

SERVANTBOY.COM - PHYSICS

Question 1

The force F between two point charges q_1 and q_2 , a distance r apart, is given by the equation

Where k is a constant.

$$F = \frac{kq_1q_2}{r^2}$$

What are the SI base units of k ? {Cambridge A level oct/nov 2016, ques 2, p11}

Solution

The SI base unit of force is Kgms^{-2}

Charge q_1 is As

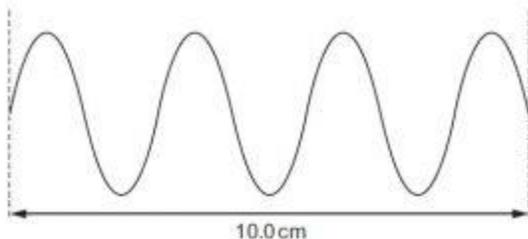
Charge q_2 is As

distance r is m

SI base unit of $k = (\text{Kgms}^{-2} \times \text{m}) / (\text{As} \times \text{As}) = \text{Kgm}^2\text{s}^{-4}\text{A}^{-2}$ (B is the correct option)

Question 2

A student uses a cathode-ray oscilloscope (C.R.O.) to measure the period of a signal. She sets the time-base of the C.R.O. to 5 ms cm^{-1} and observes the trace illustrated below. The trace has a length of 10.0 cm .



What is the period of the signal? {Cambridge A level oct/nov 2016, ques 5, p11}

Solution

From the graph there are 3.5 oscillations

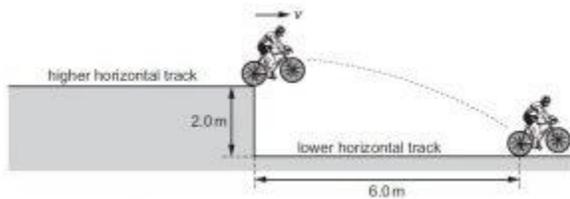
The distance to cover one oscillations = $10/3.5$ cm

Since the time-base of the c.r.o is 5 ms cm^{-1}

The period of the signal = $(10/3.5) \times 5 = 14.3 \text{ ms} = 1.4 \times 10^{-2} \text{ s}$ (D is the correct option)

Question 3

A cyclist pedals along a raised horizontal track. At the end of the track, he travels horizontally into the air and onto a track that is vertically 2.0 m lower.



The cyclist travels a horizontal distance of 6.0 m in the air. Air resistance is negligible.

What is the horizontal velocity v of the cyclist at the end of the higher track? {Cambridge A level oct/nov 2016, ques 6, p11}

Solution

There are important points to note in this question:

The horizontal velocity v is used to calculate the horizontal distance

The time to reach the maximum height is the time to travel the horizontal distance

At maximum height $u = 0$

Using $H = ut + \frac{1}{2}gt^2$

$$2 = 0 + \frac{1}{2} \times 9.81 \times t^2$$

$$(t = 0.6395 \text{ s})$$

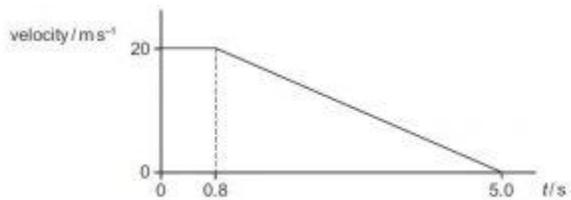
Horizontal distance = horizontal velocity(v) x time(t)

$$6 = 0.6395v$$

$$V = 9.4 \text{ms}^{-2} \text{ (B is the correct option)}$$

Question 4

A car is travelling at constant velocity. At time $t = 0$, the driver of the car sees an obstacle in the road and then brakes to a halt. The graph shows the variation with t of the velocity of the car.



How far does the car travel in the 5.0 s after the driver sees the obstacle? {Cambridge A level oct/nov 2016, ques 8, p11}

Solution

The distance travelled by the car = $20 \times 0.8 + \frac{1}{2} \times 20 \times (5 - 0.8) = 16 + 42 = 58\text{m}$ (C is the correct option)

Question 5

A car has mass m . A person needs to push the car with force F in order to give the car acceleration a . The person needs to push the car with force $2F$ in order to give the car acceleration $3a$.

