# Multiple-choice revision questions

## MODULE 1

The example mathematics questions set out below follow the sections of Module 1 in the EASA Part-66 syllabus and should be attempted in full *after studying the whole of Module 1*. Note that these questions have been separated by level, where appropriate. Several of the sections (e.g. trignometry, linear equations, number systems, logarithms, etc.) are not required for Category A certifying mechanics. Please remember that *all of these questions must be attempted without the use of a calculator* and that the pass mark for all JAR-66 multiple-choice examinations is 75.

### Arithmetic

1. The sum of twelve thousand and twelve hundred is: [A,B1,B2,B3]

    a) 12200
    b) 13200
    c) 23200

2. The product 230 × 180 is: [A,B1,B2,B3]

    a) 4140
    b) 41040
    c) 41400

3. The number 18493.4 divided by 18 is: [A,B1,B2,B3]

    a) 0.000973
    b) 102.74
    c) 1027.41

4. 0.006432 – 0.0184 is: [A,B1,B2,B3]

    a) –0.011968
    b) –0.177568
    c) –0.0177568

5. The sum of 329.67 + 1086.14 + 200.2 is: [A,B1,B2,B3]

    a) 1319.3
    b) 1616.01
    c) 1632.31

6. The equivalent of $\frac{326 \times 12.82}{0.62}$, correct to two decimal places is: [A,B1,B2,B3]

   a) 6740.84
   b) 674.08
   c) 67.41

7. 21 + 6 × (8 – 5) is equal to: [A,B1,B2,B3]

   a) 39
   b) 64
   c) 81

8. *x* and *y* are positive integers, so *x*–*y* *must* be a number that is: [B1,B2,B3]

   a) positive
   b) natural
   c) an integer

9. The value of $\sqrt{25 \times 36}$ is: [A,B1,B2,B3]

   a) 30
   b) 150
   c) 180

10. –16 + (–4) – (–4) + 22 is equal to: [A,B1,B2,B3]

    a) –2
    b) 6
    c) 14

11. $3 \times \frac{-12}{2}$ is equal to: [A,B1,B2,B3]

    a) 2
    b) –2
    c) –18

12. The value of 5 × 3 + 4 × 3 is: [A,B1,B2,B3]

    a) 57
    b) 75
    c) 27

13. The value of $a(b + c – d^2)$ when $a = 2$, $b = – 3$, $c = 4$ and $d = –2$ is: [A,B1,B2,B3]

    a) –10
    b) –6

c) 10

14. An estimate for the product 4.28 × 10.1 × 0.125 correct to 1 significant figure is: [A,B1,B2,B3]

a) 5.41
b) 5.4
c) 5

15. $2\frac{1}{50}$ written in decimal form is: [A,B1,B2,B3]

a) 2.2
b) 2.01
c) 2.02

16. The number 0.00009307, expressed in standard form is: [A,B1,B2,B3]

a) $9.307 \times 10^{-5}$
b) $9.307 \times 10^{-4}$
c) $9.307 \times 10^{4}$

17. $\frac{2}{5}$ of a consignment of 600 bolts are distributed to a spares carousel. How many are left? [A,B1,B2,B3]

a) 240
b) 360
c) 400

18. An estimate of the value of (80.125 × 20.875) – 1600, correct to three significant figures, is: [A,B1,B2,B3]

a) 74.1
b) 80. 5
c) 85.61

19. The average of $\frac{1}{4}$ and $\frac{1}{12}$ is: [A,B1,B2,B3]

a) $\frac{1}{3}$
b) $\frac{1}{6}$
c) $\frac{1}{8}$

20. The value of $\left(\frac{7}{12} \times \frac{3}{14}\right) - \frac{1}{16} + 2\frac{1}{8}$ is: [A,B1,B2,B3]

a) $2\frac{3}{16}$

b) $2\frac{1}{4}$
c) $2\frac{5}{16}$

21. The value of $\frac{3}{4}$ of $\frac{1}{3} \div \frac{1}{2} \times \frac{1}{4}$ is: [A,B1,B2,B3]

a) $\frac{1}{32}$
b) $\frac{1}{8}$
c) 2

22. $\frac{13}{25}$ as a percentage is: [A,B1,B2,B3]

a) 5.2%
b) 26%
c) 52%

23. An aircraft supplier buys 200 packs of rivets for £100.00 and sells them for 70 pence a pack. His percentage profit is: [A,B1,B2,B3]

a) 30%
b) 40%
c) 59%

24. An aircraft is loaded with 20 crates. 8 of the crates each have a mass of120 kg, the remaining crates each have a mass of 150 kg. The average mass per box is: [A,B1,B2,B3]

a) 132 kg
b) 135 kg
c) 138 kg

25. Two lengths have a ratio of 12 : 5, the second, smaller length is 25 m. The first, larger length is: [A,B1,B2,B3]

a) 60 m
b) 72 m
c) 84 m

26. An aircraft travelling at constant velocity covers the first 800 km of a journey in 1.5 hours. How long does it take to complete the total journey of 2800 km, assuming constant velocity? [A,B1,B2,B3]

a) 3.5 hours
b) 5.25 hours
c) 6.25 hours

27. An electrical resistance ($R$) of a wire varies directly as the length ($L$) and inversely as the square of the radius ($r$). This is represented symbolically by: [B1,B2,B3]

    a) $R \propto \frac{r}{L^2}$
    b) $R \propto \frac{L^2}{r}$
    c) $R \propto \frac{L}{r^2}$

28. Given that there are approximately 2.2 lb (pound mass) in a kilogram, then the number of pounds equivalent to 60 kg is: [B1,B2,B3]

    a) 132 lb
    b) 60 lb
    c) 27.3 lb

29. 1 bar pressure is approximately equal to 14.5 psi (pounds per square inch) so the number of bar equivalent to 3625 psi, is: [A,B1,B2,B3]

    a) 125 bar
    b) 250 bar
    c) 255 bar

30. There are approximately 4.5 litres in a gallon. How many litres will be registered on the fuel gauge if 1600 gallons are dispensed? [A,B1,B2,B3]

    a) 7200 litres
    b) 355.6 litres
    c) 55.6 litres

31. The mass of an electrical part is 23 grams, so the total mass, in kilograms, of 80 such parts is: [A,B1,B2,B3]

    a) 1840
    b) 184
    c) 1.84

32. $2^5 + 2^3 + 1$ may be written as the binary number: [B1,B2,B3]

    a) 10110
    b) 101001
    c) 101010

33. The denary number 37 is the binary number: [B1,B2,B3]

    a) 101001
    b) 10101
    c) 100101

34. The hexadecimal number $6E_{16}$ is equivalent to denary: [B1,B2,B3]

a) 94
b) 108
c) 110

35. The denary number 5138 is equivalent to hexadecimal: [B1,B2,B3]

a) 412
b) 214
c) 321

**Algebra**

36. The product of $3x$, $x$, $-2x^2$, is: [A,B1,B2,B3]

a) $-6x^4$
b) $-5x^4$
c) $4x - 2x^2$

37. When simplified, the expression $4(a + 3b) - 3(a - 4c) - 5(c - 2b)$ is: [A,B1,B2,B3]

a) $a + 22b + 17c$
b) $a + 22b - 17c$
c) $a + 22b + 7c$

38. When simplified, $\frac{(a+b)(a-b)}{a^2-b^2}$ is: [A,B1,B2,B3]

a) 1
b) $a + b$
c) $a - b$

39. When simplified, $(a - b)^2 - (a^2 - b^2)$ is: [A,B1,B2,B3]

a) $2\,a^2 - 2ab$
b) $2b^2$
c) $2b^2 - 2ab$

40. When simplified, $\frac{5a}{4} - \frac{a-1}{3}$ is: [A,B1,B2,B3]

a) $\frac{11a+1}{12}$
b) $\frac{11a+4}{12}$
c) $\frac{11a-4}{12}$

41. When simplified, $\frac{12x^2+16x^4-24x^6}{4x^2}$ is equivalent to: [A,B1,B2,B3]

a) $4x^2 - 9x^4$
b) $4x^2 - 2x^4$
c) $3 + 4x^2 - 6x^4$

42. $(x - 2)^2 + x - 2$ is equivalent to: [A,B1,B2,B3]

a) $(x - 2)(x - 3)$
b) $(x - 2)(x - 1)$
c) $(x - 2)(x + 1)$

43. The expression $\frac{3^3\times3^{-2}\times3}{3^{-2}}$ is equivalent to: [B1,B2,B3]

a) 81
b) 1
c) $\frac{1}{27}$

44. The expression $\frac{(2^3)\left(4^{\frac{1}{2}}\right)^3}{(3^{-3})(2^3)^2}$ simplifies to: [B1,B2,B3]

a) $\frac{1}{27}$
b) $\frac{1}{9}$
c) 27

45. The expression $\frac{1}{2^{-3}} + \frac{1}{2^{-4}} - \frac{1}{2^{-2}}$, when simplified, is equal to: [B1,B2,B3]

a) $-\frac{1}{16}$
b) 20
c) 32

46. The expression simplified $\left[\frac{(a^2b^3c)(a^2)(a^2b)d}{(ab^2c^2)}\right] - \left[\frac{(a^6b^3c^{-2}d)}{abc^{-1}}\right] + 1$ is: B1,B2,B3]

a) –1
b) 0
c) 1

47. The factors of $3x^2 - 2x - 8$ are: [A,B1,B2,B3]

a) $(3x - 2)(x + 4)$
b) $(3x + 4)(x - 2)$
c) $(3x + 2)(x - 4)$

48. Which of the following is a common factor of $x^2 - x - 6$ and $2x^2 - 2x - 12$: [B1,B2,B3]

a) $x + 2$
b) $x - 2$
c) $2x - 6$

49. The factors of $a^3 + b^3$ are: [B1,B2,B3]

a) $(a + b)$ and $(a^2 - ab + b^2)$
b) $(a - b)$ and $(a^2 - ab - b^2)$
c) $(a + b)$ and $(a^2 - 2ab + b^2)$

50. A correct transposition of the formula $x = \frac{ab-c}{a+c}$ is: [A,B1,B2,B3]

a) $c = \frac{a(b-x)}{x+1}$
b) $c = \frac{ab-ax}{x-1}$
c) $c = \frac{a(b-x)}{2}$

51. The formula $X = \sqrt{Z^2 - R^2}$, correctly transposed for R, is: [A,B1,B2,B3]

a) $R = \sqrt{Z^2 - X^2}$
b) $R = \sqrt{Z^2 + X^2}$
c) $R = Z - X$

52. The value of $F$ in the formula $F = \frac{mV^2}{r}$ when $V = 20$, $r = 5$ and $m = 64$ is: [A,B1,B2]

a) 256
b) 512
c) 5120

53. The value of $L$ in the formula $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$, when $R = 4$, $C = 0.00625$ and $Q = 1$ is: [A,B1,B2,B3]

a) 2.5
b) 1.0
c) 0.1

54. $\frac{4}{x} = 3 + \frac{3}{x}$, then $x$ is: [A,B1,B2,B3]

a) $\frac{1}{3}$
b) $2\frac{1}{3}$
c) 3

55. If the simultaneous equations are $\frac{8x+10y=35}{2x-10y=5}$ then $x$ is: [B1,B2,B3]

a) 5
b) 4
c) $-\frac{3}{10}$

56. If $a$ is a positive integer and $a^2 + a - 30 = 0$, then the value of $a$ is: [B1,B2,B3]

a) 6
b) 5
c) 4

57. An aircraft travels a distance $s$ km in 15 minutes. It travels at this same average speed for $h$ hours. The total distance it travels in kilometres is: [A,B1,B2,B3]

a) $\frac{sh}{15}$
b) $\frac{15h}{2}$
c) $4sh$

58. The solution to the equation $(x - 2)^2 + 3 = (x + 1)^2 - 6$ is: [B1,B2,B3]

a) 2
b) –2
c) 1

59. The roots of the quadratic equation $x^2 + 10x = 96$ are: [B1,B2,B3]

a) 6, –16
b) –6, 10
c) –6, 16

60. The mantissa for the natural logarithm of the number 484.76 will be: [B1,B2,B3]

a) 1
b) 2
c) 3

61. The logarithm of the decimal number 0.1768 will lie between: [B1,B2,B3]

a) –1 and 0
b) 0 and 1
c) 1 and 2

62. The $\sqrt{2520}$ is approximately: [A,B1,B2,B3]

a) 40
b) 50
c) 60

63. The product of (8900) × (82) correct to 2 significant figures is: [B1,B2,B3]

a) 730000
b) 728000
c) 720000

64. $\left(\sqrt{3600}\right) \times \left(\sqrt{4900}\right)$ is equal to: [A,B1,B2,B3]

a) 1764
b) 4620
c) 4200

65. A circle of diameter = 10 cm will have a circumference of: [A,B1,B2,B3]

a) 31.4 cm
b) 15.7 cm
c) 62.8 cm

66. A circle of radius = 15 cm will have an area of: [A,B1,B2,B3]

a) 707.14 $cm^2$
b) 1414.28 $cm^2$
c) 94.25 $cm^2$

67. The volume of a right cylinder of height 15 cm and base radius 5 cm is: [A,B1,B2,B3]

a) 1125 $\pi$ $cm^2$
b) 375 $\pi$ $cm^2$
c) 75 $\pi$ $cm^2$

68. The surface area of a sphere of radius 10 mm is: [A,B1,B2,B3]

a) 1333.3 $\pi$ $mm^2$
b) 750 $\pi$ $mm^2$
c) 400 $\pi$ $mm^2$

69. A hollow fuel pipe is 20 m long and has an internal diameter of 0.15 m and an external diameter of 0.20 m. The volume of the material from which the fuel pipe is made will be: [A,B1,B2,B3]

a) 0.35 $\pi$ $m^3$
b) 3.5 $\pi m^3$
c) 0.45$\pi m^3$

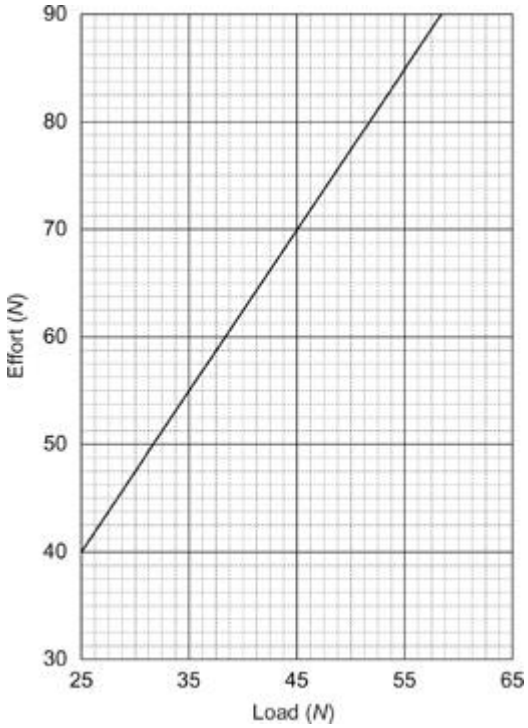
**Geometry and trigonometry**

70. In the equation of the straight line graph $y = mx + c$, which of the following statements is *true?* [A,B1,B2,B3]

    a) $y$ is the independent variable
    b) $m$ is the gradient of the line
    c) $c$ is the dependent variable

