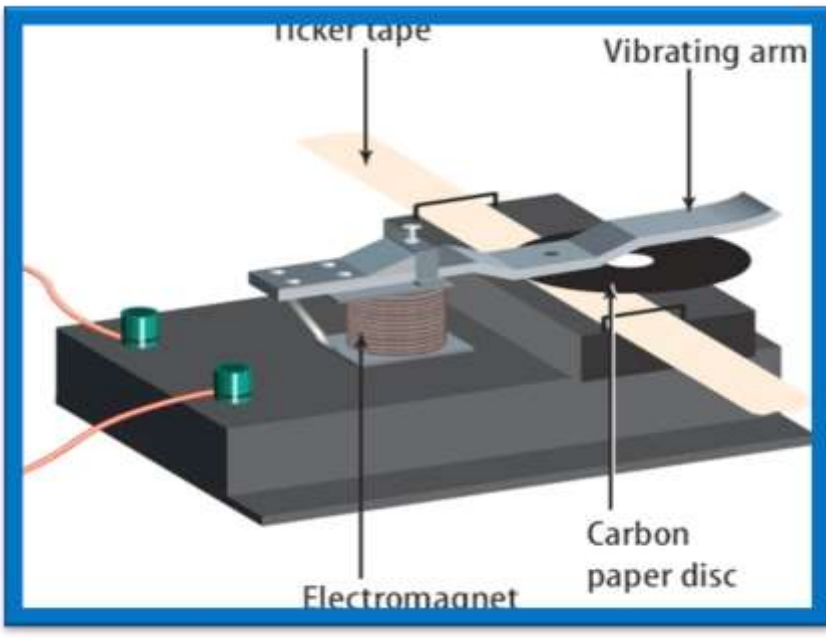
PHYSICS
KNOWLEDGEBASE

2020

LINEAR MOTION



TEACHERS OF PHYSICS
www.teachersofphysics.com
8/19/2020

1. Distinguish between distance and displacement. (1 mk)

Distance the actual length covered by a moving body while displacement is the distance covered in specified direction.

2. Differentiate speed from velocity. (1 mk)

Speed is the distance covered per unit time while velocity is change of displacement per unit time.

3. Distinguish between the terms 'uniform velocity' and 'uniform acceleration.'

Uniform velocity is the constant movement of an object with the same speed while uniform acceleration is the motion of an object where the velocity of an object changes by an equal amount every equal period of time.

4. A body accelerates uniformly from initial velocity**, U** to the final velocity **V**, in time **t**, the distance traveled during this time interval is **S.** If the acceleration is shown by the letter **a**, show that;

i) V= U + at

Acceleration a is rate of change of velocity

$a = \frac{V-U}{t}$

$V = U + at$

ii) $S= Ut + ½ at^2$

Distance is average velocity * time

$S = \frac{(v + u)t;}{2}$

Substitution for V with u + at;

$S = ut + ½ at^2$

(iii) $V^2 =U^2 + 2aS$

Taking average displacement $s=\frac{(u+V)}{2}t$ .....(i)

From v=u+at .....(ii)

Replacing equation (ii) in eqn (i)

Using $t = \frac{V-U}{a}$;

$S=\frac{(u+V)}{2} \times \frac{(V-U)}{a}$

$S=\frac{v(v)-uv+uv-u(u)}{2a}$

$V^2 = u^2 \div 2as$

5. A body initially moving at **72km/h** accelerates uniformly to a velocity of **180km/h** in **3**seconds. Calculate its acceleration. (3mk)

U=72km/h-change in m/s

$72\times\frac{5}{18}$

=20m/s

V=180km/h

$180\times\frac{5}{18}$

=50m/s

$a=\frac{V-U}{t}$

$a=\frac{50-20}{3}$

$a=10m/s^2$

6. A bus accelerates from **36km/h** to **72km/h** in **15s**. Determine the distance covered. (3mk)

$36\times\frac{5}{18}$

$=10m/s$

$V=72km/h$

$72\times\frac{5}{18}$

$=20m/s$

$\mathbf{s=\frac{(u+V)}{2}t}$

$\mathbf{s=\frac{(10+20)}{2}15}$

$\mathbf{s=225m}$

7. A particle starts from rest and accelerates uniformly in a straight line. After **3** seconds it is **9m** from the starting point. Determine the acceleration of the particle. 3mk

$S = ut + ½ at^2$

$9=0+½ a(3)^2$

$9=4.5a$

$a=2m/s^2$

8. A boulder is sliding down a slope, with a uniform acceleration of **3 ms^{-2}**; calculate its velocity after it has slid **10m** down the slope.