Which expression gives the constant resistive force opposing the motion of the car? {Cambridge A level oct/nov 2016, ques 11, p11}

Solution

Resultant force = applied force – resistive force

$$Ma = F - R$$

$$R = F - ma \text{ ---i}$$

$$3ma = 2F - R$$

$$R = 2F - 3ma \text{ ---ii}$$

Substitute for R in eq i

$$2F - 3ma = F - ma$$

$$F = 2ma$$

Therefore, $R = 2ma - ma = ma$

Resistive force = ma (A is the correct option)

Question 6

A car travels at a constant speed of 25 m s^{-1} up a slope. The wheels driven by the engine exert a forward force of 3000 N . There is a drag force due to air resistance and friction of 2100 N . The weight of the car has a component down the slope of 900 N . What is the rate at which thermal energy is dissipated? {Cambridge A level oct/nov 2016, ques 20, p12}

Solution

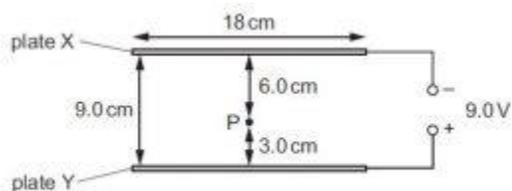
Rate at which thermal energy is dissipated = power loss

Power = force \times velocity

Rate at which thermal energy is dissipated = drag force \times velocity = $25 \times 2100 = 5.3 \times 10^4 \text{ W}$ (C is the correct option)

Question 7

Two parallel circular metal plates X and Y, each of diameter 18 cm , have a separation of 9.0 cm . A potential difference of 9.0 V is applied between them.



Point P is 6.0 cm from the surface of plate X and 3.0 cm from the surface of plate Y.

What is the electric field strength at P? {Cambridge A level oct/nov 2016, ques 30, p12}

Solution

The kind of field in this is a uniform electric field. Therefore, at any point in the field the electric field strength is constant.

Electric field strength = potential difference / distance between the plate = 9 / 0.09

Electric field strength at P = 100 Nc^{-1} (B is the correct option)

Question 8

If a current of 2.5A flows through an electrolyte for 3 hours and 1.8g of a substance is deposited, what is the mass of the substance that will be deposited if a current of 4A flows through it for 4.8 hours?{UTME 2013}

- A. 4.8g B. 2.4g C. 3.2g D. 4.2g E. 4.6g

Solution

$$M = Zit$$

$$Z = M / It = 1.8 / 2.5 \times 3 = 0.24 \text{ g/Ah}$$

Z is electrochemical equivalence and it is a constant

If the current and the time changes

$$M = 0.24 \times 4 \times 4.8 = 4.6\text{g}$$

E is the correct option

Question 9

An electric device is rated 2000W, 250V. Calculate the maximum current it can take. {UTME 2013}

- A. 6A B. 9A C. 8A D. 7A

Solution

$$P = Iv$$

$$2000 = 250 \times I$$

$$I = 2000/250$$

$$I = 8\text{A}$$

C is the correct option

Question 10

A house has ten 40W and five 100W bulbs. How much will it cost the owner of the house to keep them lit for 10 hours if the cost of a unit is N5?{utme2013}

- A. N20 B. N90 C. N50 D. N45

Solution

$$\text{Total power} = 10 \times 40 + 5 \times 100 = 900\text{W} = 0.9\text{kW}$$

$$\text{Energy} = \text{power} \times \text{time}(\text{hour}) = 0.9 \times 10 = 9\text{kWh}$$

$$1\text{kWh} = \text{N}5$$

$$9\text{kWh} = \text{N}5 \times 9 = \text{N}45$$

D is the correct answer

Solution 11

A man 1.5m tall is standing 3m in front of a pinhole camera whose distance between the hole and the screen is 0.1m.

What is the height of the image of the man on the screen? {utme 2013}

- A. 1.00m B. 0.05m C. 0.15m D. 0.30m

Solution

Image distance/object distance = image height/object height

$$0.1/3 = \text{image height} / 1.5$$

$$\text{Image height} = 1.5 \times 0.1 / 3 = 0.05 \text{ m}$$

B is the correct option

Question 12

Two liquids X and Y having the same mass are supplied with the same quantity of heat. If the temperature rise in X is twice that of Y, the ratio of specific heat capacity of X to that of Y is {UTME 2013}

- A. 1 : 4 B. 2 : 1 C. 1 : 2 D. 4 : 1

Solution

$$m_x c_x Q_x = m_y c_y Q_y$$

$$m_x = m_y$$

$$Q_x = 2Q_y$$

$$c_x \times 2Q_y = c_y Q_y$$

$$c_x / c_y = 2/1 = 2:1$$

B is the correct option

Question 13

Which of the following consists entirely vector quantities? {UTME 2001}

- A. Work, pressure and moment B. Velocity, magnetic flux and reaction.
C. Displacement, impulse and power. D. Tension, magnetic flux and mass.

