Test: MTY Stage Test 18/08 **Duration:** 182

Single Correct:

Question 1: a

In this case, both direction as well as magnitude remain constant.

Question 2: d

$\vec{a} = \hat{i} + \hat{j}, \quad \vec{b} = 2\hat{j} + 2\hat{k}$

$|a| = \sqrt{2} \quad |b| = 2\sqrt{2}$

$\vec{a}.\vec{b} = |a||b|\cos\theta$

$(\hat{i} + \hat{j}).(2\hat{j} + 2\hat{k}) = \sqrt{2}.2\sqrt{2}\cos\theta$

$\Rightarrow \quad 2 = 2.2\cos\theta$

$\cos\theta = \frac{1}{2} = \frac{\pi}{3}$

Question 3: d

Work has magnitude but no direction .

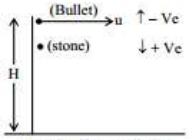
Question 4: d

D)

Question 5: a

A)

Question 6: a



For bullet, using

$s_y = u_y t_B + \frac{1}{2} a_y t_B^2$

$H = 0\,(t_B) + \frac{1}{2} g t_B^2$

$t_B = \sqrt{\frac{2H}{g}}$

For stone, $s = ut_s + \frac{1}{2} a t_S^2$

$H = 0(t_s) + \frac{1}{2} g t_s^2$

$t_s = \sqrt{\frac{2H}{g}}$

Question 7: b

Given : T – time period, H – maximum height

$\frac{H}{T} = \frac{\frac{u^2 \sin^2\theta}{2g}}{\frac{2u\sin\theta}{g}} = \frac{1}{4} u \sin\theta.$

Question 8: a

$R = \frac{u^2}{g} = d \text{ (given)}$

$H_{max.} = \frac{u^2}{2g} = \frac{d}{2}$

Question 9: b

Average velocity in time interval when it crosses half of maximum height

vertical displacement = 0 so $\bar{v}_y = 0$

horizontal velocity remains constant

so $v_{av} = u\cos\theta$.

Question 10: b

$R_{max} = \frac{v^2}{g}$

Area of ground = $\pi R_{max}^2 = \pi \left(\frac{v^2}{g}\right)^2 = \pi \frac{v^4}{g^2}$

Question 11: a

For same range there are two possible angles of projection θ and $90° - \theta$

Let u be velocity of projection

$\therefore R = \frac{u^2 \sin 2\theta}{g}$

In 1st case, $h = \frac{u^2 \sin^2 \theta}{2g}$

In IInd case, $h' = \frac{u^2 \sin^2 (90-\theta)}{2g} = \frac{u^2 \cos^2 \theta}{2g}$

$\therefore hh' = \frac{u^4 \sin^2 \theta \cos^2 \theta}{4g^2}$

$= \frac{u^4 4 \sin^2 \theta \cos^2 \theta}{16 g^2} = \frac{u^2 \sin^2 2\theta}{16 g^2}$

$16\, hh' = \left(\frac{u^2 \sin 2\theta}{g}\right)^2 = R^2$

$\therefore R = \sqrt{16hh'} = 4\sqrt{hh'}$

Question 12: d

Let speed of projection be u. For same range the angle of projection are θ and $90° - \theta$

$\therefore$ Angle of projection in other case

$$= \frac{\pi}{2} - \frac{\pi}{3} = \frac{\pi}{6}$$

$\therefore$ In 1st case, $y_1 = \frac{u^2 \sin^2 \frac{\pi}{3}}{2g} = \frac{3}{4}\left(\frac{u^2}{2g}\right)$

In IInd case, $y_2 = \frac{u^2 \sin^2 \frac{\pi}{6}}{2g} = \frac{1}{4}\left(\frac{u^2}{2g}\right)$

Clearly, $y_1 = 3y_2$ or $y_2 = \frac{y_1}{3}$

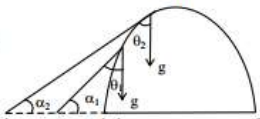
Question 13: d

(1)

The only force acting on the particle is $m\vec{g}$

Hence acceleration $= \frac{\vec{F}}{m} = \frac{m\vec{g}}{m} = \vec{g}$ at all points

(2)



Clearly, tangential component of acceleration = g cos θ = g cos $(90° - \alpha)$ = g sin α

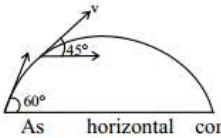
As the ball ascends α decreases (as is clear from fig. $\alpha_2 < \alpha_1$)

Hence tangential component of acceleration decreases.

