BRAINSTORM GROUP (BSG)

PHY113

Compiled E-test Questions with Answers & written Solutions

(PHY113 CQA-S)

DYNAMICS

1. A car travels 20.0 km due North and then 35.0 km in a direction of 60^o West of North. Find the magnitude of the resultant displacement of the car.
A. 48.2 km B. 30.0 km
C. 82.5 km D. 15.0 km
2. A car is driven Northeast for 40 km, then Northwest for 50 km and then South for 30 km. Determine the resultant displacement of the car.
A. 38.34 km B. 34.38 km
C. 58.2 km D. 43.25 km
3. An aircraft is flying Northwards at 300 km/h when a steady wind is blowing Westwards at 80 km/h. What is the actual velocity with which the aircraft travels over the ground?
A. 380.0 km/h B. 220.0 km/h
C. 310.48 km/h D. 350.0 km/h
4. A car travels 3.0 km due South and then 4.0 km due West. What is its displacement from the starting point?
A. 5 km Northwest B. 7 km Southwest
C. 7 km Northwest D. 5 km Southwest
5. A body of mass 2 kg undergoes a constant horizontal acceleration of 5 m/s^2. Calculate the resultant horizontal force acting on the body.
A. 10 N B. 2.5 N
C. 0.4 N D. 8 N
6. What will be the resultant force on a body of mass 50 kg when it moves with a uniform velocity of 10 m/s?
A. 500 N B. 0 N
C. 5 N D. 25 N
7. A car of mass 600 kg moving with a forward acceleration of 5 m/s^2 is acted upon by a constant resistive force of 1000 N. Calculate the force exerted from the engine to maintain this forward acceleration.
A. 2 kN B. 4 kN
C. 3 kN D. 5 kN
8. A force of 100 N acts for 20 s. What is the change in momentum of the body?
A. 200 Ns B. 2500 Ns
C. 2000 Ns D. 1200 Ns
9. A body of mass 5 kg moving with a speed of 30 m/s is suddenly hit by another body moving in the same direction thereby changing the speed of the former body to 60 m/s. What is the impulse received by the first body?
A. 450 Ns B. 300 Ns
C. 250 Ns D. 150 Ns
10. A body of mass 5 kg is to be given an acceleration of 20 m/s^2. Calculate the force required when the acceleration is vertically upwards (Take g = 10 m/s^2).
A. 150 N B. 100 N
C. 250 N D. 120 N
11. Calculate the force required to impart an acceleration of 5 m/s^2 to a mass 10 kg.
A. 2.0 N B. 50.0 N
C. 0.2 N D. 5.0 N
12. What force would be required to accelerate an electron (mass = 9×10^{-31}kg) from rest to a velocity of 104 m/s in 10 seconds?
A. 9.36×10^{-31}N
B. 9.63×10^{-31}N
C. 9.36×10^{-30}N
D. 9.63×10^{-30}N
13. A block of weight 7.0 N rests on a level floor. The frictional force between the block and the floor is 1.0 N. A horizontal force of 1.4 N is used to pull the block for 4 seconds. What is the velocity of the block after this time?
A. 3.2 m/s B. 2.5 m/s
C. 2.3 m/s D. 5.0 m/s
14. A player hits a ball of mass 0.3 kg which was moving eastwards with a velocity of 10 m/s, causing it now to move with velocity 15 m/s westwards. The force of the blow acts on the ball for 0.01 s.

Calculate the average force exerted on the ball by the player

A. 550 N B. 650 N
C. 450 N D. 750 N

15. A bullet of mass 0.045 kg is fired from a gun of mass 9 kg the bullet moving with an initial velocity of 200 m/s. Find the initial backward velocity of the gun.
A. 1.0 m/s B. 1.2 m/s
C. 0.9 m/s D. 2.0 m/s
16. A jet engine develops a thrust of 270 N when the velocity of the exhaust gases relative to the engine is 300 m/s. Find the mass of the gas ejected per second.
A. 0.9 kg/s B. 0.7 kg/s
C. 0.8 kg/s D. 1.0 kg/s
17. A gun fires a shell of mass 5 kg in horizontal direction. The gun recoils at 0.4 m/s and its mass is 3000 kg, calculate the velocity of the shell.
A. 220 m/s B. 350 m/s
C. 240 m/s D. 175 m/s
18. A riffle bullet weighing 7 g leaves the barrel of riffle with a velocity of 300 m/s. If the riffle recoils with a velocity of 1 m/s, find the mass of the riffle.
A. 2.1 kg B. 1.2 kg
C. 3.4 kg D. 2.3 kg
19. A constant force acts on a body of mass 50 kg and reduces its speed from 90 m/s to 20 m/s in 20 s. Calculate the magnitude of the force
A. 175 N B. 165 N
C. 162 N D. 172 N
20. A 2000 kg truck moving at 24 m/s is stopped in 16 s by the action of brakes. What is the average force applied by the brakes?
A. 2.43×10^3N
B. 1.24×10^3N
C. 3.3×10^3N
D. 3.0×10^3N
21. Object A of mass 20 kg moving with a velocity of 3 m/s makes a head-on collision with object B, mass 10 kg, moving with a velocity of 2 m/s in the opposite direction. If A and B stick together after collision, calculate their common velocity V in the direction of A.
A. 1.67 m/s B. 2.36 m/s
C. 1.23 m/s D. 1.33 m/s
22. A body of mass 2 kg moving with velocity of 6 m/s collides with a stationary object of mass 0.5 kg. If the two bodies move together after the impact, calculate their common velocity.
A. 24.0 m/s B. 2.6 m/s
C. 4.8 m/s D. 8.4 m/s
23. A railway engine of mass 5 ton travels along a level track at 75 km/h and collides with a wagon of mass 15 ton travelling in the opposite direction at 20 km/h. After impact the engine is seen to travel in the same direction as before with a speed of 3 km/h. Find the speed of the wagon.
A. 2 km/h B. 3 km/h
C. 4 km/h D. 5 km/h
24. A 1000 kg elevator is descending vertically with an acceleration of 1.0 m/s^2. If the acceleration due to gravity is 10.0 m/s^2, the tension in the suspending cable is
A. 1.0 N B. 10.0 N
C. 9000.0 N D. 11000.0 N
25. Fuel was consumed at a steady rate 5.0×10^{-2}kg per second in a rocket engine and ejected as a gas with a speed of 4×10^3m/s. Determine the thrust on the rocket
A. 200 N B. 150 N
D. 250 N D.115 N
26. A sub machine gun of mass 20 kg fires a bullet of mass 100 g due south with a velocity of 250 m/s. What is the recoil velocity of the gun?
A. 2.25 m/s due North
B. 1.25 m/s due North

C. 1.25 m/s due South
D. 2.25 m/s due South

27. An arrow of mass 0.3 kg is fired with a velocity of 100 m/s into a wooden block of mass 0.7 kg. Calculate the final kinetics energy after impact, given that the wooden block can freely move
A. 550 J B. 250 J
C. 450 J D. 625 J

28. When taking a penalty kick, a footballer applies a force of 30.0 N for a period of 0.05 s. If the mass of the ball is 0.075 kg, calculate the speed with which the ball moves off.
A. 4.5 m/s B. 11.25 m/s
C. 20.0 m/s D. 45.00 m/s

29. A 0.05 kg bullet travelling at 500 m/s horizontally strike a thick vertical wall. It stops after penetrating through the wall a horizontal distance of 0.25 m. What is the magnitude of the average force the wall exerts on the bullet?
A. 11000 N B. 5000 N
C. 26500 N D. 25000 N

30. A rope is being used to pull a mass of 10 kg vertically upward, Determine the tension in the rope if, starting from rest, the mass acquires a velocity of 4 m/s in 8 s ($g = 10 m/s^2$)
A. 105 N B. 95 N
C. 50 N D. 5 N

31. A body of mass 2 kg moving vertically upwards has its velocity increased uniformly from 10 m/s to 40 m/s in 4 s. Neglecting air resistance, calculate the upward vertical force acting on the body ($g = 10 m/s^2$)
A. 15 N B. 20 N
C. 35 N D. 45 N

32. A ball of mass 100 g travelling with a velocity of 100 m/s collides with another ball of mass 400 g moving at 50 m/s in the same direction. If they stick together, what will be their common velocity?
A. 65 m/s B. 60 m/s
C. 68 m/s D. 71 m/s

33. A gun of 3 kg fires a bullet of mass 20 g with a velocity of 500 m/s. Calculate the recoil velocity of the gun.
A. 2.35 m/s C. 6.67 m/s
C. 3.33 m/s D. 6.12 m/s