71. A straight line passes through the points (3,1) and (6, 4), the equation of the line is: [A,B1,B2,B3]

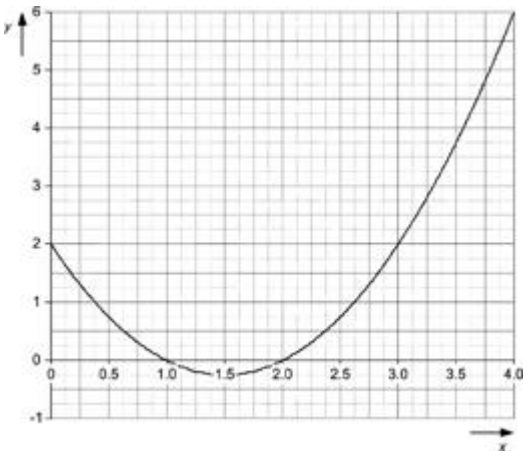
    a) $y = x + 2$
    b) $y = 2x - 2$
    c) $y = x - 2$




**A.7** Straight line graph of effort against load

72. The straight line graph shown in Figure A.7 takes the form $y = mx + c$. The value of $m$ will be approximately: [A,B1,B2,B3]

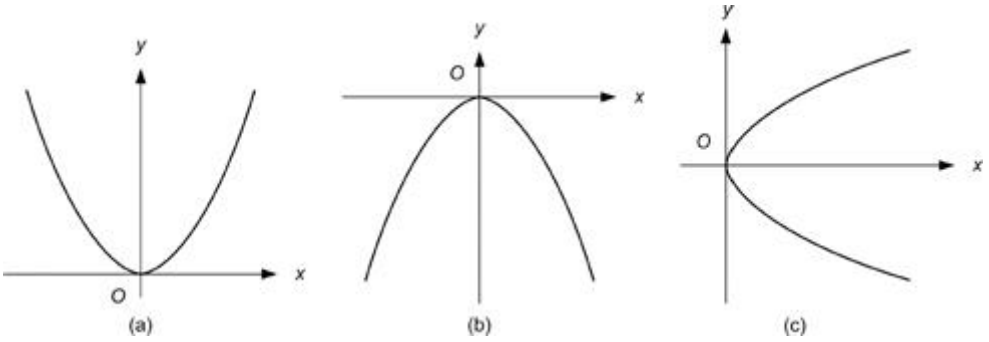
    a) 40
    b) – 30
    c) 1.5




**A.8** Graph of the equation $y = x^2 - 3x + 2$

73. The graph of the quadratic equation $y = x^2 - 3x + 2$ is shown in Figure A.8. From this graph an estimate for the roots of the equation $y = x^2 - 3x + 1$ is: [A,B1,B2,B3]

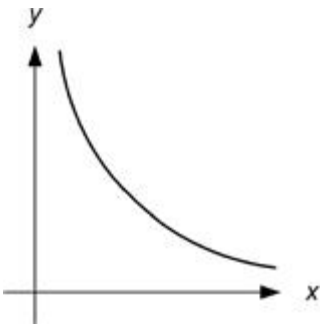
    a) $x = 1$ and $x = 2$
    b) $x = 0.6$ and $x = 2.4$
    c) $x = 0.4$ and $x = 2.6$




**A.9**

74. Which one of the graphs shown in Figure A.9 represents the relationship that $y \propto -x^2$? [B1,B2,B3]

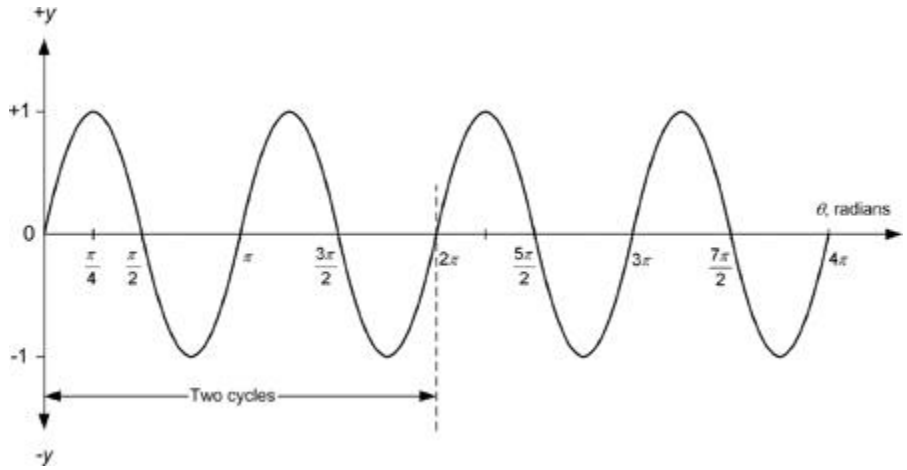
    a) A
    b) B
    c) C




**A.10**

75. Which of the following relationships is represented by the graph shown in Figure A.10? [A,B1,B2,B3]

    a) $y \propto x$
    b) $y \propto \sqrt{x}$
    c) $y \propto \frac{1}{x}$




**A.11**

76. Which of the following functions is represented by the graph shown in Figure A.11? [B1,B2,B3]

    a) $y = \sin \theta$
    b) $y = 2 \sin \theta$
    c) $y = \sin 2\theta$

77. The cosine of 60° is: [B1,B2,B3]

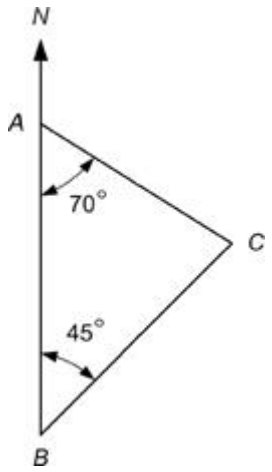
    a) 0.5
    b) 0.866
    c) $\frac{2}{\sqrt{3}}$

78. If $\sin A = \frac{3}{5}$, then $\cos A$ [B1,B2,B3]

a) $\frac{4}{5}$
b) $\frac{2}{5}$
c) $\frac{3}{4}$

79. From the top of a 40 m high control tower a runway landing light makes an angle of depression of 30°. How far is the light from the base of the control tower? [B1,B2,B3]

a) 69.3 m
b) 56.7 m
c) 23.1 m




**A.12**

80. In the triangle *ABC* shown in Figure A.12, the bearing of *B* from *C* is: [B1,B2,B3]

a) 45°
b) 225°
c) 245°

81. When converting rectangular to polar coordinates, the radius *r* of the polar coordinates is found from: [B1,B2,B3]

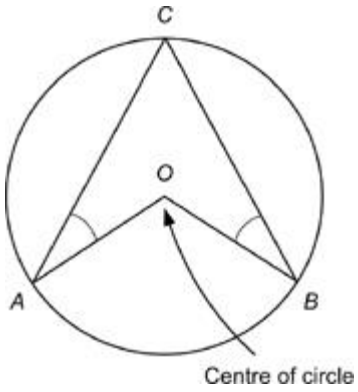
a) $r = x \tan \theta$
b) $r = \sqrt{x^2 + y^2}$
c) $r = \sqrt{x^2 - y^2}$

82. The rectangular coordinates (5, 12) in polar form are: [B1,B2,B3]

a) 13∠67.4
b) 11.79∠67.4
c) 12∠112.6

83. The polar coordinates (15/30) in rectangular form may be found from: [B1,B2,B3]

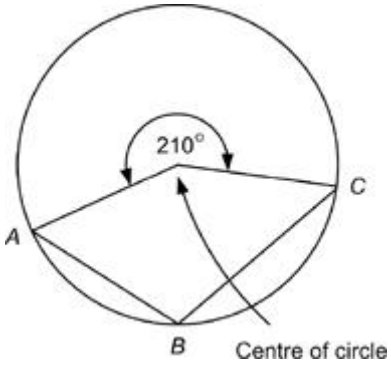
a) $y = 15 \sin 30$ and $x = 15 \cos 30$
b) $y = 15 \cos 30$ and $x = 15 \sin 30$
c) $y = 30 \cos 15$ and $x = 30 \sin 15$




**A.13**

84. From Figure A.13, the $\angle AOB$ is equal to: [B1,B2,B3]

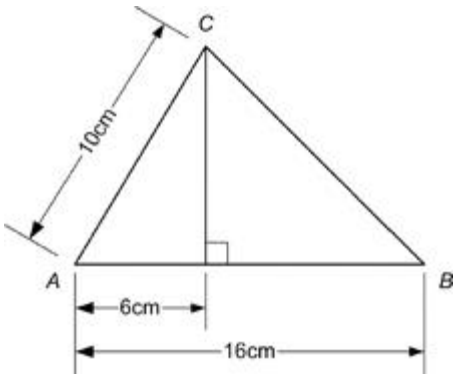
a) 180 – 2AB
b) 270 – (A + B)
c) $2A + 2B$




**A.14**

85. In Figure A.14, $\angle ABC$ is equal to: [B1,B2,B3]

a) 75°
b) 105°
c) 150°




**A.15**

86. For the triangle shown in Figure A.15, what is the value of cos B? [B1,B2,B3]

a) $\frac{10}{16}$
b) $\frac{8}{\sqrt{164}}$
c) $\frac{10}{\sqrt{164}}$

**General non-calculator mathematics**

87. The sum of 320.8 + 97.6 + 1001.7 correct to 4 significant figures is: [A,B1,B2,B3]

a) 1421
b) 1420
c) 1400

88. The exact value of $\frac{8(86-51.2)}{\sqrt{16}}$ is: [A,B1,B2,B3]

a) 169.6
b) 69.6
c) 69.8

89. The value of $p(q + r^2 – s/2)$ when $p = 2$, $q = 3$, $r = –4$ and $s = 18$ is: [A,B1,B2,B3]

a) 20
b) –44
c) 2

90. The number 1834900.0 expressed in standard form is: [A,B1,B2,B3]
a) $1.8349 \times 10^5$
b) $1.8349 \times 10^6$
c) $1.8349 \times 10^7$

91. The value of $\frac{2}{3}$ of $\frac{3}{4} \times \frac{1}{2} \div \frac{3}{4}$ [A,B1,B2,B3]

a) $\frac{1}{16}$
b) $\frac{1}{8}$
c) $\frac{1}{3}$

92. $\frac{14}{152}$ as a percentage is: [A,B1,B2,B3]

a) 0.92%
b) 2.9%
c) 9.2%

93. The binary number 01010 is the denary number: [A,B1,B2,B3]

a) 42
b) 82
c) 84

94. The expression $(a - b)^2 - (a^2 + b^2)$ when simplified is: [A,B1,B2,B3]

a) 0
b) $+2b^2$
c) $-2ab$

95. The factors of $2x^2 - 5x - 3$ are: [A,B1,B2,B3]

a) $(2x + 1)(x - 3)$
b) $(2x - 1)(x + 3)$
c) $(2x + 3)(x - 1)$

96. The formula $v^2 = u^2 + 2as$, correctly rearranged for $a$ is: [A,B1,B2,B3]

a) $a = \sqrt{\frac{v^2 - u^2}{2s}}$
b) $a = \frac{v^2 + u^2}{2s}$
c) $a = \frac{v^2 - u^2}{2s}$

97. If $\left(\frac{x-3}{2}\right) - \left(\frac{2x+4}{2}\right) = 0$, then $x$ is: [B1,B2,B3]

a) 7
b) –7
c) –3.5

98. A straight line passes through the points (4,1) and (7,4). The equation of the line is: [A,B1,B2,B3]

a) $y = x + 3$
b) $y = x - 3$
c) $y = 2x - 3$

99. If $A = \frac{\sqrt{3}}{2}$, then cos $A$ is: [B1,B2,B3]

a) $\frac{1}{2}$
b) $\frac{1}{\sqrt{3}}$
c) $\sqrt{3}$

100. Bearings are measured conventionally: [A,B1,B2,B3]

a) Anticlockwise from North
b) Clockwise from East
c) Anticlockwise from East

**MODULE 2**

The example questions set out below follow the sections of Module 2 in the EASA Part-66 syllabus. In addition there are questions on the atmospheric physics contained in Module 8 – Basic Aerodynamics. (It was felt that the subject matter concerning atmospheric physics was better placed within this chapter.)

Also note that the questions in this paper have been set by level. Much of the thermodynamics and all of the material on light and sound are not required for Category A certifying mechanics. Also, in the new syllabus, those taking the Category B3 licence are not examined on light and sound, apart from this exception all other (B1 and B2) questions should be attempted by B3 candidates. The Category B questions have all been set at the highest B1 level for the subject matter in the mechanics and fluid mechanics sections.

Remember that *all of these questions must be attempted without the use of a calculator* and that the pass mark for all EASA Part-66 multiple-choice examinations is 75%.

