INDIAN SCHOOL MUSCAT

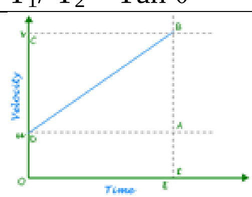
FIRST TERM EXAMINATION

SEPTEMBER 2018 (23-09-2018)

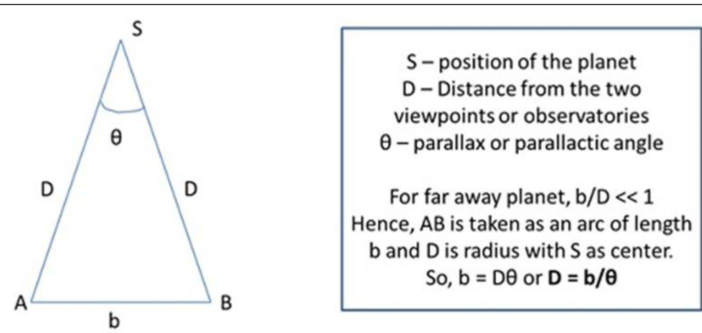
CLASS XI

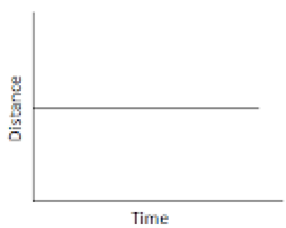
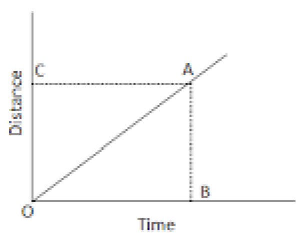
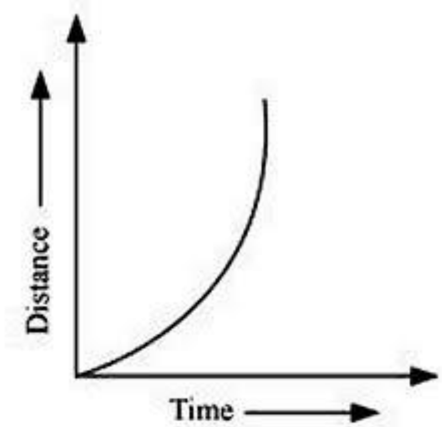
PHYSICS

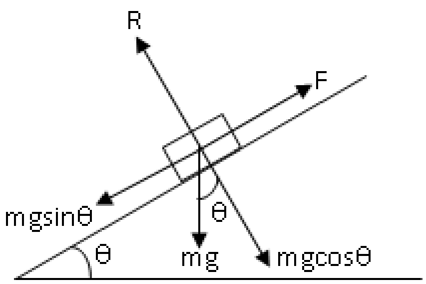
MARKING SCHEME SET A

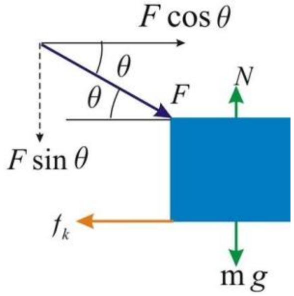
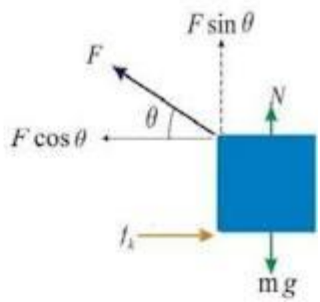
Q.NO.	Answers	Marks
1	Gravitational force < weak nuclear force < electromagnetic force < strong nuclear force.	1M
2	1A.U.< 1 light year < 1 parsec	1M
3	$[G] = [M^{-1} L^3 T^{-2}]$	1M
4	(a) 3 (b) 3	½ + ½
5	F = 9N mv-mu = F x t = 9 X 2 = $18 Kgms^{-1}$	½ + ½
6	Dimensional formula for force $M^1L^1T^{-2}$ Converting 100N into dynes by using dimensional analysis $100N = 10^7 dyne$	1M 1M
7	(a) 1 : 3 (b) Zero	1M 1M
8	$T_1 = 2uSin\,\theta/g$, $T_2 = 2uSin(90 - \theta)/g$ $T_1/T_2 = Tan\,\theta$	1M 1M
9	 The distance covered by the object moving with uniform acceleration is given by the area of trapezium ABDOE Therefore, Area of trapezium ABDOE =1/ 2×(sum of parallel sides) X distance between parallel sides) ⇒ Distance (s) =1/ 2(DO+BE)×OE=1/ 2(DO+BE)×OE ⇒s=1/2(u+v)×t ----(iii) Now from equation (ii) a=(v−u)/t ∴t=(v-u) / a ----(iv) After substituting the value of t from equation (iv) in equation (iii) ⇒2as=(v+u)(v−u)⇒2as=(v+u)(v-u) ⇒2as=v2-u2	½ M 1½M
10	We know that horizontal range is maximum if the angle of projection is 45^o and is given by $R_{max} = u^2 / g$ Here, R_{max} = 100 m so, u^2 / g = 100 m	1M