(3) Normal component of acceleration = g sin θ = g sin $(90° - \alpha)$ = g cos α

$\therefore$ As the ball ascends α decreases hence a_N increases and becomes g at the highest point of path

Question 14: c



As horizontal component of velocity remains unchanged

So, $20 \cos 60° = 10$

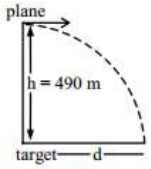
$$\tan\theta = \frac{v_y}{v_x} = \frac{u\sin 60° - gt}{\theta\cos 60°} = \frac{20\times\frac{\sqrt{3}}{2} - 10\times t}{20 - \frac{1}{2}}$$

$$\tan 45° = \frac{\frac{\sqrt{3}}{2} - \frac{t}{2}}{\frac{1}{2}}$$

$$1 = \frac{\sqrt{3} - t}{1}$$

$$t = (\sqrt{3} - 1)$$

Question 15: b



Horizontal velocity of plane = 720km/hr = 200 m/s.

Time taken by bomb to reach the surface

$$y = \frac{1}{2}\, gt^2$$

$$t^2 = \frac{2y}{g} = \frac{2\times 490}{9.8}$$

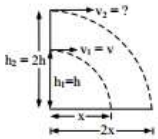
$t^2 = 100$ sec; $t = 10$ sec

In this time interval horizontal distance travelled by bomb

$= v_x \times t = 200 \times 10 = 2000$ m

so correct option is (2)

Question 16: b



$$h_1 = \frac{1}{2}\, gt_1^2$$

$$h_2 = \frac{1}{2}\, gt_2^2$$

$$\frac{h}{2h} = \frac{\frac{1}{2}gt_1^2}{\frac{1}{2}gt_2^2} \qquad [\text{Given } h_1 = h,\ h_2 = 2h]$$

$$\frac{t_1^2}{t_2^2} = \frac{1}{2};\ t_2 = \sqrt{2}\, t_1 \qquad \ldots(1)$$

$R_1 = v_{x1} \times t_1;\ R_2 = v_{x2} \times t_2 \quad [R_1 = x, R_2 = 2x]$

$$\frac{1}{2} = \frac{v_{x_1}\times t_1}{v_{x_2}\times t_2};\ \frac{v_{x_1}}{v_{x_2}} \times \frac{1}{\sqrt{2}} = \frac{1}{2}$$

$$v_{x_1} = v_1, \qquad v_{x_2} = v_2$$

$v_2 = \sqrt{2}\, v_1$ so correct option is (2)

Question 17: a

$$S_n \text{ (distance travel in last sec)} = \frac{g}{2}\,(2n - 1)$$

$$S_n = 24.5 = \frac{g}{2}\,(2n - 1);\ n = 3 \text{ sec}$$

$$S = \frac{1}{2}\, gt^2 = \frac{1}{2} \times g\,(3)^2 = 43.60$$

Question 18: a

Given : 80 ft = 80 × 3.281 m/sec, s = 96 feet]

$S = ut - \frac{1}{2} gt^2$

put the value of u & s in above relation. Convert the given values of u & s is M.K.S.

$u = 80 \frac{ft}{sec} = \frac{80}{3.281} = 24.382$ m/s

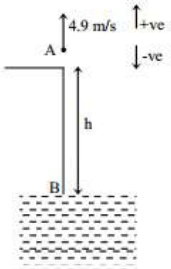
$h = 96$ feet $= \frac{96}{3.281} = 29.25$ m

$29.25 = 24.382\ t - \frac{1}{2} \times 10 \times t^2$

Question 19: a

Frame or system which in rest or moving with same velocity means non-accelerated frame in this no pseudo force is act so time to come at the floor in both cases are same.

Question 20: b



For motion of pebble from A to B,

$u = +4.9$ m/s, $t = 2$ sec,

$s = -h$, $a = -9.8$ m/s^2

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

$-h = 4.9(2) + \frac{1}{2}(-9.8)(2)^2$

$-h = 9.8 - 19.6$

$h = 9.8$ m

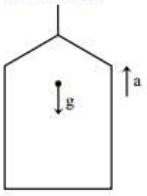
$v = u + at \Rightarrow v = 4.9 + (-9.8)(2)$

$v = -14.7$ m/s

–ve sign implies that velocity of pebble is directed downwards while striking water surface.

Question 21: d

The acceleration of the stone after release is g because when stone is dropped then only force mg acts on stone downward.