ANSWERS TO DYNAMICS							
1.	A	11.	B	21.	D	31.	C
2.	B	12.	D	22.	C	32.	B
3.	C	13.	C	23.	C	33.	C
4.	D	14.	D	24.	C		
5.	A	15.	A	25.	A		
6.	B	16.	A	26.	B		
7.	B	17.	C	27.	C		
8.	C	18.	A	28.	C		
9.	D	19.	A	29.	D		
10.	A	20.	D	30.	A		

KEY NOTES

Conversion from km/hr to m/s

$1000\,m = 1\,km$ and $3600\,s = 1\,hr$

$\therefore \frac{1000m}{1km} = 1$ and $\frac{1hr}{3600s} = 1$

~~a km~~ a km/hr

$= a \frac{\cancel{km}}{\cancel{hr}} \times \frac{1000m}{1\cancel{km}} \times \frac{1\cancel{hr}}{3600s}$

$= a \times \frac{1000\,m}{3600\,s} = a \times \frac{5}{18}\,m/s$

You can just multiply by $\frac{5}{18}$ to convert

Example

$36\,km/hr = 36 \times \frac{5}{18} = 10\,m/s$

$108\,km/hr = 108 \times \frac{5}{18} = 30\,m/s$

Equations of motion

i) $v = u + at$

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

iii) $v^2 = u^2 + 2as$

iv) $s = \bar{v}t = \left(\frac{v+u}{2}\right)t$

for constant velocity i.e $v = u$

(iv) becomes $s = ut$ — (v)

Free fall / Vertical motion

$a = g$, $s = h$

when the body moves upward $g = -ve$

when the body moves downward $g = +ve$

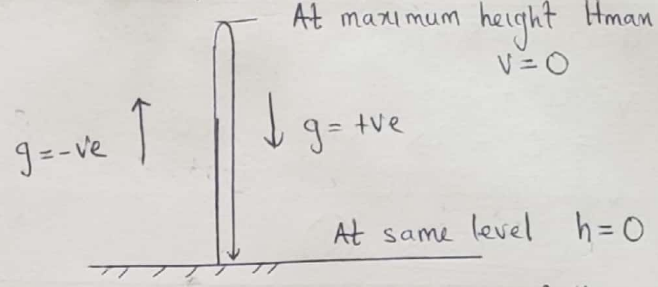
$\therefore$ (i) $v = u + at \Rightarrow v = u \pm gt$

(ii) $v^2 = u^2 + 2as \Rightarrow v^2 = u^2 \pm 2gh$

(iii) $s = ut + at^2 \Rightarrow h = ut \pm gt^2$

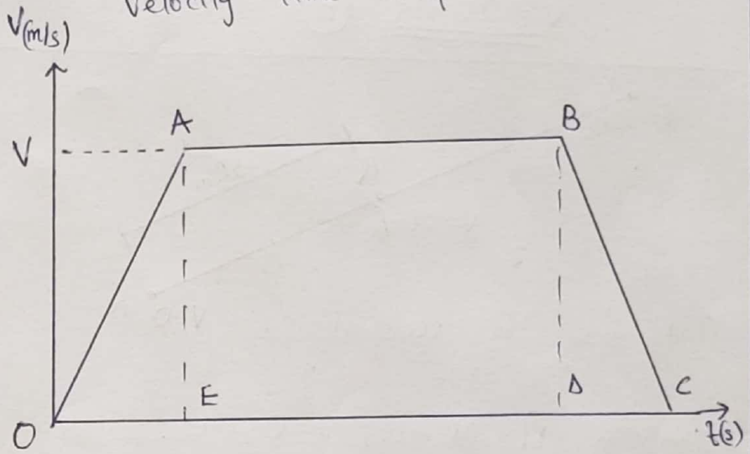
* when a body is released / dropped / falls

$u = 0$



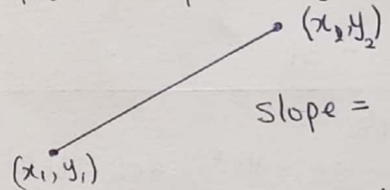
When a body is thrown horizontally, the vertical component of the body's velocity is 0 i.e $u_y = 0$

Velocity - time Graph



- Slope = acceleration / retardation
  i.e /OA/ and /BC/

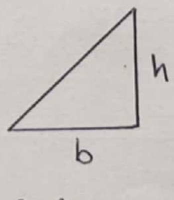
To find a slope e.g



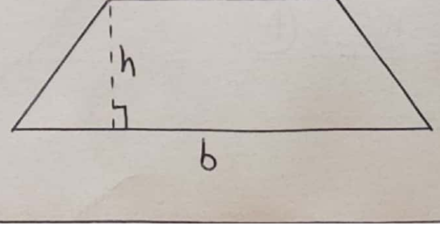
$\text{slope} = \frac{y_2 - y_1}{x_2 - x_1}$ (MAT112)

- Uniform speed = horizontal e.g /AB/
- Distance covered = Area of the shape considered

Area of triangle $= \frac{1}{2} b \times h$



Area of trapezium $= \frac{1}{2}(a+b) \times h$



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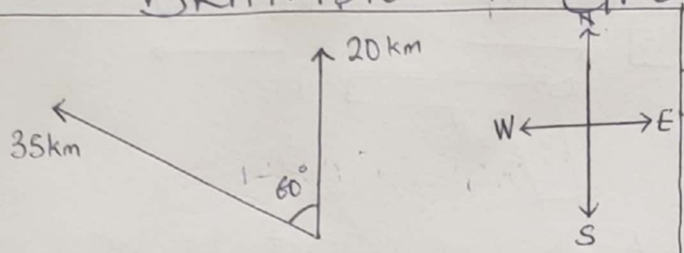
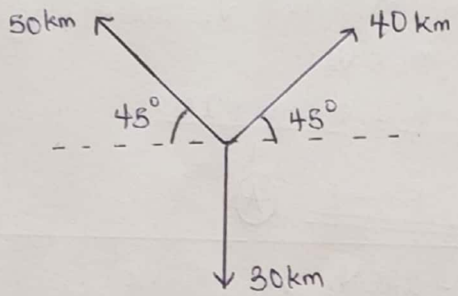
1



Using parallelogram law

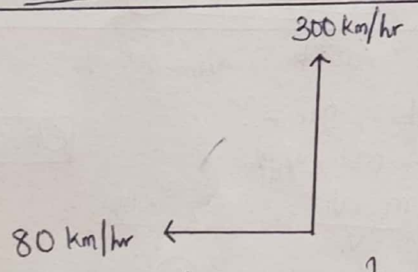
$$R^2 = 35^2 + 20^2 + 2 \times 35 \times 20 \cos 60^\circ$$
$$= 1225 + 400 + 1400 \times 0.5$$
$$= 2325$$
$$R = \sqrt{2325} = 48.22$$
$$\underline{R = 48.2\text{km}} \quad \text{A}$$

2



$$F_x = 40\cos 45^\circ - 50\cos 45^\circ - 30\cos 90^\circ$$
$$= 28.28 - 35.36 - 0$$
$$= -7.08$$
$$F_y = 40\sin 45^\circ + 50\sin 45^\circ - 30\sin 90^\circ$$
$$= 28.28 + 35.36 - 30$$
$$= 33.64$$
$$F = \sqrt{F_x^2 + F_y^2} = \sqrt{(-7.08)^2 + 33.64^2}$$
$$= \underline{34.38\text{km}} \quad \text{B}$$

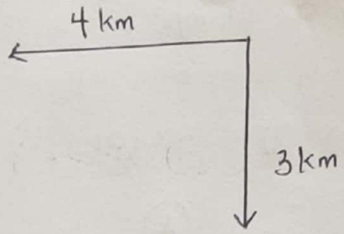
3



Since both vectors are at right angle to each other, let use Pythagoras theorem

$$R = \sqrt{300^2 + 80^2}$$
$$= \sqrt{96400}$$
$$\underline{R = 310.48 \text{ km/hr}} \quad \text{C}$$

4



Using Pythagoras too here

$$R = \sqrt{4^2 + 3^2} = \sqrt{16 + 9} = \sqrt{25}$$
$$\underline{R = 5\text{km South West}} \quad \text{D}$$

5 $m = 2\text{kg}$, $a = 5\text{ms}^{-2}$, $F = ?$

$$F = ma = 2 \times 5 = 10\text{N}$$
$$\underline{F = 10\text{N}} \quad \text{A}$$

6 $m = 50\text{kg}$, $V = 10\text{ m/s}$, $F = ?$

Since velocity is constant i.e both initial and final velocity are 10m/s

$$F = ma = m\left(\frac{v-u}{t}\right) = 50 \times \left(\frac{10-10}{t}\right)$$
$$= 50 \times \left(\frac{0}{t}\right) = 50 \times 0$$
$$\underline{F = 0} \quad \text{B}$$