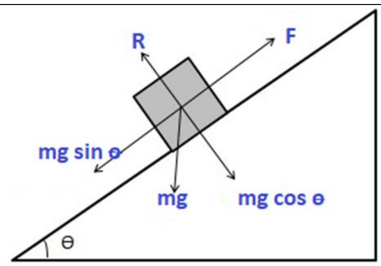
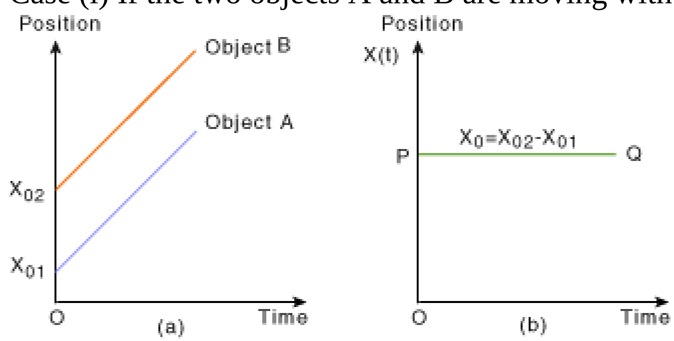
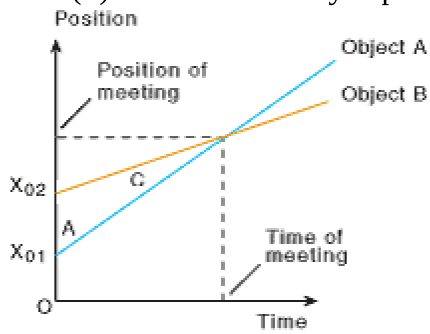
	If the cricketer throws the ball vertically upward then the ball will attain the maximum height from the ground $H_{max} = u^2 / 2g = 100 /2 = 50$ m.	 1M
11	First law from second law F = ma, if F = 0 i.e., ma = 0 m is not equal to 0 a = 0, this shows that a body at rest will continue to be rest or a body moving with uniform velocity will continue to move with the same velocity if no external force acts on it. Third law from second law: $F_{12} = - F_{21}$	1M 1M
12	Case (a) Mass of the monkey, m = 40 kg Acceleration due to gravity, g = 10 m/s Maximum tension that the rope can bear, Tmax = 600 N Acceleration of the monkey, a = 6 m/s2 upward T – mg = ma ∴T = m(g + a) = 40 (10 + 6) = 640 N Since T > Tmax, the rope will break in this case. Case (b) mg – T = ma ∴T = m (g – a) = 40(10 – 4) = 240 N Since T < Tmax, the rope will not break in this case. Case (c) a = 0. T – mg = ma T – mg = 0 ∴T = mg = 40 × 10 = 400 N Since T < Tmax, the rope will not break in this case. Case (d) When the monkey falls freely under gravity, its will acceleration become equal to the acceleration due to gravity, i.e., a = g mg – T = mg ∴T = m(g – g) = 0 Since T < Tmax, the rope will not break in this case. (OR) impulse J=FΔT —————-equation 1 We know that Force(F)=ma putting this value of F in equation 1,we get	½ + ½ + ½ + ½ 2M

