

Applied Analytics

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Module Code: ACMA4009 APPLIED ANALYTICS

1. Write down the base units for the following:

- a) Temperature
- b) Luminous Intensity
- c) Volume
- d) Displacement
- e) Time

Answers:

- a) Kelvin (K)
- b) Candela (cd)
- c) Cubic meter (m^3)
- d) Meter (m)
- e) Second (s)

2. Given that Pressure is defined as;

$$\text{Pressure} = \text{Force} / \text{Area}$$

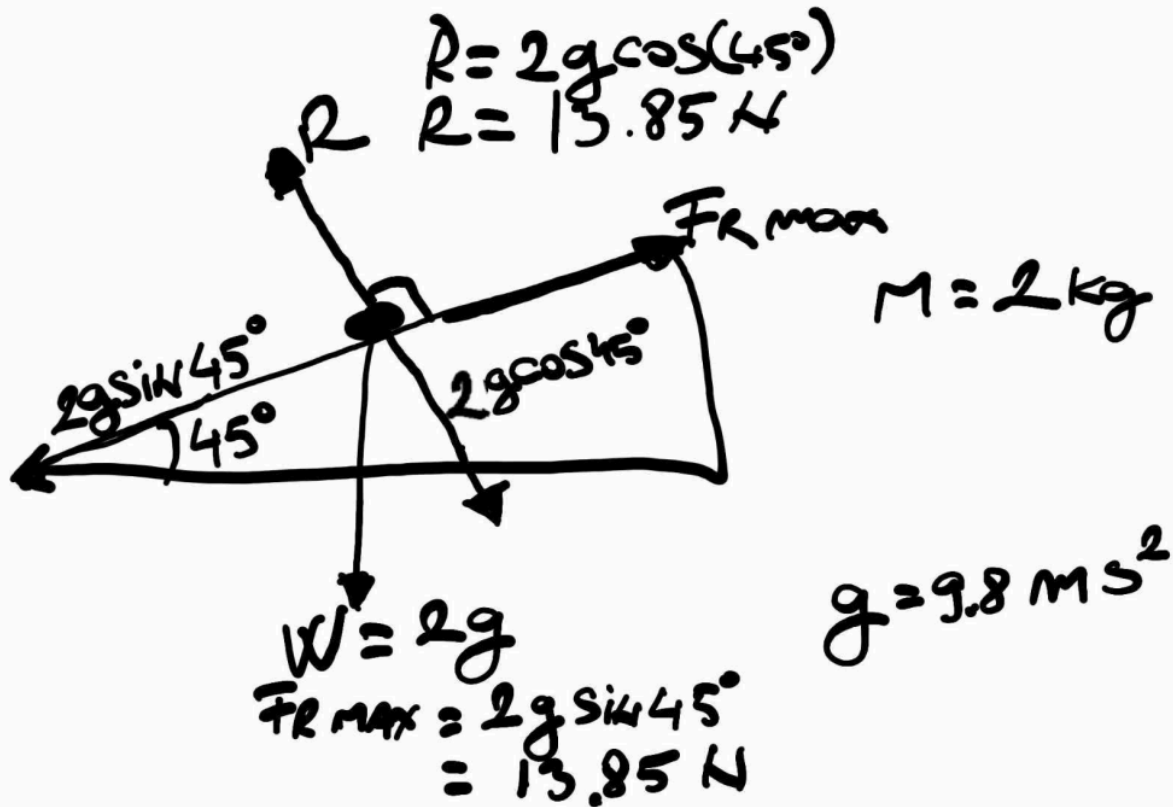
Write down the base units of Pressure.

Answer:

Pressure is defined as Force/Area. The base unit for Force is Newton, which is equivalent to $\text{kg}\cdot\text{m}/\text{s}^2$. The base unit for Area is square meter (m^2). Therefore, the base unit for Pressure is N/m^2 , which can also be written as $\text{kg}/(\text{m}\cdot\text{s}^2)$.

3. A body of mass 2kg rests in limiting equilibrium on a rough inclined plane, which is at an angle of 45° to the horizontal.
- a) Draw a free your answer booklet showing the frictional force, normal reaction and the body diagram in component of weight that acts down the slope.
 - b) Calculate the maximum magnitude of frictional force.
 - c) State which of the other forces are equal and give a reason why you can state this without calculation.
 - d) Calculate the magnitude of the normal reaction to the surface.

Answers:



In limiting equilibrium on an inclined plane, the following forces are equal:

- The component of the weight force acting parallel to the inclined plane
- The maximum frictional force

Reason:

Limiting equilibrium means the object is on the verge of sliding.

For this to happen, the forces acting parallel to the inclined plane must be balanced.