$S = ut + ½ at^2$

$10=0+½ (3)t^2$

$10=1.5t^2$

$t^2=6.667$

$t=2.58s$

$V=u+at$

$V=0+3\times 2.58$

$V=7.75m/s$

9. A body initially moving at **50m/s** decelerates uniformly at **2m/s^2** until it comes to rest. What distance does it cover during this time. 3mk

$V^{2=}u^2-2as$

$0^2=50^2-2\times 2\times s$

$2500=4s$

$S=625m$

10. A car is brought to rest from a speed of **30m/s**in **2s**.If the driver's reaction time is **0.3s**, determine the shortest stopping distance. (3mk)

Reaction time=0.3s

Distance travelled during the period=30×0.3

$=9m$

$a=\frac{V-U}{t}$

$a=\frac{0-30}{2}=-15m/s^2$

$v=0,u=30$

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

$0^2=30^2-2\times 15\times s$

$0=900-30s$

$30s=900$

$S=30m$

Total distance =30+9=39m.

11. A car can be brought to rest from a speed of **200m/s** in a time of **2s**.

i) Calculate the average deceleration

$a = \frac{V-U}{t}$

$a = \frac{0-200}{2}$

$=-100 m/s^2$

ii) If the driver reaction time is **0.2s,** Determine the shortest stopping distance.

Reaction time=2s

Distance travelled during this time=200×2

$=400m$

Total distance travelled

$V^2=u^2+2as$

$0^2=200^2-2\times 100 \times s$

$40000=200s$

$S=200m$

Total distance=200+400=600m

12. A body is moving with uniform acceleration. Its velocity after **5** seconds is **26m/s** and after **9** seconds it is **42m/s**. calculate

a) The acceleration of the body (2mks)

$a = \frac{V-U}{t}$

$a = \frac{42-26}{9}$

$=4m/s^2$

b) Its initial velocity (2mks)

$a = \frac{V-U}{t}$

$4m/s^2 = \frac{26-u}{5}$

$20=26-u$

$U=6m/s$

c) The average velocity between the fifth and ninth second and hence the displacement covered during this period (3mk)

average velocity

$= \frac{V+U}{t}$

$= \frac{26+42}{2}$

$=34m/s$

Displacement = average velocity $\times$ *time*

$=34\times 4$

$=136m$

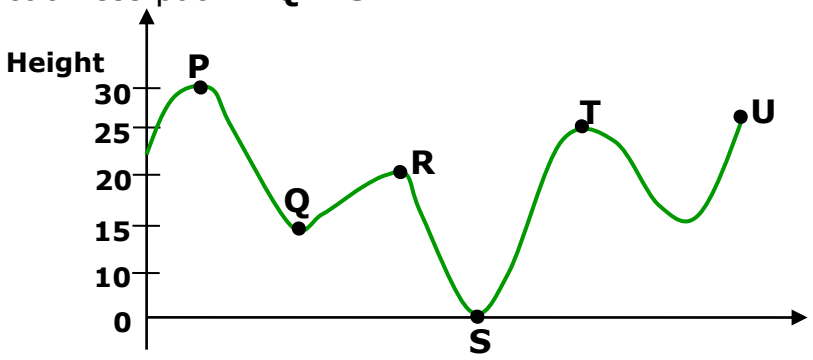
d) Its displacement in **10** seconds (3mk)

s== average velocity $\times$ *time*

$=34\times 10$

$=340m$

13. A body of a mass **10kg** moves from rest at point **P** to a point **T** along frictionless path **P Q R S T**.

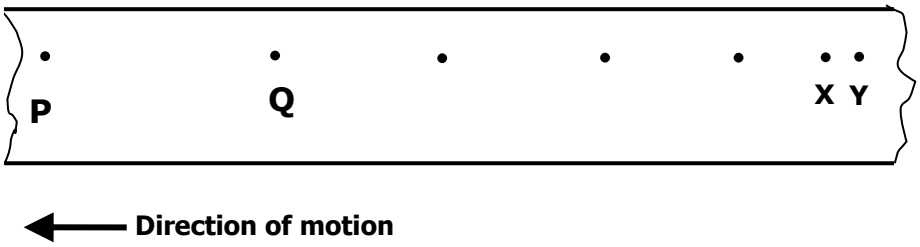


Calculate the maximum velocity it attained.