	$J = ma\Delta T$——————equation 2 equation 2 can also be written as $J = m\Delta v/\Delta T \times \Delta T$ now the value of $J = m\Delta V$ $m\Delta v$=change in linear momentum… $J = m\Delta V$ This is the relation between Impulse and momentum.	
13	$M = k V^a \rho^b g^c$ where, k is a proportionality constant $[M] = [V]^a[\rho]^b[g]^c$ Writing the dimensions of each physical quantity. $M^1L^0T^0 = (L^1T^{-1})^a(M^1L^{-3})^b(L^1T^{-2})^c$ $M^1L^0T^0 = M^b L^{a-3b+c} T^{-a-2c}$ On Comparing the powers on both sides of the above dimensional equation: b = 1, a - 3b + c = 0 Hence, a - 3(1) + c = 0 a + c = 3 ------------(i) -a - 2c = 0 ----------(ii) On solving (i) and (ii) a + c = 3 -------------(iii) -a - 2c = 0------------(iv) On adding (iii) and (iv) -c = 3, Hence, c = - 3. Substituting c = -3 in equation (I), a = 6. Thus, $M = k V^6 \rho g$ ∴ M is proportional to the 6^{th} power of V if the mass of the largest (M) stone that can be moved by flowing river depends (i.e., directly proportional to) on velocity (v), the density (ρ), and acceleration due to gravity (g)	1M 1M 1M
14	(a) a **light-year** is the distance that **light** travels in vacuum in one **year** . $1ly = 9.46 \times 10^{15} M$ (b) Unit for b is ms^{-1} and unit for c is ms^{-2}	1M 2M
15	 Parallax method to determine distance of a planet -	1M 2M

	(OR) A1=2.56s A2=2.62s A3=2.70s A4=2.58s A5=2.45s avg a=2.582 absolute error in the measurements are=(2.56-2.58)=-0.02 (2.62-2.62)=0 (2.70-2.62)=0.08 (2.58-2.62)=-0.04 (2.45-2.62)=-0.17 mean absolute errors=(-0.02+0+0.08-0.04-0.17)/5=-0.03 relative error=±0.03/2.58=±0.011 percentage error=1.16%	
16	 **Figure 3: -** Distance time graph for objects at rest  **Figure 4: -** Calculation of speed from distance time  	1+1+1
17	U= 0 , v= 180km/hr = 180×5/18=50m/s, t= 25s v=u+at 50 = 0 + a x 25 a = $2ms^{-2}$	1M 1M

	$s = ut + \frac{1}{2} at^2$ $s = 0 + \frac{1}{2} \times 2 \times 625$ $= 625m = 0.625km$	1M
18	The horizontal range is maximum when the angle of projection is 45°. ...(1) Maximum height for angle of projection is, ...(2) Therefore, from equation (1) and (2), R = 4H Range is 4 times the maximum height attained by a projectile	1M 1M 1M
19	(a) A unit vector is a vector of magnitude of one, sometimes also called a direction vector. The unit vector having the same direction as a given vector. **(b) A** X **B** = 0 Which shows that **A** is parallel to **B**	1M 2M
20	Angle of repose is defined as the minimum angle made by an inclined plane with the horizontal such that an object placed on the inclined surface just begins to slide. Relation between Angle of Friction and Angle of Repose Let us consider a body of mass 'm' resting on a plane. Also, consider when the plane makes 'θ' angle with the horizontal, the body just begins to move.  Let 'R' be the normal reaction of the body and 'F' be the frictional force. Here, mgsinθ = -F ——> (i) mgcosθ = -R ——>(ii) Dividing equation (i) by (ii) $\frac{mg\sin\theta}{mg\cos\theta} = \frac{-F}{-R}$ Or, $\tan\theta = \frac{F}{R}$ $\tan\theta = \mu$,	1M 2M
21	(i) apparent weight, N = W = mg = 75 x 10 = 750N	1M