**Units**

1. The SI unit of mass is the: [A, B1, B2]

a) newton
b) kilogram
c) pound

2. The SI unit of thermodynamic temperature is the: [A, B1, B2]

a) degree celsius
b) degree fahrenheit

c) kelvin

3. In the English engineering system, the unit of time is: [A, B1, B2]

   a) second
   b) minute
   c) hour

4. In the SI system the radian is a: [A, B1, B2]

   a) supplementary unit
   b) base unit
   c) measure of solid angle

5. In the SI system the unit of luminous intensity is the: [B1,B2]

   a) lux
   b) candela
   c) foot candle

6. 500 mV is the equivalent of: [A, B1, B2]

   a) 0.05V
   b) 0.5 V
   c) 5.0V

7. An area 40 cm long and 30 cm wide is acted upon by a load of 120 kN. This will create a pressure of: [A, B1, B2]

   a) 1 $MN/m^2$
   b) 1 $kN/m^2$
   c) 1200 $N/m^2$

8. A light aircraft is filled with 400 imperial gallons of aviation gasoline. Given that a litre of aviation gasoline equals 0.22 imperial gallons, then the volume of the aircraft fuel tanks is approximately: [A, B1, B2]

   a) 88 litres
   b) 880 litres
   c) 1818 litres

9. If one bar pressure is equivalent to 14.5 psi, then 290 psi is equivalent to: [B1, B2]

   a) 20 kPa
   b) 2.0 MPa
   c) 2000 mbar

10. Given that the conversion factor from mph to m/s is approximately 0.45, then 760 mph is approximately equal to: [A, B1, B2]

    a) 1680m/s
    b) 380 m/s
    c) 340 m/s

11. If the distance travelled by a satellite from its gravitation source is doubled and the satellite originally weighed 1600 N, then its weight will be reduced to: [B1, B2]

    a) 1200 N
    b) 800 N
    c) 400 N

12. In the engineer's version of the FPS system the amount of mass when acted upon by 1 lbf, experiencing an acceleration of 1 $ft/s^2$ is: [A, B1, B2]

    a) 1 lb
    b) 1 lbf
    c) 32.17 lb

**Matter**

13. Which of the following statements is true? [A, B1, B2]

    a) Protons carry a positive charge, neutrons carry a negative charge
    b) Electrons carry a negative charge, protons have no charge
    c) Protons carry a positive charge, electrons carry a negative charge

14. The valence of an element is identified by the: [B1, B2]

    a) number of electrons in an atom of the element
    b) column in which it sits within the periodic table
    c) number of electrons in all of the p-shells within the atom of the element

15. Ionic bonding involves: [A, B1, B2]

    a) electron transfer
    b) the sharing of electrons
    c) weak electrostatic attraction of dipoles

16. An ion is: [A, B1, B2]

    a) an atom with loosely bound electrons
    b) a positively or negatively charged atom
    c) an atom with a different number of protons and neutrons

17. Matter is generally: [A, B1, B2]

    a) considered to exist in solid, liquid and gaseous forms
    b) made up from solid elements
    c) considered to have an interatomic binding force of zero

18. Gases: [A, B1, B2]

    a) always fill the available space of their containing vessel
    b) are always made up from single atoms
    c) have molecules that always travel in curved paths

**Statics**

19. A vector quantity: [A, B1, B2]

    a) is measured only by its sense and direction
    b) has both magnitude and direction
    c) is represented by an arrow showing only its magnitude

20. Two vector forces: [A, B1, B2]

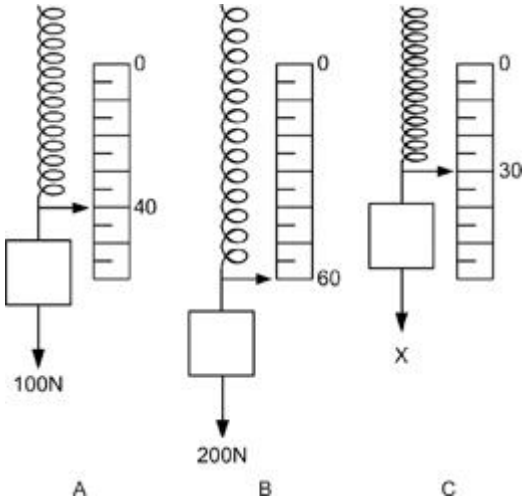
    a) can only be added using the triangle rule
    b) are always added using the head-to-head rule
    c) may be added head-to-tail using the triangle law

21. The resultant of two or more forces is that force which acting alone: [A, B1, B2]

    a) against the other forces in the system places the body in equilibrium
    b) acts normal to all the other forces in the system
    c) produces the same effect as the other forces acting together in the system

22. Figure A.16 shows a spring with a pointer attached, hanging next to a scale. Three different weights are hung from it in turn, as shown. If all the weight is removed from the spring, which mark on the scale will be indicated by the pointer?: [A, B1, B2]

    a) 0
    b) 10
    c) 20



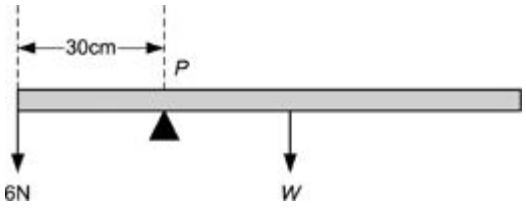

**A.16** Spring with pointer attached

23. With reference to Figure A.16, what is the weight of X? [A, B1, B2]

    a) 10 N
    b) 50 N
    c) 0

24. With reference to forces acting on a uniform beam, one of the conditions for static equilibrium is that: [A, B1, B2]

    a) horizontal forces must be equal
    b) vertical forces and horizontal forces must be equal
    c) the algebraic sum of the moments must equal zero



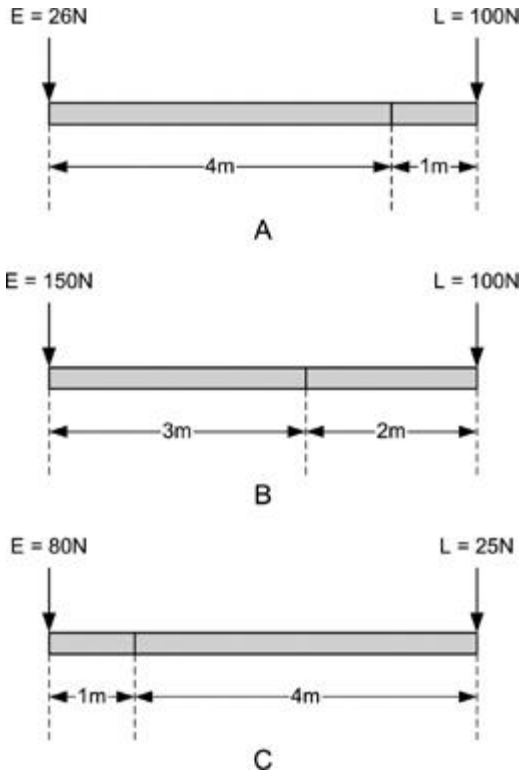

**A.17** A uniform metre rule balanced as shown

25. A uniform metre rule is balanced as shown in Figure A.17. The weight *W* of the metre rule is: [A, B1, B2]

    a) 4 N
    b) 5 N
    c) 9 N

26. With respect to Figure A.17, the force on the rule at point *P* is: [A, B1, B2]

    a) 3 N acting vertically down
    b) 15 N acting vertically up
    c) 15 N acting vertically down




**A.18** Levers

27. In Figure A.18 which lever will rotate clockwise? [A, B1, B2]

    a) A
    b) B
    c) C

28. Torque may be defined as the: [A, B1, B2]

    a) turning moment of a couple measured in newton-metres (Nm)
    b) turning moment of a force measured in newtons (N)
    c) moment of a couple measured in newtons (N)

29. When calculating the distance of the centre of gravity (CG) of an aircraft from a datum x, this distance is equal to the sum of the: [B1, B2]

    a) masses multiplied by the total mass
    b) moments of the masses divided by the total mass
    c) moments of the masses multiplied by the total mass

30. The stress of a material is defined as: [A, B1, B2]

    a) Force/Area, with units in $Nm^2$
    b) Force × Area, with units in $Nm^2$
    c) Force/Area, with units in $N/m^2$

31. The stiffness of a material when subject to tensile loads is measured by the: [A, B1, B2]

    a) tensile stress
    b) modulus of rigidity
    c) modulus of elasticity

32. When a metal rod 20 cm long is subject to a tensile load, it extends by 0.1 mm. Its strain will be: [A, B1, B2]

    a) 0.0005
    b) 2.0
    c) 0.05

33. Ductility may be defined as the: [A, B1, B2]

    a) tendency to break easily or suddenly with little or no prior extension
    b) ability to be drawn out into threads of wire
    c) ability to withstand suddenly applied shock loads

34. Specific strength is a particularly important characteristic for aircraft materials because: [A, B1, B2]

    a) it is a measure of the energy per unit mass of the material
    b) the density of the material can be ignored
    c) it is a measure of the stiffness of the material

35. You are required to find the shear stress, torque and polar second moment of area of a circular section aircraft motor drive shaft when given the radius of the shaft. Which of the following formulae would be the most useful? [B1, B2]

    a) $\frac{\tau}{r} = \frac{G\theta}{l}$
    b) $\frac{\tau}{r} = \frac{T}{J}$
    c) $\frac{T}{J} = \frac{G\theta}{l}$

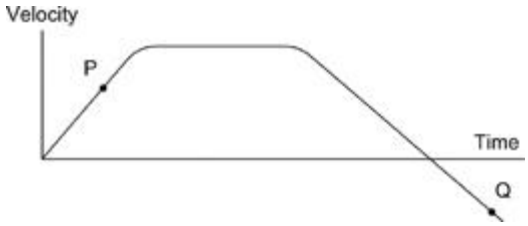
36. For an aircraft tubular control rod, subject to torsion, the maximum stress will occur: [B1, B2]

    a) where the radius is a maximum
    b) axially through the centre of the shaft
    c) across the shaft diameter

**Kinematics and dynamics**

37. The linear equations of motion rely for their derivation on one very important fact which is that the: [A, B1, B2]

a) velocity remains constant
b) velocity is the distance divided by the time taken
c) acceleration is assumed to be constant



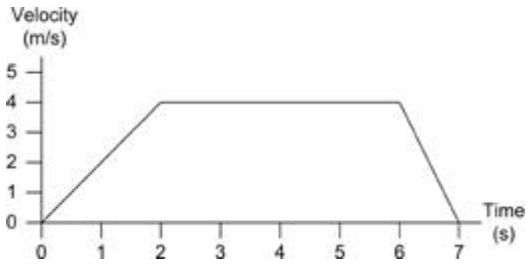

**A.19**

38. With reference to the graph given in Figure A.19, at the point P the vehicle must be: [A, B1, B2]

a) stationary
b) accelerating
c) travelling at constant velocity

39. With reference to the graph given in Figure A.19, at the point Q the vehicle must be: [A, B1, B2]

a) stationary
b) travelling downhill
c) travelling in the reverse direction




**A.20** Velocity-time graph

40. Figure A.20 shows a velocity–time graph for a vehicle, for which the: [A, B1, B2]

a) initial acceleration is 2 $m/s^2$
b) maximum velocity is 7 m/s
c) acceleration between 2 and 6 s is 1 $m/s^2$

41. Given that an aircraft accelerates from rest at 3 $m/s^2$, its final velocity after 36 s will be: [A, B1, B2]

a) 118 m/s
b) 72 m/s
c) 12 m/s

42. Newton's Third Law essentially states that: [A, B1, B2]

a) the inertia force is equal and opposite to the accelerating force
b) a body stays in a state of rest until acted upon by an external force
c) force is equal to mass multiplied by acceleration

43. The force produced by a fluid is the: [A, B1, B2]

a) fluid mass flow rate divided by its velocity
b) fluid mass flow rate multiplied by its velocity
c) mass of the fluid multiplied by its velocity

44. The mass airflow through a propeller is 400 kg/s. If the inlet velocity is 50 m/s and the outlet velocity is 100 m/s, the thrust developed is: [B1, B2]

a) 20 kN
b) 8 kN
c) 2000 N

45. Given that 1 rev = 2π rad and assuming $\pi = 22/7$, then 14 rev is equivalent to: [A, B1, B2]

a) 22 rad
b) 44 rad
c) 88 rad

46. With respect to the torque created by rotating bodies in the formula $T = I\alpha$, the symbol $I$ represents the: [B1, B2]

a) angular inertial acceleration and has units of $m/s^2$
b) mass moment of inertia and has units of $kg/m^2$
c) mass moment of inertia and has units of $kg/m^4$

47. Given that the formula for centripetal force is $F_c = mv^2/r$, the centripetal force required to hold an aircraft with a mass of 90,000 kg in a steady turn of radius 300 m, when flying at 100 m/s, is: [B1, B2]

a) 3.0 MN
b) 300 kN
c) 30 kN

48. Gyroscopes are used within aircraft inertial navigation systems because they possess: [A, B1, B2]

a) rigidity and precess when their rotor assembly is acted upon by an external force
b) agility and process when their rotor assembly is acted upon by an external force
c) agility and precess when their rotor assembly is acted upon by an external force

49. With respect to simple harmonic motion, amplitude is defined as the: [B1, B2]

    a) distance completed in one time period
    b) number of cycles completed in unit tim
    c) distance of the highest or lowest point of the motion from the central position

50. Which of the following devices has been designed to convert electrical energy into sound energy? [A, B1, B2]

    a) Mains transformer
    b) Loudspeaker
    c) Telephone mouthpiece

51. Which of the following expressions defines power? [A, B1, B2]

    a) Work done per unit time
    b) Force per unit length
    c) Force per unit time

52. Which of the following quantities has the same units as energy? [A, B1, B2]

    a) Work
    b) Power
    c) Velocity

53. Which of the following quantities remains constant for an object falling freely towards the earth? [A, B1, B2]

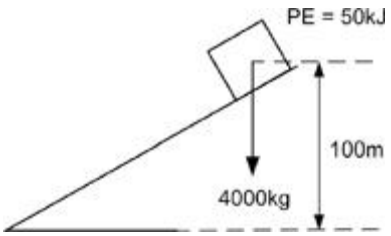
    a) Potential energy
    b) Acceleration
    c) Kinetic energy