$$P.E=mgh$$
$$=10\times 10\times 30$$
$$=3000J$$
$$P.E=K.E$$
$$3000=\frac{1}{2}mv^2$$
$$3000=\frac{1}{2}\times 10\times v^2$$
$$3000=5v^2$$
$$V^2=600$$
$$V=24.49m/$$

TICKER-TIMER

1. The figure below shows a section of a tape (***drawn to scale***) after passing through a ticker time of frequency 50Hz. The tape is attached to a trolley moving in the direction shown.



Determine the velocity between

(i) P and Q (4mk)

measure distance PQ = 3cm and XY = 0.5cm using a ruler

f = 50 HZ

$$\mathbf{T=\frac{1}{50}=0.02sec}$$

$$\mathbf{Velocity\ between\ P\ and\ Q\ =\frac{3cm}{0.02sec}}$$

$$\mathbf{=150\ cm/s}$$

(ii) X and Y (2mk)

$$\text{Velocity between X and Y} = \frac{0.5\ cm}{0.02\ sec}$$
$$= 25 \text{ cm/s}$$

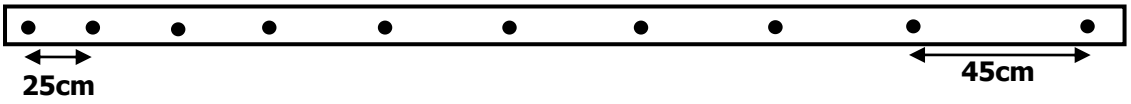
(iii) Determine the acceleration of the trolley (3mk)

Time interval t, between P and Y is $0.02 \times 6 = 0.12$ sec

$$a = \frac{v-u}{t} = \frac{25-150}{0.12}$$

$$a = -1041.67 \text{ cm/s}^2$$

2. The dots below were made by a ***ten tick- timer*** of **100Hz.** Determine the acceleration of the body



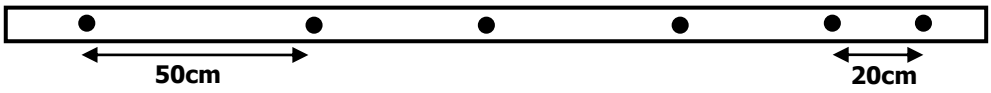
$$f = 100 \text{ HZ}$$
$$T = \frac{1}{100} = 0.01 \text{ sec}$$

$$u = \frac{25}{0.01} = 2500 \text{ cm/s}$$

$$v = \frac{45}{0.01} = 4500 \text{ cm/s}$$

$$a = \frac{v-u}{t} = \frac{4500-2500}{0.01\times 9} = 22222.22 \text{cm/s}^2$$

3. The tape below was obtained from an experiment using a **ticker timer**of frequency **50Hz**. Calculate the acceleration of the body



$$f = 50 \text{ HZ}$$
$$T = \frac{1}{50} = 0.02 \text{ sec}$$

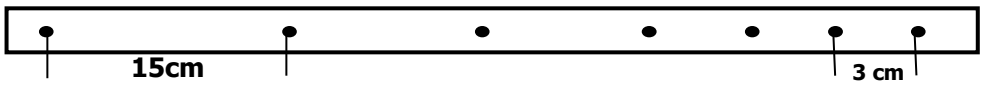
$$u = \frac{50}{0.02} = 2500 \text{ cm/s}$$

$$v = \frac{20}{0.02} = 1000 \text{ cm/s}$$

$$t = 0.02 \times 5 = 0.1 \text{ sec}$$

$$a = \frac{v-u}{t} = \frac{1000-2500}{0.1} = -15000 cm/s^2$$

4. Figure below shows a piece of tape pulled through a **ticker–timer** of frequency **100Hz** by a trolley. Determine the deceleration of the trolley.



