cannot travel in a vacuum.

Q27. The change in frequency of a wave in relation to an observer who is moving relative to the wave source is called:

✓ **Correct Answer: B) The Doppler Effect**

Explanation: The Doppler Effect is the change in frequency or wavelength of a wave in relation to an observer who is moving relative to the wave source (e.g., the changing pitch of a passing siren).

Q28. Which electromagnetic waves have the longest wavelength?

✓ **Correct Answer: D) Radio waves**

Explanation: Radio waves have the longest wavelengths and lowest frequencies in the electromagnetic spectrum. Gamma rays have the shortest wavelengths.

Q29. The bending of light as it passes from one medium to another of different density is called:

✓ **Correct Answer: B) Refraction**

Explanation: Refraction is the bending of a wave when it enters a medium where its speed is different.

Q30. What is the speed of light in a vacuum?

✓ **Correct Answer: A) 300,000 km/s**

Explanation: The speed of light in a vacuum is approximately 3×10^8 m/s, or 300,000 km/s.

SECTION 7: Mechanics & Circular Motion

Q31. The force that keeps an object moving in a circular path and is directed towards the centre of the circle is:

✓ **Correct Answer: B) Centripetal force**

Explanation: Centripetal force is the net force causing uniform circular motion, directed towards the centre. In an aircraft turn, the horizontal component of lift provides this force.

Q32. Momentum is defined as:

✓ **Correct Answer: A) Mass $\times$ Velocity**

Explanation: Momentum (p) is the product of the mass and velocity of an object ($p = mv$).

Q33. In an elastic collision between two objects:

✓ **Correct Answer: C) Both momentum and kinetic energy are conserved**

Explanation: In a perfectly elastic collision, there is no loss of kinetic energy in the system, and momentum is also conserved.

Q34. Torque is best described as:

✓ **Correct Answer: B) Rotational force**

Explanation: Torque is a measure of the force that can cause an object to rotate about an axis. It is the rotational equivalent of linear force.

Q35. The tendency of an object to resist changes in its state of motion is called:

✓ **Correct Answer: C) Inertia**

Explanation: Inertia is the resistance of any physical object to any change in its velocity. This includes changes to the object's speed, or direction of motion.

SECTION 8: Properties of Matter

Q36. Density is defined as:

✓ **Correct Answer: C) Mass ÷ Volume**

Explanation: Density (ρ) is the mass per unit volume of a substance ($\rho = m/V$).

Q37. Hooke's Law relates to:

✓ **Correct Answer: C) Elasticity of springs**

Explanation: Hooke's Law states that the force needed to extend or compress a spring by some distance is proportional to that distance ($F = -kx$).

Q38. Pascal's principle states that pressure applied to an enclosed fluid is:

✓ **Correct Answer: B) Transmitted undiminished to every part of the fluid**

Explanation: Pascal's principle is the basis for hydraulic systems in aircraft. Pressure applied to an enclosed fluid is transmitted equally in all directions.

Q39. The temperature at which a liquid turns into a gas is its:

✓ **Correct Answer: C) Boiling point**

Explanation: The boiling point is the temperature at which the vapor pressure of a liquid equals the external pressure surrounding the liquid.

Q40. Which state of matter has a definite volume but no definite shape?

✓ **Correct Answer: B) Liquid**

Explanation: Liquids have a definite volume but take the shape of their container. Solids have definite shape and volume. Gases have neither.

SECTION 9: Aviation Science Applications

Q41. Why do high-altitude runways require longer takeoff distances?

✓ Correct Answer: B) Air density is lower

Explanation: At high altitudes, air density is lower. This reduces both aerodynamic lift (requiring higher speed to take off) and engine thrust, resulting in longer takeoff rolls.

Q42. The Pitot-static system on an aircraft measures:

✓ Correct Answer: C) Dynamic and static air pressure

Explanation: The Pitot-static system measures total (dynamic + static) pressure and static pressure to determine airspeed, Mach number, altitude, and altitude trend.

Q43. What is the primary purpose of an aircraft's flaps?

✓ Correct Answer: A) To increase lift and drag during takeoff and landing

Explanation: Flaps change the camber (curvature) of the wing, increasing both lift and drag, allowing the aircraft to fly at slower speeds during takeoff and landing.

Q44. In a jet engine, what is the function of the compressor?

✓ Correct Answer: C) To increase the pressure of incoming air

Explanation: The compressor draws in air and compresses it (increasing its pressure and temperature) before it enters the combustion chamber.

Q45. The Mach number is the ratio of the aircraft's speed to:

✓ Correct Answer: B) The speed of sound in the surrounding air

Explanation: Mach number is a dimensionless quantity representing the ratio of flow velocity past a boundary to the local speed of sound.

SECTION 10: General Science & Calculations

Q46. If a 12V battery is connected to a 4Ω resistor, what is the current flowing through the circuit?

✓ **Correct Answer: B) 3 A**

Explanation: Using Ohm's Law ($I = V/R$): $I = 12V / 4\Omega = 3$ Amperes.

Q47. A lever has a load of 100 N at a distance of 2 m from the fulcrum. What effort force must be applied at a distance of 4 m on the other side to balance it?

✓ **Correct Answer: B) 50 N**

*Explanation: Principle of moments: Load $\times$ Load Distance = Effort $\times$ Effort Distance. $100 \times 2 = \text{Effort} \times 4$.
Effort = $200 / 4 = 50$ N.*

Q48. What is the mechanical advantage of a pulley system that lifts a 600 N load using an effort of 150 N?

✓ **Correct Answer: C) 4**

Explanation: Mechanical Advantage = Load / Effort = $600 \text{ N} / 150 \text{ N} = 4$.

Q49. An object falls freely from rest. Ignoring air resistance, what is its velocity after 3 seconds? ($g \approx 9.8 \text{ m/s}^2$)

✓ **Correct Answer: C) 29.4 m/s**

Explanation: $v = u + at$. $v = 0 + (9.8 \times 3) = 29.4 \text{ m/s}$.

Q50. A hydraulic system has an input piston with an area of 10 cm^2 and an output piston with an area of 100 cm^2 . If a force of 50 N is applied to the input piston, what is the output force?

✓ **Correct Answer: C) 500 N**

Explanation: Pressure = Force/Area. $P_{in} = 50/10 = 5 \text{ N/cm}^2$. By Pascal's principle, $P_{out} = P_{in}$. $F_{out} = P_{out} \times \text{Area}_{out} = 5 \times 100 = 500 \text{ N}$.