19 Understanding units

Learning objectives

Study of this chapter will enable the reader to:

1. practice answering short questions from a multiple choice of answers;
2. test own understanding of using units of measurement;
3. prepare for tests, assignments and written examinations where this form of questioning is provided;
4. evaluate why some answers are not entirely correct for the question;
5. have discussions with peers and instructors over the meaning of the incorrect answers;
6. lead into further study and investigation;
7. answer a range of questions relevant to the fifth edition and building services engineering work generally.

Key terms and concepts

acceleration due to gravity 398; atmospheric pressure 398; Celsius 403; density of water 399; electrical units 401; exponential 400; frequency 402; humid air 399; Joule 401; Kelvin 403; Newton 404; pressure 402; pressure drop rate 404; specific heat capacity 398; standard atmosphere 398; Stefan–Boltzmann 399; time 400; volume 404; Watt 401.

Introduction

This is a general knowledge section of questions covering measurement unit topics within the fifth edition and building services engineering generally. All questions should be understood by students of this topic area. There is only one absolutely correct answer to each question. Tackling these may stimulate additional study, discussion, questioning with peers or the instructor.

Questions

1. Which of these equals one standard atmosphere at sea level?

    1. 1.013 tonne/m^2.
    2. 1 bar.
    3. 10 000 N/m^2.
    4. 1013.25 mb.
    5. 10^6 N/m^2.

2. Which of these equals one standard atmosphere at sea level?

    1. 1013 tonne/m^2.
    2. 10^5 bar.
    3. 10^9 N/m^2.
    4. 14.7 lb/in^2.
    5. 10^6 N/m^2.

3. Which of these equals one standard atmosphere at sea level?

    1. 1×10^5 Pa.
    2. 1.01325×10^5 N/m^2.
    3. 1×10^4 N/m^2.
    4. 30 m H_2O.
    5. 1013.25 mm *Hg*.

4. Which of these equals one standard atmosphere at sea level?

    1. 9.807 m H_2O.
    2. 29.35 m H_2O.
    3. 10.3 m H_2O.
    4. 101 325 kJ/m^2.
    5. 1.205 kg/m^2.

5. Which of these is the acceleration due to gravity, *g*?

    1. 10 m/s^2.
    2. 30 ft/s^2.
    3. 186 000 miles/h.
    4. Gravity is static.
    5. 9.807 m/s^2.

6. Which of these describes the acceleration due to gravity, *g*?

    1. Calculated from a 1 kg weight free falling from a height.
    2. Relative to distance from the Moon.
    3. Constantly 9.807 m/s^2.
    4. Varies with height above sea level.
    5. Inversely proportional to depth below sea level.

7. Which is the specific heat capacity of air?

    1. Sensible heat content kJ/kg.
    2. Total heat content kJ/kg.
    3. 1.205 kJ/kg.
    4. 1.012 kJ/kg K.
    5. 4.186 kJ/kg K.

8. Which is the specific heat capacity of air?

    1. Ratio of C_p/C_v.
    2. Cannot be defined.
    3. Varies with atmospheric pressure.
    4. 1.012 kgK/W.
    5. 1.012 kJ/kgK.

9. Which is the specific heat capacity of water?

    1. 1.013 kW/kgK.
    2. 1.012 MJ/kgK.
    3. 4.186 kg K/kW.
    4. 4.186 kJ/kgK.
    5. 4.2 kg K/kJ.

10. Which is correct about the specific heat capacity of water?

    1. Varies with water pressure.
    2. 4.19 kW s/kgK.
    3. A ratio.
    4. 1.102 kJ/kgK.
    5. Used to calculate the flow rate of heating and cooling system water.

11. Which is correct about the Stefan–Boltzmann constant?

    1. Used to calculate convective heat transfer.
    2. 4.186 kJ/kgK.
    3. 1.012 kJ/kgK.
    4. 5.67×10^{-8} W/m^{2}K^4.
    5. Combines convective and radiant heat transfer.

12. Which is correct about the density of humid air?

    1. Decreases with increasing pressure.
    2. Increases with increasing air temperature.
    3. Varies with air temperature and pressure.
    4. Not affected by humidity.
    5. Increases as air velocity increases.

13. Which is correct about the density of humid air?

    1. 4.186 kg/m^3 at 21°C, 60% relative humidity.
    2. 1.013 kg/m^3 at 20°C, sea level.
    3. 0.802 m^3/kg.
    4. 1.205 kg/m^3 at 20°C, 1013.25 mb.
    5. 5.67 kg/m^3.

14. Which is correct about the density of water?

    1. Always 10^3 kg/m^3.
    2. 1013.25 m^3/kg.
    3. 101 325 kg/m^3.
    4. 1.205 MJ/m^{3}K.
    5. 1000 kg/m^3 at 4°C.

15. Which is correct about the density of water?

    1. Cannot be measured.
    2. Cannot be measured accurately.
    3. Always relative to the specific gravity number.
    4. 1000 times that of air.
    5. Specific gravity is 1.0.