54. The force acting on a 10 kg mass is 25 N. The acceleration is: [A, B1, B2]

    a) 0.4 $m/s^2$
    b) 25 $m/s^2$
    c) 2.5 $m/s^2$

55. Given that the strain energy of a spring in tension or compression is = $\frac{1}{2}kx^2$, then the strain energy contained by a spring with a spring constant of 2000 N/m, stretched 10 cm, is: [B1, B2]

    a) 10 J
    b) 100 J
    c) 100 kJ




**A.21**

56. Figure A.21 shows a vehicle of mass 4000 kg sitting on a hill 100 m high, having a potential energy of 50 kJ. If all this potential energy is converted into kinetic energy as the vehicle rolls down the hill, then its velocity at the bottom of the hill will be: [B1, B2]

    a) 5 m/s
    b) 25 m/s
    c) 40 m/s

57. Which of the following statements concerning friction is true? [A, B1, B2]

    a) Static friction is equal to sliding friction
    b) The frictional resistance is dependent on the type of surfaces in contact
    c) The coefficient of friction is equal to the product of the sliding friction force and the normal force

58. A body weighing 3000 N is moved along a horizontal plane by a horizontal force of 600 N. The coefficient of friction will be: [A, B1, B2]

    a) 0.2
    b) 2.0
    c) 5.0

59. The mechanical advantage (MA) of a machine is equal to: [A, B1, B2]

    a) distance moved by load/distance moved by effort
    b) load/effort
    c) distance moved by effort/distance moved by load

60. The efficiency of a machine is given by the mechanical advantage (MA) divided by the velocity ratio (VR). If a machine is 50% efficient and has a VR = 150, then its MA will be: [A, B1, B2]

    a) 75
    b) 300
    c) 7500

**Fluid dynamics**

61. With reference to the laws of fluid pressure, which one of the statements given below is true? [A, B1, B2]

    a) Pressure acts vertically upwards from all surfaces
    b) Pressure at a given depth depends on the shape of the containing vessel
    c) Pressure at a given depth in a fluid is equal in all directions

62. If the gauge pressure of a fluid is 200 kPa and atmospheric pressure is 100 kPa, then the absolute pressure will be: [A, B1, B2]

    a) 2 kPa
    b) 100 kPa
    c) 300 kPa

63. If the density of mercury is 13,600 kg/m$^3$ and we assume that the acceleration due to gravity is 10 m/s$^2$ then a 10 cm column of mercury will be the equivalent to a gauge pressure of: [A, B1, B2]

    a) 1360 Pa
    b) 13,600 Pa
    c) 1360 kPa

64. A man weighing 800 N is wearing snow shoes. The area of each of his snow shoes is ¼ m$^2$. The pressure exerted on the ground by each of his snow shoes is: [A, B1, B2]

    a) 100 N/m$^2$
    b) 400 N/m$^2$
    c) 3200 N/m$^2$

65. An object completely immersed in still water will remain at a fixed depth when the: [A, B1, B2]

    a) weight of the fluid displaced equals the weight of the object
    b) upthrust force reaches a uniform velocity
    c) apparent loss of weight remains stable

66. The boundary layer: [B1, B2]

    a) remains stable at constant velocity
    b) is the thin layer of fluid between the fixed and moving boundary
    c) has an exponential velocity gradient between the fixed and moving boundary

67. Kinematic viscosity is: [B1, B2]

    a) equal to the dynamic viscosity multiplied by the velocity
    b) density dependent and varies with temperature
    c) pressure dependent and varies with weight

68. Streamline flow may be defined as: [A, B1, B2]

    a) flow in which fluid particles move perpendicular and parallel to the surface of the body
    b) flow where the density does not change from point to point
    c) flow in which fluid particles move in an orderly manner and retain the shape of the body over which they are flowing

69. Given that a stream tube at a point has a cross-sectional area of 1.5 $m^2$ and an incompressible fluid flows steadily past this point at 6 m/s, then the volume flow rate will be: [A, B1, B2]

    a) 9 $m^3/s$
    b) 4 $m^3/s$
    c) 0.25 $m^3/s$

70. A wind tunnel is subject to an incompressible steady flow of air at 40 m/s, upstream of the working section. If the cross-sectional area (csa) in the upstream part of the wind tunnel is twice the csa of the working section, then: [A, B1, B2]

    a) the working section velocity will be 1600 m/s
    b) the working section velocity will be twice that of the upstream velocity
    c) the working section velocity will be half that of the upstream velocity

71. The Bernoulli's equation which applies the conservation of energy to fluids in motion is represented in its energy form by: [B1, B2]

    a) $\rho g h_1 + 1/2 m v_1^2 + p_1 V_1 = \rho g h_2 + 1/2 m v_2^2 + p_1 V_1$
    b) $mgh_1 + 1/2 m v_1^2 + p_1 V_1 = mgh^2 + 1/2 m v_2 h + p_2 V_2$
    c) $\rho g h_1 + 1/2 \rho v_1^2 + p_1 = \rho g h_2 + 1/2 \rho v_2^2 + p_2$

72. As subsonic fluid flow passes through a Venturi tube, at the throat the fluid pressure: [A, B1, B2]

    a) increases and the fluid velocity decreases
    b) decreases and the fluid velocity decreases
    c) decreases and the fluid velocity increases

**Atmospheric physics**

73. Starting at sea level, the atmosphere is divided into the following regions: [A, B1, B2]

    a) troposphere, stratosphere and ionosphere

b) exosphere, troposphere and stratosphere
c) troposphere, ionosphere and stratosphere

74. Boyle's Law states that the volume of a fixed mass of gas is inversely proportional to its: [A, B1, B2]

a) temperature providing the pressure of the gas remains constant
b) pressure providing the temperature of the gas remains constant
c) pressure providing the density of the gas remains constant

75. The altitude of the tropopause in the International Standard Atmosphere (ISA) is: [A, B1, B2, B3]

a) 39000 feet
b) 11 km
c) 11 miles

76. The equation $PV/T$ = constant, for an ideal gas, is known as: [A, B1, B2]

a) Charles' Law
b) Combined gas equation
c) Boyle's Law

77. In the characteristic gas equation given by: $PV = mRT$ the symbol $R$ is the: [B1, B2]

a) universal gas constant with a value of 8314.4 J/kmolK
b) characteristic gas constant that has units of J/kg K
c) special gas constant, that has units of kg/kmol K

78. If the temperature of the air in the atmosphere increases but the pressure remains constant, the density will: [A, B1, B2]

a) decrease
b) remain the same
c) increase

79. The temperature at the tropopause in the International Standard Atmosphere (ISA) is approximately: [A, B1, B2]

a) –56 K
b) –56°F
c) –56°C

80. The ISA sea-level pressure is expressed as: [A, B1, B2]

a) 29.92 mbar
b) 1 bar

c) 101,320 Pa

81. With increase in altitude, the speed of sound will: [A, B1, B2]

a) increase
b) decrease
c) remain the same

82. Temperature falls uniformly with altitude in the: [A, B1, B2]

a) ionosphere
b) stratosphere
c) troposphere

83. The simple relationship $T_h = T_0 - Lh$ may be used to determine the temperature at a given height ($h$) in km. The symbol $L$ in this equation represents the: [B1, B2]

a) linear distance in metres between the two altitudes
b) log-linear temperature drop measured in kelvin
c) the temperature lapse rate measured in °C/1000m

84. A gas occupies a volume of 4 $m^3$ at a pressure of 400 kPa. At constant temperature, the pressure is increased to 500 kPa. The new volume occupied by the gas is: [A, B1, B2]

a) 5 $m^3$
b) 3.2 $m^3$
c) 0.3 $m^3$

**Thermodynamics**

85. The temperature of a substance is: [A, B1, B2]

a) a measure of the energy possessed by the vibrating molecules of the substance
b) a direct measure of the pressure energy contained within a substance
c) directly dependent on the volume of the substance

86. The equivalent of 60°C in kelvin is approximately: [A, B1, B2]

a) 213 K
b) 273 K
c) 333 K

87. Alcohol thermometers are most suitable for measuring: [A, B1, B2]

a) jet pipe temperatures
b) cyrogenic substances
c) temperatures down to – 115°C

88. The increase in length of a solid bar 5 m in length is = $\alpha l(t_2 - t_1)$. If the linear expansion coefficient for a solid is $2 \times 10^{-6}$ and the solid is subject to a temperature rise of 100°C, then the increase in length will be: [A, B1, B2]

    a) $1 \times 10^{-3}$ m
    b) $1 \times 10^{-4}$ m
    c) $1 \times 10^{-5}$ m

89. The temperatures of the melting point of ice and the boiling point of water are: [A, B1, B2]

    a) 0 K and 373 K
    b) 273 K and 373 K
    c) 173 K and 273 K

90. Heat energy: [A, B1, B2]

    a) is the internal energy stored within a body
    b) travels from a cold body to a hot body
    c) is transient energy

91. Heat transfer by conduction: [B1, B2]

    a) is where a large number of molecules travel in bulk in a gas
    b) involves energy transfer from atoms with high vibration energy to those with low vibration energy
    c) involves changes in electron energy levels which emits energy in the form of electromagnetic waves

92. How much thermal energy is required to raise the temperature of 2 kg of aluminium by 50°C, if the specific heat capacity of aluminium is 900 J/kgK? [B1, B2]

    a) 90 kJ
    b) 22,500 J
    c) 9000 J

93. The specific heat capacity at constant pressure $c_P$ is: [B1, B2]

    a) less than the specific heat capacity at constant volume $c_v$ for the same substance
    b) based on constant volume heat transfer
    c) always greater than $c_v$

94. The specific latent heat of fusion of a substance is the heat energy required to: [B1, B2]

    a) change any amount of a substance from a solid into a liquid
    b) turn any amount of a substance from a liquid into a solid
    c) turn unit mass of a substance from a liquid into a solid

95. A closed thermal system is one: [B1, B2]

a) that always has fixed system boundaries
b) that always allows the mass transfer of system fluid
c) in which there is no mass transfer of system fluid

96. The First Law of Thermodynamics, applied to a closed system, may be represented symbolically by: [B1, B2]

a) $U_1 + Q = U_2 + W$
b) $Q + W = \Delta U$
c) $U_1 - Q = U_2 + W$

97. The enthalpy of a fluid is the combination of: [B1, B2]

a) kinetic energy + pressure energy
b) internal energy + pressure energy
c) potential energy + kinetic energy

98. An isentropic process is one in which: [B1,B2]

a) the enthalpy remains constant
b) no heat energy is transferred to or from the working fluid
c) both heat and work may be transferred to or from the working fluid

99. From the Second Law of Thermodynamics, the thermal efficiency (η) of a heat engine may be defined as: [B1, B2]

a) total heat supplied/work done
b) $Q_{aut} + Q_{in}/Q_{aut}$
c) net work done/total heat supplied

100. The ideal air standard Otto cycle is: [B1, B2]

a) based on constant pressure heat rejection
b) used as the basis for the aircraft gas turbine engine cycle
c) based on constant volume heat rejection

101. Entropy is: [B1, B2]

a) a measure of the degree of disorder in a system
b) the product of internal energy and pressure–volume energy
c) the adiabatic index of the system fluid

102. A polytropic process is: [B1, B2]

a) one that obeys the law $pv^{\gamma} = c$

b) one in which heat and work transfer may take place
c) has constant entropy

**Light and sound**

103. Light: [B1, B2]

a) is a longitudinal wave that travels through air at 340 m/s
b) is an electromagnetic wave that travels at $3 \times 10^8$ m/s
c) cannot transfer energy from one place to another

104. With respect to the laws of reflection: [B1, B2]

a) the angle of incidence is equal to the angle of refraction
b) the incident ray and the normal lie within the same plane
c) images from plane mirrors are real and laterally converted

105. The light rays from a concave mirror: [B1, B2]

a) converge at the principal focus
b) diverge at the principal focus
c) diverge at the pole which is approximately twice the radius of curvature

106. Given that $1/u = 1/v + 1/f$, the object distance = 50 mm and the focal length = 150 mm, then the distance of the object from the mirror is: [B1, B2]

a) 37.5 mm
b) 75 mm
c) 150 mm

107. As light travels from one medium to another medium with a greater refractive index, its speed: [B1, B2]

a) is increased
b) remains the same
c) is decreased

108. Fibre-optic cables use the principle of: [B1, B2]

a) total external reflection to enable light to travel along the cable
b) internal refraction to enable light to travel along the cable
c) total internal reflection to enable light to travel along the cable

109. Convex lenses: [B1, B2]

a) form real, inverted, small images of distant objects
b) create virtual, inverted, small images of near objects

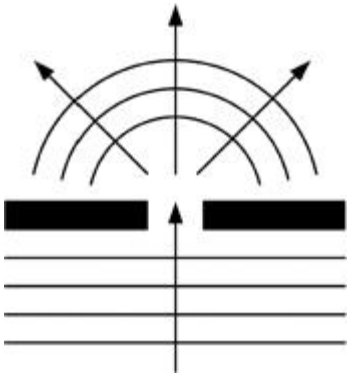
c) produce images where the focal length is always negative

110. Sound waves: [B1, B2]

a) are transverse waves that are able to travel through a vacuum
b) form part of the electromagnetic spectrum, with low or high frequencies
c) are longitudinal waves that need a medium through which to travel

111. The speed of a wavefront is linked by the relationship $v = f\lambda$. Given that the wave frequency = 1 kHz and the speed of propagation is 100 m/s, the wavelength is: [B1, B2]

a) 0.1 m
b) 10 m
c) $1 \times 10^5$m



**A.22**

112. With respect to the behaviour of waves, Figure A.22 illustrates: [B1, B2]

a) diffraction
b) reinforcement
c) destructive interference

113. Radio waves travel as: [B1, B2]

a) sound waves, carrier waves, longitudinal waves
b) ground waves, sky waves, space waves
c) aerial waves, longitudinal waves, Doppler waves

114. An aircraft microwave landing system is likely to operate at an approximate frequency of: [B1, B2]

a) 500 kHz
b) 5000 kHz
c) 5000 MHz

115. The phenomenon where a change in wave frequency is brought about by relative motion is known as: [B1, B2]

a) radio wave travel effect
b) the Doppler effect
c) transmitter effect

## MODULE 3

The example questions set out below follow the sections of Module 3 in the Part-66 syllabus. Several of the sections (e.g. DC circuits, resistance, power, capacitance, magnetism, inductance, etc.) are not required for Category A certifying mechanics. *Remember that all of these questions must be attempted without the use of a calculator* and that the pass mark for all Part-66 multiple-choice examinations is 75%.

