write the scientific term

1-It is comparing a physical quantity with another quantity of its kind to find out how many times the first includes the second. (measurment)

2- It is the difference between the actual value and the measured value. (Absolute)

3- It is the ratio between the absolute error to the real value of the measured physical quantity.

4- A physical quantity that can be fully defined by its magnitude (scalar → relative)

5- A physical quantity that can be fully defined by its magnitude and direction. (vector)

6- A system which use centimeter to measure the length. (French)

7- The system which use pound to measure mass. (British)

8- The unit of time in all systems of basic quantities. (second)

9- The measuring unit of temperature in international system (Kelvine)

10- It can be used to test the validity of laws (D.F)

11- The measuring unit of the amount of matter in the international system. (mole)

12- The physical quantity which is measured in candela. (L. intensity)

13- The measuring unit of solid angle. (steradian)

14- The physical quantity which is used to measure plane angle. (radian)

15- It is the distance between the two marks engraved at both ends of rod of the alloy platinum – Iridium kept at zero $_{o}$C. (Standard meter)

16-Equal to the cylinder block from the alloy platinum ± Iridium with specific dimensions kept at zero °C. (Standard kg)

17- Type of measurement using a single tool. (direct)

18- Type of measurement using more than one tool. (indirect)

19- The international scale of measuring temperature. (Kelvin)

20- It is the change in the body position as the time passes relative to position of another body. (motion)

21- It is the motion of the body in straight line in one direction (translational)

22- It is the motion which has start point and end point (translational)

23- It is the motion which repeats itself through equal periods of time (Periodic)

24- It is the change in distance covered by the body in one second. (Speed)

25- The numerical value of velocity without direction (Speed)

26- It is the velocity at which the body covers equal displacement in equal time Uniform velocity

27- It is the velocity at which the body covers unequal displacement in equal time. non uniform velocity

28- It is the velocity of a body at certain instant (instantaneous velocity)

29- It is the displacement from start point to end point divided by total time Vav velocity

30- It is total distance divided by total time (average speed)

31- It is the rate of change in velocity (acceleration)

32- It is the uniform acceleration of objects that fall freely (free fall acc)

33- It is an external influence that affects the object to change its state or direction of motion. Force

34- A static object keeps its state of rest, and a moving object keeps its state of motion at uniform velocity in a straight line unless acted upon by a resultant force Newton's 1st Law

35- The tendency of an object to keep its state of rest or state of motion at its original velocity uniformly in a straight line. (inertia)

36- When a resultant force affects an object, the object acquires an acceleration which is directly proportional to the resultant force and inversely proportional to the object mass. Newton's 2nd Law

37- It is the force that when acts on an object of mass 1 kg accelerates it at 1 m/s^2 Newton

38- Its resistance of a body to change its Kinematic state. (inertial mass)

39- Its resistance of a body to gain acceleration. (〃)

40- It is the force of gravity acting on the body. (Weight)

41- For every action there is a reaction equal in magnitude and opposite in direction. 3rd Law

42- The product of the mass of the body and its acceleration (resultant Force)

43- The resistance of a body to change its velocity. (Inertial mass)

44- The resistance of a body to gain acceleration. (〃)

45- Motion at which the body changes its direction continuously while its speed is constant uniform circular motion

46- Direction of the body moves in circle when the force is removed (tangential direction)

47- It is the motion of a body in a circular path at a constant speed but changeable direction uniform circular motion

48- It is the force acting continuously in a direction normal to the motion of a body Centripetal Force

49- It is the force originated in the string connected to a body moves in circular path. tension Force

50- A force exists between the Earth and the Sun normal to the direction of motion of the Earth. gravitational Force

51- It is a force originated between the road and the car tires normal to the direction of the car motion toward the center of the circle. (Friction force)

52- A force it's a horizontal component helps in turning the car (reaction Force)

53- It is the acceleration acquired by the body in a circular motion due to a change in the direction of its velocity. (centripetal acc)

54- The distance between the body and the center of a circular path (orbital radius)

55- It is the time taken by a body to complete one revaluation. (Periodic Time)

56- A body in the universe attracts any other body by a force; this force is directly proportional to the product of their masses and inversely proportional to square the distance between their centers. (general gravitational law)

57- It is the space in which the gravitational forces appear (gravitational field)

58- It is the attraction force of Earth to a mass of (1kg). (gravitational field intensity)

59- The gravitational force between two bodies each one1kg and the distance between their centers 1m. general gravitational constant

60- The velocity by which a satellite orbits the earth. (orbital velocity)

61- A type of satellites transmit sphone calls, radio and TV signals. (Communication Sat)

62- huge telescopes roaming in the space, and they can image the orbs accurately astronomical sat

63- A type of satellites are used in studying and monitoring the emigrant birds, determining mineral resources (Remot sensing sat)

64- They are satellites which abound the information needed by military (Spying)

65- The product of the force and the displacement. (work)

66- A measuring unit that equivalent to N.m (Joule)

67- It is the work done by a force of one Newton to move an obj ect through a displacement of one meter in the direction of the force. (Joule)

68- It is capacity to do work. (Energy)

69- it is energy of moving object (K.e)

70- It is energy can be stored in objects due to their new positions. (P.e)

General Exercise on the First Unit

1 Choose the correct answer for each phrase of the following:

a A derived quantity of the following is (length – mass – time – velocity)

b In the international system of units, the ampere is the unit of the .....
(electric current intensity – electric charge – length – luminous intensity)

c Dimensions of acceleration are (LT - LT^{-1} - LT^{-2} - L^2T^{-1})

2 Write the dimensions of each of:

Force ..... MLT^{-2}

Work ..... ML^2T^{-2}

$P = \frac{F}{A}$ Pressure (equals force by area). ..... $ML^{-1}T^{-2}$

3 Express the following values using the standard formula in writing numerals:

a The radius of Earth = *6000000 m* ..... 6×10^6 m

b The radius of the hydrogen atom = *0.00000000005 m* ..... 5×10^{-11} m

a The elephant mass = *5000 kg* ..... 5×10^3 kg

b Speed of light through space *c* is about *300000000 m/s* ..... 3×10^8 m/s

4 What is the difference between the concepts of distance and displacement? Give an example.
distance :- The actual path covered from position to another
displacement :- The length of straight line from start to end in one direction

1 What is the difference between the fundamental physical quantity and the derived physical quantity? .....
Fundamental :-
derived :- .....