7 $m = 600\text{kg}$, $a = 5\text{ m/s}^2$, $F_R = 1000\text{N}$

Force from engine

= Force to accelerate the car

\+

Force to overcome the resistance

$$F = ma + F_R = 600 \times 5 + 1000$$
$$= 3000 + 1000$$
$$\underline{F = 4000\text{N} = 4\text{kN}} \quad \text{B}$$

8 $F = 100\text{N}$, $t = 20\text{s}$, $p = ?$

change in momentum = Impulse

$$p = F \times t = 100 \times 20$$
$$\underline{p = 2000\text{Ns}} \quad \text{C}$$

9 $m = 5\text{kg}$, $u = 30\text{m/s}$, $V = 60\text{m/s}$

$$\text{Impulse} = \Delta \text{ momentum}$$
$$= m(v-u) = 5 \times (60 - 30)$$
$$= 5 \times 30$$
$$\underline{\text{Impulse} = 150\text{Ns}} \quad \text{D}$$

(Δ means change)

10 $m = 5kg$, $a = 20m/s^2$, $g = 10m/s^2$

when the body is moving up

$$F = m(a+g) = 5 \times (20+10)$$
$$= 5 \times 30$$
$$\underline{F = 150N} \quad (A)$$

11 $F = ?$, $a = 5m/s^2$, $m = 10kg$

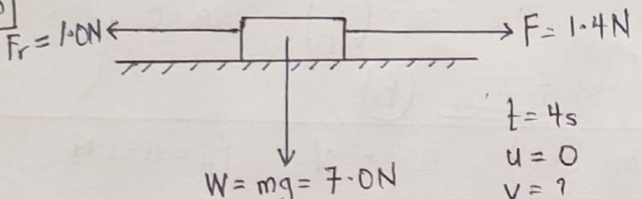
$$F = ma = 10 \times 5$$
$$\underline{F = 50N} \quad (B)$$

12 $m_e = 9 \times 10^{-31} kg$, $u = 0$, $V = 104\, m/s$

$t = 10s$

$$F = m\left(\frac{V-u}{t}\right) = 9 \times 10^{-31} \times \left(\frac{104-0}{10}\right)$$
$$= 9 \times 10^{-31} \times \frac{104}{10} = 9 \times 10^{-31} \times 10.4$$
$$= \underline{9.36 \times 10^{-30} N} \quad (D)$$

13



$t = 4s$
$u = 0$
$V = ?$
$g = 10m/s^2$

from the weight

$$W = mg = 7.0N, \quad m = \frac{7.0}{g} = \frac{7.0}{10} = 0.7kg$$

$$F = ma + F_r$$
$$\therefore \; ma = F - F_r = 1.4 - 1.0 = 0.4N$$
$$a = \frac{0.4}{m} = \frac{0.4}{0.7} = 0.5714\, m/s^2$$
$$a = \frac{V-u}{t} = \frac{V-0}{4} = 0.5714$$
$$V = 0.5714 \times 4 = 2.2857 m/s$$
$$\underline{V = 2.3 m/s} \quad (C)$$

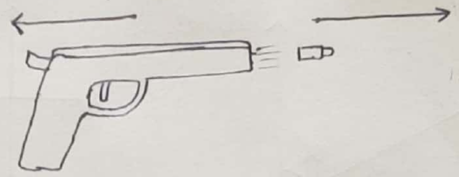
14 Let east be the positive direction (i.e west is the negative direction)

$m = 0.3kg$, $u = 10m/s$, $V = -15m/s$, $t = 0.01s$

Impulse = Δ in momentum

$$F \times t = m(V-u)$$
$$F = \frac{m(V-u)}{t} = \frac{0.3(10 - -15)}{0.01}$$
$$= \frac{0.3 \times (10+15)}{0.01} = \frac{0.3 \times 25}{0.01}$$
$$= \underline{750N} \quad (D)$$

15



As the gun is shot, the bullet and gun will move in different directions i.e if the bullet moves towards the east the gun will moves towards the west (recoil) and from Newton's third law, action and reaction are equal but opposite

$$\therefore \; \text{momentum}_{(gun)} = \text{momentum}_{(bullet)}$$
$$mV_{(gun)} = mV_{(bullet)}$$

$m_b = 0.045kg$, $m_g = 9kg$, $V_b = 200m/s$, $V_g = ?$

$$m_g \times V_g = m_b \times V_b$$
$$V_g = \frac{m_b \times V_b}{m_g} = \frac{0.045 \times 200}{9}$$
$$\underline{V_g = 1.0 m/s} \quad (A)$$

16 Thrust $F = 270N$, $V = 300m/s$

let m_s be mass of gas ejected per second

$$F = m_s \times V, \quad m_s = \frac{F}{V} = \frac{270}{300}$$
$$\underline{m_s = 0.9 kg/s} \quad (A)$$

17 $m_s = 5kg$, $m_g = 3000 kg$, $V_g = 0.4m/s$, $V_s = ?$

$$m_s \times V_s = m_g \times V_g$$
$$V_s = \frac{m_g \times V_g}{m_s} = \frac{3000 \times 0.4}{5}$$
$$\underline{V_s = 240 m/s} \quad (C)$$

Check Q15

18 $m_b = 7g = 7 \times 10^{-3} kg$, $V_b = 300m/s$

$V_r = 1m/s$, $m_r = ?$

Check Q15

$$m_r \times V_r = m_b \times V_b$$
$$m_r = \frac{m_b \times V_b}{V_r} = \frac{7 \times 10^{-3} \times 300}{1}$$
$$\underline{m_r = 2.1 kg} \quad (A)$$

19 $m = 50kg$, $u = 90m/s$, $V = 20m/s$, $t = 20s$

$$F = ma = \frac{m(V-u)}{t} = 50 \times \frac{(20-90)}{20}$$
$$= \frac{-50 \times 70}{20} = -175N$$

The negative sign shows F is a resisting force i.e its direction is opposite to the direction of motion

$$\underline{F = 175N} \quad (A)$$

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20 $m = 2000kg$, $u = 24m/s$, $V = 0$, $t = 16s$

$$F = ma = m\frac{(v-u)}{t} = \frac{2000 \times (0-24)}{16}$$

$$= -3000 \quad (\text{-ve shows resisting force})$$

$$F = 3 \times 10^3 N \quad (D)$$

21 $m_A = 20kg$, $U_A = 3m/s$

$m_B = 10kg$, $U_B = -2m/s$ (opposite direction)

A and B stick together means they move with the same velocity after colliding

$\therefore V_A = V_B = V \quad — (\alpha)$

momentum before collision = momentum after collision

$$m_A U_A + m_B U_B = m_A V_A + m_B V_B$$

$$= m_A V + m_B V \quad \text{from} - (\alpha)$$

$$= V(m_A + m_B)$$

$$\therefore V = \frac{m_A U_A + m_B U_B}{m_A + m_B}$$

$$= \frac{20 \times 3 + 10 \times (-2)}{20+10} = \frac{20 \times 3 - 10 \times 2}{20+10}$$

$$= \frac{60-20}{30} = \frac{40}{30} = 1.33m/s$$

$$V = V_A = V_B = 1.33m/s \quad (D)$$

22 $m_1 = 2kg$, $U_1 = 6m/s$

$m_2 = 0.5kg$, $U_2 = 0$, $V_1 = V_2 = V$

$\therefore m_1 U_1 + m_2 U_2 = V(m_1 + m_2)$ [Check Q21]

$$V = \frac{m_1 U_1 + m_2 U_2}{m_1 + m_2} = \frac{2 \times 6 + 0.5 \times 0}{2 + 0.5}$$

$$= \frac{12+0}{2.5} = \frac{12}{2.5} = 4.8$$

$$V = V_1 = V_2 = 4.8m/s \quad (C)$$

23 $m_e = 5\,ton$, $U_e = 75\,km/hr$

$m_w = 15\,ton$, $U_w = -20\,km/hr$

$V_e = 3\,km/hr$, $V_w = ?$

momentum before collision = momentum after collision

i.e $m_e U_e + m_w U_w = m_e V_e + m_w V_w$

$$m_w V_w = m_e U_e + m_w U_w - m_e V_e$$

$$V_w = \frac{m_e U_e + m_w U_w - m_e V_e}{m_w}$$

$$= \frac{5 \times 75 + 15 \times (-20) - 5 \times 3}{15} = \frac{375 - 300 - 15}{15}$$

$$= \frac{60}{15} = 4\,km/hr \quad (\text{i.e in the direction of the railway engine})$$

$$V_w = 4\,km/hr \quad (C)$$

24 $m_e = 1000kg$, $a = 1.0m/s^2$, $g = 10.0m/s^2$

Since the elevator is decending

$$F = m(g-a) = m_e(g-a)$$

$$= 1000(10-1) = 1000(9)$$

$$= 9000N$$

$$F = 9{,}000N \quad (C)$$

25 let the rate of consumption of fuel be m_s in kg/s

$\therefore m_s = 5.0 \times 10^{-2} kg/s$, $V = 4 \times 10^3 m/s$

Thrust, $F = m_s \times V$

$$= 5.0 \times 10^{-2} \times 4 \times 10^3 = 200$$

$$F = 200N \quad (A)$$

26 $m_g = 20kg$, $m_b = 100g = 0.1kg$

$V_b = 250\,m/s$ (South), $V_g = ?$ [Check Q15]

$$m_g \times V_g = m_b \times V_b$$

$$V_g = \frac{m_b \times V_b}{m_g} = \frac{0.1 \times 250}{20} = 1.25m/s$$

$$V_g = 1.25m/s \text{ due North} \quad (B)$$

27 Note:

- The wood block is at rest i.e $U_w = 0$
- The arrow will penetrate then stick to the wood block, since the wood block can move freely, both the arrow and block will move after impact i.e they'll have the same velocity (V).