### Electron theory

1. Within the nucleus of the atom, protons are:

a) positively charged
b) negatively charged
c) neutral

2. A positive ion is an atom that has:

a) gained an electron
b) lost an electron
c) an equal number of protons and electrons

3. Within an atom, electrons can be found:

a) along with neutrons as part of the nucleus
b) surrounded by protons in the centre of the nucleus
c) orbiting the nucleus in a series of shells

4. A material in which there are no free charge carriers is known as:

a) a conductor
b) an insulator
c) a semiconductor

5. The charge carriers in a metal consist of:

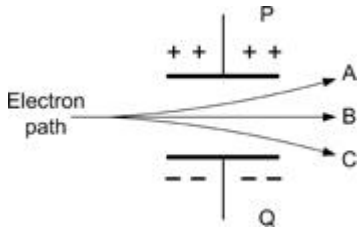
a) free electrons
b) free atoms

c) free neutrons

**Static electricity and conduction**

6. Two charged particles are separated by a distance, d. If this distance is doubled (without affecting the charge present) the force between the particles will:

   a) increase
   b) decrease
   c) remain the same




**A.23**

7. A beam of electrons moves between two parallel plates, P and Q, as shown in Figure A.23. Plate P has a positive charge whilst plate Q has a negative charge. Which one of the three paths will the electron beam follow?

   a) A
   b) B
   c) C

8. The force between two charged particles is proportional to the:

   a) product of their individual charges
   b) sum of their individual charges
   c) difference between the individual charges

9. Two isolated charges have dissimilar polarities. The force between them will be:

   a) a force of attraction
   b) a force of repulsion
   c) zero

10. Which one of the following gives the symbol and abbreviated units for electric charge?

    a) Symbol, *Q*; unit, C
    b) Symbol, *C*; unit, F
    c) Symbol, *C*; unit, V

**Electrical terminology**

11. Which one of the following gives the symbol and abbreviated units for resistance?

    a) Symbol, *R*; unit, Ω
    b) Symbol, *v*; unit, V
    c) Symbol, *R*; unit, A

12. Current can be defined as the rate of flow of:

    a) charge
    b) resistance
    c) voltage

13. A current of 3 A flows for a period of 2 min. The amount of charge transferred will be:

    a) 6 C
    b) 40 C
    c) 360 C

14. The volt can be defined as:

    a) a joule per coulomb
    b) a watt per coulomb
    c) an ohm per watt

15. Conventional current flow is:

    a) always from negative to positive
    b) in the same direction as electron movement
    c) in the opposite direction to electron movement

16. Conductance is the inverse of:

    a) charge
    b) current
    c) resistance

**Generation of electricity**

17. A photocell produces electricity from:

    a) heat
    b) light
    c) chemical action

18. A secondary cell produces electricity from:

    a) heat
    b) light
    c) chemical action

19. A thermocouple produces electricity from:

    a) heat
    b) light
    c) chemical action

20. Which of the following devices uses magnetism and motion to produce electricity?

    a) a transformer
    b) an inductor
    c) a generator

21. A small bar magnet is moved at right-angles to a length of copper wire. The e.m.f. produced at the ends of the wire will depend on the:

    a) diameter of the copper wire and the strength of the magnet
    b) speed at which the magnet is moved and the strength of the magnet
    c) resistance of the copper wire and the speed at which the magnet is moved

**DC sources of electricity**

22. The e.m.f. produced by a fresh zinc–carbon battery is approximately:

    a) 1.2V
    b) 1.5V
    c) 2 V

23. The electrolyte of a fully charged lead– acid battery will have a relative density of approximately:

    a) 0.95
    b) 1.15
    c) 1.26

24. The terminal voltage of a cell falls slightly when it is connected to a load. This is because the cell:

    a) has some internal resistance
    b) generates less current when connected to the load
    c) produces more power without the load connected

25. The electrolyte of a conventional lead–acid cell is:

    a) water
    b) dilute hydrochloric acid
    c) dilute sulphuric acid

26. The positive terminal of a conventional dry (Leclanché) cell is made from:

    a) carbon
    b) copper
    c) zinc

27. A junction between two dissimilar metals that produces a small voltage when a temperature difference exists between it and a reference junction is known as a:

    a) diode
    b) thermistor
    c) thermocouple

28. A photocell consists of:

    a) two interacting layers of a semiconductor material
    b) two electrodes separated by an electrolyte
    c) a junction of two dissimilar metals

29. The materials used in a typical thermocouple are:

    a) silicon and selenium
    b) silicon and germanium
    c) iron and constantan

**DC circuits**

30. The relationship between voltage, $V$, current, $I$, and resistance, $R$, for a resistor is:

    a) $V = IR$
    b) $V = \frac{R}{I}$
    c) $V = IR^2$

31. A potential difference of 7.5 V appears across a 15 Ω resistor. Which of the following is the current flowing:

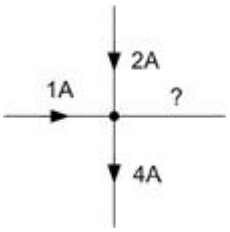
    a) 0.25 A
    b) 0.5 A
    c) 2 A

32. A DC supply has an internal resistance of 1 Ω and an open-circuit output voltage of 24 V. What will the output voltage be when the supply is connected to a 5 Ω load?

a) 19V
b) 20 V
c) 24 V

33. Three 9 V batteries are connected in series. If the series combination delivers 150 mA to a load, which of the following is the resistance of the load?

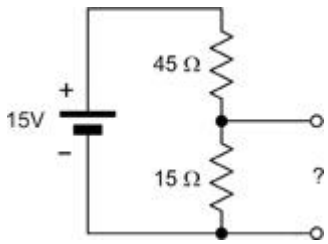
a) 60 Ω
b) 180 Ω
c) 600 Ω




**A.24**

34. The unknown current shown in Figure A.24 will be:

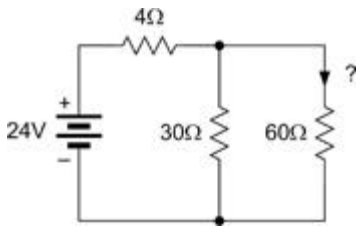
a) 1 A flowing towards the junction
b) 1 A flowing away from the junction
c) 4 A flowing towards the junction




**A.25**

35. Which of the following is the output voltage produced by the circuit shown in Figure A.25?

a) 3.75 V
b) 1.9V
c) 4.7 V




**A.26**

36. Which of the following gives the current flowing in the 60 Ω resistor shown in Figure A.26?

    a) 0.33 A
    b) 0.66 A
    c) 1 A

**Resistance and resistors**

37. A 20m length of cable has a resistance of 0.02 Ω. If a 100 m length of the same cable carries a current of 5 A flowing in it, what voltage will be dropped across its ends?

    a) 0.02 V
    b) 0.1 V
    c) 0.5 V

38. The resistance of a wire conductor of constant cross-section:

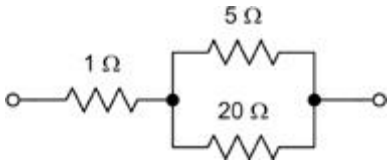
    a) decreases as the length of the wire increases
    b) increases as the length of the wire increases
    c) is independent of the length of the wire

39. Three 15 Ω resistors are connected in parallel. Which of the following is the effective resistance of the parallel combination?

    a) 5 Ω
    b) 15 Ω
    c) 45 Ω

40. Three 15 Ω resistors are connected in series. Which of the following is the effective resistance of the series combination?

    a) 5 Ω
    b) 15 Ω
    c) 45 Ω




**A.27**

41. Which of the following is the effective resistance of the circuit shown Figure A.27?

    a) 5 Ω
    b) 6 Ω
    c) 26 Ω

42. A 10 Ω wirewound resistor is made from 0.2m of wire. A second wirewound resistor is made from 0.5 m of the same wire. The second resistor will have a resistance of:

    a) 4 Ω
    b) 15 Ω
    c) 25 Ω

**Power**

43. The relationship between power, *P*, current, *I*, and resistance, *R*, is:

    a) $P = I \times R$
    b) $p = \frac{R}{I}$
    c) $P = I^2 \times R$

44. A DC generator produces an output of 28 V at 20 A. The power supplied by the generator will be:

    a) 14W
    b) 560 W
    c) 1.4 kW

45. A cabin reading lamp consumes 10 W from a 24 V DC supply. The current supplied will be:

    a) 0.42 A
    b) 0.65 A
    c) 2.4 A

46. A generator delivers 250W of power to a 50 Ω load. The current flowing in the load will be:

    a) 2.24 A
    b) 5 A

c) 10 A

47. An aircraft cabin has 110 passenger reading lamps each rated at 10 W, 28 V. What is the maximum load current imposed by these lamps?

a) 25.5 A
b) 39.3 A
c) 308 A

48. An aircraft fuel heater consists of two parallel-connected heating elements each rated at 28 V, 10 A. What total power is supplied to the fuel heating system?

a) 140 W
b) 280 W
c) 560 W

49. An aircraft battery is being charged from a bench DC supply that has an output of 28 V. If the charging current is 10 A, what energy is supplied to the battery if it is charged for 4 hours?

a) 67 kJ
b) 252 kJ
c) 4.032 MJ

50. A portable power tool operates from a 7 V rechargeable battery. If the battery is charged for 10 hours at 100 mA, what energy is supplied to it?

a) 25.2 kJ
b) 252 kJ
c) 420 kJ

**Capacitance and capacitors**

51. The high-voltage connection on a power supply is fitted with a rubber cap. The reason for this is to:

a) provide insulation
b) concentrate the charge
c) increase the current rating

52. Which of the following is the symbol and abbreviated units for capacitance?

a) Symbol, *C*; unit, C
b) Symbol, *C*; unit, F
c) Symbol, *Q*; unit, C

53. A capacitor is required to store a charge of 32 μC when a voltage of 4 V is applied to it. The value of the capacitor should be:

    a) 0.125 μF
    b) 0.25 μF
    c) 8 μF

54. An air-spaced capacitor has two plates separated by a distance, d. If the distance is doubled (without affecting the area of the plates) the capacitance will:

    a) be doubled
    b) be halved
    c) remain the same

55. A variable air-spaced capacitor consists of two sets of plates that can be moved. When the plates are fully meshed, the:

    a) capacitance will be maximum and the working voltage will be reduced
    b) capacitance will be maximum and the working voltage will be unchanged
    c) capacitance will be minimum and the working voltage will be increased

56. A 20 μF capacitor is charged to a voltage of 50 V. The charge present will be:

    a) 0.5 μC
    b) 2.5 μF
    c) 1 mC

57. A power supply filter uses five parallel-connected 2200 μF capacitors each rated at 50 V. What single capacitor could be used to replace them?

    a) 11,000 μF at 10 V
    b) 440 μF at 50V
    c) 11,000 μF at 50 V

58. A high-voltage power supply uses four identical series-connected capacitors. If 1 kV appears across the series arrangement and the total capacitance required is 100 μF, which one of the following gives a suitable rating for each individual capacitor?

    a) 100 μF at 250V
    b) 25 μF at 1 kV
    c) 400 μF at 250V

59. Which one of the following materials is suitable for use as a capacitor dielectric?

    a) aluminium foil
    b) polyester film
    c) carbon granules

60. The relationship between capacitance, $C$, charge, $Q$, and potential difference, $V$, for a capacitor is:

    a) $Q = CV$
    b) $Q = \frac{C}{V}$
    c) $Q = CV^2$

61. The material that appears between the plates of a capacitor is known as the:

    a) anode
    b) cathode
    c) dielectric

**Magnetism**

62. Permanent magnets should be stored using:

    a) anti-static bags
    b) insulating material such as polystyrene
    c) soft iron keepers

63. Lines of magnetic flux:

    a) originate at the south pole and end at the north pole
    b) originate at the north pole and end at the south pole
    c) start and finish at the same pole, either south or north

64. The magnetomotive force produced by a solenoid is given by:

    a) the length of the coil divided by its cross-sectional area
    b) number of turns on the coil divided by its cross-sectional area
    c) the number of turns on the coil multiplied by the current flowing in it

65. An air-cored solenoid with a fixed current flowing through it is fitted with a ferrite core. The effect of the core will be to:

    a) increase the flux density produced by the solenoid
    b) decrease the flux density produced by the solenoid
    c) leave the flux density produced by the solenoid unchanged

66. The permeability of a magnetic material is given by the ratio of:

    a) magnetic flux to cross-sectional area
    b) magnetic field intensity to magnetomotive force
    c) magnetic flux density to magnetic field intensity

67. The relationship between permeability, μ, magnetic flux density, $B$, and magnetizing force, $H$, is:

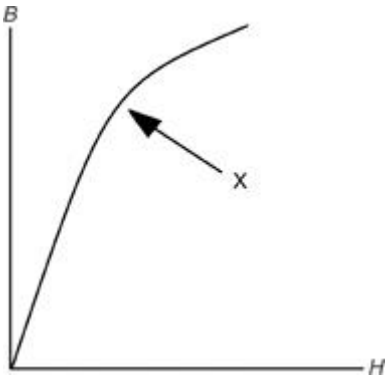
a) $\mu = B \times H$
b) $\mu = B/H$
c) $\mu = H/B$