The component of the weight force acting parallel to the plane pulls the object downwards.

The maximum frictional force opposes this motion.

Since the object is not sliding, these two forces must be equal in magnitude.

4. Solve the following by factorising:

i) $x^2 - 5x + 6 = 0$

ii) $x^2 + 7x + 6 = 0$

iii) $x^2 + 10x = -25$

iv) $x^2 - 2x - 15 = 0$

v) $2x^2 + 3x + 1 = 0$

Answers:

a)

Handwritten solution for $x^2 - 5x + 6 = 0$:

$x^2 - 5x + 6 = 0$? + ? = 5
 ? x ? = 6

$(x - 2) \cdot (x - 3) = 0$

↓ or ↓

$x - 2 = 0$ $x - 3 = 0$
 $x = 2$ $x = 3$

b)

$$x^2 + 7x + 6 = 0$$

$$? + ? = 7$$

$$? \cdot ? = 6$$

$$(x + 1) \cdot (x + 6) = 0$$

$$\begin{array}{ccc} \downarrow & \text{or} & \downarrow \\ x + 1 = 0 & & x + 6 = 0 \\ x = -1 & & x = -6 \end{array}$$

c)

$$x^2 + 10x = -25$$

$$x^2 + 10x + 25 = 0$$

$$(x + 5)(x + 5) = 0$$

$$x + 5 = 0$$

$$x = -5$$

d)

$$\begin{aligned}x^2 - 2x - 15 &= 0 \\(x-5)(x+3) &= 0\end{aligned}$$

↓ OR ↓

$$\begin{array}{ll}x-5=0 & x+3=0 \\x=5 & x=-3\end{array}$$

e)

$$\begin{aligned}2x^2 + 3x + 1 &= 0 \\(2x+1)(x+1) &= 0\end{aligned}$$

↓ OR ↓

$$\begin{array}{ll}2x+1=0 & x+1=0 \\2x=-1 & x=-1 \\x=-0.5 & x=-1\end{array}$$

5. Solve the following (to 2d.p's) by using the **quadratic formula**:

a) $x^2 - 4x - 1 = 0$

$$x^2 - 4x - 1 = 0$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$a = 1$$

$$b = -4$$

$$c = -1$$

$$x = \frac{-(-4) \pm \sqrt{(-4)^2 - 4(1)(-1)}}{2(1)}$$

$$x = \frac{4 \pm \sqrt{16 + 4}}{2}$$

$$x = \frac{4 \pm \sqrt{20}}{2}$$

$$x = \frac{4 - \sqrt{5}}{2} = -0,23 \quad \text{OR}$$

$$x = \frac{4 + \sqrt{5}}{2} = 4,23$$

b) $2x^2 + 3x - 1 = 0$

$$2x^2 + 3x - 1 = 0$$
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$a = 2, b = 3, c = -1$$