$$f = 100\ HZ$$

$$T = \frac{1}{100} = 0.01\ sec$$

$$u = \frac{15}{0.01} = 1500\ cm/s$$

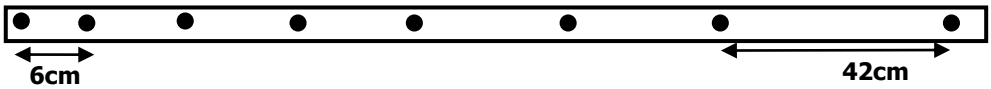
$$v = \frac{3}{0.01} = 300\ cm/s$$

$$t = 0.01 \times 6 = 0.06\ sec$$

$$a = \frac{v-u}{t} = \frac{300-1500}{0.06} = -20000 cm/s^2$$

$$\text{deceleration of the trolley} = 20000 cm/s^2$$

5. The figure below shows a section of a tape from a ***ten-tick timer*** of frequency **50Hz.** Determine the acceleration of the trolley pulling the tape.



$$f = 50\ HZ$$

$$T = \frac{1}{50} = 0.02\ sec$$

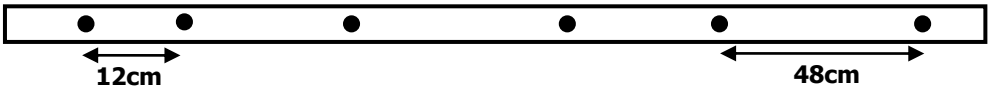
$$u = \frac{6}{0.02} = 300\ cm/s$$

$$v = \frac{42}{0.02} = 2100\ cm/s$$

$$t = 0.02 \times 7 = 0.14\ sec$$

$$a = \frac{v-u}{t} = \frac{2100-300}{0.14} = 12857.14 cm/s^2$$

6. Figure below shows a tape made from a ***ten-tick timer*** running at **50Hz.** Find the acceleration of the body



$\mathbf{f = 50\ HZ}$

$\mathbf{T = \frac{1}{50} = 0.02\ sec}$

$\mathbf{u = \frac{12}{0.02} = 600\ cm/s}$

$\mathbf{v = \frac{48}{0.02} = 2400\ cm/s}$

$\mathbf{a = \frac{v-u}{t} = \frac{2400-600}{0.02\times5} = 18000 cm/s^2}$

7. The dots below were made by a ***ten-tick timer*** of **100Hz.** Determine the acceleration of the body

$\mathbf{f = 100\ HZ}$

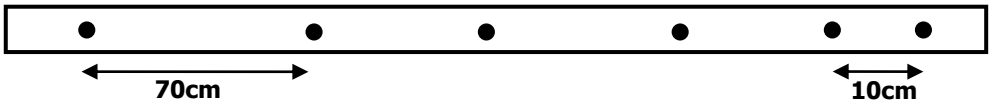
$\mathbf{T = \frac{1}{100} = 0.01\ sec}$

$\mathbf{u = \frac{10}{0.01} = 1000\ cm/s}$

$\mathbf{v = \frac{60}{0.01} = 6000\ cm/s}$

$\mathbf{a = \frac{v-u}{t} = \frac{6000-1000}{0.01\times9} = 55555.56 cm/s^2}$

8. The tape below was obtained from an experiment using a ***ten-tick timer*** of frequency **50Hz**. Calculate the acceleration of the body



$\mathbf{f = 50\ HZ}$

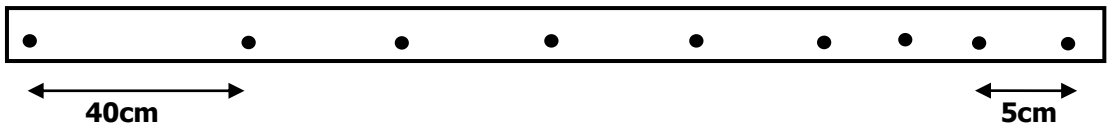
$\mathbf{T = \frac{1}{50} = 0.02\ sec}$

$\mathbf{u = \frac{70}{0.02} = 3500\ cm/s}$

$\mathbf{v = \frac{10}{0.02} = 500\ cm/s}$

$$a = \frac{v-u}{t} = \frac{500-3500}{0.02\times5} = -30000\,cm/s^2$$

9. Figure below shows a piece of tape pulled through a ***ten-tick timer*** of frequency **100Hz** by a trolley. Determine the deceleration of the trolley.



