DYNAMICS ASSIGNMENT

1. Two straight railways converge to a level crossing at an angle α and two trains are moving towards the crossing with velocities *u* and *v*. If *a* and *b* are the initial distances of the trains from the crossing, the least distance between them will be after time *t* given by

(a) $\frac{(au+bv)+(av+bu)\cos\alpha}{u^2+v^2+2uv\cos\alpha}$ (b) $\frac{(au+bv)-(av+bu)\cos\alpha}{u^2+v^2-2uv\cos\alpha}$ (c) $\frac{(au+bv)-(av+bu)\cos\alpha}{u^2+v^2+2uv\cos\alpha}$ (d) None of these

2. A particles moves from rest, away from a fixed point *O*, with an acceleration $\frac{\mu}{x^2}$, where *x* is the distance of the particle from *O*. If it is at rest, then its distance from *O* is *b*. The velocity when it is at a distance 2*b* from *O* is

(a) $\frac{\mu}{b}$ (b) $\frac{\mu}{b^2}$ (c) $\sqrt{\frac{\mu}{b^2}}$ (d) $\sqrt{\frac{\mu}{b}}$

3. The velocity *v* of a particle is at any time related to the distance travelled by the particle by the relation $v = as + b$, where $a > 0$ and $b \le a/2$. Which of the following statements will be true for this motion (Given $s = 0$ when $t = 0$)

(a) The displacement of the particle at time *t* is $s = \frac{b}{a}(e^{at}-1)$ (b) The particle will experience a retardation if $b > 0$

(c) The particle will be at rest at $t = 0$ (d)The motion of the particle is under constant acceleration

4. A particle moving in a straight line is subject to a resistance which produces a retardation kv^3, where *v* is the velocity and *k* is a constant. If *u* is the initial velocity of the particle, then

(a) $v = \frac{u}{1+kxu}$ (b) $v = \frac{u}{1+xu}$ (c) $v = \frac{ku}{1+kxu}$ (d) $v = \frac{u}{1-kxu}$

5. A man rows directly across a flowing river in time t_1 and rows an equal distance down the stream in time t_2. If *u* be the speed of the man in still water and *v* be that of the stream, then $t_1 : t_2 =$

(a) $u+v : u-v$ (b) $u-v : u+v$ (c) $\sqrt{u+v} : \sqrt{u-v}$ (d) $\sqrt{u-v} : \sqrt{u+v}$

6. A person travelling towards the north-east, finds that the wind appears to blow from north, but when he doubles his speed it seems to come from a direction inclined at an angle $\tan^{-1}\frac{1}{2}$ on the east of north. The true direction of the wind is towards

(a) North-east (b) North (c) East (d) None of these

7. A man is walking towards north with speed 4.5 *km/hr* . Another man is running towards west with speed 6 *km/hr*. The magnitude and direction of the relative velocity of the second with respect to first is

(a) 7.5 *km/hr* at an angle $\tan^{-1}\left(\frac{3}{4}\right)$ south of west (b) 7.5 *km/hr* at an angle $\tan^{-1}\left(\frac{3}{4}\right)$ west of south

(c) 7.5 *km/hr* south-west (d) None of these

8. A man is swimming in a lake in a direction 30^o east of north with a speed of 5 *km/hr* and a cyclist is going on the road along the lake shore towards east at a speed of 10 *km/hr*. The direction of the swimmer relative to the cyclist is

(a) 30^o west of north (b) West-north (c) 60^o west of north (d) None of these

9. Two cars *A* and *B* are moving uniformly on two straight roads at right angles to one another at 40 and 20 *km/hr* respectively. A passes the intersection of the road when *B* has still to move 50 *km* to reach it. The shortest distance between the two cars and the time when they are closest are

(a) $20\sqrt{5}\ km$, 30 minutes (b) 20 *km*, 10 *minutes* (c) 20 *km*, 20 *minutes* (d) None of these