	(ii) N/g = 750/10 = 75kg (iii) N = m(g-a) = 75(10-5) = 375kg	1M 1M
22	When you push there is one component of force that adds to the weight of the body and hence there is more friction. When you pull the vertical component of force is against the weight of body and hence there is less overall friction. So it is easy to pull than push an object.  N = Mg+Fsinθ Pulling is more effective. You must know that the friction experienced by a body is directly proportional to the normal force acting on it.  N = Mg-Fsinθ	1M 1M 1M
23	According to the Newton's 2nd Law of motion, the rate of change of linear momentum of a body is directly proportional to the applied external force and in the direction of force. Now According to Newton's 2nd Law of Motion: Force is directly proportional to rate of change of momentum, that is F α dp/dt F = k dp/dt F = k d(mv)/dt F = k md(v)/dt F = k ma Experimentally k =1 F = k ma Which is the required equation of force.	1M 2M

Q.No	Answer	Marks
24		1M
	Consider a plane is inclined to the horizontal at an angle ϴ. Let the body placed on the inclined plane slide down with an acceleration a, then The reaction R = mg cos ϴ ------Eqn (1) Net force on the body down the inclined plane = f = mg sin ϴ – F f = ma = mg sin ϴ – μR as μ = F / R ---- Eqn (2) Now substitute for R, from equation (1) ma = mg sin ϴ – μ mg cos ϴ = mg(sin ϴ - μ cos ϴ) **a = g(sin ϴ - μ cos ϴ)** The acceleration of the body down a rough inclined plane is always less than the acceleration due to gravity g. that is a < g	2M
25	(i) Relative velocity is defined as the time rate of change of relative position of one object with respect to another.	1M
	Case (i) If the two objects A and B are moving with same velocity [v1 = v2] 	1M
	Case(ii): Relative velocity is positive **($v_2 – v_1$) is positive** 	1M
	(ii) Speed of the jet airplane, v_{jet} = 500 km/h Relative speed of its products of combustion with respect to the plane, v_{smoke} = – 1500 km/h Speed of its products of combustion with respect to the ground = v'_{smoke} Relative speed of its products of combustion with respect to the airplane, $V_{smoke} = V'_{smoke} – V_{jet}$	2M

	$-1500 = v'_{smoke} - 500$ $v'_{smoke} = -1000$ km/h The negative sign indicates that the direction of its products of combustion is opposite to the direction of motion of the jet airplane. (OR) (i) To find the the distance travelled in nth sec. find the distance travelled in n seconds, which is- $S(n) = un + 1/2\ an^2$ ....(i) Then find the distance travelled in (n-1) seconds. So, $S(n-1) = u(n-1) + 1/2\ a\ (n-1)^2$. ....(ii) Now to find distance travelled in n seconds, substract (ii) from (i). This gives us the distance travelled in nth seconds. $S_{nth} = u + a\ (2n-1)/2$. (ii) $2u + 17a = 48$ $2u + 13a = 40$ On solving above equations, we get $a = 2ms^{-2}$ $u = 7ms^{-1}$ Distance travelled in 15^{th} second is 36m	3M 2M
26	(i) Definition of projectile Let a body is projected with speed u m/s inclined θ with horizontal line Then, vertical component of u, $= u\cos\theta$ Horizontal component of u , $= u\sin\theta$ acceleration on horizontal, $a_x = 0$ acceleration on vertical, $a_y = -g$ $x = u\cos\theta . t$ $t = x/u\cos\theta$------(1) $y = u\sin\theta t - 1/2gt^2$ Put equation (1) here, $y = u\sin\theta \times x/u\cos\theta - 1/2g \times x^2/u^2\cos^2\theta$	1M 2M