$$f = 100\ HZ$$

$$T = \frac{1}{100} = 0.01\ sec$$

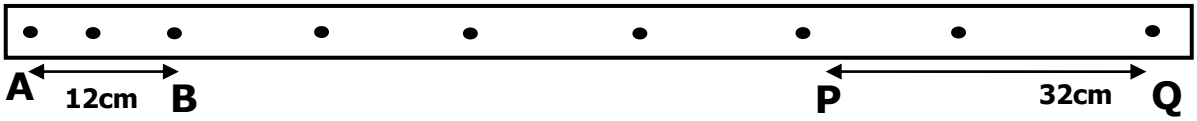
$$u = \frac{40}{0.01} = 4000\ cm/s$$

$$v = \frac{5}{0.01} = 500\ cm/s$$

$$a = \frac{v-u}{t} = \frac{500-4000}{0.01\times8} = -43750\,cm/s^2$$

deceleration of the trolley = 43750 cm/s^2

10. The figure below shows the motion of a ticker tape through a ***ten-tick timer*** whose frequency is **100Hz**



Determine

i) Velocity at **AB** and **PQ**.

$$f = 100\ HZ$$

$$T = \frac{1}{100} = 0.01\ sec$$

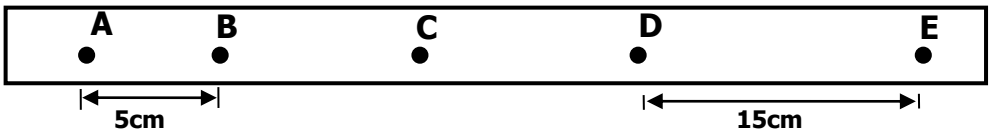
$$\text{Velocity between AB, } u = \frac{12}{0.02} = 600\ cm/s$$

$$\text{Velocity between PQ, } v = \frac{32}{0.02} = 1600\ cm/s$$

ii) Constant acceleration of the tape.

$$a = \frac{v-u}{t} = \frac{1600-600}{0.01\times 8} = 12500 cm/s^2$$

11. Figure below shows a tape made from **a ticker tape timer** running at **50Hz.**



Find,

i) The time taken for one tick interval (1mk)

$f = 50\ HZ$

$$T = \frac{1}{50} = 0.02\ sec$$

Time interval for one tick is 0.02 seconds

ii) Velocities between points **AB** and **DE** (3mk)

$$\text{velocity between points AB, } u = \frac{5}{0.02} = 250\ cm/s$$

$$\text{velocity between points DE, } v = \frac{15}{0.02} = 750\ cm/s$$

iii) Acceleration of the body over interval **AE** (2mk)

$$a = \frac{v-u}{t} = \frac{750-250}{0.01\times 4}$$

$$= 6250 cm/s^2$$

12. The section of the tape shown below was produced when a tape running down an incline plane was attached to a **ticker-tape timer** of frequency **50Hz**.

i) Indicate the direction in which the trolley was moving. (1mk)

ii) What type of current was used to operate the ticker timer? (1mk)

Alternating current (a.c)

iii) Determine the initial velocity of the trolley. (2mk)

f = 50 HZ

$T = \frac{1}{50} = 0.02$ sec

Initial velocity, $u = \frac{4}{0.02} = 200$ cm/s

iv) Determine the final velocity of the trolley. (2mk)

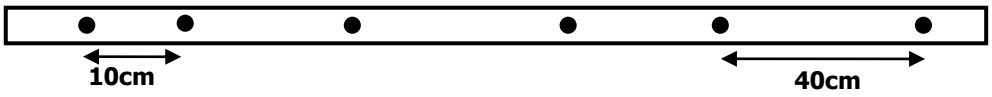
Final velocity, $v = \frac{28}{0.02} = 1400$ cm/s

v) Find the acceleration of the trolley in SI units. (3mk)

$a = \frac{v-u}{t} = \frac{1400-200}{0.02\times7}$

$= 8571.43 cm/s^2$

13. The Figurebelow shows the pattern formed on a tape in an experiment to determine the acceleration of a trolley. The figure is drawn to scale. The frequency of the **ticker tape timer** used was **50Hz**.