3 Define each of: the standard length, the standard mass, and the standard time.
Standard second :- it's equal to no of wavelengths (9192631700) by atoms of [cesium-133]

4 Complete the blanks in the table:

The physical quantity	Unit of measurement	The dimensional formula
Velocity	m/s	LT^{-1}
acceleration	m/s^2	LT^{-2}
force	kg.m/s^2	MLT^{-2}
Density	kg/m^3	ML^{-3}

5 Given that work = $\frac{1}{2}mv^2$, deduce the dimensions of work.
ML^2T^{-2}

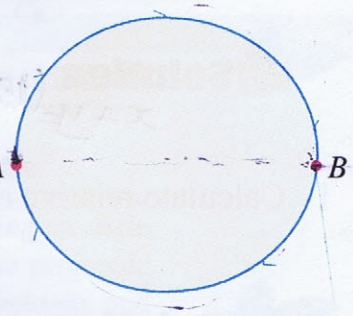
5 When is the vector summation of a number of vectors equal to zero?
They are equal and opposite direction

6 When is the difference between two vectors equal to zero?
They are equal and same direction

Unit one

Problems

5 Find the distance and displacement of an object when moving along the circumference of a circle of radius 7 m from (A) to (B). Then, find the distance and displacement when it returns to (A) another time.



$2\pi r = 2\frac{22}{7}7 = 44\,m$

Solution

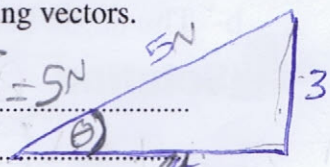
complete: distance = 44, displacement = zero

half: distance = 22 m, disp = 14 m

6 Find the magnitude and direction of the resultant of two perpendicular forces (F_1 and F_2) Where: $F_1 = 3\,N$ $F_2 = 4\,N$ Illustrate your answer by drawing vectors.

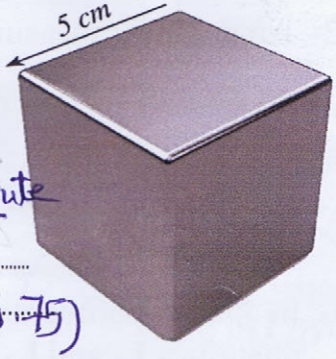
Solution

$R = \sqrt{F_1^2 + F_2^2} = \sqrt{3^2 + 4^2} = \sqrt{25} = 5N$



$\theta = \tan^{-1}\left(\frac{y}{x}\right) = \tan^{-1}\left(\frac{3}{4}\right) = 36.52^\circ$

7 Find the relative error in estimating the volume of a cube of side length 5 cm given that the relative error in estimating its length is (0.01 cm). Also, find the Absolute



Solution

$Vol = L \times L \times L$

$L = (5 \pm 0.05)$, $\Delta x = r \times x_0 = 0.05$

$r_1 = r_2 = r_3 = \frac{\Delta x}{x_0} = 0.01$

$r = 0.03$

$Vol = (125 \pm 3.75)$

$\Delta x = 3.75\,cm^3$

12 $\vec{A}$ and $\vec{B}$ are two vectors having an angle °120 between them where the magnitude of ($\vec{A}$) = 3 units and the magnitude of ($\vec{B}$) = (4) units. Find:

a Their dot product. b Their cross product.

Solution

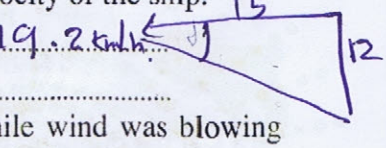
dot product $= A \cdot B \cos\theta = 3 \times 4 \cos 120 = -6$

cross product $= \vec{A} \wedge \vec{B} \sin\theta = 3 \times 4 \sin 120 = 10.4\,\vec{n}$

14 A ship sails to North at velocity 12 km/h. Due to tides, it is deviated to West at velocity 15 km/h . Find the magnitude and direction of the resultant velocity of the ship.

Solution

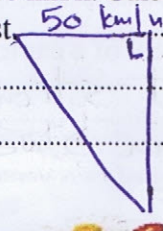
$R = \sqrt{A^2 + B^2} = \sqrt{12^2 + 15^2} = 19.2\,km/h$



$\theta = \tan^{-1}\left(\frac{12}{15}\right) = 38.39^\circ$

15 A motorcyclist drove to North at velocity 80 km/h. Meanwhile wind was blowing towards West at velocity 50 km/h. Calculate the apparent velocity of wind as observed by the motorcyclist.

Solution



$R = \sqrt{80^2 + 50^2}$

$R = 94.3\,km/h$

16 If $y = (10 \pm 0.2)$ cm, and $x = (5 \pm 0.1)$ cm, find each of:

a $x + y$ b $2x + y$ c xy d xy^2

Solution

$x+y=(15\pm0.3)$ | $2x+y$ (20 ± 0.4) | xy (50 ± 2) | xy^2 (500 ± 30)

1- Calculate relative and absolute error in measuring area of rectangle has length =(6+0.1)m and width =(5+0.2)m. $A = L \times W$

Solution

$r_1 = \frac{0.1}{6} = 0.0167$ $r_2 = \frac{0.2}{5} = 0.04$ $r = 0.0567$ | $A=(30\pm1.7)$ $\Delta x = 1.7\ m^2$

6- Two perpendicular forces F_x and F_y acting on an object where each =80 N fined

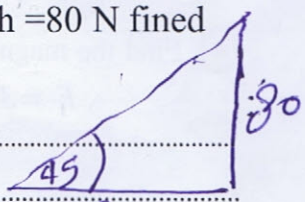
a- The resultant of the two forces F_x and F_y

b- The angle between their resultant and x-axis.

Solution

$R = \sqrt{80^2+80^2} = 113.13\ N$

$\theta = \tan^{-1}\left(\frac{y}{x}\right) = \tan^{-1}\left(\frac{80}{80}\right) = 45^\circ$



2- An engineer measured the length of a building which was equal to 55.2 m if there was an error of 0.02 m what are the probabilities of the real value of the building length.

Solution

$x = 55.2$ | $\Delta x = |x_0 - x|$ | $L = (55.2 \pm 0.02)$

$\Delta x = 0.02$ | $x_0 = x + \Delta x = 55.2 + 0.02$ | $= x - \Delta x = 55.2 - 0.02$

$x_0 =$

55.22 m

55.18 m

5- In a lab experiment to determine a physical quantity (L) by adding two physical quantities L_1 and L_2 if: $L_1 = (5.2 \pm 0.1)$ cm and $L_2 = (5.8 \pm 0.2)$ cm, Find the value of L.