	$= \tan\theta x - 1/2gx^2/u^2\cos^2\theta$ $y=Ax - Bx^2$ which is the equation of parabola hence path of a projectile is parabola. (ii) Range = $u^2\sin(2\alpha)/g$ 45 $30^2 \sin(2\alpha)/10$ $45 = 900 \sin(2\alpha)/10$ $45 = 90 \sin(2\alpha)$ $\sin(2\alpha) = 1/2$ $2\alpha = 30°$ or $150°$ $\alpha = 15°$ or $75°$ (OR) (i)Derivation for time of flight $T = 2u\sin\theta/g$ and Range $R = u^2\sin2\theta/g$. (ii) $R = u^2\sin2\theta/g$. R = 9.8 x 9.8 sin(2x45)/9.8 = 9.8m	2M (1½+ 1½) 2M
27	(i) Law of conservation of momentum states that total momentum of system remains conserved in the absence of external force. Proof: Consider a body of mass m1 moving with velocity striking against another body of mass m2 moving with velocity. Let, the two bodies remain in contact with each other for a small interval . Let, be the average force exerted by mass m1 on m2 and let be the force on m2 due to m1. Let, v1 and v2 be the velocities of two bodies after collision.  Momentum of mass m1 before collision = m1u1 Momentum of mass m2 after collision = m2 u2 Momentum of mass m1 after collision = m1v1 By using the definition of impulse, change in momentum of mass m1 is,	1M 2M

$\vec{F}_{12}\Delta t = m_1\vec{v}_1 - m_1\vec{u}_1$ ...(1)

Change in momentum of mass m_2 is,

$\vec{F}_{21}\Delta t = m_2\vec{v}_2 - m_2\vec{u}_2$ ...(2)

Adding equations (1) and (2), we have

$$(\vec{F}_{12}\Delta t + \vec{F}_{21}\Delta t) = (m_1\vec{v}_1 - m_1\vec{u}_1) + (m_2\vec{v}_2 - m_2\vec{u}_2)$$

$$\Rightarrow (\vec{F}_{12} + \vec{F}_{21})\Delta t = (m_1\vec{v}_1 + m_2\vec{v}_2) - (m_1\vec{u}_1 - m_2\vec{u}_2)$$

Since, $\vec{F}_{12}$ and $\vec{F}_{21}$ are equal and opposite,

$$\vec{F}_{12} + \vec{F}_{21} = 0$$

Thus, $(m_1\vec{v}_1 + m_2\vec{v}_2) = (m_1\vec{u}_1 - m_2\vec{u}_2)$

Momentum after collision = Momentum before collision

Hence, momentum of isolated system is conserved.

(ii) From the law of conservation of momentum ;

MV+ mv=0

[M= mass of gun

V = Recoil velocity

m = mass of shell

v = muzzle velocity]

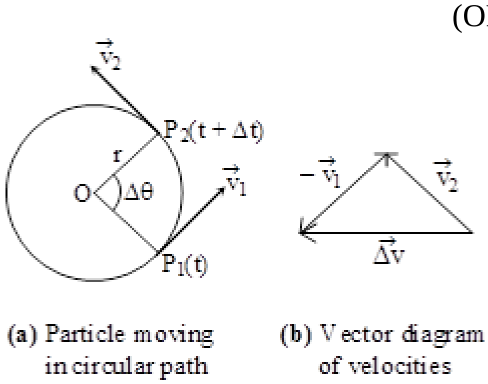
10× V = -0 .02 x 80 2M

V = -1.6 ÷10

V = -0.16 m/s

Recoil velocity = 0.16 m/s

(OR)



(a) Particle moving in circular path of radius r

(b) Vector diagram of velocities

	Derivation for $F = mv^2/r$ (ii) Let m is the mass of the bullet M = mass of the gun. v = velocity of the bullet V = velocity of recoil of gun before firing the gun and the bullet , both are at rest , therefore linear momentum before firing will be 0 . the sum of linear momentum before firing will be equal to mv+MV acc to the principle of conservation of linear momentum , the total linear momentum after firing should also be equal to 0 . therefore $mv + MV = 0$ or $V = -mv/M$	1M 2M 2M