

Sample paper 9

Question: 1

Dimensional formula of a physical quantity is given as $M^x L^y T^z$. If the dimensional formula of the physical quantity is the same as that of force, what would be the value of ?

- A. 0
- B. -1
- C. -4
- D. 1
- E. 2

Correct Answer: A

Explanation:

Dimensional formula of force is

$$MLT^{-2}$$

Dimensional formula of the physical quantity is same as that of force; hence, we can write

$$M^x L^y T^z = MLT^{-2}$$

Now, equating the exponents of common terms (M, L and T), we get

$$x = 1, y = 1 \text{ and } z = -1$$

$$x + y + z = 1 + 1 - 2$$

$$x + y + z = 0$$

Hence, A is the correct answer option.

Question: 2

A train at rest starts moving with a velocity of 30 m/s. If it reaches the next station in 30 minutes, what is the average acceleration of the train?

- A. $0.176m/s^2$
- B. $1m/s^2$
- C. $0.18m/s^2$
- D. $0.0167m/s^2$
- E. $0.0245m/s^2$

Correct Answer: D

Explanation:

Average acceleration is given as

$$\text{Average acceleration} = \text{Change in velocity} / \text{time taken}$$

$$\text{Change in velocity} = 30 - 0 \text{ Or Change in velocity} = 30m/s$$

Time taken is given in minutes so, we need to convert it into seconds.

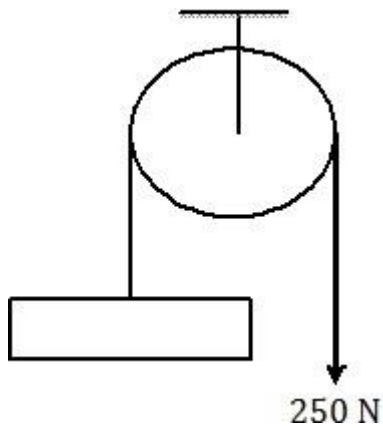
Average acceleration = $30 / 1800$

Average acceleration = 0.0167m/s

Hence, D is the correct answer option.

Question: 3

Consider the figure given below.



A plank of negligible mass contains “n” number of apples. If the weight of one apple is 0.5 N, how many apples can be supported by the plank, to keep the whole system at rest against the force applied?

- A. 250
- B. 300
- C. 500
- D. 125
- E. 100

Correct Answer: C

Explanation:

Weight of the “n” apples = Force (250 N)

Weight of “n” apples is

$$F = n \times 0.5 \text{ Or } F = 0.5n \text{ N}$$

$$0.5n = 250$$

$$n = 500$$

Hence, C is the correct answer option.

Question: 4

Force acting on a body of mass 10 kg changes its velocity from 3 m/s to 6.7 m/s in 20 seconds. What is the magnitude of the force applied on the body?

- A. 10 N
- B. 3.77 N
- C. 1.85 N
- D. 4.55 N
- E. 2.33 N

Correct Answer: C

Explanation:

The force applied on a body can make it move faster or slower or change its direction. Here, force changes (increases) the velocity of the body. Force is given as

$$F = m(v-u / t)$$

Putting the values in equation 1 we get

$$F = 10 (6.7-3 / 20) \text{ Or } F = 1.85 \text{ N}$$

Hence, C is the correct answer option.

Question: 5

What would be the work done by a force to stop a car of mass 500 kg moving with a velocity of 24 m/s?

- A. 144000 J
- B. 100000 J
- C. 12000 J
- D. 6000 J
- E. 169000 J

Correct Answer: A

Explanation:

Work-energy principle is given as

$$W = KE_2 - KE_1$$

$$W = 1/2 \times m(v^2-u^2)$$

$$1/2 \times 500 \times (0^2 - 24^2) \text{ Or } W = -144000 \text{ J}$$

Negative sign is because work is done in stopping the car (retardation). It would be coming in positive if the work is done in moving the car. Hence A is the correct answer option.