Solution

Finding the real value of (L): $L_0 = (5.2+5.8) = 11$ cm

Finding the absolute error: $\Delta L = (0.1 + 0.2) = 0.3$ cm

$L = (11 \pm 0.3)$ cm

7 Express the following values in terms of the given unit using the standard formula in writing numerals.

a mg in kilograms. 1×10^{-6}

b 3×10^{-9} s in milliseconds. $3 \times 10^{-9} \times 10^{3} = 3 \times 10^{-6}$ ms

c 88 km in meters. 8.8×10^{4} m

8 If the diameter of man's hair is about 0.05 mm. find that diameter in meters.

5×10^{-5} m

2 What is meant by saying that the displacement of a car to north is (500 m)

The length of the shortest straight line in given (north) direction between start and end = 500m

$R = \sqrt{A^2 + B^2 - AB\cos\theta}$

4 Use the ruler and protractor to find the resultant of two vectors: the magnitude of the first (9 cm), (6 cm) $\theta = 115^\circ$ $R = 12.75$

General Exercise on the Second Unit

1 Choose the correct answer for each phrase of the following:

1 A bicycle moves at uniform velocity in a straight line to East when the resultant force on the bicycle is .....

a zero b negative c positive. d towards east.

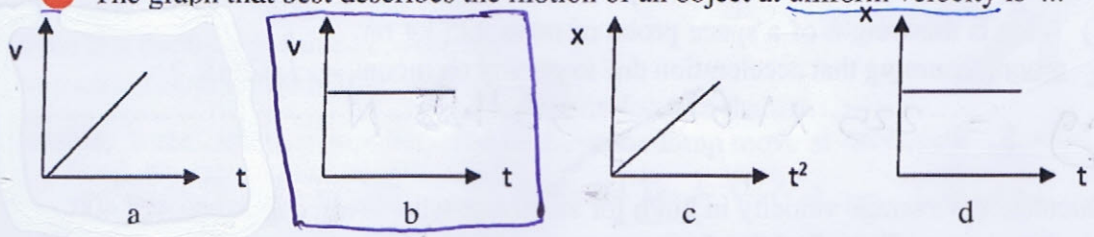
2 When an object is projected at initial velocity in a direction making an angle 60° to the horizontal to reach a horizontal range R. To make the projectile reach a greater range, it should be projected at the same initial velocity and angle ..... a 90° b 75° c °45 d 30°

3 An object moves at uniform acceleration when.....

a It covers equal displacements in equal times b Its velocity ~~decreases~~ increase with equal amounts in equal times.

c Its velocity decreases with equal amounts in unequal times. d The resultant force acting on the object is zero

4 The graph that best describes the motion of an object at uniform velocity is ...



5 When the direction of acceleration is opposite to the direction of velocity, ...

a resultant force decreases. b object velocity increases. d object velocity decreases.

1 When the resultant force acting on a moving car is zero, the car .....

a moves at positive acceleration. b moves at negative acceleration.

c moves at uniform velocity. d stops motion .

2 Newton's third law of motion can be expressed mathematically as .....

a $\Sigma F = 0$ b $\Sigma F \neq 0$ c $F = m a$ d $F_1 = - F_2$

1 Dimensions of acceleration are a LT^{-1} b LT^{-2} c $L^{-1} T^{-2}$ d $L^{-2} T^{-2}$

2 When the change in velocity of an object is zero, ...

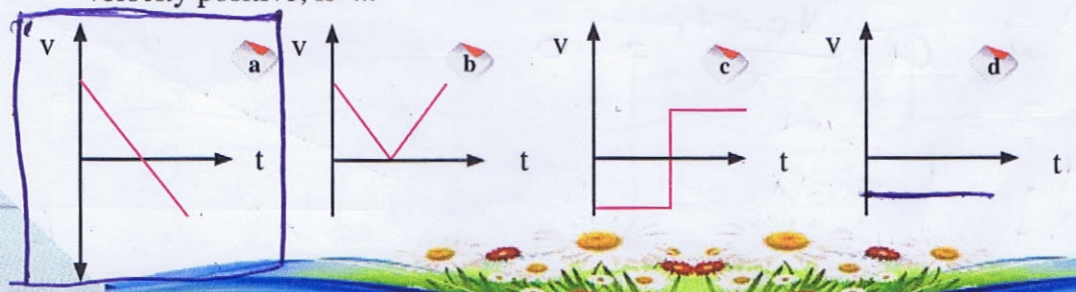
a its acceleration is positive. d the object is at rest. c its acceleration is zero

4 Two bodies of different materials having the same volume fall freely together from the same height. Which statement describes correctly their arrival to the ground?

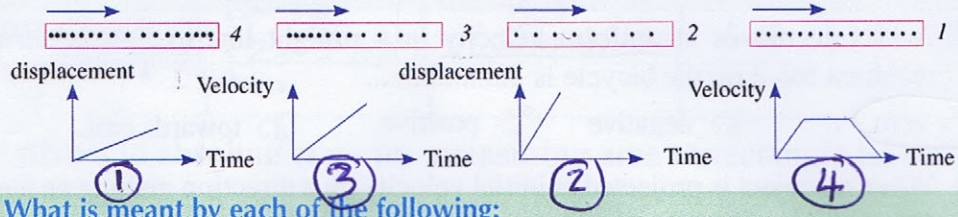
a The heavier body reaches first. b The lighter body reaches first.

c The heavier body accelerates more d They reach the ground at the same time.

5 The graph that best describes an object projected vertically upwards and returned back to the point of projection, having the direction of initial velocity positive, is ...



2 You have four ticker-tapes that describe the motion of objects. Match each ticker-tape with the proper graph that represents the same motion.



4 What is meant by each of the following:

a Displacement of a table is 3m ? shortest straight line from start to end = 3m

b Velocity of a bicycle is 5m/s ? The rate of change of displacement = 5 m/s

c Free fall acceleration is 9.8 m/s² ? The velocity of object increases by 9.8 m/s in every second when it falls freely

2 Explain this saying: "Newton's first law is a special case of Newton's second law"

Bec when $F = 0 \rightarrow a = 0$ so the body keep it's state of rest or motion

3 What is the weight of a space probe of mass 225 kg on moon, assuming that acceleration due to gravity on moon = *1.62 m/s* ?