Question 22: c

$x = \sqrt{v+1}$

$x^2 = v + 1$

$2x \frac{dx}{dt} = \frac{dv}{dt} = a$; $a = 2x \cdot v$

put the value of $v = x^2 - 1$

$a = 2x(x^2 - 1) = 2 \times 5(25 - 1)$

$= 10 \times 24 = 240$ unit

Question 23: c

$v = \frac{20}{3x - 2}$

$\frac{dx}{dt} = \frac{20}{3x-2} \Rightarrow \int_0^{20} (3x-2)dx = \int_0^t 20\,dt$

$\Rightarrow \left[\frac{3x^2}{2} - 2x\right]_0^{20} = 20\,t \Rightarrow \frac{3}{2} \times 400 - 40 = 20\,t$

$\Rightarrow 560 = 20\,t \Rightarrow t = 28$ sec

Question 24: a

Person finally reach at the point from where he starts i.e.
xf – xi = 0
so displacement is zero and average velocity of person is zero

Question 25: a

When it move 0 to a

$v = \frac{x_2 - x_1}{t} = \frac{a - 0}{t}$ $x_{max} = a$

$x = vt$; $v = \text{const}$ so $x \propto t$ …(i)

when it move 'a' to 0

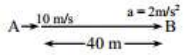
$v = x_2 - x_1 = \frac{0 - a}{t}$ $x_{min} = 0$

$v' = -v = \text{constant}$, $\frac{dx}{dt} = -v$ …(ii)

so both of condition will be satisfy through option (1).

Question 26: c

(i) Ans (1) & (ii) (2).



$s_1 = vt$

$s_2 = \ell o + 1/2\ at^2 = 40 + 1/2 \times 2 \times t^2 = 40 + t^2$

Δs (distance between A & B) $= s_2 - s_1$

$\Delta s = 40 + t^2 - 10t$

$\frac{\Delta s}{\Delta t} = 2t - 10 = 0,\ t = 5$ sec

$\frac{d^2s}{dt^2} = 2$ (constant)

so only one minimum in this function is at t = 5 sec

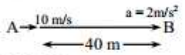
(ii) Ans (2)

Δs_{min} (at t = 5 sec.) $= 40 + t^2 - 10\ t$

$= 40 + 65 - 50 = 15$ m

Question 27: c

(i) Ans (1) & (ii) (2).



$s_1 = vt$

$s_2 = \ell o + 1/2\ at^2 = 40 + 1/2 \times 2 \times t^2 = 40 + t^2$

Δs (distance between A & B) $= s_2 - s_1$

$\Delta s = 40 + t^2 - 10t$

$\frac{\Delta s}{\Delta t} = 2t - 10 = 0,\ t = 5$ sec

$\frac{d^2s}{dt^2} = 2$ (constant)

so only one minimum in this function is at t = 5 sec

(ii) Ans (2)

Δs_{min} (at t = 5 sec.) $= 40 + t^2 - 10\ t$

$= 40 + 65 - 50 = 15$ m

Question 28: b

$v_1 \rightarrow$ velocity of boat
$v_2 \rightarrow$ velocity of river
$d \rightarrow$ distance b/w opposite ends of river
when boat moves in downstream

$$t_1 = 8 \text{ hr} = \frac{d}{v_1 + v_2} \quad \ldots(i)$$

when boat moves in up stream

$$t_2 = 12 \text{ hr} = \frac{d}{v_1 - v_2} \quad \ldots(ii)$$

from (i) & (ii) $\frac{8}{12} = \frac{2}{3} = \frac{v_1 - v_2}{v_1 + v_2}$

After solving we get $v_1 = 5\, v_2$
time taken by boat in still water
(in this case $v_2 = 0$)
$= (v_1 + v_2)\, 8 = (v_1 + 0) = t$

$$t = \frac{(v_1 + v_2)8}{v_1} \text{ put } v_2 = v_1 / 5$$

$$t = \left(\frac{v_1 + v_1/5}{v_1}\right)8 = \frac{6}{5} \times 8 = \frac{48}{5} = 9.6$$

$= 9.6$ hrs Ans.

Question 29: a

$$v_T = \sqrt{v_{TC}^2 + v_C^2} = \sqrt{(25\sqrt{3})^2 + (25)^2}$$

$$= \sqrt{1875 + 625} = \sqrt{2500} = 25 \text{ km/hr} = \frac{\sqrt{14}}{2} \text{ sq. unit}$$