Calculate

(i) The initial velocity of the trolley. (2mks)

f = 50 HZ

$T = \frac{1}{50} = 0.02$ sec

$u = \frac{10}{0.02} = 500$ cm/s

(ii) The final velocity of the trolley (2mks)

$v = \frac{40}{0.02}$

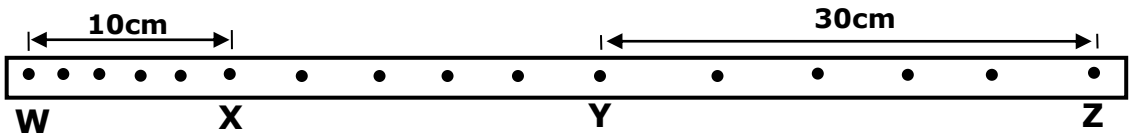
$= 2000$ cm/s

(iii) The acceleration of the trolley. (2mks)

$a = \frac{v-u}{t} = \frac{2000-500}{0.02\times5}$

$= 15000 cm/s^2$

14. The figure below shows a section of a tape from a **ticker- timer** whose frequency is **50Hz**.



Calculate

(i) The average velocity of the trolley between points

WX (2 mk)

$f = 50\ HZ$

$T = \frac{1}{50} = 0.02\ sec$

$u = \frac{10}{0.02 \times 5} = 100\ cm/s$

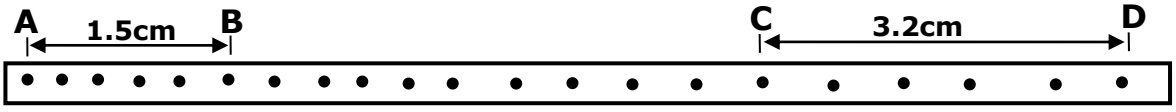
YZ (2 mk)

$v = \frac{30}{0.02 \times 5} = 300\ cm/s$

(ii) The acceleration of the trolley. (3 mk)

$a = \frac{v-u}{t} = \frac{300-100}{0.02 \times 15} = 666.67 cm/s^2$

15. A tape attached to a moving trolley is run through a **ticker timer**. Figure below shows a section of the tape after running.



If the frequency of the timer is **100Hz** determine the;

(i) Average velocity at intervals **AB** and **CD** (4mks)

$f = 100\ HZ$

$T = \frac{1}{100} = 0.01\ sec$

Average velocity at interval AB, $u = \frac{1.5}{0.01 \times 5} = 30\ cm/s$

Average velocity at interval CD, $v = \frac{3.2}{0.01 \times 5} = 64\ cm/s$

(ii) Average acceleration of the trolley (4mks)

$a = \frac{v-u}{t}$

Time interval from point A to point D = 0.01 × 20 = 0.2 seconds

$= \frac{64-30}{0.2}$

$= 170\text{cm/s}^2$

VERTICAL PROJECTION

1. In the study of free fall, it is assumed that the force **F** acting on a given body of mass, **m**, is gravitational, given by **F = mg**. State **two** other forces that act on the same body (2mk)

Weight and drag(air resistance)

2. A stone is released from a height **h,** if the acceleration due to gravity is **g,** show that the velocity is **V=$\sqrt{2gh}$** just before hitting the ground(2mks)

$V^2=u^2+2as$ where s=h,u=0

$V^2=0+2gh$

$V=\sqrt{2gh}$

3. A body of mass **20kg** is raised to a height of **3.0m**. Determine the velocity of the body when just about to hit the ground when released from this height. (**g=10ms^{-2}**) (3mks)

E=mgh

20×10×3=600J

$E=\frac{1}{2}mv^2$

$600=\frac{1}{2}\times 20\times v^2$

$V^2=60$

V=7.75m/s

4. An object is projected vertically upwards at a speed of **15m/s**. How long will Sit take to return to the same level of projection?