10. A man is tavelling in a train moving at the rate of $60\sqrt{3}$ *km/hr* and the rain is falling vertically at the rate of 60 *km/hr*. The magnitude and direction of the apparent velocity of the rain to the man sitting in the train

(a) 120 *km/hr*, making an angle of 60^o with the motion of the train

(b) 120 *km/hr* making an angle of 30^o with the motion of the train

(c) 120 *km/hr* making an angle of 45^o with the motion of the train

(d) None of these

11. A person travelling towards eastwards at the rate of 4 *km/hr*. finds that the wind seems to blow directly from the north. On doubling his speed it appears to come from north-east. The velocity and direction of the wind are

(a) $4\sqrt{2}\ km/hr, 90^o$ (b) $5\sqrt{2}\ km/hr, 60^o$ (c) $4\sqrt{2}\ km/hr, 135^o$ (d) None of these

12. A boat takes 10 *minutes* to cross a river in a straight line from a point *A* on the bank to a point *B* on the other bank and 20 *minutes* to do the return journey. The current flows at the rate of 3 *km/hr* and the speed of the boat relative to the water is 6 *km/hr*. The width of the river and the down stream distance from *A* to *B* are

(a) $\frac{\sqrt{15}}{4}, \frac{3}{4}$ (b) $\frac{\sqrt{10}}{4}, \frac{1}{3}$ (c) $\sqrt{6}, \frac{1}{2}$ (d) None of these

13. If a moving particle has two equal velocities inclined at an angle 2α such that their resultant velocity is twice as great as when they are inclined at an angle 2β, then

(a) $\cos\alpha = 2\cos\beta$ (b) $\cos\beta = 2\cos\alpha$ (c) $\cos\alpha = 3\cos\beta$ (d) $\cos\beta = 3\cos\alpha$

14. The speed of a boat in a river is *u m/sec* and that of the current is *v* $m/\sec$. The boat traverse *a* distance of *d metres* down the stream and then comes back to its original position. The average speed of the boat for to and fro journey is

(a) $\frac{u^2-v^2}{u^2}$ (b) $\frac{u^2-v^2}{v^2}$ (c) $\frac{u^2-v^2}{u}$ (d) $\frac{u^2-v^2}{v}$

15. A thief, when detected, jumps out of a running train at right angles to its direction with a velocity of 5 *m/min*. If the velocity of the train is 36 *km/hr*, then the angle θ between the direction in which the thief falls and the direction of motion of the train is given by

(a) $\tan^{-1}\left(\frac{5}{36}\right)$ (b) $\tan^{-1}\left(\frac{1}{20}\right)$ (c) $\tan^{-1}\left(\frac{5}{120}\right)$ (d) None of these

16. A 30 *m* wide canal is flowing at the rate of 20 *m/min*. A man can swim at the rate of 25 *m/min.* in still water. The time taken by him to cross the canal perpendicular to the flow is

(a) 1.0 *min* (b) 1.5 *min.* (c) 2.0 *min.* (d) 2.5 *min.*

17. A man crosses a 320 *m* wide river perpendicular to the current in 4 *minutes*. If in still water he can swim with a speed 5/3 times that of the current, then the speed of the current in *m/min* is

(a) 30 (b) 40 (c) 50 (d) 6

18. For $\frac{1}{m}$ of the distance between two stations a train is uniformly accelerated and $\frac{1}{n}$ of the distance it is uniformly retarded, it starts from rest at one station and comes to rest at the other. Then the ratio of its greatest velocity to its average velocity is

(a) $m+n+1:1$ (b) $\left(\frac{1}{m}+\frac{1}{n}\right):1$ (c) $\frac{1}{m}+\frac{1}{n}+1:1$ (d) $m+n+1:mn$

19. A train starts from station *A* with uniform acceleration f_1 for some distance and then goes with uniform retardation f_2 for some more distance to come to rest at *B*. If the distance between stations *A* and *B* is 4 *km* and the train takes 4 *minutes* to complete this journey, then $\frac{1}{f_1}+\frac{1}{f_2}=$