Question 30: d

Let the velocity of the scooterist $= v$
Relative velocity of scooterist with respect to bus $= (v - 10)$

$$\Rightarrow S = (v - 10) \times 100 \Rightarrow 1000 = (v - 10) \times 100$$

$$\therefore v = 10 + 10 = 20 m/s$$

Question 31: d

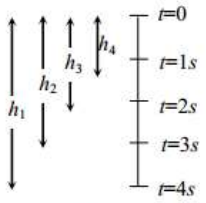
$$a = \frac{dv}{dt} = \frac{dv}{dx}\frac{dx}{dt} = v\frac{dv}{dx} = -\alpha x^2 \quad \text{(given)}$$

$$\Rightarrow \int_{v_0}^{0} v\,dv = -\alpha \int_{0}^{S} x^2 dx \Rightarrow \left[\frac{v^2}{2}\right]_{v_0}^{0} = -\alpha \left[\frac{x^3}{3}\right]_{0}^{S}$$

$$\Rightarrow \frac{v_0^2}{2} = \frac{\alpha S^3}{3} \Rightarrow S = \left(\frac{3v_0^2}{2\alpha}\right)^{\frac{1}{3}}$$

Question 32: a

For first marble, $h_1 = \frac{1}{2} g \times 16 = 8g$



For Second marble, $h_2 = \frac{1}{2} g \times 9 = 4.5g$

For third marble, $h_3 = \frac{1}{2} g \times 4 = 2g$

For fourth marble, $h_4 = \frac{1}{2} g \times 1 = 0.5g$

$\therefore\ h_1 - h_2 = 8g - 4.5g = 3.5g = 35m.$
$h_2 - h_3 = 4.5g - 2g = 2.5g = 25\text{m}$ and
$h_3 - h_4 = 2g - 0.5g = 1.5g = 15\text{m}$.

Question 33: c

For first projectile, $h_1 = ut - \frac{1}{2}gt^2$

For second projectile, $h_2 = u(t-T) - \frac{1}{2}g(t-T)^2$

When both meet *i.e.* $h_1 = h_2$

$ut - \frac{1}{2}gt^2 = u(t-T) - \frac{1}{2}g(t-T)^2$

$\Rightarrow uT + \frac{1}{2}gT^2 = gtT$

$\Rightarrow t = \frac{u}{g} + \frac{T}{2}$

and $h_1 = u\left(\frac{u}{g} + \frac{T}{2}\right) - \frac{1}{2}g\left(\frac{u}{2} + \frac{T}{2}\right)^2$

$= \frac{u^2}{2g} - \frac{gT^2}{8}$.

Question 34: c

Due to constant velocity along horizontal and vertical downward force of gravity stone will hit the ground following parabolic path.

Question 35: b

Because the vertical components of velocities of both the bullets are same and equal to zero and $t = \sqrt{\frac{2h}{g}}$.

Question 36: b

Due to air resistance, it's horizontal velocity will decrease so it will fall behind the aeroplane.

Question 37: c

-

Question 38: c

$H = \frac{u^2 \sin^2\theta}{2g} \therefore H \propto u^2$. If initial velocity be doubled then maximum height reached by the projectile will quadrupled.

Question 39: a

An external force by gravity is present throughout the motion so momentum will not be conserved

Question 40: a

Range $= \frac{u^2 \sin 2\theta}{g}$; when $\theta = 90°$, $R = 0$ *i.e.* the body will fall at the point of projection after completing one dimensional motion under gravity.

Question 41: c

$R = 4H\cot\theta$.

When $R = H$ then $\cot\theta = 1/4 \Rightarrow \theta = \tan^{-1}(4)$

Question 42: c

Because there is no accelerating or retarding force available in horizontal motion

Question 43: a

Direction of velocity is always tangent to the path so at the top of trajectory, it is in horizontal direction and acceleration due to gravity is always in vertically downward direction. It means angle between and are perpendicular to each other.

Question 44: d

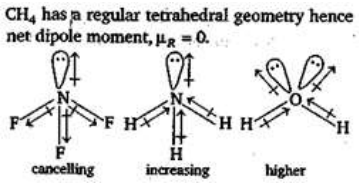
$R = 4H\cot\theta$ if $\theta = 45°$ then $R = 4H\cot(45°) = 4H$

Question 45: d

Acceleration through out the projectile motion remains constant and equal to g

Single Correct:

Question 46: a



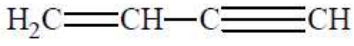
Question 47: d

$$\Delta E = E_2 - E_1 = \frac{-1312}{2^2} - \frac{(-1312)}{1^2}$$

$$= 1312 \times \frac{3}{4} = 984 \text{ kJ}$$

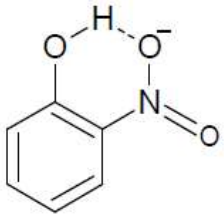
Hence, **(D)** is the correct answer.