$F_g = mg = 225 \times 1.62 = 364.5$ N

1 Calculate the average velocity in km/h for an athlete who covered a distance of 400 m in 30 minutes. Then, find the distance covered in 45 minute from start if the average velocity was kept unchanged.

given $d = 0.4$ km, $t = 0.5$ h

$V_{av} = \frac{\text{total } d}{\text{total } t} = \frac{0.4}{0.5} = 0.8$ km/h

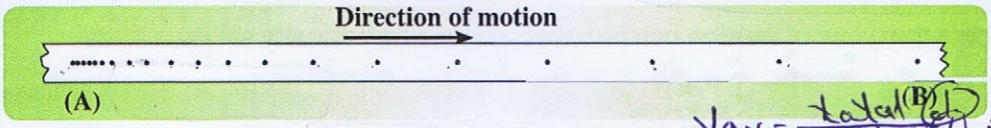
given $V_{av} = 0.8$ km/h, $t = 0.75$ h

$d = V \cdot t$

$d = 0.8 \times 0.75$

$= 0.6$ km $= 600$ m

2 A student carried out an experiment to study the motion of a cart using a ticker- timer where the position of the cart is determined every second on a ticker- tape as shown



$t = 19$ sec

$V_{av} = \frac{\text{total } d}{\text{total } t} = \frac{190}{19} = 10$ m/s

a Describe the motion of the cart. Uniform +ve acceleration

b Find the average velocity if (A) is at 190 m from (B).

c Find the acceleration of the cart. $a = \frac{2d}{t^2} = \frac{2 \times 190}{19^2} = 1.05$ m/s²

7 If the acceleration of an object equals zero, does this mean that its velocity must equal zero? Give an example. No, Bec when the body moving by Uniform velocity acc also = zero $a = \frac{V_f - V_i}{t}$

8 If the velocity of an object at a given instant equals zero, is it necessary that its acceleration equals zero? Give an example. yes

Bec when the body at rest $V_f = V_i = 0$

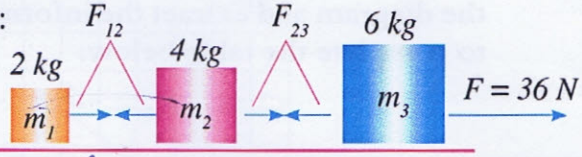
$\therefore a = \frac{V_f - V_i}{t} = 0$

Unit two

Problems

3 Three masses are connected together by weightless threads as shown in figure. They are pulled on a smooth surface by a horizontal force. Find:

- The common acceleration of these masses.
- The tension force in each thread.



Solution

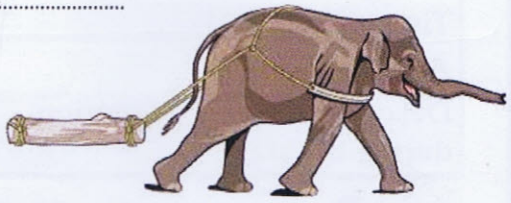
$a = \frac{\Sigma F}{\Sigma m} = \frac{36}{12} = 3\ m/s^2$

$F_1 = m_1 a = 2 \times 3 = 6\ N$

$F_2 = m_2 a = 6 \times 3 = 18\ N$

4 An elephant pulls a wooden lump of mass 0.5 ton by a rope along the ground at uniform velocity as shown in figure. Given that the friction force between the lump and ground is 200 N, find:

- The tension force in the rop
- The tension force in the rope required to make the lump move at acceleration 2 m/s^2.



Solution

1) resultant Force = Tension − Friction

$0 = 200 - 200$

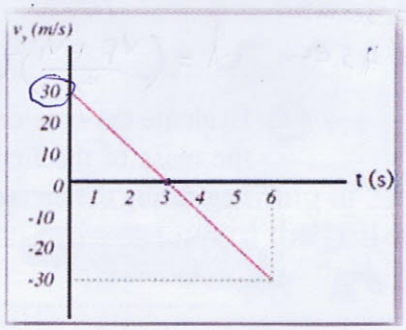
2) resultant force = Tension − Friction

$ma = 500 \times 2 = 1200 - 200$

$\frac{500}{1000}$

5 The opposite graph represents the change in the vertical component of projectile velocity in the gravitational field of Earth. If the angle of projection was 30°, calculate:

- The velocity by which the object was projected. 60 m/s
- Maximum height reached by the object.
- The horizontal range.



Solution

given $v_{iy} = 30$

$\therefore V_i = \frac{v_{iy}}{\sin 30}$

$V_i = \frac{30}{0.5} = 60\ m/s$

$h = \frac{30^2}{2g} \quad \frac{30^2}{20}$

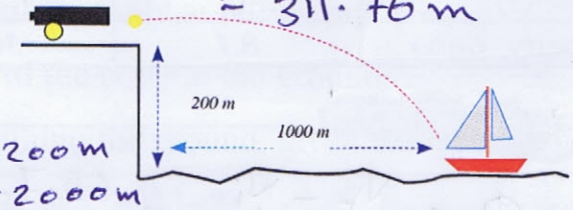
$h = 45\ m$

$R = \frac{2 v_i^2 \sin\theta \cos\theta}{g}$

$= \frac{2(60)^2 \sin 30 \cos 30}{10}$

$= 311.76\ m$

6 Use the data given in figure to find the projection velocity of a cannonball that is required to hit the ship. ($g = 10\ m/s^2$)



$h = 200\ m$

$R = 2000\ m$

Solution

$h = \frac{v_{iy}^2}{2g}$

$\therefore V_{iy} = \sqrt{2gh}$

$V_{iy} = \sqrt{2 \times 10 \times 200} = 63.2$

$t = \frac{v_{iy}}{g} = \frac{63.2}{10}$

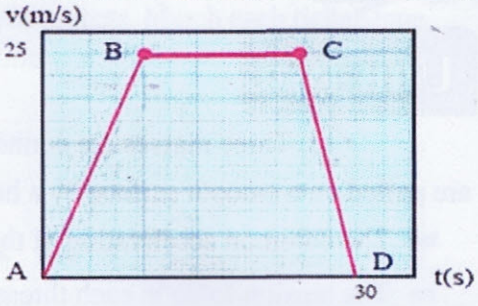
$t = 6.325\ sec$

$R = V_{ix} \times t$

$\therefore V_{ix} = \frac{R}{2t}$

$V_{ix} = \frac{2000}{2 \times 6.32} = 158.22\ m/s$

The velocity of a car moving in a straight line was recorded during 30 seconds and then represented graphically as shown. Work to analyze the diagram and extract the information required to complete the table below:



Stages of car motion	Stage AB	Stage BC	Stage CD
Initial velocity (v_i)	0	25	25
Final velocity (v_f)	25	25	0
Change of car velocity (Δv)	25	0	−25
Time of stage (t)	10	15	5
Acceleration (a)	2.5 m/s²	Zero	−5 m/s²
Description of motion during the stage	(+v) acc	Uniform Velocity	(−ve) acc

2 A person at the roof of a high building has projected a ball at velocity of 50 m/s. Given that the acceleration due to gravity is 10 m/s², find the velocity and displacement of the ball after 4 s in the following cases:

a The ball has been projected vertically upwards.

Solution

given
$v_i = 50$ m/s
$t = 4$ sec

$v_f = v_i - gt$

$= 50 - (10 \times 4) = 10$ m/s

$d = \left(\frac{v_f + v_i}{2}\right)t = \frac{60}{2} \times 4 = 120$ m

b The ball has been projected vertically downwards.

$v_f = v_i + gt$

$v_f = 50 + 10 \times 4 = 90$ m/s

$d = \left(\frac{v_f + v_i}{2}\right)t = \frac{140}{2} \times 4 = 280$ m

4 Evaluate the acceleration by which two loads fall freely; the mass of the first load = 5 kg and the other = 7 kg, neglecting the air resistance.

Solution

$a = \frac{g(m_2 - m_1)}{m_2 + m_1} = \frac{10(7-5)}{12}$

$a = \frac{20}{12} = 1.67$ m/s²

Represent the data recorded in the table below graphically. Then, find from the graph both acceleration and displacement after 12 s.

Time (s)	0	6	9	12
Velocity (m/s)	8.1	36.9	51.3	65.7

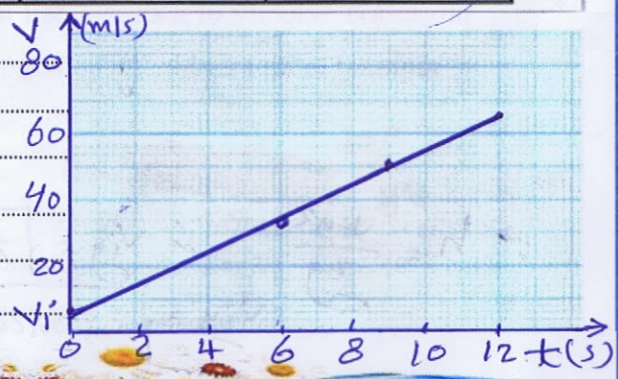
Solution

$a = \frac{v_f - v_i}{t} = \frac{65.7 - 8.1}{12}$

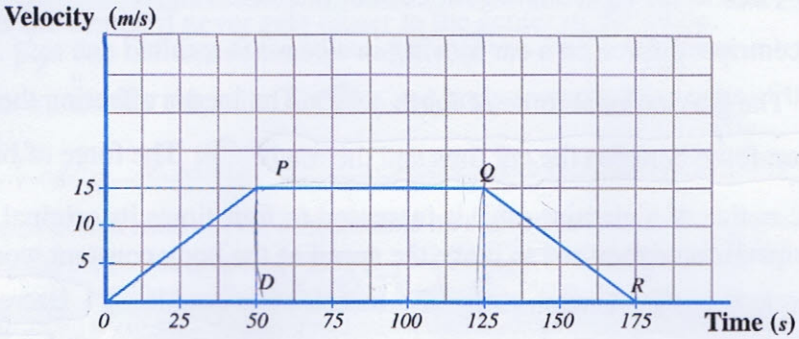
$\therefore a = 4.8$ m/s²

$d = v_i t + \frac{1}{2} a t^2 = 8.1 \times 12 + \frac{1}{2}(4.8)\,12^2$

$d = 442.8$ m



3 The graph below represents a journey of a car. Study the diagram and answer the following questions:



a What is the greatest velocity of the car motion?

15 m/s

b Describe the car motion in section PQ.

Uniform velocity

c Describe the car motion in section QR.

(-ve) Uniform accelerations

d Which point P, Q or R represents the first instant of applying the brakes?

Q

e Calculate the total distance traveled by the car in this journey.

Solution

$d_1 = \left(\frac{v_F + v_i}{2}\right) t$

$d = \frac{15}{2} \times 50$

$\therefore d_1 = 375\ m$

$d_2 = v\,t$

$= 15 \times 75$

$\therefore d_2 = 1125\ m$

$d_3 = \left(\frac{v_F + v_i}{2}\right) t$

$= \frac{15}{2} \times 50$

$= 375\ m$

$d_t = 375 + 1125 + 375 = 1875\ m$

1- In football match the ball was at 50 m away from a player who was running at 3m/s meanwhile another player was 35m from the ball and ran at 2m/s toward the ball who reached the ball first.

Solution

[The first player reach before second]

$t_1 = \frac{d_1}{v_1} = \frac{50}{3}$

$= 16.75\ sec$

$t_2 = \frac{d_2}{v_2} = \frac{35}{2}$

$t_2 = 17.55\ sec$

8- A body of mass 0.25 kg falls freely from 200 m high above the ground. Find:

a- Both potential and kinetic energies of the body at falling point.

b- Both potential and kinetic energies of the body at the ground.

c -Velocity of the body just before touching the ground, given that $g = 10\ m/s^2$

Solution

Falling point

$k.e = 0$

$p.e = mgh = 0.25 \times 10 \times 200$

$= 500\ J$

ground

$p.e = 0$

$k.e = \frac{1}{2} m v^2$

$= 0.5 \times 0.25 \times 63.25^2$

$= 500\ J$

$v_F = \sqrt{2gh}$

$v_F = 63.25\ m/s$

General Exercise on the Third Unit

1 Put (√) tick to the right answer for each of the following:

1. The centripetal force on a car moving in a curve is resulted due to:

a The gravitational force of Earth. c The inertia affecting the car driver.

b The friction force between the car tires and the road. d The force of brakes.