16. Which is correct about the density of water?

    1. 1.205×10^5 kg/m^3.
    2. 1 tonne/m^3 at 4°C.
    3. 1.012×10^3 kJ/m^3.
    4. 1.27 kJ/kg K.
    5. 100 g/cm^3.

17. Which is correct about the density of water?

    1. 1 g/cm^3.
    2. 1.2×10^3 kg/m^3.
    3. Specific gravity is 4.186.
    4. 1000 tonne/m^3 at 10°C.
    5. 1 kg/l.

18. What does the exponential *e* mean?

    1. A logarithm.
    2. A variable number.
    3. Always 10^x, ten to the power x.
    4. 2.718.
    5. Has no meaning.

19. What does the exponential *e* mean?

    1. Something which is raised to a power.
    2. $e = 10^x$.
    3. The sum of an infinite series.
    4. $e = \sqrt{-1}$.
    5. $e^1 = 2.718$.

20. Which of these has the correct units?

    1. Mass is measured in kilograms.
    2. 1 tonne $= 10^6$ kg.
    3. 1 kg $= 10^9$ mg.
    4. 10^3 kg/m^3 = 1 kg/l.
    5. 10^6 m = 1 km.

21. Which of these are not the correct units?

    1. 1 h = 3600 s.
    2. 60 h = 3600 min.
    3. 3.6×10^3 s = 1 h.
    4. 1 year = 8760 h.
    5. 1 h = 360 s.

22. Which of these has the correct units?

    1. $1\ N = 1\ kg \times 1\ m^2$.
    2. $1\ J = 1\ kg \times 1\ m$.
    3. $1\ W = 1\ kg \times g\ m/s^2$.
    4. $10^3\ J = 3600\ kN/m^2$.
    5. $1\ J = 1\ N/m^2$.

23. Which of these has the correct units?

    1. $1\ J = 1\ N \times 1\ m$.
    2. $1\ J = 1\ W/s$.
    3. $10^3\ J = 1\ kW/s$.
    4. $1\ W = 10^3\ J/s$.
    5. $1\ MJ = 10^3\ kW/s$.

24. Which of these has the correct units?

    1. $1\ W = 1\ Nms$.
    2. $1\ W = 1\ Js$.
    3. $1\ W/s = 10^3\ J$.
    4. $1\ W = 1\ Nm/s$.
    5. $1\ kW/h = 10^3\ J/h$.

25. Which of these has the correct electrical units?

    1. $1\ MW = 10^3\ W$.
    2. $10^3\ kJ = 10^3\ kW/s$.
    3. $1\ W = 1\ V \times 1\ A$.
    4. Electrical energy meters accumulate kW/h.
    5. $10^3\ W = 10^3\ V \times 10^3\ A$.

26. Which of these has the correct electrical units?

    1. $10^3\ kW/h = 10^3 \times 3600\ W/s$.
    2. kWh = energy.
    3. $1\ GJ = 10^6\ V \times 1\ A$.
    4. $1\ MJ = 10^6\ V \times 1\ A$.
    5. $1\ kJ/s = 10^3\ V \times 1\ A$.

27. Which of these has the correct electrical units?

    1. $10^3\ W = 10^3\ V \times 1\ A$.
    2. $1\ MWh = 10^3\ Ws$.
    3. $1\ kWh = 10^3\ Ws$.
    4. $1\ kWh = 1000\ W/s$.
    5. $1\ kWh = 1000\ W/h$.

28. Which of these has the correct units?

    1. $1\ atmosphere = 10^3\ b$.
    2. $1\ Pa = 1\ N/m^2$.
    3. Pascal is a unit of radiation measurement.
    4. $1\ kN/m^2 = 1\ b$.
    5. $1\ mb = 10^3\ N/m^2$.

29. Which of these has the correct pressure units?

    1. 1.01325 mb = 1 atmosphere.
    2. 1 MN = 10^3 kN/m^2.
    3. 1 b = 1 kN/m^2.
    4. 13.6 mb = 13.6 N/m^2.
    5. 1 b = 10^5 N/m^2.

30. Which of these has the correct pressure units?

    1. 1 mb = 1 N/m^2.
    2. 1 b = 10^3 mb.
    3. 1 mb = 10^3 N/m^2.
    4. 10^3 kN/m^2 = 1 b.
    5. 1 mb = 10^6 b.

31. Which of these has the correct pressure units?

    1. 1 Nm = 1 Pa.
    2. 1000 Pa = 1 atmosphere.
    3. 1 kPa = 1 kN/m^2.
    4. 1 Pa = 1 mb.
    5. 1 Pa = 1 N/m^2.

32. Which has the correct meaning for frequency?

    1. Number of times an event is repeated.
    2. Cyclic repetition of an event.
    3. Number of complete rotations per unit time.
    4. Statistical correlation.
    5. Occasional reoccurrence.