Solution

Vector quantities has both magnitude and direction

Option A – pressure and work are scalar quantities

Option B – they are all vector quantities

Option C- power is a scalar quantity

Option D – mass is a scalar quantity

B is the correct option

Question 14

A plane sound wave of frequency 85.5Hz and velocity 342ms⁻¹ is reflected from a vertical wall. At what distance

from the wall does the wave have an antinode?{UTME 2001}

- A. 0. 1m B 1m C. 2m D. 3m

Solution

$$V = f\lambda$$

$$\lambda = V/f = 342/85.5 = 4 \text{ m}$$

$$\text{Distance to have an antinode} = \lambda/4 = 4/4 = 1\text{m}$$

B is the correct option

Question 15

A string is fastened tightly between two walls 24cm apart. The wavelength of the second overtone is {UTME 2001}

- A. 12cm B. 24cm C. 8cm D. 16cm

Solution

Third harmonic is the second overtone

$$\text{Second overtone} = \lambda/2 + \lambda/2 + \lambda/2 = 3\lambda/2$$

$$3\lambda/2 = 24$$

$$\lambda = 16 \text{ cm}$$

D is the correct option

Question 16

Find the frequencies of the first three harmonics of a piano string of length 1.5m, the velocity of the waves on the string is 120ms^{-1} . {UTME 2001}

- A. 180Hz, 360Hz, 540Hz. B. 360Hz, 180Hz, 90Hz.
C. 40Hz, 80Hz, 120Hz. D. 80Hz, 160Hz, 240Hz.

Solution

$$\text{First harmonic} = f_0 = v/2l = 120/2 \times 1.5 = 120/3 = 40\text{Hz}$$

$$\text{Second harmonic} = 2f_0 = 2 \times 40 = 80\text{Hz}$$

$$\text{Third harmonic} = 3f_0 = 3 \times 40 = 120\text{Hz}$$

C is the correct option

Question 17

A gas with initial volume $2 \times 10^{-6}\text{m}^3$ is allowed to expand to six times its initial volume at constant pressure of $2 \times 10^5\text{Nm}^{-2}$. The work done is {UTME 2001}

- A. 4.0J B. 12.0J C. 2.0J D. 1.2J

Solution

$$\text{Work done} = p \Delta v$$

$$\Delta v = V_2 - V_1 = (6 \times 2 \times 10^{-6}) - 2 \times 10^{-6}$$

$$\Delta v = 12 \times 10^{-6} - 2 \times 10^{-6} = 10 \times 10^{-6}$$

$$\text{work done} = 2 \times 10^5 \times 10 \times 10^{-6} = 20 \times 10^{-1} = 2.0\text{J}$$

C is the correct answer

Question 18

The process of energy production in the sun is {UTME 2001}

- A. radioactive decay B. electron collision.
C. Nuclear fission. D. Nuclear fusion

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Solution

The answer is Nuclear Fusion

D is the correct option

Question 19

A student is at a height 4m above the ground during a thunderstorm. Given that the potential difference between the thunderstorm and the ground is 107V, the electric field created by the storm is {UTME 2001}

- A. $2.0 \times 10^6 \text{NC}^{-1}$. B. $4.0 \times 10^7 \text{NC}^{-1}$.
C. $1.0 \times 10^7 \text{NC}^{-1}$. D. $2.5 \times 10^6 \text{NC}^{-1}$

Solution

$$E = V/d = 10^7 / 4 = 2.5 \times 10^6$$

D is the correct option

Question 20

An object is weighed at different locations on the earth. What will be the right observation? {UTME 2010}

- A. Both the mass and weight vary B. The weight is constant while the mass varies
C. The mass is constant while the weight varies D. Both the mass and weight are constant.

Solution

The mass of an object doesn't change but weight changes because the force of gravity varies from place to place on the surface of earth. There are two reasons behind this variation:

The shape of earth and the rotation of the earth.