2. If the radius of a circular orbit is increased to four times its original value, the centripetal force required to make the speed of the body constant would be:

a Decreased to half. b Unchanged. c Increased to double. d Decreased to quarter its value.

3. Two satellites (A) and (B) rotate around the Earth, having the same periodic time. If the orbit radius of satellite (A) equals four times the orbit radius of satellite (B), the ratio between the velocity of satellite (A) to that of satellite (B) equals:

a (2 : 1) b (4 : 1) c (1 : 2) d (1 : 4)

4. If the distance between the centers of two identical balls is 1 m and the force of attraction between them is 1 N, the mass of each one of them equals:

a 1kg b 1.22×10^5 kg c 2×10^5kg d 0.1 kg

5. If the distance between the centers of two bodies is doubled and their masses are kept unchanged, the attractive force between them would be:

a Doubled. b Halved. c Quartered. d Increased four times .

a The acceleration due to Earth's gravity is:

➥ A general universal constant. ➥ Different through the seasons of the year.

➥ Changeable according to the height from the earth's surface.

➥ Changeable depending on the distance between the earth and the sun.

b The velocity required by a satellite to rotate around the Earth:

➥ Depends on its mass only. ➥ Is constant. ➥ Depends on mass of the Earth only.

➥ Depends on both; the mass of the Earth and the distance between them.

c The velocity of rotation required by the Earth to orbit the Sun depends on:

➥ The mass of the Earth only. ➥ The mass of the Sun only. ➥ The mass of the Sun and the distance between them.

➥ Both the mass of the Sun and the Earth, besides the distance between them.

3 Give reasons for each for the following:

a Although a body moving at a uniform circular motion acquires an acceleration, its linear speed is constant.

Bec Centripetal acceleration produced due to the change in direction only

b It is dangerous to move at high velocities in curves of roads. ($F \propto V^2$)

$F_c \propto \frac{1}{r}$ So As radius decreases The car need more centripetal force

4 Write down the scientific term for each of the following:

a The motion of an object along the circumference of a circle at a linear velocity of constant magnitude and changeable direction. Uniform circular motion

b The time taken by a body to make a complete revolution. (Periodic time

c A force always acts towards the center normally to the direction of the linear velocity during the motion of a body in a circular motion. Centripetal Force

3 Give reasons for each for the following:

a Although a body moving in a uniform circular motion is affected by a centripetal force towards the center, it never gets closer to the center of the circle.

Bec Centripetal Force is normal to direction of motion change direction only

b At curves, the motorbike rider tilts his bike and body towards the center of the circular path.

To create a force normal to direction of motion and change it's direction

c When a car moves in a road curve, it maintains its curved path and doesn't skid.

Bec Friction force is normal to direction of motion so it acts as centripetal Force

1 Complete the following statements with suitable answers:

a In the uniform circular motion, the direction of centripetal acceleration is always towards The center, and the centripetal force is in the direction of ac. No change happens in the magnitude but a change takes place in direction only

b In a uniform circular motion, the constant force that acts normally to the direction of linear velocity is called Centripetal Force

c In a uniform circular motion, the tangential velocity of a body is characterized by Constant and changable direction

d The magnitude of the centripetal acceleration during a uniform circular motion depends on radius (r) and Path of tangential Velocity (v²) square

5 Choose the proper unit from column (B) that fits each quantity in column (A):

No.	(a)	(b)	
1	Periodic time	(3)	$N.m^2kg^{-2}$
2	Centripetal force	(4)	m/s
3	Universal gravitational constant	(5)	m/s^2
4	Linear velocity	(1)	s
5	Centripetal acceleration	(2)	$kg.m/s^2$

10 A racing car of mass 905 kg moves in a circular path of perimeter 3.25 km. Calculate the tangential velocity of the car if the force required to keep the circular motion of the car = 2140 N.

given:
$m = 905\ kg$
$r = 3250\ m$
$F_c = 2140\ N$

$F_c = m\frac{v^2}{r} \Rightarrow v = \sqrt{\frac{F_c r}{m}}$

$v = \sqrt{\frac{2140 \times 3250}{905}} = 87.66\ m/s$

Unit three

Problems

2 A helicopter toy of mass 100 g flies in a circular path of radius 1 m and rotates at a rate of 100 revolutions in 20 s.

Calculate:

a. The linear (tangential) velocity of the toy.

b. The centripetal acceleration.

c. The centripetal force.

given

$m = 0.1$ kg

$r = 1$ m

$T = \frac{t}{n} = \frac{20}{100} = 0.2$ s

$T = 0.2$ sec

Solution

$V = \frac{2\pi r}{T} = \frac{2\pi \times 1}{0.2} = 31.41$ m/s

$a_c = \frac{V^2}{r} = \frac{V^2}{1}$

$a_c = (31.41)^2 = 987$ m/s^2

$F_c = m\, a_c$

$= 0.1 \times 987$

$= 98.7$ N

6 At which height from the earth's surface a satellite should rotate so that its periodic time around the Earth equals the periodic time of Earth's spinning? Knowing that the Earth's day = 24 hours, the universal gravitational constant ($G = 6.67 \times 10^{-11}$ N.m^2 kg^{-2}), the mass of the Earth ($M_E = 5.98 \times 10^{24}$ Kg), and the radius of the Earth ($R = 6378$ km).

Solution

$V_o = \frac{2\pi (R+h)}{T} = \sqrt{\frac{G\, m_e}{R+h}}$

$\frac{4\pi^2 (R+h)^2}{T^2} = \frac{G\, m_e}{R+h}$

$\therefore (R+h)^3 = \frac{G\, m_e T^2}{4\pi^2}$

$(6378 \times 10^3 + h)^3 = \frac{6.67 \times 10^{-11} \times 5.98 \times 10^{24} (86400)^2}{4\pi^2}$

$h = 35877 \times 10^3$ m

3 If the mass of the Planet Mercury is (3.3×10^{23} kg) and its radius is (2.439×10^6 m), what is the weight of a body of mass (65 kg) on Mercury, and what is the weight of the same body on the Earth? Knowing the Universal Gravitational Constant (G) = 6.67×10^{-11} N.m^2 kg^{-2}.