68. The relationship between absolute permeability, $\mu$, relative permeability, $\mu_r$, and the permeability of free-space, $\mu_0$, is given by:

a) $\mu = \mu_0 \times \mu_r$
b) $\mu = \mu_0/\mu_r$
c) $\mu = \mu_r/\mu_0$

69. The relative permeability of steel is in the range:

a) 1 to 10
b) 10 to 100
c) 100 to 1000




**A.28**

70. The feature marked *X* on the *B–H* curve shown in Figure A.28 is:

a) saturation
b) reluctance
c) hysteresis

## Inductance and inductors

71. Which of the following is the symbol and abbreviated units for inductance?

a) Symbol, *I*; unit, L
b) Symbol, *L*; unit, H
c) Symbol, *H*; unit, L

72. Which of the following materials is suitable for use as the coil winding of an inductor?

a) brass
b) copper
c) steel

73. Which of the following materials is suitable for use as the laminated core of an inductor?

a) brass
b) copper
c) steel

74. Lenz's Law states that:

a) the reluctance of a magnetic circuit is zero
b) an induced e.m.f. will always oppose the motion that created it
c) the force on a current-carrying conductor is proportional to the current flowing

75. The inductance of a coil is directly proportional to the:

a) current flowing in the coil
b) square of the number of turns
c) mean length of the magnetic path

76. The inductance of a coil can be increased by

a) a low number of turns
b) a high permeability core
c) wire having a low resistance

**DC motor and generator theory**

77. The commutator in a DC generator is used to:

a) provide a means of connecting an external field current supply
b) periodically reverse the connections to the rotating coil winding
c) disconnect the coil winding when the induced current reaches a maximum value

78. The core of a DC motor/generator is laminated in order to:

a) reduce the overall weight of the machine
b) reduce eddy currents induced in the core
c) increase the speed at which the machine rotates

79. The brushes fitted to a DC motor/generator should have:

a) low coefficient of friction and low contact resistance
b) high coefficient of friction and low contact resistance
c) low coefficient of friction and high contact resistance

80. A feature of carbon brushes used in DC motors and generators is that they are:

a) self-lubricating
b) self-annealing
c) self-healing

81. Self-excited generators derive their field current from:

a) the current produced by the armature
b) a separate field current supply
c) an external power source

82. In a series-wound generator:

a) none of the armature current flows through the field
b) some of the armature current flows through the field
c) all of the armature current flows through the field

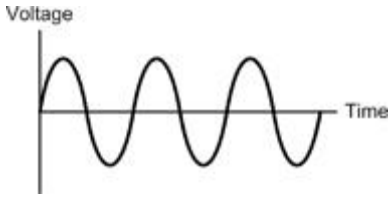
83. In a shunt-wound generator:

a) none of the armature current flows through the field
b) some of the armature current flows through the field
c) all of the armature current flows through the field

84. A compound-wound generator has:

a) only a series field winding
b) only a shunt field winding
c) both a series and a shunt field winding

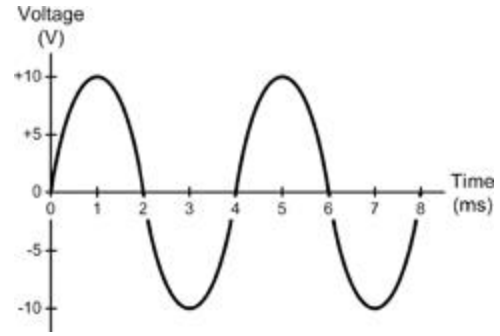
**AC theory**




**A.29**

85. Figure A.29 shows a waveform that is a:

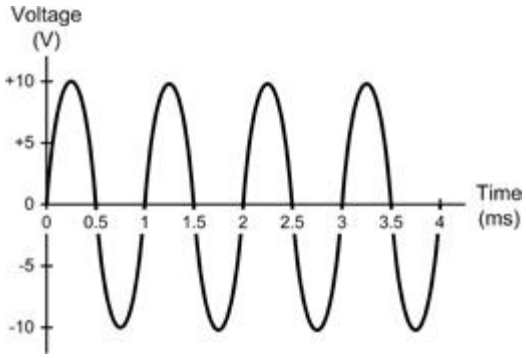
a) square wave
b) sine wave
c) triangle wave




**A.30**

86. Figure A.30 shows an AC waveform. The periodic time of the waveform is:

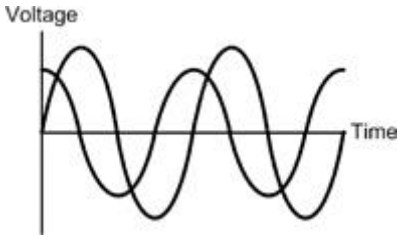
a) 1 ms
b) 2 ms
c) 4 ms




**A.31**

87. Figure A.31 shows an AC waveform. The amplitude of the waveform is:

a) 5 V
b) 10V
c) 20 V




**A.32**

88. Figure A.32 shows two AC waveforms. The phase angle between these waveforms is:

a) 45°
b) 90°
c) 180°

89. An AC waveform has a frequency of 400 Hz. Which of the following is its period?

a) 2.5 ms
b) 25 ms
c) 400 ms

90. An AC waveform has a period of 4 minutes. Which of the following is its frequency?

a) 25 Hz
b) 250 Hz
c) 4 kHz

91. Which of the following is the angle between the successive phases of a three-phase supply?

a) 60°
b) 90°
c) 120°

92. An aircraft supply has an r.m.s value of 115 V. Which of the following is the approximate peak value of the supply voltage?

a) 67.5 V
b) 115V
c) 163V

93. The peak value of current supplied to an aircraft TRU is 28 A. Which of the following is the approximate value of r.m.s. current supplied?

a) 10 A
b) 14 A
c) 20 A

**Resistive, capacitive and inductive circuits**

94. A circuit consisting of a pure capacitance is connected across an AC supply. Which of the following is the phase relationship between the voltage and current in this circuit?

a) The voltage leads the current by 90°
b) The current leads the voltage by 90°
c) The current leads the voltage by 180°

95. An inductor has an inductive reactance of 50 Ω and a resistance of 50 Ω. Which of the following is the phase relationship between the voltage and current in this circuit?

a) The current leads the voltage by 45°

b) The voltage leads the current by 45°
c) The voltage leads the current by 90°

96. A capacitor having negligible resistance is connected across a 115 V AC supply. If the current flowing in the capacitor is 0.5 A, which of the following is its reactance?

a) 0 Ω
b) 50 Ω
c) 230 Ω

97. A pure capacitor having a reactance of 100 Ω is connected across a 200VAC supply. Which of the following is the power dissipated in the capacitor?

a) 0 W
b) 50 W
c) 400 W

98. The power factor in an AC circuit is defined as the:

a) ratio of true power to apparent power
b) ratio of apparent power to true power
c) ratio of reactive power to true power

99. The power factor in an AC circuit is the same as the:

a) sine of the phase angle
b) cosine of the phase angle
c) tangent of the phase angle

100. An AC circuit consists of a capacitor having a reactance of 40 Ω connected in series with a resistance of 30 Ω. Which of the following is the impedance of this circuit?

a) 10 Ω
b) 50 Ω
c) 70 Ω

101. An AC circuit consists of a pure inductor connected in parallel with a pure capacitor. At the resonant frequency, the:

a) impedance of the circuit will be zero
b) impedance of the circuit will be infinite
c) impedance of the circuit will be the same as at all other frequencies

**Transformers**

102. A transformer has 2400 primary turns and 600 secondary turns. If the primary is supplied from a 220V AC supply, which of the following is the resulting secondary voltage:

a) 55V
b) 110V
c) 880V

103. Two inductive coils are placed in close proximity to one another. Minimum flux linkage will occur between the coils when the relative angle between them is:

a) 0°
b) 45°
c) 90°

104. The primary and secondary voltage and current for an aircraft transformer are given in the table below:

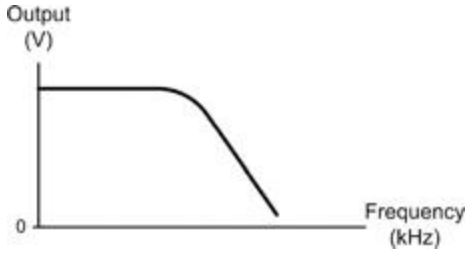
| | Primary | Secondary |
|---|---|---|
| Voltage (V) | 110 | 50 |
| Current (A) | 2 | 4 |

Which of the following is the approximate efficiency of the transformer?

a) 63%
b) 85%
c) 91%

105. The "copper loss" in a transformer is a result of:

a) the $I^2R$ power loss in the transformer windings
b) the power required to magnetize the core of the transformer
c) eddy currents flowing in the magnetic core of the transformer

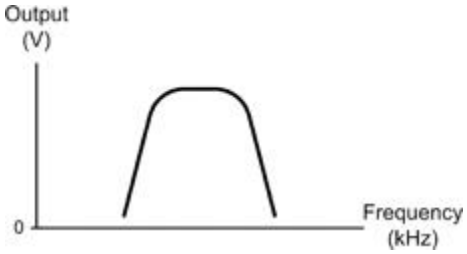



**A.33**

**Filters**

106. The frequency response shown in Figure A.33 represents the output of a:

a) low-pass filter
b) high-pass filter
c) band-pass filter




**A.34**

107. The frequency response shown in Figure A.34 represents the output of a:

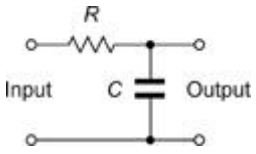
a) low-pass filter
b) high-pass filter
c) band-pass filter

108. Signals at 10 kHz and 400 Hz are present in a cable. The 10 kHz signal can be removed by means of an appropriately designed:

a) low-pass filter
b) high-pass filter
c) band-pass filter

109. Signals at 118, 125 and 132 MHz are present in the feeder to an antenna. The signals at 118 and 132 MHz can be reduced by means of a:

a) low-pass filter
b) high-pass filter
c) band-pass filter




**A.35**

110. The circuit shown in Figure A.35 is a:

a) low-pass filter
b) high-pass filter
c) band-pass filter

**AC generators**

111. The slip rings in an AC generator provide a means of:

a) connecting an external circuit to a rotating armature winding
b) supporting a rotating armature without the need for bearings
c) periodically reversing the current produced by an armature winding

112. Decreasing the field current in a generator will:

a) decrease the output voltage
b) increase the output voltage
c) increase the output frequency

113. A single-phase AC generator has 12 poles and it runs at 600 rpm. Which of the following is the output frequency of the generator?

a) 50 Hz
b) 60 Hz
c) 120 Hz

114. In a star-connected three-phase system, the line voltage is found to be 200 V. Which of the following is the approximate value of phase voltage?

a) 67 V
b) 115V
c) 346 V

115. In a delta-connected three-phase system, the phase current is found to be 2 A. Which of the following is the approximate value of line current?

a) 1.2 A
b) 3.5 A
c) 6 A

116. In a balanced star-connected three-phase system the line current is 2 A and the line voltage is 110 V. If the power factor is 0.75 which of the following is the total power in the load?

a) 165 W
b) 286 W
c) 660 W

**AC motors**

117. The rotor of an AC induction motor consists of a:

a) laminated iron core inside a “squirrel cage” made from copper or aluminium
b) series of coil windings on a laminated iron core with connections via slip rings
c) single copper loop which rotates inside the field created by a permanent magnet

118. The slip speed of an AC induction motor is the difference between the:

a) synchronous speed and the rotor speed
b) frequency of the supply and the rotor speed
c) maximum speed and the minimum speed

119. When compared with three-phase induction motors, single-phase induction motors:

a) are not inherently “self-starting”
b) have more complicated stator windings
c) are significantly more efficient

120. The use of laminations in the construction of an electrical machine is instrumental in reducing the:

a) losses
b) output
c) weight

**MODULE 4**

These example questions follow the sections of Module 4 in the Part-66 syllabus. *Remember that all of these questions must be attempted without the use of a calculator* and that the pass mark for all Part-66 multiple-choice examinations is 75%.

**Semiconductors**

1. Which of the following materials are semiconductors:

a) aluminium and copper
b) germanium and silicon
c) aluminium and zinc

2. The connections on a diode are labelled:

a) anode and cathode
b) collector and emitter
c) source and drain

3. The stripe on a plastic encapsulated diode usually indicates the:

a) anode connection
b) cathode connection
c) earth or ground connection

4. The direction of conventional current flow in a diode is from:

a) anode to cathode
b) cathode to anode
c) emitter to collector

5. A diode will conduct when the:

a) anode is more positive than the cathode
b) cathode is more positive than the anode
c) collector is more positive than the emitter

6. An ideal diode would have:

a) zero forward resistance and infinite reverse resistance
b) infinite forward resistance and zero reverse resistance
c) zero forward resistance and zero reverse resistance

7. The region inside a diode where no free charge carriers exist is known as the:

a) conduction layer
b) depletion layer
c) insulation layer

8. When a diode is forward biased it exhibits:

a) zero resistance
b) a very low resistance
c) a very high resistance

9. When a diode is reverse biased it exhibits:

a) zero resistance
b) a very low resistance
c) a very high resistance

10. Which of the following is the approximate forward voltage drop for a silicon diode?

a) 0.2 V
b) 0.6 V
c) 1.2V

11. Which of the following is the approximate forward voltage drop for a germanium diode?

a) 0.2 V
b) 0.6 V
c) 1.2V

12. Which of the following is a typical value of forward current for a small-signal silicon signal diode?

a) 10 mA
b) 1 A
c) 10 A

13. Which of the following is a typical maximum reverse voltage rating for a small-signal silicon signal diode?

a) 0.6 V
b) 5 V
c) 50 V

14. Which of the following is a typical maximum forward current rating for a silicon rectifier?

a) 10 mA
b) 100 mA
c) 3 A

15. A diode has the following specifications: Forward voltage of 0.2 V at 1 mA forward current; Maximum forward current of 25 mA; Maximum reverse voltage of 50 V. A typical application for this diode is a:

a) rectifier in a power supply
b) voltage regulator reference
c) signal detector in a radio receiver

16. A diode has the following specifications: Forward voltage of 0.7 V at 1 A forward current; Maximum forward current of 5 A; Maximum reverse voltage of 200 V. A typical application for this diode is a:

a) rectifier in a power supply
b) voltage regulator reference
c) signal detector in a radio receiver