Question: 6

A stone is tied at one end of a string of length 1 m and rotated. The stone is rotating with a velocity of 2 m/s. If the tangential acceleration of the stone is 2.5 m/s², what is the net acceleration experienced by the stone?

- A. 3.22 m/s²
- B. 2.14m/s²
- C. 4.72m/s²
- D. 1.56m/s²
- E. 5.56m/s²

Correct Answer: C

Explanation:

Radial acceleration is given as

$$a_r = v^2 / r$$

$$a_r = 2^2 / 1 \text{ or } a_r = 4 \text{ m/s}^2$$

Net acceleration is given as

$$a = \sqrt{a_r^2 + a_t^2 + 2a_r a_t \cos\theta}$$

$$a = \sqrt{4^2 + 2.5^2 + (2 \times 4 \times 2.5 \times \cos 90^\circ)} \text{ or } a = \sqrt{4^2 + 2.5^2 + (2 \times 4 \times 2.5 \times 0)}$$

$$a = 4.72 \text{ m/s}^2$$

Hence, C is the correct answer option.

Question: 7

A vertical U tube contains water up to a height of 0.1 m (from the base). If the water of one side of the liquid column is lifted up and then released the liquid sets into oscillation, what is the time period of the oscillation?

- A. 0.72 s
- B. 0.63 s
- C. 0.345 s
- D. 0.512 s
- E. None of the given choices

Correct Answer: B

Explanation:

The time period of oscillating liquid in a U tube is given as

$$T = 2\pi \sqrt{h / g}$$

$$T = 2\pi \times \sqrt{0.1 / 9.8}$$

$$T = 0.63 \text{ s}$$

Hence, B is the correct answer option.

Question: 8

The weight of a block is 200 N in air. If the block is immersed completely in water, its weight becomes 120 N, what is the relative density of the block?

- A. 2.5
- B. 1.67
- C. 0.6
- D. 3.5
- E. 0.1

Correct Answer: A

Explanation:

RD = weight of body in air / loss of weight in water

loss of weight in water = Actual weight in air – weight in water;

Therefore, loss of weight in water = 200 – 120 = 80 N;

$$RD = 200 / 80$$

$$RD = 2.5$$

Hence, A is the correct answer option.

Question: 9

Air is filled in a piston of capacity 100 liters at 313 K. At what temperature should the piston be heated so that volume increases to 120 liters for an isobaric process?

- A. 375.6 K
- B. 373 K
- C. 300.45 K
- D. 413.5 K
- E. 343.7 K

Correct Answer: A

Explanation:

According to Charles' law

$$V_1/T_1 = V_2 / T_2$$

$$100/313 = 120/T_2$$

$$T_2 = 375.6 \text{ K}$$

Hence, A is the correct answer option.

Question: 10

The electric potential in a region at 2 m from a point charge is + 15 V. What is the magnitude and sign (positive/negative) of charge?

- A. $+2.45 \times 10^{-7} \text{ C}$
- B. $-1.12 \times 10^{-7} \text{ C}$
- C. $+5.67 \times 10^{-7} \text{ C}$
- D. $+3.33 \times 10^{-7} \text{ C}$
- E. $-4.77 \times 10^{-7} \text{ C}$

Correct Answer: D

Explanation:

Potential due to point charge is given as

$$V = 1/4\pi\epsilon_0 q/r$$

$$1/4\pi\epsilon_0 = 9 \times 10^9 \text{ Nm}^2\text{C}^{-2}$$

Putting the values in the equation we get

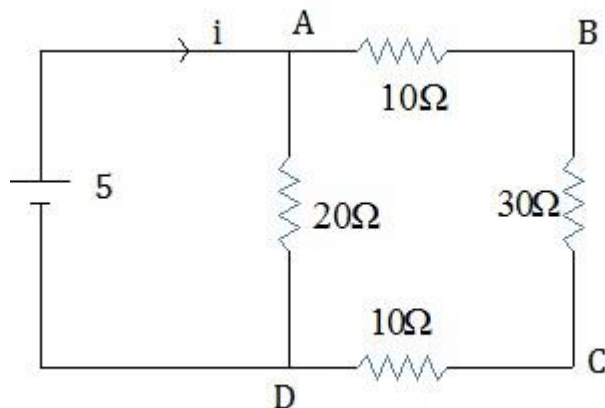
$$15 = 9 \times 10^9 \times q / 2$$

Since, the potential field in the region is positive, q must be positive.