C is the correct option

Question 21

In a hydraulic press, the pump piston exerts a pressure of 100 Pa on the liquid. What force is exerted in the second piston of cross-sectional area 3m^2 ? {UTME 2010}

- A. 200 N B. 100 N C. 150 N D. 300 N

Solution

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

$$100 = \text{force}/3$$

Force exerted = 300 N

D is the correct answer

Question 22

If the angle between two vectors P and Q is 0 degree, the vectors are said to

A. be perpendicular B. be parallel C. intersect at angle 60° . D. intersect at angle 45° . (UTME 2004)

Solution

The angle between two parallel lines is zero, therefore, B is the correct option

Question 23

What happens to the rays in a parallel beam of light?

A. They diverge as they travel. B. They meet at infinity. C. They intersect D. They converge as they travel. (UTME 2004)

Solution

Parallel beam of light meet at infinity

B is the correct option

Question 24

The process whereby a liquid turns spontaneously into vapour is called

A. boiling B. evaporation C. sublimation D. relegation. (UTME 2005)

Solution

Solid to gas is sublimation

Liquid to vapour at all temperature is evaporation

Liquid to vapour at a fixed temperature is boiling

Since the word spontaneous is used in the question which means occur without having been planned, therefore, evaporation is the best answer.

B is the correct option

Question 25

A bullet fired vertically upward from a gun held 2.0m above the ground reaches its maximum height in 4.0 s. calculate its initial velocity. {2009}

- A. 10ms^{-1} B. 8ms^{-1} C. 40ms^{-1} D. 20ms^{-1}

$[g = 10\text{ms}^{-2}]$

Solution

$$\begin{aligned}v &= u - at \\0 &= u - 10 \times 4 \\u &= 40\text{ms}^{-1}\end{aligned}$$

C is the correct option

Question 26

An object of mass 80kg is pulled on a horizontal rough ground by a force of 500N. Find the coefficient of static friction. {2009}

- A. 0.8 B. 0.4 C. 1.0 D. 0.6

$[g = 10\text{ms}^{-2}]$

Solution

$$\begin{aligned}\mu &= \frac{F}{mg} \\ \mu &= \frac{500}{80 \times 10} \\ \mu &= 0.6\end{aligned}$$

D is the correct option

Question 27

Two cars moving in the same direction have speeds of 100kmh^{-1} and 130kmh^{-1} . What is the velocity of the faster car as measured by an observer in the slower car? {2010}

- A. 130kmh^{-1} B. 230kmh^{-1} C. 200kmh^{-1} D. 30kmh^{-1}

Solution

You are to calculate the relative speed

$$u_2 - u_1 = 130 - 100 = 30 \text{ km h}^{-1}$$

D is the correct option

Question 28

A car moves with an initial velocity of 25 ms^{-1} and reaches a velocity of 45 ms^{-1} in 10s. What is the acceleration of the car? {2010}

- A. 5 ms^{-1} B. 25 ms^{-1} C. 20 ms^{-1} D. 2 ms^{-1}

Solution

$$\begin{aligned}v &= u + at \\45 &= 25 + 10a \\10a &= 20 \\a &= 2 \text{ ms}^{-2}\end{aligned}$$

D is the correct option

Question 29

Two balls X and Y weighing 5g and 50kg respectively were thrown up vertically at the same time with a velocity of 100 ms^{-1} . How will their positions be one second later? {2011}

- A. X and Y will both be 500m from the point of throw
B. X and Y will be 500m from each other
C. Y will be 500 m ahead of X
D. X will be 500m ahead of Y.

Solution

The distance covered after one second

$$v^2 = u^2 - 2as$$

$$0^2 = 100^2 - 2 \times 10 \times s$$

$$s = \frac{10000}{20}$$

$$S = 500\text{m}$$

The position the two balls will be from the point of throw is independent on their mass.

A is the correct option

Question 30

If it takes an object 3s to fall freely to the ground from a certain height, what is the distance covered by the object?

- A. 60 m B. 90 m C. 30 m D. 45 m.

$$[g = 10\text{ms}^{-2}]$$

Solution

Initial velocity = 0

$$s = ut + \frac{1}{2}at^2$$

$$s = 0 \times 3 + \frac{1}{2} \times 10 \times 3^2$$

$$S = 45\text{m}$$

D is the correct option

Question 31

Calculate the total distance covered by a train before coming to rest if its initial speed is 30ms^{-1} with a constant retardation of 0.1ms^{-2} . {UTME 2012}

- A. 5500m

- B. 4500m
- C. 4200m
- D. 3000m.