**A.36**

17. The device shown in Figure A.36 is a:

a) rectifier diode
b) light emitting diode
c) silicon controlled rectifier

**A.37**

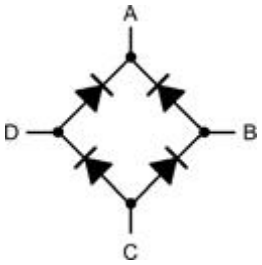
18. The device shown in Figure A.37 is a:

a) signal diode
b) light emitting diode
c) varactor diode

**A.38**

19. The device shown in Figure A.38 is a:

a) signal diode
b) light emitting diode
c) Zener diode




**A.39**

20. The alternating current input to the bridge rectifier shown in Figure A.39 should be connected at terminals:

a) A and B
b) A and C
c) B and D

21. The connections to a silicon controller rectifier are labelled:

    a) emitter, base and collector
    b) anode, cathode and gate
    c) source, drain and gate

22. A typical application for a rectifier diode is:

    a) detecting signals in a radio receiver
    b) converting alternating current to direct current in a power supply
    c) switching current in an alternating current power controller

23. A typical application for a silicon controlled rectifier is:

    a) detecting signals in a radio receiver
    b) converting alternating current to direct current in a power supply
    c) switching current in an alternating current power controller

24. A typical application for a varactor diode is:

    a) detecting signals in a radio receiver
    b) converting alternating current to direct current in a power supply
    c) varying the frequency of a tuned circuit

25. A typical application for a Zener diode is:

    a) regulating a voltage supply
    b) controlling the current in a load
    c) acting as a variable capacitance in a tuned circuit

26. The connections to a Zener diode are labelled:

    a) source and drain
    b) anode and cathode
    c) collector and emitter

27. When a reverse voltage of 4.7 V is applied to a Zener diode, a current of 25 mA flows through it. When 4.8 V is applied to the diode, the current flowing is likely to:

    a) fall slightly
    b) remain at 25 mA
    c) increase slightly

28. When a reverse voltage of 6.2 V is applied to a Zener diode, a current of 25 mA flows through it. When a reverse voltage of 3.1 V is applied to the diode, the current flowing is likely to:

a) be negligible
b) increase slightly
c) fall to about 12.5 mA

29. Which of the following types of diode emits visible light when current flows through it?

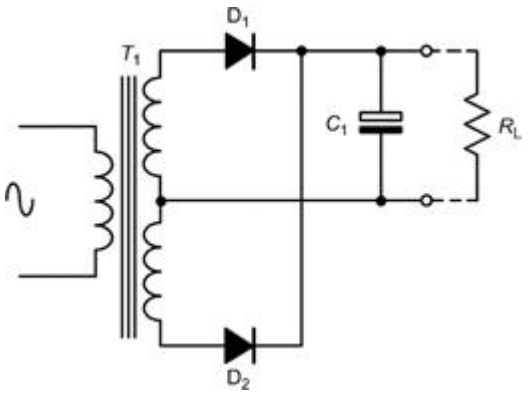
a) A light emitting diode
b) A photodiode
c) A zener diode

30. Which of the following gives the typical forward current for a light emitting diode?

a) 2 mA
b) 20 mA
c) 200 mA

31. The forward voltage drop for a light emitting diode is approximately:

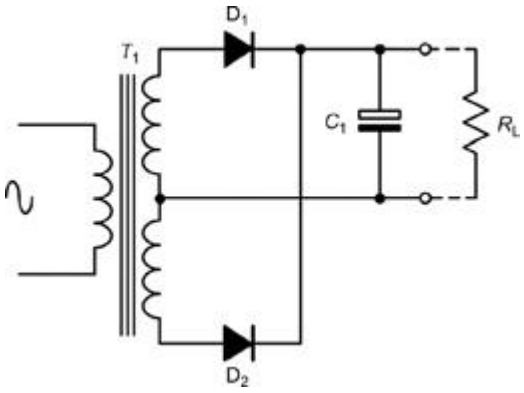
a) 0.2 V
b) 0.6 V
c) 2 V




**A.40**

32. The output of the circuit shown in Figure A.40 will consist of a:

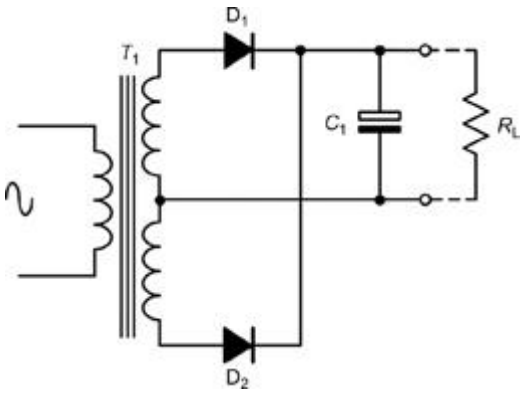
a) sine-wave voltage
b) square-wave voltage
c) steady direct current voltage




**A.41**

33. The function of $C_1$ in the circuit shown in Figure A.41 is to:

a) form a load with $R_1$
b) act as a reservoir
c) block direct current at the output




**A.42**

34. The circuit provided in Figure A.42 shows a:

a) full-wave power supply
b) half-wave power supply
c) regulated power supply

**A.43**

35. The device shown in Figure A.43 is:

a) an NPN bipolar junction transistor
b) a PNP bipolar junction transistor
c) a junction gate field effect transistor

36. The connections to a JFET are labelled:

a) collector, base and emitter
b) anode, cathode and gate
c) source, gate and drain

37. In normal operation of a bipolar junction transistor the:

a) base–emitter junction is forward biased and the collector–base junction is reverse biased
b) base–emitter junction is reverse biased and the collector–base junction is forward biased
c) both junctions are forward biased

38. Which of the following statements is true?

a) The base current for a transistor is very much smaller than the collector current
b) The base current for a transistor is just slightly less than the emitter current
c) The base current for a transistor is just slightly greater than the emitter current

39. Corresponding base and collector currents for a transistor are $I_B$ = 1 mA and $I_C$ = 50 mA. Which of the following is the value of common-emitter current gain?

a) 0.02
b) 49
c) 50

40. The corresponding base and collector currents for a transistor are $I_B$ = 1 mA and $I_C$ = 50 mA. Which of the following is the value of emitter current?

a) 49 mA
b) 50 mA
c) 51 mA

41. If the emitter current of a transistor is 0.5 A and the collector current is 0.45 A, which of the following is the base current?

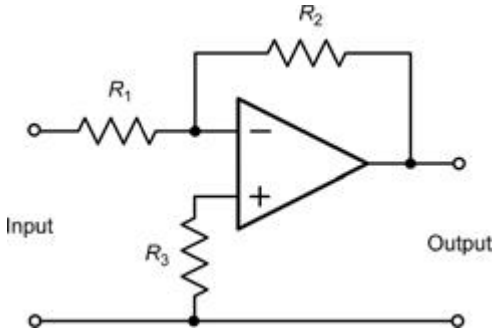
a) 0.05 A
b) 0.4 A
c) 0.95 A

42. The common-emitter current gain of a transistor is found from the ratio of:

a) collector current to base current
b) collector current to emitter current
c) emitter current to base current

43. The input resistance of a transistor in common-emitter mode is found from the ratio of:

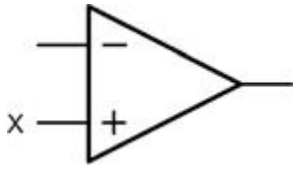
a) collector-base voltage to base current
b) base–emitter voltage to base current
c) collector–emitter voltage to emitter current




**A.44**

44. The voltage gain produced by the circuit shown in Figure A.44 will depend on the:

a) ratio of $R_1$ to $R_2$
b) ratio of $R_1$ to $R_3$
c) ratio of $R_2$ to $R_1$




**A.45**

45. The terminal marked “X” in Figure A.45 is the:

a) inverting input
b) non-inverting input
c) positive supply connection

## Printed circuits

46. The tracks on a printed circuit board are made from:

a) aluminium
b) copper
c) steel

47. The width of the track on a printed circuit board determines the:

a) voltage that can be carried

b) current that can be carried
c) speed at which information can be carried

48. Printed circuit board edge connectors are frequently gold plated. This is because it:

a) increases the contact resistance
b) improves contact reliability
c) reduces contact friction

49. Which of the following is *not* a suitable material for manufacturing a printed circuit board:

a) glass fibre
b) synthetic resin bonded paper
c) polystyrene

50. A surface mounted device is attached to a printed circuit board using:

a) pins and holes
b) contact pads
c) terminal pins

51. A cable is attached to a printed circuit board using an indirect printed circuit board connector. This connecting arrangement uses a:

a) header to terminate the cable
b) series of soldered connections at the end of the cable
c) number of individual crimped connections

**Servomechanisms**

52. A servo-based position control system is an example of:

a) an open-loop system
b) an automatic closed-loop system
c) a system that exploits positive feedback

53. The output from a control system is usually referred to as the:

a) set point
b) error signal
c) controlled variable

54. The input to a control system is usually referred to as the:

a) set point
b) error signal

c) controlled variable

55. In a control system the difference between the desired value and the actual value of the output is referred to as the:

a) error signal
b) demand signal
c) feedback signal

56. A signal that varies continuously from one level to another is called:

a) an error signal
b) a digital signal
c) an analogue signal

57. Digital signals vary:

a) in discrete steps
b) continuously between set levels
c) slowly from one level to another level

58. In a digital control system values are represented by an eight-bit code. How many different values are possible in this system?

a) 8
b) 80
c) 256

59. A digital control system is required to have a resolution of 2%. With how many bits should it operate?

a) 4
b) 5
c) 6

60. Which of the following is an input transducer?

a) An actuator
b) A motor
c) A potentiometer

61. Which of the following is an output transducer?

a) A heater
b) A photodiode
c) A potentiometer

62. A target modifies the electric field generated by a sensor. This is the principle of the:

a) optical proximity sensor
b) inductive proximity sensor
c) capacitive proximity sensor

63. A foil element with polyester backing is resin bonded to mechanical component. This is the principle of the:

a) resistive strain gauge
b) inductive strain gauge
c) capacitive strain gauge

64. Which of the following sensors produces a digital output?

a) Magnetic reed switch
b) Piezoelectric strain gauge
c) Light-dependent resistor

65. Which of the following is an active sensor?

a) Tachogenerator
b) Resistive strain gauge
c) Light-dependent resistor

66. Minimum flux linkage will occur when two coils are aligned at a relative angle of:

a) 0°
b) 45°
c) 90°

67. A differential transformer is made from:

a) U- and I-laminations
b) E- and I-laminations
c) E- and H-laminations

68. The reference voltage in a differential transformer is applied to a winding on:

a) the centre limb of the E-lamination
b) all three limbs of the E-laminations
c) one of the outer limbs of the E-lamination

69. The laminations of a differential transformer are usually made from:

a) ceramic material
b) low-permeability steel

c) high-permeability steel

70. Identical root mean square voltages of 26 V are measured across each of the secondary windings of a differential transformer. Which of the following is the value of output voltage produced by the transformer?

a) 0V
b) 26V
c) 52 V

71. A synchro-transmitter is sometimes also referred to as a:

a) linear transformer
b) variable transformer
c) differential transformer

72. How many stator connections are there in a synchro-transmitter?

a) 1
b) 2
c) 3

73. The alternating current supply to a synchro-transmitter is connected to the connections marked:

a) $R_1$ and $R_2$
b) $S_1$ and $S_2$
c) $S_1$, $S_2$ and $S_3$

74. A synchro-resolver has multiple rotor and stator windings spaced by:

a) 45°
b) 90°
c) 120°

75. A conventional synchro-transmitter has stator windings spaced by:

a) 45°
b) 90°
c) 120°

76. When a synchro-transmitter and -receiver system are in correspondence the current in the stator windings will:

a) be zero
b) take a maximum value
c) be equal to the supply current

77. Which two synchro leads should be reversed in order to reverse the direction of a synchro-receiver relative to a synchro-transmitter?

a) $R_1$ and $R_2$
b) $S_1$ and $S_2$
c) $S_1$ and $S_3$

78. An open-loop control system is one in which:

a) no feedback is applied
b) positive feedback is applied
c) negative feedback is applied

79. A closed-loop control system is one in which:

a) no feedback is applied
b) positive feedback is applied
c) negative feedback is applied

80. In a closed-loop system the error signal can be produced by:

a) an amplifier
b) a comparator
c) a tachogenerator

81. The range of outputs close to the zero point that a control system is unable to respond to is referred to as:

a) hunting
b) deadband
c) overshoot

82. Overshoot in a control system can be reduced by

a) increasing the gain
b) reducing the damping
c) increasing the damping

83. The output of a control system cycles continuously above and below the required value. This characteristic is known as:

a) hunting
b) deadband
c) overshoot

## MODULE 8

The example questions set out below follow the sections of Module 8 in the EASA Part-66 syllabus. In addition there are questions on aircraft manual flying controls. It is felt that an introduction to control and controllability must accompany the knowledge required on aircraft stability that forms a core element of this module.

Please note that for this module there are only a few questions that are considered inappropriate for those strictly following the Category A pathway and these have been annotated as B1, B2, B3. However, the authors feel that it would be to the advantage of potential Category A mechanics if they studied this module at the Category B level. All questions have thus been designed to test the knowledge required to the highest Category B certifying technician level, in line with the chapter content.

Remember, again, that *all questions must be attempted without the use of a calculator* and that the pass mark for all Part-66 multiple-choice examinations is 75%.