(a) 1 (b) 2 (c) 4 (d) None of these

20. A bullet moving at 100 *m/sec* is fired into a wood-block in which it penetrates 50 *cm*. If the same bullet moving with the same velocity were fired into a similar piece of wood but only 12.5 *cm* thick, then the velocity with which it emerges is

(a) 500 *m/sec* (b) $\frac{500}{\sqrt{3}}m/\sec$ (c) $500\sqrt{3}m/\sec$ (d) None of these

21. A body traversed half the distance with velocity v_0. The remaining part of the distance was covered with velocity v_1 for half the time and with velocity v_2 for the other half of the time. The mean velocity of the body averaged over the whole time of motion is

(a) $\frac{v_0+v_1+v_2}{3}$ (b) $\frac{2v_0+v_1+v_2}{4}$ (c) $\frac{2v_0(v_1+v_2)}{2v_0+v_1+v_2}$ (d) $\frac{v_0(v_1+v_2)}{v_0+v_1+v_2}$

22. Two points move in the same straight line starting at the same moment from the same point in the same direction. The first moves with constant velocity *u* and the second starts from rest with constant acceleration *f*. The distance between the two points will be maximum at time

(a) $t=\frac{2u}{f}$ (b) $t=\frac{u}{f}$ (c) $t=\frac{u}{2f}$ (d) $t=\frac{u^2}{f}$

23. A train starts from rest from a station with constant acceleration for 2 *minutes* and attains a constant speed. It then runs for 11 *minutes* at this speed and retards uniformly during the next 3 *minutes* and stops at the next station which is 9 *km* off. The maximum speed (in *km/hr*) attained by the train is

(a) 30 (b) 35 (c) 40 (d) 45

24. A point moves from rest with constant acceleration. If it covered $\frac{9}{25}$ part of its total distance in its last second of motion, then upto what time it travelled

(a) 5 *second* (b) $\frac{5}{9}$ *second* (c) (a) and (b) both are true (d) $6\frac{1}{3}$ *second*

25. If a body is projected vertically upwards with velocity *u* and *t* seconds after words another body is similarly projected with the same velocity, then the two bodies will meet after *T seconds* of the projection of the second body, where *T* =

(a) $\frac{u-gt}{2g}$ (b) $\frac{u-2gt}{2g}$ (c) $\frac{2u-gt}{g}$ (d) $\frac{2u-gt}{2g}$

26. A stone falling from the top of a vertical tower described *m metres*, when another is let fall from a point *n metres* below the top. If the two stones fall from rest and reach the ground together, then the time taken by them to reach the ground is

(a) $\frac{n+m}{\sqrt{2gm}}$ (b) $\frac{n+m}{\sqrt{2gn}}$ (c) $\frac{n-m}{\sqrt{2gm}}$ (d) $\frac{m-n}{\sqrt{2gn}}$

27. Let $g_1\, m/\sec^2$, $g_2\, m/\sec^2$ be the accelerations due to gravity at two places *P* and *Q*. If a particle occupies *n seconds* less and acquires a velocity of *m metre/sec* more at place *P* than place *Q* in falling through the same distance, then *m/n* equals

(a) $g_1 g_2$ (b) $\sqrt{\frac{g_1}{g_2}}$ (c) $\sqrt{\frac{g_2}{g_1}}$ (d) $\sqrt{g_1 g_2}$

28. After a ball has been falling under gravity for 5 *seconds* it passes through a pane of glass and loses half of its velocity and now reaches the ground in one second. The height of the glass above the ground is

(a) 2000 *m* (b) 2500 *m* (c) 2943 *m* (d) None of these

29. A tower is 61.25 *m* high. A rigid body is dropped from its top and at the same instant another body is thrown upwards from the bottom of the tower with such a velocity that they meet in the middle of the tower. The velocity of the projection of the second body is

(a) 20 *m/sec* (b) 25 *m/sec* (c) 24.5 *m/sec* (d) None of these

30. A particle is dropped from the top of a tower *h metres* high and at the same moment another particle is projected upwards from the bottom of the tower. If the two particles meet when the upper one has described $\left(\frac{1}{n}\right)^{th}$ of the distance, then the velocities when they meet are in the ratio