V=u-gt

0=15-10t

T=1.5s

Total time=2× 1.5=3s

5. A stone was thrown vertically upwards with a velocity of **20m/s**.

(i) State the acceleration of the stone at its maximum point **(1mk**)

It's accelaration is directed downwards

(ii) Calculate the time taken for the stone to fall back to the throwers hands (2mk

V=u-gt

0=20-10t

T=2s

Total time=2× 2=4s

6. An object is projected vertically upwards with a velocity of **200m/s.** Calculate:

(i) Its velocity after **5** seconds (2mks)

V=u-gt

=200-10(5)

=150m/s

(ii) The distance covered in the first **8** seconds (2mks)

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

$=200(8)-\frac{1}{2}\times 10\times 64$

$=1600-320$

$=1280m$

(iii) The maximum height reached (2mks)

$V^2=u^2-2gs$

$0=200^2-2(10)s$

$20s=4000$

$S=2000m$

7. A ball is thrown vertically upwards and returns to its starting point after **6** seconds. Calculate the maximum height reached **$g=10m/s^2$** (3mk)

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

$0=u(6)-\frac{1}{2}\times 10\times 36$

$6u=180$

$U=30m/s$

$V^2=u^2-2gs$

$0=30^2-2(10)s$

$20s=900$

$S=45m$

8. An object dropped from a height **h**, attains a velocity of **$12ms^{-1}$** just before hitting the ground. Calculate the value of **h**. (2mks)

$V^2=u^2+2gs$

$12^2=0^2+2(10)h$

$20h=144$

$h=7.2m$

9. A small iron ball is dropped from the top of a vertical cliff and takes **2.5 seconds** to reach the sandy beach. Find the velocity with which it strikes the sand. (3mks)

$V=u+at$

$V=0+10(2.5)$

$V=25m/s$

10. A body dropped from rest falls half its total distance in the last second before it strikes the ground. From what height was it released (3mks)

$V^2=u^2+2g(\frac{H}{2})$,u=0

$V^2=gH$

$S=v^2+\frac{1}{2}gt^2$

$\frac{H}{2}=(gH)\frac{1}{2}+\frac{g}{2}$,t=1s

$\frac{(H-g)}{2}2=gH$

$H^2-2gH+g^2=4Gh$ but $g=10m/s^2$

$H^2+g^2=6gh$

$H^2+100=60H$

$H^2-60H+100=0$

H^2-60H+$(-30)^2$=-100+$(-30)^2$

$\sqrt{(H-30)}=\sqrt{800}$

$$H-30=28.28$$

H=58.28M

11. An astronaut is on the moon. He drops a hammer from a height of **5m** and it takes **3s** to hit the lunar landscape. What is the acceleration due to gravity of the moon?

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

5=0(3)+$\frac{1}{2}\times a\times 9$

5=4.5a

A=1.11m/s^2

12. A gun is fired vertically upwards from the top of an open truck moving horizontally at a uniform velocity of **50ms^{-1}**. The bullet attains a maximum height of **45m**. Calculate the distance covered by the truck just before the bullet reaches the level from which it was fired. (4mks)

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

45=0(t)+$\frac{1}{2}\times 10\times$t^2

45=5t^2

t^2=9,t=3

total time ,t=3$\times 2=6s$

distance covered by truck=v$\times t$

=50$\times 6=300m$

13. A girl dropped a stone from the top of a tower **45m** tall and a boy projected another stone vertically upwards at **25m/s** at the same time. Determine the time taken for the two stones to meet. (3mk)

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

h=25t-$\frac{1}{2}\times 10\times$t^2

h=25t-5t^2 .....(i)

For free fall u=0m/s

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

45-h=0+$\frac{1}{2}\times 10\times$t^2

45-h=5t^2 .....(ii)

Substitute eqn (i) in (ii)

45-(25t-5t^2)= 5t^2

45-25t+5t^2= 5t^2

45=25t

t=1.8s

14. A stone is allowed to fall freely from the top of a tower **60m** high. At exactly the same moment a second stone is thrown vertically upwards with a velocity of **20ms^{-1}** from the ground. Find:

(i) The time taken for the two stones pass each other. (3mks)

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

$h=20t-\frac{1}{2}\times 10\times t^2$

$h=20t-5t^2$ .....(i)

For free fall u=0m/s

$60-h=ut+\frac{1}{2}gt^2$

$60-h=0+\frac{1}{2}\times 10\times t^2$

$60-h=5t^2$ .....(ii)

Substitute eqn (i) in (ii)

$60-(20t-5t^2)=5t^2$

$60-20t+5t^2=5t^2$

$60=20t$

$t=3s$

(ii) The height at which the two stones will pass each other. (2mks)

$h=20t-5t^2$

$h=20(3)-5(3)^2$

$h=60-45$

$h=15m$

15. A helicopter, which was ascending vertically at a steady velocity of **20m/s**, released a parcel that took **20** second to reach the ground.