$m_a = 0.3kg$, $m_w = 0.7kg$,

$U_w = 0$, $U_a = 100m/s$

$$V = \frac{m_a U_a + m_w U_w}{m_a + m_w} = \frac{0.3 \times 100 + 0.7 \times 0}{0.3 + 0.7}$$

$$= \frac{30+0}{1} = 30m/s \quad \text{[Check Q15]}$$

$$K.E \text{ at impact} = \frac{1}{2}m_a V^2 + \frac{1}{2}m_w V^2 = \frac{1}{2}V^2(m_a + m_w)$$

$$= \frac{1}{2} \times 30^2 \times (0.3 + 0.7) = 450J \quad (C)$$

28 $F = 30.0N$, $t = 0.05s$, $m_b = 0.075kg$

$U_b = 0$, $V_b = ?$

δ in Momentum = Impulse

$\cancel{\frac{m(V_b - U_b)}{t}}$

$$m_b(V_b - U_b) = Ft$$

$$V_b - U_b = \frac{Ft}{m_b}$$

$$V_b - 0 = \frac{30 \times 0.05}{0.075}$$

$$V_b = 20.0\,m/s \quad (C)$$

29 $m = 0.05kg$, $U = 500m/s$, $V = 0$, $S = 0.25m$

$$V^2 = U^2 + 2aS$$

$$a = \frac{V^2 - U^2}{2S} = \frac{0^2 - 500^2}{2 \times 0.5} = -50 \times 10^5\,m/s^2$$

-ve sign shows a deceleration

$$F = ma = 0.05 \times 50 \times 10^5$$

$$= 25000$$

$$F = 25{,}000N \quad (D)$$

30 $m = 10kg$, $U = 0$, $V = 4m/s$, $t = 8$

$$a = \frac{V-U}{t} = \frac{4-0}{8} = \frac{4}{8} = 0.5\,m/s^2$$

Since the body is been pulled upward

Tension $T = F = m(g+a)$

$$= 10 \times (10 + 0.5)$$

$$= 10 \times 10.5 = 105$$

$$T = 105N \quad (A)$$

31 $m = 2kg$, $U = 10m/s$, $V = 40m/s$, $t = 4s$

$g = 10m/s^2$

Just like the previous question - Q30

$$a = \frac{V-U}{t} = \frac{40-10}{4} = \frac{30}{4} = 7.5\,m/s^2$$

$$F = m(a+g) = 2 \times (7.5 + 10)$$

$$= 2 \times 17.5 = 35$$

$$F = 35N \quad (C)$$

32 $m_A = 100g = 0.1kg$, $U_A = 100m/s$

$m_B = 400g = 0.4kg$, $U_B = 50m/s$

$V = V_A \pm V_B$

$$V = \frac{m_A U_A + m_B U_B}{m_A + m_B}$$

Check Q21

$$= \frac{0.1 \times 100 + 0.4 \times 50}{0.1 + 0.4} = \frac{10 + 20}{0.5}$$

$$= \frac{30}{0.5} = 60$$

$$V = 60m/s \quad (B)$$

33 $m_g = 3kg$, $m_b = 20g = 0.02kg$

$V_g = ?$ $\quad V_b = 500m/s$

$$V_g = \frac{m_b \times V_b}{m_g}$$

Check Q15

$$= \frac{0.02 \times 500}{3} = \frac{10}{3} = 3.33$$

$$V_g = 3.33m/s \quad (C)$$

MECHANICS

1. Determine the dimension of density.
A. ML^{-3} B. ML^2T^{-2}
C. ML^2 D. MLT^{-2}
2. What is the dimension of energy?
A. ML^2T^{-3} B. ML^2T^{-2}
C. MLT^{-2} D. ML^{-3}
3. Find the dimension of power.
A. ML^2T^{-2} B. ML^{-3}
C. ML^2T^{-3} D. MLT^{-2}
4. The dimension of momentum is
A. $ML^{-1}T^{-2}$ B. ML^2T^{-2}
C. ML^2T^{-3} D. MLT^{-1}
5. Determine the dimension of pressure.
A. $ML^{-1}T^{-2}$ B. ML^2T^{-3}
C. ML^2T^{-2} D. MLT^{-2}
6. A vector of magnitude 5 units in the North direction is combined with another vector to give a zero resultant. What is the other vector?
A. 0 units South B. 5 units South
C. 5 units North D. 0 units North
7. Which of the following is an example of an object experiencing uniform motion?
A. a baseball being hit by a bat
B. a car accelerating at a green light
C. a space shuttle launching into orbit
D. a toy car crossing the floor at a constant speed
8. Which of the following quantities represents the rate of change of an object's position?
A. velocity B. displacement
C. acceleration D. time interval
9. Which of the following is not a possible unit for velocity?
A. centimetres / month
B. millimetres / kilowatt
C. decimeters / kilosecond
D. kilometres / millisecond
10. What is the average velocity of a bird that flies 6 m (South) in 2 s?
A. 0.33 m/s (South) B. 6 m/s (South)
C. 3 m/s (South) D. 12 m/s (South)
11. A ball is thrown straight up in the air. What happens as the ball travels upward?
A. Acceleration is negative and velocity is negative.
B. Acceleration is zero and velocity is positive.
C. Acceleration is negative and velocity is positive.
D. Acceleration is zero and velocity is negative.
12. Which of the following examples describe a ball experiencing positive acceleration?
I. a ball rolling down a ramp.
II. a ball being dropped straight down.
III. a ball rolling up a steep ramp.
A. I and III B. I, II, and III
C. II and III D. I and II
13. When a penny is dropped toward the floor, which of the following quantities will change for each successive time interval?
I. acceleration
II. displacement
III. Velocity
A. II and III B. I and III
C. I, II, and III D. I and II
14. Which of the Newton's law state that, "when a body is acted upon by a force, its resulting acceleration is directly proportional to the force and inversely proportional to the mass"?
A. first Newton's law
B. second Newton's law
C. third Newton's law
D. fourth Newton's law
15. If a bike moves with a uniform velocity of 4 m/s, determine its acceleration after 30 s.
A. 120 m/s^2 B. 7.5 m/s^2
C. 0.133 m/s^2 D. 0 m/s^2
16. The force acting on a body moving with a uniform velocity is
A. uniform B. constant
C. zero D. unknown

17. The sum of kinetic energy and potential energy of a system at any point in a close system is
A. zero B. unity
C. constant D. not constant
18. When a lift moves downwards with an acceleration, a, the unbalanced force or the weight, W of the object in the lift is given by
A. $W = mg$ B. $W = m(a + g)$
C. $W = 0$ D. $W = m(g - a)$
19. When a lift accelerates upwards with an acceleration a, the unbalanced force or the weight, W of the object in the lift is given by
A. $W = mg$ B. $W = m(a + g)$
C. $W = m(g - a)$ D. $W = 0$
20. Energy is never created or destroyed but only changed from one form to another is refer to as which principle?
A. Conservation of energy
B. Conservation of momentum
C. Conservation of power
D. Principle of energy
21. The following are all source of energy except
A. Coal B. Oil and gas
C. Wind D. Plastic
22. _____ is the product of a force and displacement?
A. Energy B. Work
C. Power D. Momentum
23. The energy associated with the position of a body in a gravitational field is the ____ of the body.
A. Potential Energy B. Kinetic Energy
C. Light energy D. Heat energy
24. A ball is thrown vertically upwards. The quantity which remains constant is
A. acceleration B. velocity
C. kinetic energy D. speed
25. The acceleration of a moving object is equal to the
A. gradient of a displacement – time graph
B. gradient of a velocity – time graph
C. area below a speed – time graph
D. area below a velocity – time graph
26. The idea of inertia is postulated by
A. principle of momentum
B. Newton's second law
C. Newton's first law
D. law of motion
27. Two bodies of masses collide and the total kinetic energy is not conserved, this kind of collision is referring to?
A. Elastic collision
B. Inelastic collision
C. Collision theory
D. Unconserved collision
28. A scalar quantity is completely specified by a
A. number and direction
B. number and unit
C. volume and number
D. unit and direction
29. Which of the following pairs are scalar quantities?
A. Force and Gravity
B. Work and Energy
C. Displacement and Length
D. Frequency and Tension
30. A vector is described by
A. magnitude, unit and direction
B. magnitude and scale
C. magnitude and size
D. force and acceleration
31. Which of the following is not a vector?
A. force B. direction
C. momentum D. displacement
32. Which of the following is not a vector?
A. 2 m due east
B. Acceleration due to gravity
C. Force of gravity
D. Work, Energy and Power
33. If a particle moves 2 m due east and 2 m due west in a straight line, its total displacement is
A. 4 m due west B. 4 m due east
C. 0 m D. 4 m east-west