33. Which has the correct meaning for frequency?

    1. Alternating current rate of increase.
    2. Electrical single- or three-phase.
    3. Torque of a motor.
    4. Air changes per hour.
    5. Revolutions per minute.

34. Which is not correct in relation to frequency?

    1. 3000 RPM = 50 Hz.
    2. 1 Hz = 1 Nm/s.
    3. High-frequency fluorescent lamps work at 20 000 Hz.
    4. VFD means variable frequency drive.
    5. 60 Hz = 3600 RPM.

35. Which is correct about Kelvin?

    1. Name of the engineer who designed the first steam engine.
    2. Unit of heat.
    3. Measured in kJ/kgs.
    4. Temperature scale.
    5. Absolute temperature.

36. Which is correct about Kelvin?

    1. Where absolute zero gravity starts.
    2. Something to do with temperature.
    3. First name of Dr K. Celsius.
    4. °C + 273.
    5. Engineered the first closed-circuit piped heating system.

37. Which is correct about Kelvin degrees?

    1. Celsius scale plus 180.
    2. Are always negative values of Celsius degrees.
    3. Symbol K.
    4. Awarded by Kevin University, Peebles, Scotland.
    5. $K = C \times (9/5) + 32$.

38. Which is correct about Kelvin?

    1. Name of a famous Scottish scientist.
    2. Invented first bicycle in Scotland.
    3. $K = C + 273$.
    4. Kelvin McAdam invented tarmacadam for road surfacing.
    5. Degrees measured above absolute zero at −180°F.

39. Which is correct about Kelvin degrees?

    1. Measurement of room air temperature.
    2. Always used in heat transfer units.
    3. Used to specify absolute temperature and temperature difference.
    4. Fahrenheit plus 180.
    5. Zero scale commences at −40°C.

40. Which is correct about Celsius?

    1. Latin name of inventor of Roman hypocaust under floor heating system in 200 BC.
    2. Fahrenheit minus 32.
    3. $C = F \times (5/9) + 32$.
    4. $C = 32 - F \times (5/9)$.
    5. $C = (F - 32) \times (5/9)$.

41. Which is correct about Celsius?

    1. Called °C units.
    2. Kelvin degrees plus 273.13.
    3. $C = (F + 32) \times (5/9)$.
    4. Commonly used for cryogenic applications.
    5. $F = (C - 32) \times (5/9)$.

42. Which is correct about Celsius?

    1. Temperature scale in the centimetre, gram, second, CGS, metric system.
    2. Name of the Roman Senator in 35 AD who stabbed Caesar.
    3. $C = (F - 180) \times (5/9)$.
    4. Defines normal human body temperature of 98.4°.
    5. Temperature scale in the metre, kilogram, second, MKS, metric system.

43. Which is correct about volume?

    1. 1 cm^3 water occupies 1 l.
    2. 1 tonne water occupies 1000 m^3.
    3. 1 $m^3 = 1000$ l.
    4. 1 l water weighs 100 kg.
    5. 1 l water weighs 10 kg.

44. Which is correct about volume?

    1. 1 m^3 air weighs around 100 kg.
    2. 1 m^3 air weighs around 10 kg.
    3. 1 m^3 air weighs around 1 kg.
    4. 1 l occupies 1 m^2 area and 100 mm height.
    5. 1 l occupies 1 m^2 area and 10 mm height.

45. Which is correct about volume?

    1. 1 l water is contained in a cube of 100 mm sides.
    2. 1 l air is contained in a cube of 1000 mm sides.
    3. There is such a thing as a volume sensor for a control system.
    4. 100 concrete blocks of 300 mm x 200 mm x 100 mm occupy a volume of 6 m^3.
    5. 1 tonne water occupies 10 m^3.

46. What is the volume of a room 12 m long, 8 m wide and having an average height of 4 m?

    1. 400 m^3.
    2. 62 m^3.
    3. 462 m^3.
    4. 384 m^3.
    5. 192 m^3.

47. Which is the correct length of a 1200 m^3 sports hall of average height 4 m and width 12 m?

    1. 25 m.
    2. 10 m.
    3. 250 m.
    4. 120 m.
    5. 12.5 m.

48. What are the units for pressure drop rate in a pipeline?

    1. m head H_2O/m run.
    2. N/m^2.
    3. mb/m.
    4. N/m^3.
    5. kN/m^3.

49. What does N/m^3 stand for?

    1. Nanometres per m^2 pressure drop per metre run of pipe.
    2. Neurons per cubic metre of room volume.
    3. Newton's per square metre pressure drop per metre run of pipe or duct.

4. Newton per cubic metre is a density.
5. Nano-particles of Radon gas per cubic metre of air in a building.

50. What does N/m^3 stand for?

1. Normalized volumetric air change rate for a room.
2. Number of people in a building divided by building volume.
3. Volumetric coefficient.
4. Noise rating divided by room volume.
5. Pressure drop rate in a pipe or duct.