Question 48: b

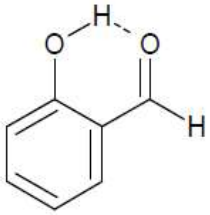


Question 49: d

Both o–nitrophenol and salicylaldehyde undergo intramolecular hydrogen bonding.



o-nitrophenol



Salicylaldehyde

Hence, **(D)** is the correct answer.

Question 50: c

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Question 51: d

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Question 52: c

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Question 53: a

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Question 54: b

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Question 55: c

Larger the ion, more is its polarization

Hence, (3) is the correct answer.

Question 56: a

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Question 57: d

-

Question 58: d

-

Question 59: d

-

Question 60: d

-

Question 61: d

-

Question 62: c

-

Question 63: a

-

Question 64: c

-

Question 65: c

-

Question 66: b

-

Question 67: b

-

Question 68: b

-

Question 69: c

-

Question 70: d

-

Question 71: b

-

Question 72: b

-

Question 73: a

100g have 2 g

12 g have $\frac{2}{100} \times 12 \times \frac{1}{14} \times N_A \times 1$

$= 1.2 \times 10^{22}$ atoms

Question 74: d

$(NH_4)_2Cr_2O_7 = 19 \times 6.02 \times 10^{23} = 114 \times 10^{23}$ atoms

Question 75: b

$4\,(V.D.)_A = (V.D.)_B$

$(V.D.)_B = \frac{M_B}{2}$ ...(1)

$(V.D.)_A = \frac{M_A}{2}$ ...(2)

$4 \times \frac{M_A}{2} = \frac{M_B}{2}$

$M_A = \frac{M_B}{2} \times \frac{2}{4}$

$M_A = \frac{M_B}{4}$

Question 76: d

Simple ratio of atom $= \frac{254}{127} = 2$ for I

Simple ratio of atom $= \frac{80}{16} = 5$ for O

So I_2O_5

Question 77: d

$H_2O\% = \frac{55}{100} = \frac{18n}{142+18n} = n = 10$

Question 78: b

$$\underset{1}{Mg} + \underset{2}{2HCl} \longrightarrow \underset{1}{MgCl_2} + \underset{1}{H_2}$$

$\frac{1}{2}$ 1 $\frac{1}{2}$ $\frac{1}{2}$ $H_2\uparrow$

Question 79: d

$CaCO_3 \longrightarrow CaO + CO_2$

100 g 56 g 44 g

100 g $CaCO_3$ give = 56g CaO

1 g $CaCO_3$ give = $\frac{56}{100}$

$200 \times \frac{95}{100}$ g $CaCO_3$ give $= \frac{56}{100} \times \frac{100}{200 \times 95}$

$= 106.4$ kg

Question 80: d

$CaCO_3 \longrightarrow CaO + CO_2$

100 g 56 g 44 g

100 g $CaCO_3$ give = 56g CaO

1 g $CaCO_3$ give = $\frac{56}{100}$

$200 \times \frac{95}{100}$ g $CaCO_3$ give $= \frac{56}{100} \times \frac{100}{200 \times 95}$

$= 106.4$ kg

Question 81: c

$$\frac{w_1}{E_1}=\frac{w_2}{E_2}=\frac{x\times\frac{70}{100}}{49}=1\times 1$$

$$x=\frac{49\times 100}{70}=70\text{ gm}$$

Question 82: c

$H_2 + Cl_2 \longrightarrow 2HCl$

1 mole 1 mole 2 mole

11.2 litre at NTP gas has = 0.5 mole Cl_2

11.2 = 12 litre NTP = 0.5 mole H_2

0.8 litre H_2 = remaining

1 mole HCl = 22.4 litre

Question 83: b

$$\text{Molarity}=\frac{n\times 1000}{V(ml)}$$

$$V=\frac{n\times 1000}{M}=\frac{600\times 10^{-3}\times 1000\times 10}{0.4\times 56}=26.78\text{ ml}$$

Question 84: b

Mole fraction of $I_2 = X_A$

$$X_A=\frac{n_1}{n_1+n_2} \qquad X_B=\frac{n_2}{n_1+n_2}$$

$X_A + X_B = 1$

$X_A = 0.2$

$X_B = 0.8$

$$\frac{X_A}{X_B}=\frac{n_1}{n_2}$$

$n_1 : n_2 = 1 : 4$

Mass of solvent

$$\because n_2=\frac{w}{M}$$

$$w = n_2\times M = 4\times 78(g)$$

$$\text{Molality} = \frac{n_1}{\text{mass of solvent (in kg)}}$$

$$=\frac{1}{4\times 78}\times 1000 = 3.21\text{ m}$$

Question 85