34. Which of the following units cannot be used to measure speed?
A. ms^{-1} B. kms^{-1}
C. mh^{-1} D. kgs^{-1}
35. The acceleration of a body falling under gravity on the surface of the earth is
A. constant
B. increasing
C. decreasing
D. varies
36. The area under a velocity – time graph represents
A. Speed
B. Acceleration
C. Moment
D. Distance
37. The gradient of a displacement–time graph represents
A. Speed
B. Velocity
C. Acceleration
D. Total distance
38. The mass of a load is doubled while the force acting on it is halved. The resulting acceleration of the load is
A. Quadrupled
B. Quartered
C. Halved
D. Doubled
39. Which of the following statements about a moving object is correct?
A. When accelerating, the resultant force acting on it must be equal to zero
B. There must always be a non-zero resultant force acting on it
C. At a steady velocity, the resultant force acting on it must be equal to zero
D. At a steady velocity, the air resistance must be equal to zero
40. The time rate of increase in velocity is called
A. Force
B. Momentum
C. Acceleration
D. Speed
41. Which of the following quantities is a vector?
A. Volume
B. Momentum
C. Energy
D. Work
42. In an elastic collision, kinetic energy is conserved as well as
A. velocity
B. momentum
C. potential energy
D. speed
43. When the linear momentum of a body is constant, the net force acting on it
A. is zero
B. increases
C. decreases
D. remains constant
44. Which of the following is equivalent to Watt?
A. kgm^{-2} B. kgm^2s^{-3}
C. kgm^2s^2 D. kgm^2s^{-1}
45. The total area under a force-velocity graph represents
A. Energy
B. Momentum
C. Power
D. Work

ANSWERS TO MECHANICS									
1.	A	11.	C	21.	D	31.	B	41.	B
2.	B	12.	D	22.	B	32.	D	42.	B
3.	C	13.	A	23.	A	33.	C	43.	A
4.	D	14.	B	24.	A	34.	D	44.	B
5.	A	15.	D	25.	B	35.	A	45.	C
6.	B	16.	C	26.	C	36.	D	46.	
7.	D	17.	C	27.	B	37.	B	47.	
8.	A	18.	D	28.	B	38.	B	48.	
9.	B	19.	B	29.	B	39.	C	49.	
10.	C	20.	A	30.	A	39.	C	50.	

1) Density $= \frac{\text{mass}}{\text{volume}} = \frac{kg}{m^3} = kgm^{-3} = ML^{-3}$ $\boxed{A}$

2) Energy = Force × distance
= mass × acceleration × distance
= kg × ms^{-2} × m
$= kgm^2s^{-2} = ML^2T^{-2}$ $\boxed{B}$

3) Power $= \frac{\text{Energy}}{\text{time}} = \frac{ML^2T^{-2}}{T} = ML^2T^{-3}$ $\boxed{C}$

4) momentum = mass × velocity
= kg × ms^{-1} = $kgms^{-1}$
$= MLT^{-1}$ $\boxed{D}$

5) Pressure $= \frac{\text{Force}}{\text{Area}} = \frac{\text{mass} \times \text{acceleration}}{\text{Area}}$
$= \frac{kg \times ms^{-2}}{m^2} = kgm^{-1}s^{-2}$
$= ML^{-1}T^{-2}$ $\boxed{A}$

6) The vector 5units North will give a zero resultant if combined with a vector of equal ~~but opposite~~ in magnitude but opposite in direction
Hence 5units South. $\boxed{B}$

7) An object is said to be in uniform motion if the distance travelled by the object, is same at several time intervals i.e constant velocity $\boxed{D}$

8) (Time) rate of change of an object position (displacement). i.e
$\frac{\text{change in position}}{\text{change in time}} = \frac{dx}{dt}$ = velocity $\boxed{A}$

9) Velocity $= \frac{\text{Distance}}{\text{time}} \left(\frac{\text{meter}}{\text{seconds}}\right)$

month, milliseconds, kiloseconds are all derivatives of seconds, but kilowatt is not (unit of power) $\boxed{B}$

10) Average velocity $= \frac{\text{Displacement}}{\text{time}} = \frac{6m\ (\text{South})}{2s}$
$= 3m/s$ (South) $\boxed{C}$

11) During ascent, ball is going upward therefore its position is positive (upward direction is taken to be positive). Now, though the velocity is decreasing but its direction is upward, hence the velocity is positive.

Since the ball is moving against ~~acc~~ gravity (which is always acting downward) its acceleration is negative. $\boxed{C}$

12) A ball rolling down a ramp and one being dropped straight down both moves/act in the same direction as gravity, hence their acceleration is positive

While the ball rolling up a steep ramp moves against gravity making its acceleration to be negative $\boxed{D}$

13) Acceleration of the penny been dropped is the one due to gravity which is constant $\boxed{A}$

14) <u>Newton's Law of Motion</u>

<u>First law</u> states that every object continues in its state of rest or of uniform motion in a straight line unless acted upon by an external force

<u>Second law</u> states that the rate of change of momentum is proportional to the impressed force and takes place in the direction of that force.

<u>Third law</u> states that Action and Reaction are equal ~~and~~ opposite. Or To every Action there is an equal and opposite Reaction

from second law

$$f \propto \frac{\text{change in momentum}}{\text{time taken for change}}$$

$$f \propto \frac{mv - mu}{t}$$

$$f \propto m\frac{(v-u)}{t}$$

$f \propto ma \quad \therefore a \propto \frac{f}{m}$ $\boxed{B}$

15.) $v = u + at$

Since velocity is uniform, final and initial velocity are equal, $v = u = 4\,m/s$.

$t = 30s$

$a = \frac{v-u}{t} = \frac{4-4}{30} = \frac{0}{30} = 0$ $\boxed{D}$

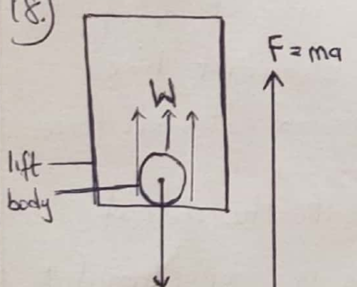
16.) $F = ma$

from (15) above, acceleration of a uniform velocity is zero.

Hence $F = m \times 0 = 0$ $\boxed{C}$

17.) ~~Kno~~ ~~Cons~~ In a closed system, there is no inflow or out flow of energy i.e energy is conserved, constant. $\boxed{C}$

18.)



$+\uparrow \sum f_y = 0:$

$F + W - W_g = 0$

$W = W_g - F$

$W = mg - ma$

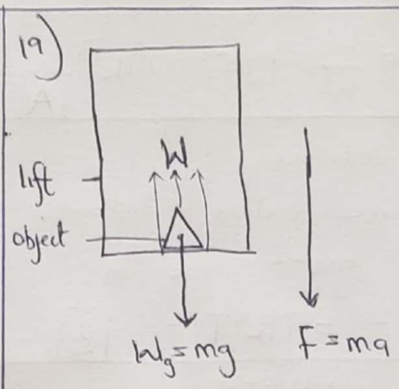
$W = m(g-a)$ $\boxed{D}$

W_g – weight of object (true weight)

W – (apparent) weight of object

F – resultant upward force

19)



$+\uparrow \sum f_y = 0:$

$W - W_g - F = 0$

$W = F + W_g$

$W = ma + mg$

$W = m(a+g)$ $\boxed{B}$

F – resultant downward force

W_g – apparent weight of object

W – weight of object (true weight) [reaction of the floor of the lift on the object]

20.) Conservation of energy $\boxed{A}$

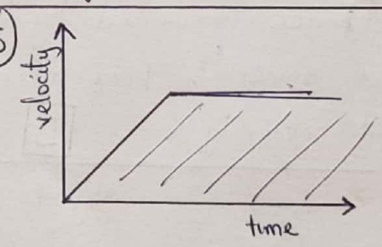
21.) Plastic is not a source of energy $\boxed{D}$