1. The composition by volume of the gases in the atmosphere is:

   a) 78% oxygen, 21% nitrogen 1% other gases
   b) 78% nitrogen, 21% oxygen, 1% other gases
   c) 81% oxygen 18% nitrogen, 1% other gases

2. The layer of the atmosphere next to the surface of the earth is called:

   a) Ionosphere
   b) Stratosphere
   c) Troposphere

3. Approximately 75% of the mass of the gases in the atmosphere is contained in the layer known as the:

   a) Chemosphere
   b) Stratosphere
   c) Troposphere

4. If the temperature of the air in the atmosphere increases but the pressure remains constant, the density will:

   a) decrease
   b) increase
   c) remain the same

5. In the ICAO standard atmosphere (ISA), the stratosphere commences at an altitude of:

   a) 11 km
   b) 30 km
   c) 11,000 feet

6. In the ISA, the mean sea-level temperature is set at:

   a) 15 K
   b) 288°C
   c) 288 K

7. In the ISA, the mean sea-level density is set at:

   a) 1.2256 kg/m$^3$
   b) 1.01325 kg/m$^3$
   c) 14.7 kg/m$^3$

8. With increase in altitude, with respect to the pressure and density in the atmosphere:

   a) pressure increases, density decreases
   b) pressure decreases, density increases
   c) both decrease

9. The temperature at the tropopause in the ISA atmosphere is approximately:

   a) 15 K
   b) –56°C
   c) –56 K

10. The transition level between the troposphere and stratosphere is known as:

    a) Tropopause
    b) Stratopause
    c) Chemopause

11. The rate of decrease of temperature in the first layer of the ISA atmosphere is assumed linear and is given by the formula: [B1, B2, B3]

    a) $T_0 = T_h - L\text{h}$
    b) $L\text{h} = T_0 - T_\text{h}$
    c) $T_\text{h} = T_0 - L\text{h}$

12. With increase in altitude, the speed of sound will:

    a) increase
    b) decrease
    c) remain the same

13. If the density ratio at an altitude in the ISA is 0.5, then the density at that altitude will be approximately:

    a) 2.4512 kg/m$^3$

b) 1.2256 kg/m$^3$
c) 0.6128 kg/m$^3$

14. Given that the speed of sound at altitude may be estimated from the relationship $a = 20.05\sqrt{T}$, then the speed of sound at the tropopause in the ISA will be approximately: [B1, B2, B3]

a) 400 m/s
b) 340 m/s
c) 295 m/s

15. The dynamic viscosity of the air in the ISA is given a value of:

a) $1.789 \times 10^{-5}$ N.s/m$^2$
b) 6.5 K/km
c) 9.80665 m/s$^2$

16. Bernoulli's theorem is represented by the equation:

a) $p + V$ = constant
b) $pT + \rho V^2$ = constant
c) $p + \frac{1}{2}\rho v^2 = \text{constant}$

17. The component of the total reaction that acts parallel to the relative airflow is known as:

a) lift
b) drag
c) thrust

18. Flow in which the particles of the fluid move in an orderly manner and maintain the same relative positions in successive cross-sections is known as:

a) turbulent flow
b) streamline flow
c) downwash flow

19. The dimension from port wing tip to starboard wing tip is known as:

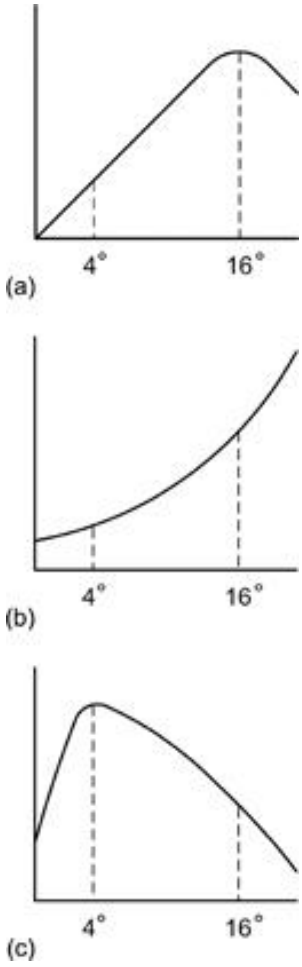
a) wing span
b) wing chord
c) aspect ratio

20. The mean camber line is defined as:

a) the line drawn halfway between the upper and lower curved surfaces of an aerofoil
b) the line joining the centre of curvature of the trailing and leading edge of an aerofoil
c) the straight line running from wing root to wing tip

21. The angle of attack (AOA) is defined as:

a) the angle between the relative airflow and the longitudinal axis of the aircraft
b) the angle between the chord line and the relative airflow
c) the angle between the maximum camber line and the relative airflow




**A.46**

22. Which of the three graphs (Figure A.46) correctly shows the relationship between $C_L$ and angle of attack for a symmetrical aerofoil?

23. The angle of incidence:

a) is a fixed rigging angle on conventional layout aircraft
b) varies with aircraft attitude
c) is altered using the tailplane

24. A primary reason for having thin aerofoil sections on high-speed aircraft is to:

a) increase the speed of the relative airflow over the top surface of the aerofoil section
b) help reduce the time spent in the transonic range
c) increase the fuel dispersion throughout the wing and improve handling quality

25. The lift created by a symmetrical aerofoil is due to:

a) decrease in pressure on both the upper and lower surfaces due to shape
b) increase in pressure on lower surface due to shape
c) downwash over upper surface and angle of attack of aerofoil

26. The efficiency of an aerofoil is measured using:

a) *W/L* ratio
b) *L/D* ratio
c) *T/L* ratio

27. Select the true statement:

a) the relative airflow changes direction in flight in relation to the pitching angle
b) the pitching angle differs in the same way as the AOA
c) the pitching angle remains constant with respect to the relative airflow

28. Once the stalling angle of an aerofoil has been reached the CP will:

a) move rapidly backwards to about the mid-chord position
b) move rapidly forwards towards the leading edge
c) oscillate rapidly around the CG

29. Boundary layer separation may be delayed using:

a) all moving tailplane
b) elevons
c) vortex generator

30. At the transition point the boundary layer becomes:

a) thicker with turbulent flow
b) thinner with turbulent flow
c) thinner with laminar flow

31. An equation for calculating the lift produced by an aerofoil is:

a) $\frac{1}{2}\rho VSC_L^2$
b) $\frac{1}{2}\rho V^2 SC_L$
c) $\frac{1}{2}\rho VSC_D$

32. The components of zero lift profile drag are:

a) skin friction drag, form drag and interference drag
b) induced drag, form drag and interference drag

c) skin friction drag, vortex drag and induced drag

33. Interference drag may be reduced by:

a) highly polished surface finish
b) high aspect ratio wings
c) fairings at junctions between fuselage wing

34. Form drag may be reduced by:

a) streamlining
b) highly polished surface finish
c) increased use of high lift devices

35. The term “wash-out” is defined as:

a) decrease of incidence towards the wing tip
b) increase of incidence towards the wing tip
c) a chord wise decrease in incidence angle

36. If lift increases, vortex drag:

a) increases
b) decreases
c) remains the same

37. The aspect ratio may be defined as:

a) span square/chord
b) span squared/area
c) chord/span

38. Profile drag:

a) is not affected by airspeed
b) increases with the square of the airspeed
c) decreases with the square of the airspeed

39. Tapered wings will produce:

a) less vortex drag than a non-tapered wing
b) more vortex drag than a non-tapered wing
c) the same vortex drag as a non-tapered wing

40. Glaze ice:

a) forms on the surface of a wing at a temperature below which frost is formed in the adjacent air

b) forms in freezing fog from individual water droplet particles
c) forms in freezing rain, where the air temperature and that of the airframe are both below freezing point

41. With respect to ice accretion and aircraft performance select the one correct statement:

a) Increases in lift and drag will occur as a result of changes to the wing section
b) A decrease in drag and increase in lift will occur due to decrease in friction over wing surface
c) Aerodynamic instability may occur

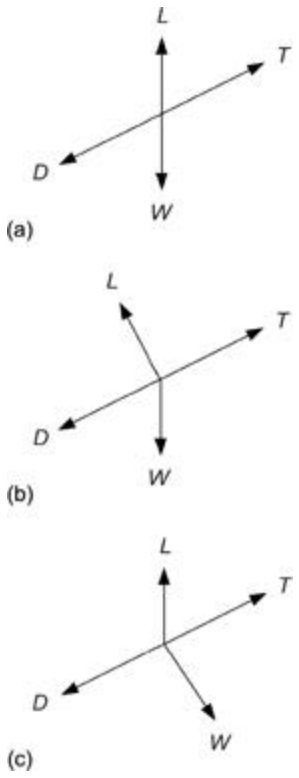
42. The ratio of the length of a streamlined body to its maximum diameter is the:

a) aspect ratio
b) thickness ratio
c) finess ratio

43. Which force system (Figure A.47) correctly shows the relationship between the forces acting on an aircraft in a steady climb?

44. To fly an aircraft close to the stalling speed, the aircraft must be flown with wings:

a) at a high AOA
b) at zero angle of incidence
c) at or near the angle of incidence




**A.47**

45. Stalling speed increases with increase in altitude because: [B1, B2, B3]

a) temperature decreases
b) air density decreases
c) the lift coefficient is increased

46. In a climb at steady speed the:

a) thrust is greater than the drag
b) thrust is equal to the drag
c) thrust is less than the drag

47. When climbing at constant speed with climb angle $\gamma$, the lift may be found from the relationship: [B1, B2, B3]

a) $L = W \sin \gamma$
b) $L = W \cos \gamma$
c) $L = D \cos \gamma$

48. The angle of bank for an aircraft in a steady turn may be calculated from the formula: [B1, B2, B3]

a) $\tan\theta = \frac{V^2}{gr}$
b) $\sin\theta = \frac{V^2}{gr}$
c) $\cos\theta = \frac{V^2}{gr}$

49. Aircraft load factor is found from the relationship:

a) lift/drag
b) lift/weight
c) weight/drag

50. The flight manoeuvring envelope is a means of displaying:

a) gust conditions requiring no further investigation
b) discharge coefficients
c) flight operating strength limitations

51. The taper ratio is the ratio of the wing:

a) tip chord to root chord
b) root thickness to tip thickness
c) root thickness to mean chord

52. If a disturbing force is removed from a body and the body immediately tends to return towards the equilibrium, then it is:

a) statically stable
b) dynamically stable
c) dynamically unstable

53. The function of the tailplane is to assist:

a) lateral stability about the longitudinal axis
b) longitudinal stability about the lateral axis
c) directional stability about the normal axis

54. If a disturbing force is removed from a body and the body settles in a position away from its previous equilibrium position, it is said to be:

a) statically stable
b) dynamically stable
c) neutrally stable

55. The function of the horizontal stabilizer is to assist:

a) lateral stability about the longitudinal axis
b) longitudinal stability about the lateral axis
c) lateral stability about the lateral axis

56. Spiral divergence is a form of: [B1, B2, B3]

a) lateral dynamic instability
b) longitudinal dynamic instability
c) lateral static stability

57. The effect on an aircraft subject to a nose-up pitching moment is:

a) to cause the CP to move backwards
b) an increase in the angle of attack
c) to cause a nose-down pitching moment

58. Phugoid motion is a form of: [B1, B2, B3]

a) longitudinal dynamic stability
b) directional dynamic instability
c) lateral dynamic instability

59. When an aircraft starts to roll, the effective angle of attack is:

a) increased on the up-going wing and decreased on the down-going wing

b) decreased on the up-going wing and increased on the down-going wing
c) increased on both wings

60. To ensure longitudinal stability in flight, the position of the CG should:

a) be aft of the neutral point
b) coincide with the neutral point
c) be forward of the neutral point

61. Anhedral is defined as:

a) the upward and outward inclination of the wings
b) the downward and outward inclination of the aircraft wings
c) the forward sloping canard stabilizer

62. The fin of an aircraft helps to provide a restoring moment when an aircraft:

a) dives
b) pitches
c) yaws

63. The dihedral angle of a wing provides a restoring moment when an aircraft:

a) climbs
b) pitches
c) rolls

64. On a swept wing aircraft that enters a sideslip the air velocity normal to the leading edge increases: [B1, B2]

a) on both wings
b) on the up-going wing
c) on the down-going wing

65. Control of yaw is mainly influenced by:

a) the fin
b) the rudder
c) the tailplane

66. Movement of an aircraft about its normal axis is called:

a) yawing
b) rolling
c) pitching

67. For a symmetrical aerofoil, downward deflection of a control surface:

a) increases both lift and drag
b) increases lift, decreases drag
c) decreases lift, increases drag

68. Different drag force between up-going and down-going ailerons is counteracted by:

a) aerodynamic balance control
b) static balance
c) differential aileron movement

69. The drag produced by aileron movement is:

a) greater on the down-going aileron
b) less on the down-going aileron
c) equal on both ailerons

70. At low speeds and at high angles of attack the wing with the down-going aileron may:

a) bend
b) stall
c) twist

71. At high speeds, the wing with the down-going aileron may:

a) turn at wing tip
b) yaw at the wing tip
c) twist at the wing tip

72. The frise type aileron is used to:

a) increase directional control
b) reduce high-speed aileron reversal
c) reduce aileron drag

**A.48**

73. The lift augmentation device shown in Figure A.48 is a:

a) plain flap
b) Kruger flap
c) split flap

74. A Fowler flap:

a) increases the wing camber and the angle of attack

b) increases the wing camber and reduces the effective wing area
c) increases the lift coefficient and stalling angle

**A.49**

75. The device shown at the leading edge of Figure A.49 is:

a) flap
b) slat
c) slot

76. All types of trailing edge flaps

a) decrease $C_{Lmax}$ and increase $C_D$
b) increase $C_{Lmax}$ and decrease $C_D$
c) increase both $C_{Lmax}$ and $C_D$

77. If air is blown over the top surface of an aerofoil from within, the effect is to:

a) reduce surface friction drag
b) increase the boundary layer and so reduce form drag
c) re-energize the boundary layer and delay separation

78. The device used to produce steady flight conditions and reduce control column forces to zero is called:

a) a servo-tab
b) a trim tab
c) a balance tab

79. The device used to assist the pilot to move the controls is called:

a) a servo-tab
b) a trim tab
c) a balance tab

80. A servo-tab is deflected:

a) in the same direction as the control surface
b) parallel to the direction of the control surface
c) in the opposite direction to the control surface

81. An anti-balance tab is used to:

a) reduce pilot control column forces to zero

b) assist the pilot to move the control
c) provide more feel to the control column

82. When the control column of a manual control system is pushed forward, a balance tab on the elevator would:

a) move to the neutral position
b) move down
c) move up