Solution

$$V = 0$$

$$U = 30\text{ms}^{-1}$$

$$a = -0.1\text{ms}^{-2}$$

The a is negative because the motion is retarding i.e. deceleration

$$\begin{aligned} 0^2 &= 30^2 + 2 \times -0.1 \times s \\ -0.2s &= -900 \\ s &= \frac{-900}{-0.2} \end{aligned}$$

$$S = 4500 \text{ m}$$

B is the correct option

Question 32

A car starts from rest and moves with a uniform acceleration of 30ms^{-2} for 20s. Calculate the distance covered at the end of the motion. {UTME 2012}

- A. 6km
- B. 12km
- C. 18km
- D. 24km.

Solution

$$\begin{aligned} s &= \frac{1}{2}at^2 \\ s &= \frac{1}{2} \times 30 \times 20^2 \end{aligned}$$

$$S = 6000\text{m} = 6\text{km}$$

A is the correct option

Question 33

An object of mass 20kg slides down an inclined plane at an angle of 30° to the horizontal. The coefficient of static friction is {2012}

- A. 0.2 B. 0.3 C. 0.5 D. 0.6

$$[g = 10\text{ms}^{-2}]$$

Solution

$$\mu = \tan\theta$$

$\mu = \text{coefficient of friction}$

$$\begin{aligned}\mu &= \tan 30 \\ \mu &= 0.577 = 0.6\end{aligned}$$

D is the correct answer

Question 34

A train with an initial velocity of 20ms^{-1} is subjected to a uniform deceleration of 2ms^{-2} . The time required to bring the train to a complete halt is

- A. 40s B. 5s C. 10s D. 20s

Solution

$$V = 0$$

$$U = 20$$

$$a = -2$$

$$v = u + at$$

$$0 = 20 - 2t$$

$$t = \frac{20}{2}$$

$$t = 10s$$

C is the correct option

Question 35

Calculate the apparent weight loss of a man weighing 70kg in an elevator moving downwards with an acceleration of 1.5ms^{-2} . {UTME 2013}

- A. 105N B. 686N C. 595N D. 581N

Solution

The apparent weight loss = $ma = 70 * 1.5 = 105\text{N}$

A is the correct option

Question 36

The coefficient of friction between two perfectly smooth surfaces is {UTME2013}

- A. Zero B. Infinity C. One D. Half

Solution

A is the correct option

Question 37

The resultant of two forces is 50N. If the forces are perpendicular to each other and one of them makes an angle of 30° with the resultant, find its magnitude

- A. 25.0N B. 100.0N C. 57.7N D. 43.3N

Solution

Since the two forces are perpendicular, it can be represented using a right-angle triangle. Also one of the forces makes an angle 30 degree with the resultant.

Using SOHCAHTOA

The resultant is the hypotenuse

$$\cos \theta = \text{adj} / \text{hyp}$$

$$\cos 30 = x / 50$$

$$0.866 * 50 = x$$

$$x = 43.3 \text{ N}$$

D is the correct option

Question 38

A simple pendulum of length 0.4m has a period 2s. What is the period of a similar pendulum of length 0.8m at the same place?

.

A. $\sqrt{2s}$

B. 8s

C. 4s

D. $2\sqrt{2s}$

Solution

$$T = 2\pi \sqrt{\frac{l}{g}}$$

$$\frac{T_1}{\sqrt{l_1}} = \frac{T_2}{\sqrt{l_2}}$$

$$\frac{2}{\sqrt{0.4}} = \frac{T}{\sqrt{0.8}}$$

Cross multiply

$$T_2 = 2\sqrt{2}$$

D is the correct option

Question 39

An object is moving with a velocity of 5ms⁻¹. At what height must a similar body be situated to have a potential energy equal in value with the kinetic energy of the moving body?

A. 1.0m B. 25.0m C. 20.0m D. 1.3m

[g ≈ 10ms⁻²]

Solution

K.E = Mgh

$$\frac{1}{2} mv^2 = mgh$$

$$\frac{1}{2} * m * 5^2 = m * 10 * h$$

$$25 / 2 = 10h$$

$$h = 25 / 20$$

$$h = 1.25 \text{ m, approximately} = 1.3 \text{ m}$$

D is the correct option

Question 40

If a sonometer has a fundamental frequency of 450Hz, what is the frequency of the fifth overtone?

A. 75Hz B. 2700Hz C. 456Hz D. 444Hz

Solution for a sonometer box

First overtone = 2f₀

Second overtone = 3f₀

Third overtone = 4f₀

Fourth overtone = 5f₀

Fifth overtone = $6f_0$

Therefore,

Fifth overtone = $6 * 450 = 2700 \text{ Hz}$

B is the correct option

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