22.) Work = force × distance $\boxed{B}$

23) Potential energy is the energy possessed by a body by virtue of its position or state or configuration. $\boxed{A}$

24.) Acceleration of the ball is that of gravity which is constant $\boxed{A}$

25)



Gradient : Velocity ÷ time = acceleration

Area : velocity × time = distance $\boxed{B}$

26) Check (14) $\boxed{C}$

27.) In elastic collision, kinetic energy is conserved i.e. initial kinetic energy before collision is same as that after collision while inelastic collision, kinetic energy is not conserved. Momentum is conserved in both. $\boxed{B}$

28.) A scalar quantity is completely specified by number (magnitude) and its unit while a vector quantity by number, unit and direction $\boxed{B}$

29.) $\boxed{B}$

Examples of Scalar quantity	Example of vector quantity
mass, time, length, temperature, work, speed, volume, area power, density, energy, frequency pressure, entropy charge e.t.c	displacement, velocity, weight, acceleration, momentum, impulse, friction, force, voltage, field, torsion e.t.c

30) Check (28) $\boxed{A}$

31.) Direction check (29) $\boxed{B}$

32) check (29) $\boxed{D}$

33.) Check (6)

Since 2m due east and 2m due west are of same magnitude and opposite direction, resultant displacement is zero. $\boxed{C}$

34.) $kg\,s^{-1}$ is not a unit of velosity in either its fundamental of derivative form. $\boxed{D}$

35) Acceleration due to gravity is constant, approximatly $9.8ms^{-2}$ $\boxed{A}$

36) Distance, check (25) $\boxed{D}$

37) For displacement-time graph,

Gradient: displacement / time

= velocity $\boxed{B}$

38) $F_1 = m_1 a_1$ —— (I)

Force is halved, mass is doubled

$\frac{F_1}{2} = (2m_1)a_2$ —— (II)

$\frac{(II)}{(I)} : \frac{F_1/2}{F_1} = \frac{(2m_1)a_2}{a_1}$

$\frac{1}{2} = \frac{2a_2}{a_1}, \quad a_2 = \frac{a_1}{4}$

The new acceleration is one-quarter of the initial acceleration $\boxed{B}$

39.) Check (16) $\boxed{C}$

40) The rate of increase in velocity:

$\frac{dV}{dt} = a$, acceleration $\boxed{C}$

41) Check (29) $\boxed{B}$

42.) Check (27) $\boxed{B}$

43.) For Newton's second law

$f \propto \frac{\text{(changes in momentum)}}{\text{time taken}}$

$f \propto \frac{(0)}{\text{time taken}}, \quad f = k(0) = 0$ $\boxed{A}$

44.) Watt is a unit of power

Power(watt) = $\frac{\text{Work (J)}}{\text{time (s)}} = \frac{\text{force(N)} \times \text{distance(m)}}{\text{time (s)}}$

$= \frac{\text{mass (kg)} \times \text{acceleration} (ms^{-2}) \times \text{distance}}{\text{time (s)}}$

$= \frac{kg \times ms^{-2} \times m}{s} = kgm^2s^{-3}$ $\boxed{B}$

45.) Area under force-velocity graph is

force × velocity = force × $\frac{\text{displacement}}{\text{time}}$

$= \frac{\text{work}}{\text{time}}$ = Power $\boxed{C}$

KINEMATICS

1. A car moves from rest with an acceleration of 0.2 m/s^2. Find its velocity when it has moved a distance of 50 m.
   A. 4.47 m/s B. 10.0 m/s
   C. 250.0 m/s D. 5.45 m/s
2. A car has a uniform velocity of 108 km/h. How far does it travel in ½ minute?
   A. 15 km B. 0.9 km
   C. 3240 km D. 900 km
3. A train slows from 108 km/h with a uniform retardation of 5 m/s^2. How long will it take to reach 18 km/h?
   A. 18 s B. 25. 2
   C. 5 s D. 7s
4. A train slows from 108 km/h with a uniform retardation of 5 m/s^2. What is the distance covered when the velocity is 18 km/h?
   A. 450.0m B. 630.0m
   C. 95.6m D. 87.5 m
5. A car starts from rest and accelerates uniformly until it reaches a velocity of 30 m/s after 5 s. It travels with uniform velocity of 30 m/s for 15 s and is then brought to rest in 10 s with a uniform retardation. Determine the acceleration of the car.
   A. 6 m/s^2 B. 8 m/s^2
   C. 7.5 m/s^2 D. 5.5 m/s^2
6. A car starts from rest and accelerates uniformly until it reaches a velocity of 30 m/s after 5 s. It travels with uniform velocity of 30 m/s for 15 s and is then brought to rest in 10 s with a uniform retardation. Determine the retardation of the car.
   A. 5 m/s^2 B. 4 m/s^2
   C. 3 m/s^2 D. 2 m/s^2
7. A car starts from rest and accelerates uniformly until it reaches a velocity of 30 m/s after 5 s. It travels with uniform velocity of 30 m/s for 15 s and is then brought to rest in 10 s with a uniform retardation. Determine the distance covered after 5s.
   A. 77.4 m B. 66.8 m
   C. 82.3 m D. 75 m
8. A car starts from rest and accelerates uniformly until it reaches a velocity of 30 m/s after 5 s. It travels with uniform velocity of 30 m/s for 15 s and is then brought to rest in 10 s with a uniform retardation. Determine the total distance covered.
   A. 566 m B. 675 m
   C. 560 m D. 660 m
9. A ball is released from a height of 20 m. Calculate the time it takes to hit the ground.
   A. 1.5 s B. 2.0 s
   C. 2.5 s D. 2.8 s
10. A ball is released from a height of 20 m. Calculate the velocity with which it hits the ground.
    A. 12 m/s B. 22.6 m/s
    C. 20.0 m/s D. 35.6 m/s
11. A ball is thrown up vertically with a velocity of 40 m/s. Calculate the maximum height reached.
    A. 45.2 m B. 78.0 m
    C. 76.5 m D. 80 m
12. A ball is thrown up vertically with a velocity of 40 m/s. Calculate the time to reach the maximum height.
    A. 4.0 s B. 3.5 s
    C. 3.3 s D. 2.0 s
13. A ball is thrown up vertically with a velocity of 40 m/s. Calculate the time to return to the ground.
    A. 15.0 s B. 12.2 s
    C. 7.8 s D. 8.0 s
14. A body is projected horizontally from the top of a vertical cliff 40 m high, with a velocity of 20 m/s. Calculate the time taken for the body to fall to the ground.
    A. 2.83 s B. 1.22 s

C. 5.52 s D. 2.21 s

15. A body is projected horizontally from the top of a vertical cliff 40 m high, with a velocity of 20 m/s. Calculate the vertical component of the velocity when the body hits the ground.
A. 18.55 m/s B. 35.52 m/s
C. 28.28 m/s D. 45.0 m/s

16. A body is projected horizontally from the top of a vertical cliff 40 m high, with a velocity of 20 m/s. Calculate the distance from the cliff when it strikes the ground.
A. 56.57 m B. 57.56 m
C. 65.75 m D. 75.65 m

17. A body moving with a constant velocity along a straight line PQR takes 30 s to go from P to Q and 10 s to go from Q to R. If PR = 4 m, Find PQ.
A. 3 m B. 1 m
C. 2 m D. 4 m

18. An object moves in a straight line, starting from rest. There are two stages in the journey: (a) it gains speed uniformly for 2.0 s and attains a speed of 8.0 m/s. (b) it continues at the speed for a further 1.5 s. Find the acceleration in stage (a).
A. 1 m/s^2 B. 2 m/s^2
C. 3 m/s^2 D. 4 m/s^2

19. An object moves in a straight line, starting from rest. There are two stages in the journey: (a) it gains speed uniformly for 2.0 s and attains a speed of 8.0 m/s. (b) it continues at the speed for a further 1.5 s. Find the acceleration in stage (b).
A. 0 m/s^2 B. 1 m/s^2
C. 2 m/s^2 D. 3 m/s^2

20. An object moves in a straight line, starting from rest. There are two stages in the journey: (a) it gains speed uniformly for 2.0 s and attains a speed of 8.0 m/s. (b) it continues at the speed for a further 1.5 s. Find the total distance moved during stages (a) and (b).
A. 20 m B. 25 m
C. 27 m D. 31 m

21. A train starts from rest from a station and travels with uniform acceleration 0.5 m/s^2 for 20 s. It travels with uniform velocity for another 30 s, the brakes are then applied so that a uniform retardation is obtained and the train comes to rest in a further 10 s. Calculate the total distance travelled by the train.
A. 400 m B. 420 m
C. 450 m D. 485 m