Solution

• The weight on earth

$F_g = mg = 65 \times 9.8 = 637$ N

• The weight on mercury

$g = G \frac{m}{r^2} = \frac{6.67 \times 10^{-11} \times 3.3 \times 10^{23}}{(2.439 \times 10^6)^2}$

$g = 3.7$ m/s^2

$F_g = m\, g$

$= 65 \times 3.7$

$= 240.5$ N

4 A satellite rotates in an orbit at a height (h) = 300 km from the Earth's surface. Find:

a. Its orbital velocity.

b. The periodic time of the satellite around the earth.

c. The centripetal acceleration of its motion.

$g = G \frac{m_e}{r^2}$

$\therefore m = \frac{g r^2}{G}$

Knowing that: Radius of the Earth: $R = 6378$ km

Acceleration due to gravity at the Earth's surface: $g = 9.8$ m/s^2

Solution

a) $V_o = \sqrt{G \frac{m_e}{r_o}} = \sqrt{\frac{G}{r} \times \frac{g r^2}{G}} = \sqrt{g r} = \sqrt{9.8 \times 6678 \times 10^3}$

$\therefore V_o = 8.089 \times 10^3$ m/s

b) $T = \frac{2\pi r_o}{V} = \frac{2\pi (6678 \times 10^3)}{8.089 \times 10^3} = 5.187 \times 10^3$ sec

c) $a_c = \frac{V^2}{r} = \frac{(8.089 \times 10^3)^2}{6687 \times 10^3} = 9.78$ m/s^2

8 A car of mass 1000 kg is moving at a constant speed of 5 m/s around a curve of radius 50 m. Calculate the centripetal friction force that keeps the car moving around the curve.

given

$m = 1000$ kg

$V = 5$ m/s

$r = 50$ m

Solution

$\therefore F_c = m \frac{V^2}{r} = \frac{1000 \times (5)^2}{50}$

$F_c = 500$ N

3 A body of mass 100 gm moves along the circumference of a circle of radius 50 cm at a uniform circular motion. It takes a time of 90 s to make 45 complete revelations.

Calculate: a Periodic time. b Linear velocity. c Centripetal acceleration.

Solution

given
$m = 0.1$ kg
$r = 0.5$ m

(a) $T = \frac{t}{n} = \frac{90}{45}$
$T = 2$ s

(b) $V = \frac{2\pi r}{T} = \frac{2\pi \times 0.5}{2}$
$V = 1.57$ m/s

(c) $a_c = \frac{V^2}{r} = \frac{(1.57)^2}{0.5}$
$\therefore a_c = 4.9$ m/s^2

9 A bicycle rider moves in a circular path at a tangential velocity of 13.2 m/s. If the radius of the path is 40 m, and the force keeping the bicycle in a circular path equals 377 N, Calculate the mass of both the bicycle and the rider.

Solution

given
$V = 13.2$ m/s
$r = 4.0$ m
$F_c = 377$ N

$\therefore F_c = m\frac{V^2}{r} \Rightarrow m = \frac{F_c r}{V^2}$
$\therefore m = \frac{377 \times 40}{(13.2)^2} = 86.55$ kg

7 A body of mass 2 kg is attached to the end of a string to rotate in a horizontal circular path of radius 1.5 m, so as to make 3 revolutions in one second, calculate:

a Linear (tangential) velocity.

b Centripetal acceleration.

c Tension force in the string.

given
$m = 2$ kg
$r = 1.5$ m
$T = \frac{t}{n} = \frac{1}{3}$ sec

Solution

a) $V = \frac{2\pi r}{T} = \frac{2\pi \times 1.5}{\frac{1}{3}} = 28.26$ m/s

b) $a_c = \frac{V^2}{r} = \frac{(28.26)^2}{1.5} = 532.4$ m/s^2

c) $F_c = m a_c = 2 \times 532.4 = 1064.8$ N

General Exercise on the Fourth Unit

1 Choose the correct answer for each phrase of the following:

a The kinetic energy of an object is 4 J. what is its kinetic energy if its speed is doubled?

➥ 8J ➥ 16J ➥ 4J ➥ 0.8J

b An object of mass 2 kg is at 5 m high above the ground. Its potential energy equals:

➥ 98J ➥ 10J ➥ 2.5J ➥ 9.8J

c The stored energy in a compressed spring is:

➥ kinetic energy. ➥ potential energy. ➥ nuclear energy. ➥ repulsion energy.

1 When the speed of a car is doubled, its kinetic energy .....

a is halved . b is doubled. c increases four times. d remains constant.

2 A man went to his apartment twice; once using the stairs and another using the elevator. Which statement is correct?

a more potential energy when using the stairs. b more potential energy when using the elevator

c no potential energy when using the elevator. d the same potential energy in both cases.

3 Mechanical energy of an object equals .....

a The difference between its kinetic energy and potential energy.

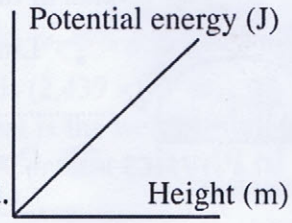
b The sum of its kinetic energy and potential energy.

c The ratio between its kinetic energy and potential energy.

d The product of its kinetic energy and potential energy.

4 The slope of the straight line in the opposite graph represents .....

a Object mass. b Object weight c Object displacement. d Object speed.



2 Give reasons for:

a Work is a scalar quantity. Bec work is product of 2 vector quantity

b Potential energy of water is greater at the top of waterfall than that at the bottom. P.e a h

c A person carrying a suitcase does not do any work when moving horizontally. $\theta = 90$, $\cos 90 = 0$, $\therefore W = 0$

Unit Four Problems

3 A force of 100 N acts on an object to displace it through 2.5 m. find the work done by this force in the following cases:

a If the force acts in the same direction of object motion.

b If the force direction makes an angle 60° to the direction of object motion.

c If the force acts perpendicular to the direction of object motion.

Solution

a) $W = F.d = 100 \times 2.5 = 250\ J$

b) $W = F.d\cos\theta = 100 \times 2.5 \cos 60 = 125\ J$

c) $W = F.d\cos 90 = 0$

4 Calculate the mass of an object if its potential energy at a point 5 m high above the ground equals 980 J, and acceleration due to gravity = 9.8 m/s².