$$x = \frac{-3 \pm \sqrt{3^2 - 4(2)(-1)}}{2(2)}$$

$$x = \frac{-3 \pm \sqrt{17}}{4}$$

$$x = \frac{-3 - \sqrt{17}}{4} = -1,78$$

$$x = \frac{-3 + \sqrt{17}}{4} = 0,28$$

6 Solve the following equations

a) $\frac{3(x-1)}{2} = \frac{x+2}{4}$

$$\frac{3(x-1)}{2} = \frac{x+2}{4}$$

$$2(3(x-1)) = x+2$$

$$6x - 6 = x + 2$$

$$6x - x = 2 + 6$$

$$5x = 8$$

$$x = \frac{8}{5} \text{ or } 1.6$$

b) $2x + 5y = 7$
 $3x + 2y = 5$

$$2x + 5y = 7 \quad \textcircled{A} \times 2$$

$$3x + 2y = 5 \quad \textcircled{B} \times 5$$

$$4x + 10y = 14$$

$$15x + 10y = 25$$

$$\textcircled{B} - \textcircled{A}$$

$$11x = 11$$

$$x = 1$$

$$2(1) + 5y = 7$$

$$2 + 5y = 7$$

$$5y = 5$$

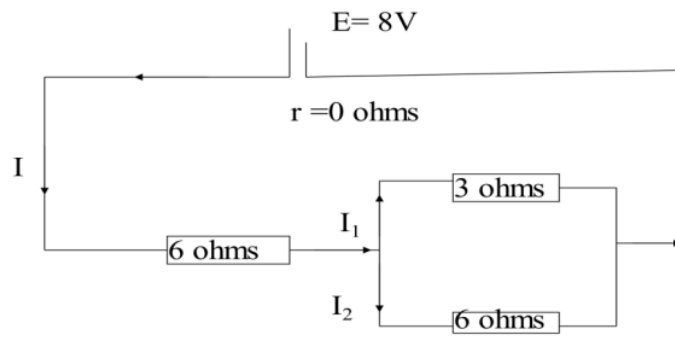
$$y = 1$$

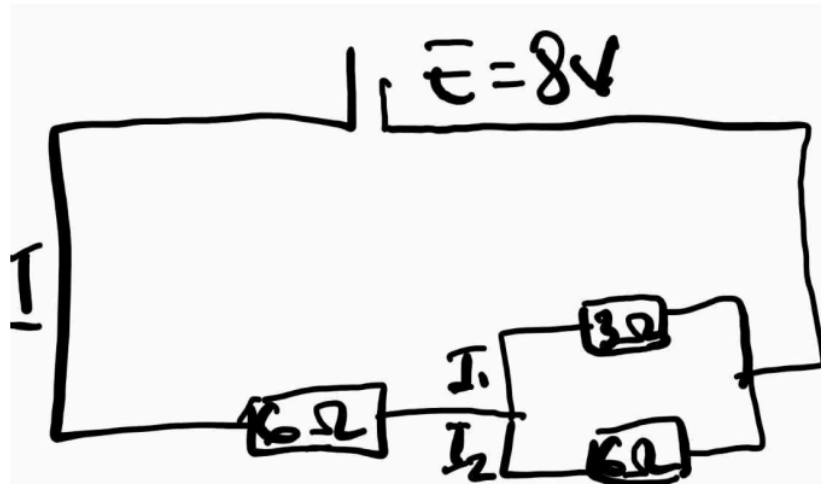
$$x = 1, y = 1$$

7. For the following electrical circuit :

Find:

- a) The total resistance of the circuit
- b) Current I_2 in the branched circuit.
- c) The power supplied by the cell





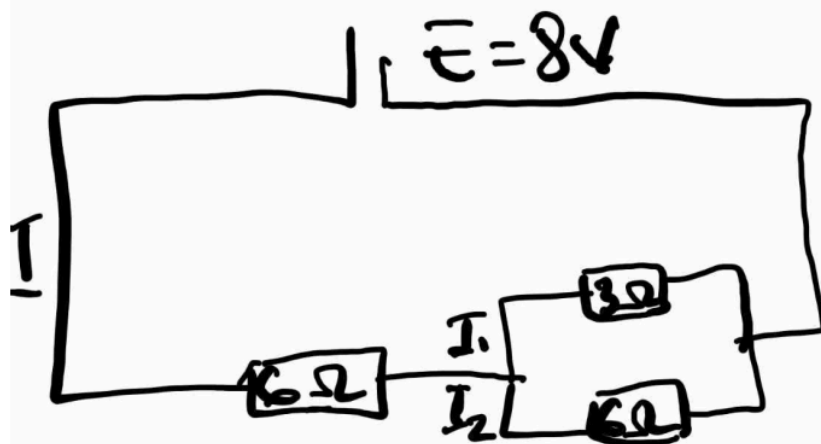
$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{3} + \frac{1}{6}$$

$$\frac{1}{R} = \frac{1}{2} \rightarrow R = 2\Omega$$

$$R_{\text{Total}} = 6\Omega + 2\Omega = 8\Omega$$

$$\bar{I} = \frac{\bar{\epsilon}}{R_T} = \frac{8V}{8\Omega} = 1A$$



$$V = I \times R = 1A \times 6\Omega = 6V$$

$$I_2 = \frac{V}{R} = \frac{6V}{3\Omega} = \underline{2A}$$

$$\text{Power } P = E \times I$$

$$8V \times 1A = 8W$$

Applied Analytics

GRADEMARK REPORT

FINAL GRADE

97 / 100

GENERAL COMMENTS

Q1 BASE UNITS

[5MARKS]

All correct [5 marks]

Q2 DERIVED UNITS

[5 MARKS]

All correct [5 marks]

Q3 EQUILIBRIUM OF AN OBJECT ON AN INCLINED PLANE

[11 MARKS]

All correct [11 marks]

Q4 SOLVING QUADRATIC EQUATIONS BY FACTORISING

[15 MARKS]

In c) $x = -5$ twice [14 marks]

Q5 SOLUTION OF QUADRATIC EQUATIONS BY FORMULA

[10 MARKS]

All correct [10 marks]

Q6 SIMULTANEOUS LINEAR EQUATIONS

[10 MARKS]

All correct

[10 marks]

Q7 SIMPLE ELECTRICAL CIRCUIT

[9 MARKS]

Error in calculating the PD across parallel resistors. 2
volts. Method is ok [7 marks].

total = 63/65 97%

Very well done!

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