22. A ball thrown vertically upwards from ground level hits the ground after 4 s. Calculate the maximum height it reached during its journey.
($g = 10$ m/s^2).
A. 20.0 m B. 18.0 m
C. 17.5 m D 16.9 m

23. A body is dropped from rest at a height of 80 m. How long does it take to reach the ground? ($g = 10$ m/s^2).
A. 5 s B. 6 s C. 4 s D. 7 s

24. A stone is thrown vertically upwards with an initial speed U. If g is the acceleration due to gravity, at what time will the stone return to the starting point.
A. 2U/g B. g/2U
C. U/2g D. 2g/U

25. A motor car is uniformly retarded and brought to rest from a velocity 36 km/h in 5 s. Find its retardation.
A. 4 m/s^2 B. 3 m/s^2
C. 1 m/s^2 C. 2 m/s^2

26. A motor car is uniformly retarded and brought to rest from a velocity 36 km/h in 5 s. Find the distance covered during this period.
A. 25 m B. 20 m
C. 18 m D. 18.5 m

27. A body travels from rest with acceleration 8 m/s^2. Find its velocity when it has covered a distance of 100 m.

A. 42.3 m/s B. 45.5 m/s
C. 40.0 m/s D. 45.0 m/s

28. An object falls from a height of 20 m. What is its velocity just before hitting the ground?
(Take g = 10 m/s^2).
A. 20.5 m/s B. 20.0 m/s
C. 24.5 m/s D. 18.0 m/s

29. A particle moving in straight line with uniform deceleration has a velocity of 40 m/s at a point P, 20 m/s at a point Q and comes to rest at a point R, where QR = 50 m. Calculate the distance PQ.
A. 144 m B. 158 m
C. 150 m D. 160 m

30. A particle moving in straight line with uniform deceleration has a velocity of 40 m/s at a point P, 20 m/s at a point Q and comes to rest at a point R, where QR = 50 m. Calculate the time taken to cover PQ.
A. 5 s B. 4 s C. 6 s D. 2 s

31. A particle moving in straight line with uniform deceleration has a velocity of 40 m/s at a point P, 20 m/s at a point Q and comes to rest at a point R, where QR = 50 m. Calculate the time taken to cover PR.
A. 15 s B. 13 s
C. 12 s D. 10 s

32. A ball is thrown horizontally from the top of a cliff 20 m high. If the initial horizontal velocity is 8.0 m/s, find how long it takes to reach the horizontal plane at the foot of the cliff. (Take g = 10 m/s^2).
A. 2.02 s B. 2.20 s
C. 2.41 s D. 2.14 s

33. A ball is thrown horizontally from the top of a cliff 20 m high. If the initial horizontal velocity is 8.0 m/s, find how far from the foot of the cliff it strikes the ground.
(Take g = 10 m/s^2).
A. 16.2 m B. 14.45 m
C. 10.2 m D. 12.0 m

34. A ball is thrown horizontally from the top of a cliff 20 m high. If the initial horizontal velocity is 8.0 m/s find the speed with which it strikes the ground
(Take g = 10 m/s^2).
A. 18.9 m/s B. 19.8 m/s
C. 17.5 m/s D. 15.7 m/s

35. New born hatchling turtles can swim approximately 40 km in 30 hours. How long would it take them to swim 15 m?
A. 40.5 s B. 20.0 s
C. 11.3 s D. 5.5 s

ANSWERS TO KINEMATICS							
1.	A	2.	C	21.	C	31.	D
2.	B	12.	A	22.	A	32.	A
3.	C	13.	D	23.	C	33.	A
4.	D	14.	A	24.	A	34.	B
5.	A	15.	C	25.	C	35.	A
6.	C	16.	B	26.	A		
7.	D	17.	A	27.	C		
8.	B	18.	D	28.	B		
9.	B	19.	A	29.	C		
10.	C	20.	A	30.	A		

BRAINSTORM GROUP (BSG)

1 $a = 0.2\,m/s^2$, $s = 50m$, $u = 0$, $v = ?$

$v = u + at$ = No we can't use this

$v^2 = u^2 + 2as = 0^2 + 2 \times 0.2 \times 50$

$v^2 = 20$

$v = \sqrt{20} = 4.472$

$\underline{v = 4.47\,m/s}$ (A)

2 $u = 108\,km/hr = 30\,m/s$ $\quad S = ?$

$t = 0.5\,min = 30s = \frac{1}{120}hr$

$S = ut$ since velocity is constant

$= 108 \times \frac{1}{120} = 0.9$

$\underline{S = 0.9km}$ (B)

3 $u = 108\,km/hr = 30\,m/s$

$a = -5\,m/s^2$

$v = 18\,km/hr = 5\,m/s$

$v - u = at$, $t = \frac{v-u}{a} = \frac{5-30}{-5} = \frac{-25}{-5}$

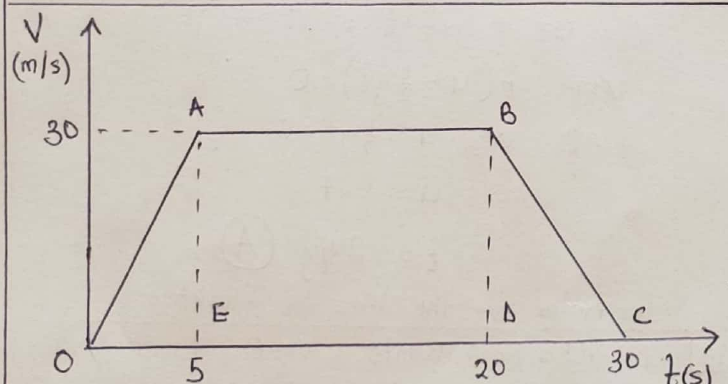
$\underline{t = 5s}$ (C)

4 $v^2 = u^2 + 2aS$

$S = \frac{v^2 - u^2}{2a} = \frac{5^2 - 30^2}{2 \times -5} = \frac{25 - 900}{-10}$

$= \frac{-875}{-10} = 87.5$

$\underline{S = 87.5m}$ (D)



$\boxed{\text{For Q 5-8}}$

5 Considering ΔAOE

$a = \frac{30-0}{5-0} = \frac{30}{5} = 6\,m/s^2$

$\underline{a = 6\,m/s^2}$ (A)

6 Considering ΔBCD

$a = \frac{0-30}{30-20} = \frac{-30}{10} = -3$, −ve is showing that its deceleration

$\underline{a = 3\,m/s^2}$ (C)

7 Considering ΔAOE

S = Area of $\Delta AOE = \frac{1}{2} \times 30 \times 5 = 75$

$\underline{S = 75m}$ (D)

8 Considering the whole shape i.e trapezium

$S = \text{Area} = \frac{1}{2}(15 + 30) \times 30$

$= \frac{1}{2} \times 45 \times 30 = 675$

$\underline{S = 675m}$ (B)

9 $h = 20m$, $u = 0$, $g = 10\,m/s^2$, $t = ?$

$h = ut + \frac{1}{2}gt^2 = 0 \times t + \frac{1}{2} \times 10t^2$

$20 = 5t^2$

$t^2 = 4$, $\quad \underline{t = 2s}$ (B)

10 $v^2 = u^2 + 2gh = 0^2 + 2 \times 10 \times 20 = 400$

$v = \sqrt{400} = 20$

$\underline{v = 40\,m/s}$ (C)

11 $u = 40\,m/s$, $\cancel{h} = 0$, $g = -10\,m/s^2$, $t = ?$

at maximum height $v = 0$

$v^2 = u^2 + 2g\,h_{max}$

$h_{max} = \frac{v^2 - u^2}{2g} = \frac{0 - 40^2}{2 \times -10} = \frac{-1600}{-20} = 80$

$\underline{h_{max} = 80m}$ (D)

12 $v = u + gt$, $t = \frac{v-u}{g}$

$t = \frac{0-40}{-10} = \frac{-40}{-10} = 4$

$\underline{t = 4s}$ (A)

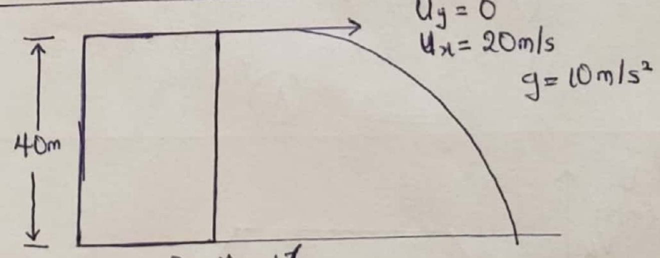
13 $h = ut + \frac{1}{2}gt^2$

$0 = 40t + \frac{1}{2} \times -10t^2 = 40t - 5t^2$

$8t - t^2 = t(8 - t) = 0$

$\therefore t = 0$ or 8

$\underline{t = 8s}$ (D)