Solution

$m = \frac{P.e}{gh} = \frac{980}{10 \times 5} = 19.6\ kg$ required

given: $h = 5\ m$, $P.e = 980\ J$, $g = 10$

2. An athlete of weight 700 N climbed a mountain. Find the work he did when he reached to 200 m above the ground. $W = F \cdot d = 700 \times 200 = 1.4 \times 10^5$ J

3. Two boxes (A) and (B) have weights 40 N and 60 N respectively. The box (A) is on the ground while the box (B) is at 2 m high above the ground. What is the height of the box (A) so that it has the same potential energy as the box (B)? 3m

4. Find the work done to push a cart by a force 20 N through a displacement of 3.5 m. $W = F \cdot d = 20 \times 3.5 = 70$ J

5. Find the kinetic energy of a car of mass 2000 kg that is moving at a speed of 60 km/h. $K.e = \frac{1}{2} m v^2 = \frac{1}{2} \times 2000 \times (60)^2 = 3.6 \times 10^6$ J

Mention the function of the following:

The instrument	The function
Vernier caliper	measuring short lengths by mm
8-Remote sensing sate.	studying and monitoring the emigrant birds, determining mineral resources and their ratios underground
micrometer	measuring v. small lengths by μm
hydrometer	measuring liquid density
Spring balance	measuring Force "weight"
12-Communication sate.	Transmit phone calls, radio and TV signals
13-Astronomical sate	Image the orbs accurately
14-Explanatory and spying satellites	Abound the information needed by military and political leaders to make decisions and monitor combats.

When does each of the following vanish?

a- Work done. $\theta = 90 \quad \cos 90 = 0 \Rightarrow W = F \cdot d \cos\theta = 0$

What is meant by:

a -The slope of line in the graph between square of speed on y-axis and reciprocal of mass on x-axis equals 10 J. $(K.e) = 5$ J

b -A body moves at acceleration of $(3\ m/s^2)$ The velocity increases by 3m/s in every sec

Factor	10^{-9}	10^{-6}	10^{-3}	10^{-2}	10^{3}	10^{6}	10^{9}
Name	Nano	Micro	Millie	Centi	Kilo	Mega	Giga
Symbol	n	μ	m	c	K	M	G

Mention the measuring unit of the following

The physical quantity	The unit
Free fall acceleration (g)	m/s^2
Inertial mass	kg
average velocity	m/s
Velocity (V)	m/s
orbital velocity	m/s
Kinetic energy (K.E)	J
Potential energy	J
Mechanical energy(M.E)	J
g. field intensity	m/s^2 or N/kg
Body weigh (F_g)	N
Periodic Time	sec
The force (F)	N
Centripetal acceleration(a	m/s^2
Gravitational constant (G)	$N \cdot m^2/kg^2$
Gravitational force (F_g)	N
Acceleration (a)	m/s^2
Time (t)	sec

Mention the factors of the following:

The physical quantity	Its factors
The weight	mass, gravity acc
Potential energy	p.e = mgh mass, gravity, height

What will happen if?

1- A body is allowed to fall freely. it's velocity increases by 9.8 m/s in sec

2- A body moves with uniform velocity. a = 0 keeps it's stat

4- A body is affected by two or more external forces (equal and opposite) $\Sigma f = 0$

5- A gun is fired .(The bullet goes out and the gun kicks back in your shoulder)

6- When you hold any body (the weight of the body does not make work)

7- The centripetal force becomes zero.
(The body leaves the circular path in a tangential direction with velocity (V).

10- The body is moving in the same direction of the force
($\theta = o$) so $\cos\theta = 1$ so $w = F.d$ (max. work).

11- The direction of the force is the same direction of the displacement. max work done

18- The force doing work acts perpendicular to the direction of motion. work done = 0

A force of 20N acted on the body if the relation between kinetic energy and the square velocity shown as in the table. (Fym. 2013)

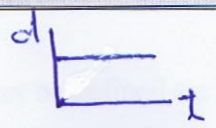
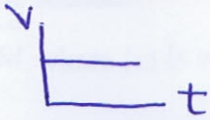
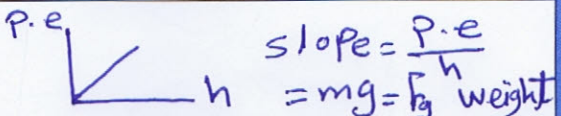
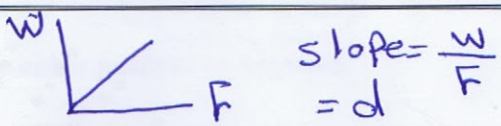
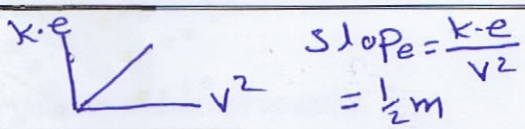
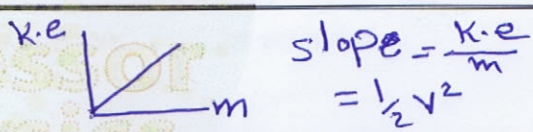
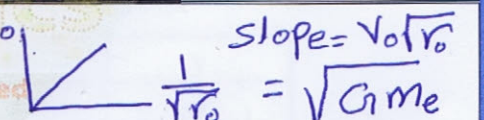
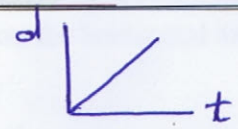
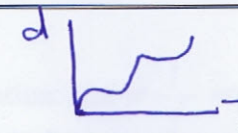
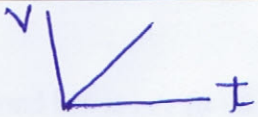
k.e	2	8	18	32	50	72
V^2	1	4	9	16	25	36

The graph between k.e on y-axis and V on x-axis then find the acceleration of the body

F = 20N
m = 4Kg

$a = \frac{F}{m} = \frac{20}{4} = 5\ m/s^2$

Draw the graph:

The description	The graph
A body at rest	
body moves by constant velocity	
Potential energy with vertical distance	 slope = P.e / h = mg = weight
Work with force	 slope = W / F = d
Kinetic energy with square velocity	 slope = K.e / v^2 = $\frac{1}{2}m$
Kinetic energy with body mass	 slope = K.e / m = $\frac{1}{2}v^2$
orbital velocity of sat with radius	 slope = $V_o\sqrt{r_o}$ = $\sqrt{GM_e}$
A body moves with uniform velocity	
A body moves with non-uniform velocity	
A body moves with uniform acceleration	

Mark distribution

1) Class activities and exams. → 4
2) Practical exam (lab) → 4
3) Final exam → 12

Total = 20 marks