Hence, D is the correct answer option.

Question: 11

Calculate the potential drop across the 30Ω resistance in the given circuit.



- A. 2V
- B. 1.5V
- C. 3V
- D. 4V
- E. 6V

Correct Answer: C

Explanation:

$$V_{\text{out}} = R_3 / R_1 + R_2 + R_3$$

$$V_{30} = (30/50) \times 5$$

$$V_{30} = 3V$$

Hence, the C is the correct option.

Question: 12

Find the pole strength of a magnet for which the magnetic moment is $6.1 \times 10^{-5} \text{Am}^2$ and the length of the magnet is 2 cm.

- A. $5.25 \times 10^{-5} \text{Am}^2$
- B. $4.45 \times 10^{-5} \text{Am}^2$
- C. $4.75 \times 10^{-5} \text{Am}^2$
- D. $3.05 \times 10^{-5} \text{Am}^2$
- E. $3.75 \times 10^{-5} \text{Am}^2$

Correct Answer: D

Explanation:

Magnetic moment is given in terms of pole strength and length of the magnet as

$$M = pl \text{ ----- (1)}$$

We have to convert length from cm to m. Therefore,

$$6.1 \times 10^{-5} = p \times 2 \times 10^{-2}$$

$$p = 6.1 \times 10^{-5} / 2 \times 10^{-2}$$

$$p = 3.05 \times 10^{-3}$$

Hence pole strength of the magnet is $3.05 \times 10^{-3} \text{ Am}$. Therefore D is the correct answer option.

Question: 13

An object of height 5 cm is kept at 8 cm from a concave mirror. If the image is formed at 10 cm, what is height of the image?

- A. 4.25cm
- B. 16cm
- C. 6.25cm
- D. 2.25cm
- E. 4.5cm

Correct Answer: C

Explanation:

Magnification is given as

$$m = -d_i / d_o = h_i / h_o$$

$$- 10/8 = h_i / 5$$

$$h_i = -6.25\text{cm}$$

Negative sign signifies that image is inverted. Hence, C is the correct answer option.

Question: 14

If an electron jumps from higher energy shell of energy E_2 to lower energy shell E_1 , what will be the wavelength of the photon emitted during the process?

- A. $h (c / E_1 - E_2)$
- B. $h (c / E_1 \times E_2)$
- C. $h (c / E_1 \div E_2)$
- D. $h (c / E_2)$
- E. $h (c / E_2 - E_1)$

Correct Answer: E**Explanation:**

Energy of photon is given as,

$$E = hf$$

Speed of a electromagnetic wave is given as

$$c = f\lambda$$

$$E = h (c/\lambda) \text{ Or } \lambda = h (c/E)$$

Since, an electron makes transition from higher energy shell to lower energy shell, difference between the energies will result in emission of photon.

$$\text{Therefore } \lambda = h (c / E_2 - E_1)$$

Hence, E is the correct answer option.

Question: 15

A particle in SHM has a time period of 3 s and amplitude of 0.1 m. What is the displacement of the particle after 1 s?

- A. 0.011 m
- B. 0.23 m
- C. 0.087 m
- D. 0.754 m
- E. Zero

Correct Answer: C

Explanation:

The general expression of displacement of a particle in SHM given as

$$y(t) = A \sin \left(\frac{2\pi}{T} t \right)$$

$$y(1) = 0.1 \times \sin \left[\frac{2\pi}{3} \times 1 \right] \text{ Or } y(1) = 0.1 \times \sin \left[\frac{2\pi}{3} \right]$$

$$y(1) = 0.1 \times \frac{\sqrt{3}}{2}$$

$$y(1) = 0.087 \text{ m}$$

Hence, C is the correct answer option.