For Q 14-16

14 $h = u_y t + \frac{1}{2}gt^2$

$40 = 0t + \frac{1}{2} \times 10t^2$

$40 = 5t^2$

$t^2 = 8$, $t = \sqrt{8} = 2.83$

$\underline{t = 2.83s}$ (A)

BRAINSTORM GROUP (BSG)

15 $V_y^2 = U_y^2 + 2gh$

$= 0^2 + 2\times10\times40 = 800$

$V_y = \sqrt{800} = 28.28$

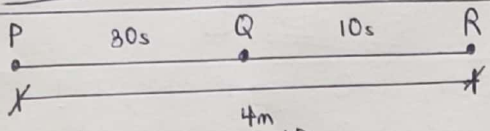
$V_y = 28.28\,m/s$ (C)

16 $S = U_x t$

$= 20\times2.828 = 56.56$

$S = 56.56m$ (B)

17



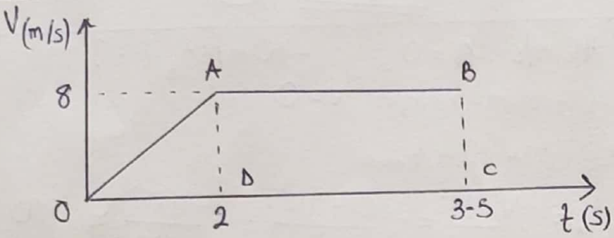
total time $t_T = 30+10 = 40s$

$S = ut_T \quad \therefore \; u = \frac{S}{t_T} = \frac{4}{40} = 0.1\,m/s$

The constant velocity $u = 0.1\,m/s$

$S_{PQ} = ut = 0.1\times30 = 3$

$S_{PQ} = 3m$ (A)



For Q 18 - 20

18 Considering Δ OAD

$a = \frac{8-0}{2-0} = \frac{8}{2} = 4$

$a = 4\,m/s^2$ (D)

19 considering shape ABCD (rectangle)

$a = \frac{8-8}{3.5-2} = \frac{0}{1.5} = 0$

$a = 0$ (A)

20 considering the whole shape (trapezium)

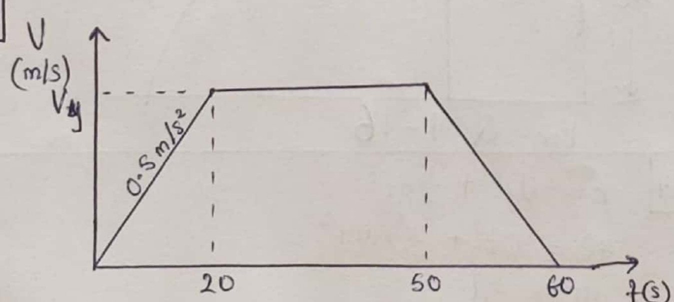
S = Area of OABCD

$= \frac{1}{2}(AB + OC)\times AD$

$= \frac{1}{2}(1.5+3.5)\times8 = \frac{1}{2}\times5\times8 = 20$

$S = 20m$ (A)

21



$0.5 = \frac{V_y - 0}{20-0} = \frac{V_y}{20}$

$V_y = 20\times0.5 = 10\,m/s$

S = Area of the whole shape (trapezium)

$= \frac{1}{2}(30+60)\times10$

$= \frac{1}{2}\times90\times10 = 450$

$S = 450m$ (C)

22 $h=0,\; t=4s,\; g=-10\,m/s^2,\; u=?$

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

$0 = 4u + \frac{1}{2}\times-10\times4^2$

$0 = 4u - 80$

$4u = 80, \quad u = 20\,m/s$

At h_{max} $V=0$

$\therefore$ ~~$v-u = gt$~~ ~~$0 + 20 = 10$~~ $\quad V^2 = u^2 + 2gh_{max}$

$h_{max} = \frac{V^2-u^2}{2g}$

$h_{max} = \frac{0^2-20^2}{2\times-10} = \frac{-400}{-20} = 20$

$h_{max} = 20m$ (A)

23 $u=0,\; h=80m,\; g=10\,m/s^2,\; t=?$

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

$80 = 0\times t + \frac{1}{2}\times10t^2$

$80 = 5t^2$

$t^2 = 16$

$t = 4s$ (C)

24 $u,\; -g,\; h=0,\; t=?$

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

$0 = ut + \frac{1}{2}\times-gt^2 = ut - \frac{1}{2}gt^2$

$t(u - \frac{1}{2}gt) = 0$

$\therefore t = 0$ or $u - \frac{1}{2}gt = 0$

$u = \frac{1}{2}gt$

$t = 2u/g$ (A)

formular for the time of flight

25 $u = 36km/hr = 10m/s, \; V=0, \; t=5$

$a = \frac{V-u}{t} = \frac{0-10}{5} = \frac{-10}{5} = -2$

retardation $= 2\,m/s^2$ (C)

26 $V^2 = u^2 + 2aS$

$S = \frac{V^2-u^2}{2a} = \frac{0^2-10^2}{2\times-2} = \frac{-100}{-4}$

$S = 25m$ (A)

BRAINSTORM GROUP (BSG)

27 $u=0,\ a=8m/s^2,\ s=100m,\ v=?$

$v^2=u^2+2as$

$=0^2+2\times8\times100=1600$

$v=\sqrt{1600}=40$

$\underline{v=40m/s}$ (C)

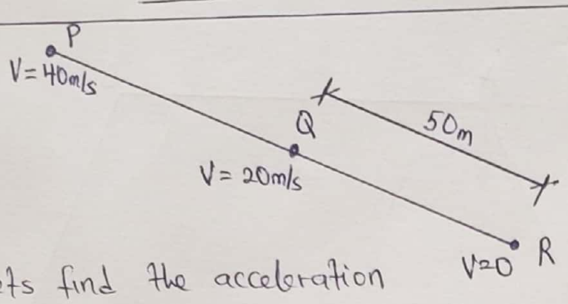
28 $u=0,\ h=20m,\ g=10m/s^2,\ v=?$

$v^2=u^2+2gh$

$=0^2+2\times10\times20=400$

$v=\sqrt{400}=20$

$\underline{v=20m/s}$ (B)



lets find the acceleration considering QR

$S=50m,\ u=20m/s,\ v=0,\ a=?$

$v^2=u^2+2aS$

$a=\frac{v^2-u^2}{2S}=\frac{0^2-20^2}{2\times50}=\frac{0-400}{100}=\frac{-400}{100}$

$=-4m/s^2$

For Q 29 – 31

29 $v^2=u^2+2aS$

$S=\frac{v^2-u^2}{2a}=\frac{20^2-40^2}{2\times-4}=\frac{400-1600}{-8}$

$=\frac{-1200}{-8}=150$

$\underline{S=150m}$ (C)

30 $v=u+at$

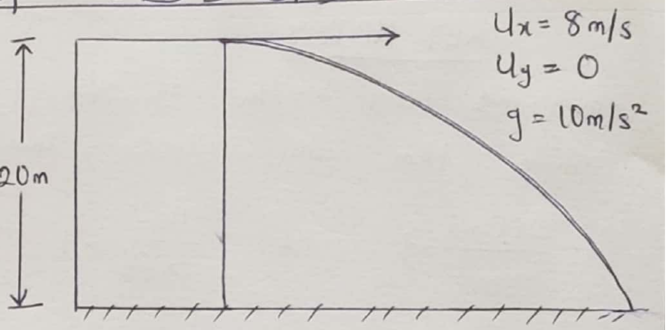
$t=\frac{v-u}{a}=\frac{20-40}{-4}=\frac{-20}{-4}=5$

$\underline{t=5s}$ (A)

31 $v=u+at$

$t=\frac{v-u}{a}=\frac{0-40}{-4}=\frac{-40}{-4}=10$

$\underline{t=10s}$ (D)



Q 32 – 34

32 $h=20m,\ U_y=0,\ g=10$

$h=u_yt+\frac{1}{2}gt^2$

$20=0\times t+\frac{1}{2}\times10t^2$

$20=5t^2$

$t^2=4,\quad t=\sqrt{4}=2$

$\underline{t=2s}$ (A)

33 $S=U_xt$

$=8\times2=16$

$\underline{S=16m}$ (A)

34 $V_y=?,\ U_y=0,\ g=10m/s^2,\ t=2$

$V_y=U_y+gt$

$=0+10\times2=20$

$\underline{V_y=20m/s}$ (B)

35 Speed $=\frac{40km}{30hr}=\frac{4}{3}$ km/hr

Converting to m/s

$\frac{4}{3}\times\frac{5}{18}=\frac{10}{27}$ m/s

$S=ut$ (since velocity is constant)

$t=\frac{S}{u}=S\div u=15\div\frac{10}{27}=15\times\frac{27}{10}$

$\underline{t=40\cdot5s}$ (A)