(a) $2 : n-2$ (b) $(n-2) : 2$ (c) $(n+2) : 2$ (d) $2 : n+2$

31. A particle was dropped from the top of the tower of height *h* and at the same time another particle is thrown vertically upwards form the bottom of the tower with such a velocity that it can just reach the top of the tower. The two particles meet at a height

(a) $\frac{h}{2}$ (b) $\frac{3}{5}h$ (c) $\frac{3h}{4}$ (d) $\frac{h}{4}$

32. A stone is dropped from an aeroplane which is rising with acceleration *f* and *t seconds* after this another stone is dropped. The distance between the two stones at time *T* after the *second* stone is dropped is

(a) $\frac{1}{2}(g+f)(t+T)$ (b) $\frac{1}{2}(g+f)(t+2T)$ (c) $\frac{1}{2}(g+f)(2t+T)$ (d) $\frac{1}{2}(g-f)(t+2T)$

33. A stone is dropped slowly from the top of the wall and it reaches the surface of the water with the velocity 3924 *cm/sec,* if sound of splash is heard after $4\frac{109}{475}$ *seconds*, then the velocity of sound will be

(a) 312 *metre/sec* (b) 302 *metre/sec.* (c) 321 *metre/sec* (d) 342 *metre/sec*

34. From the gun cartage of mass *M*, a fire arm of mass *m* with velocity *u* relative to gun cartage is fired. The real velocities of fire arms and gun cartage will be respectively

(a) $\frac{Mu}{M+m} = \frac{Mu}{M-u}$ (b) $\frac{Mu}{M+m} = \frac{mu}{M+m}$ (c) $\frac{M+m}{Mu} = \frac{M+m}{mu}$ (d) $\frac{M+m}{M-m} = \frac{M+m}{Mm}$

35. The shortest time from rest to rest in which a steady load of *P* tons can lift a weight of *W* tons through a vertical distance *h* feet is

(a) $\sqrt{\left(\frac{2h}{g}.\frac{P}{P-W}\right)}$ (b) $\sqrt{\left(\frac{2h}{g}.\frac{P}{P+W}\right)}$ (c) $\sqrt{\left(\frac{2h}{g}.\frac{P+W}{P-W}\right)}$ (d) None of these

36. A shot, whose mass is 400 *kg*, is discharged from a 80 metric ton gun with a velocity of 490 *m/sec.* The necessary force required to stop the gun after a recoil of 1.6 *m* is

(a) 245/16 metric ton (b) 15 metric ton (c) 20 metric ton (d) None of these

37. A rough plane is 100 *ft* long and is inclined to the horizon at an angle $\sin^{-1}(3/5)$, the coefficient of friction being 1/2, and a body slides down it from rest at the highest point, the velocity on reaching the bottom would be

(a) $16/\sqrt{5}$ *ft/sec* (b) $16\, ft/\sec$ (c) $16\sqrt{5}\, ft/\sec$ (d) $16/\sqrt{7}\, ft/\sec$.

38. A particle slide down a rough inclined plane whose inclination to the horizontal is 45^o and whose coefficient of friction is 3/4. The time of descending the distance $4\sqrt{8/5}$ *m* down the plane is

(a) 0.8 *sec* (b) 1.2 *sec* (c) 1.4 *sec* (d) 1.62 *sec*

39. The times of ascent and descent of a particle projected along an inclined plane of inclination α are t_1 and t_2 respectively, the coefficient of friction is

(a) $\frac{t_2-t_1}{t_2+t_1}\tan\alpha$ (b) $\frac{t_2+t_1}{t_2-t_1}\tan\alpha$ (c) $\frac{t_2^2-t_1^2}{t_2^2+t_1^2}\tan\alpha$ (d) $\frac{t_2^2+t_1^2}{t_2^2-t_1^2}\tan\alpha$

40. A light string passing over a light smooth pulley carries masses of 3 *kg* and 5 *kg* at its ends. If the string breaks after the masses have moved 9 *m*, how much further the 3 *kg* mass will rise (Take g = 10 m/sec^2)

(a) 1.75 *m* (b) 1.95 *m* (c) 2.05 *m* (d) 2.25 *m*

41. A mass 2*Q* on a horizontal table, whose coefficient of friction is $\sqrt{3}$ is connected by a string with a mass $6Q$ which hangs over the edge of the table. Eight seconds after the commencement of the motion, the string breaks. The distance of the new position of equilibrium of 2*Q* from its initial position is

(a) 117.6 *m* (b) 120.4 *m* (c) 130.4 *m* (d) None of these

42. A mass of 6 *kg* slides down a smooth inclined plane whose height is half its length, and draws another mass from rest over a distance 3 *m* in 5 *sec* along a smooth horizontal table which is level with the top of the plane over which the string passes, the mass on the table is

(a) 86.5 *kg* (b) 96.5 *kg* (c) 106.5 *kg* (d) 116.5 *kg*

43. Masses of 5 *kg* and 3 *kg* rest on two inclined planes each inclined at 30^o to the horizontal and are connected by a string passing over the common vertex. After 2 *second* the mass of 5 *kg.* is removed. How far up the plane will the 3 *kg.* mass continue to move

(a) 1.9/8 *m* (b) 2.9/8 *m* (c) 3.9/8 *m* (d) 4.9/8 *m*

44. A ball falls from a height *h* upon a fixed horizontal plane, *e* is the coefficient of restitution, the whole distance described by the ball before it comes to rest is

(a) $\frac{1+e^2}{1-e^2}h$ (b) $\frac{1-e^2}{1+e^2}h$ (c) $\frac{1+e^2}{(1-e^2)h}$ (d) $\frac{1-e^2}{(1+e^2)h}$

45. A ball is thrown from a point at a distance *c* from a smooth vertical wall and against the wall and returns to the point of projection. If *e* as the coefficient of restitution, α the angle of projection, the time of flight of the ball is

(a) $\left[\frac{2(1-e)c}{eg}\tan\alpha\right]^{1/2}$ (b) $\left[\frac{2(1+e)c}{eg}\tan\alpha\right]^{1/2}$ (c) $2(1+e)c\tan\alpha$ (d) None of these

46. A ball of mass 8 *kg* and moving with velocity 4 *m/sec* collides with another ball of mass 10 *kg* moving with velocity 2 *m/sec* in the same direction. If the coefficient of restitution is 1/2, the velocities (in *m/sec*) of the balls after impact are

(a) 0, 0 (b) 7/3, 10/3 (c) 2/3, 5/3 (d) 2, 2

47. Three balls of masses m_1, m_2, m_3 are lying in straight line. The first ball is moved with a certain velocity so that it strikes the second ball directly, then the second ball collides with the third. If the coefficient of elasticity for each ball is e and after impact first ball comes to rest, while after second impact the second ball comes to rest. Then m_1, m_2, m_3 are in

(a) A.P., (b) G.P. (c) H.P. (d) None of these

48. A sphere impings directly on an equal sphere which is at rest. Then the original kinetic energy lost is equal

(a) $\frac{1+e^2}{2}$ times the initial K.E. (b) $\frac{1-e^2}{2}$ (c) $\frac{1-e^2}{2}$ times the initial K.E. (d) None of these

49. The angular elevation of an enemy's position on a hill *h* feet high is β. Show that is order to shell if the initial velocity of the projectile must not be less than

(a) $[gh(1+\sin\beta)]^{1/2}$ (b) $[gh(1-\sin\beta)]^{1/2}$ (c) $[gh(1+\text{cosec}\,\beta)]^{1/2}$ (d) $[gh(1-\text{cosec}\,\beta)]^{1/2}$

50. The ratio of the greatest range up an inclined plane through the point of projection and the distance through which a particle falls freely during the corresponding time of flight is

(a) 2 (b) $\frac{1}{2}$ (c) 1 (d) 3