(i) State the direction in which the parcel moved immediately it was released.

Upwards

(ii) Calculate the time taken by the parcel to reach the ground from the maximum height

Time taken to reach maximum height, $t=\frac{u}{g}$

$\frac{20}{10}=2s$

$time\ taken = 20-2$

$=18s$

(iii) Calculate the velocity of the parcel when it strikes the ground.

$V=u+gt, u=0m/s$

$V=gt$

$=10\times 18$

$=180m/s$

(iv) Calculate the maximum height above the ground the parcel reached.

$H_{max}=\frac{u(u)}{2g}$

$=\frac{180\times 180}{2\times 10}$

$=1620m$

(v) What was the height of the helicopter at the instant the parcel was dropped.

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

$S=(0\times 2)+\frac{1}{2}\times 10\times 2^2$

$=20m$

HORIZONTAL PROJECTION

1. A bullet is fired horizontally at a target, neglecting air resistance, give a reason why the horizontal acceleration of the bullet is zero.

The body maintains its initial horizontal velocity throughout the motion.

2. A bullet is fired horizontally at a target, neglecting air resistance; give a reason why the horizontal acceleration of the bullet is zero. 1mk

The body maintains its initial horizontal velocity throughout the motion.

3. A bullet is fired horizontally from a flat form **15m** high. If initial speed is **300ms^{-1}**, determine maximum horizontal distance covered.(**g =10ms^{-2}**)

$H=\frac{1}{2}gt^2$

$15=\frac{1}{2}\times 10\times t^2$

$15=5t^2$

$t=\sqrt{3}$

$=1.732$ second

$R=ut$

$=300\times 1.732$

$=519.6m$

4. A bomber flying horizontally at **100m/s** releases a bomb from the height of **200m**. Calculate the time taken for the bomb to hit the ground.

$H=\frac{1}{2}gt^2$

$200=\frac{1}{2}\times 10\times t^2$

$200=5t^2$

$t^2=40$

$t=\sqrt{40}$

$t=6.325$ seconds

5. A stone is thrown horizontally from a building that is **180m** high above a horizontal ground. The stone hits the ground at a point, which is **72m** from the foot of the building. Calculate the initial velocity of the stone.

$H=\frac{1}{2}gt^2$

$180=\frac{1}{2}\times 10\times t^2$

$180=5t^2$

$t=\sqrt{36}$

$=6.0$ second

$R=ut$

$72=u\times 6$

$u=12m/s$

6. A bomber flying horizontally at **100m/s** releases a bomb from a height of **300m**. Calculate:

(a) Time taken for the bomb to hit the ground.

$H=\frac{1}{2}gt^2$

$300=\frac{1}{2}\times 10\times t^2$

$300=5t^2$

$t^2=60$

$t=\sqrt{60}$

t=7.746 seconds

(b) The horizontal distance traveled when hitting the ground.

$R=ut$

$=100\times 7.746$

$=774.6m$

(c) The magnitude and direction of the velocity when hitting the ground?

$V^2=2gh$

$V^2=2\times 10\times 300$

$V=\sqrt{6000}$

$=77.46$

7. A ball-bearing **X** is dropped vertically downwards, from the edge of a table and it takes **0.5s** to hit the floor below. Another bearing **Y** leaves the edge of the table horizontally with a velocity of **5m/s**.find:

a) The time taken for bearing **Y** to reach the floor.

t=0.5 seconds-time for horizontal is the same for vertical at any given time.

b) The horizontal distance traveled by **Y** before hitting the floor.

$R=ut$

$=5\times 0.5$

$=2.5m$

c) The height of the table-top above the floor level.

$H=\frac{1}{2}gt^2$

$H=\frac{1}{2}\times 10\times 0.5^2$

$=1.25m$

8. An airplane is flying horizontally over a camp at 250m/s and drops a pack. How far from the camp will the pack land if the plane was flying **300m** above the ground?

$H=\frac{1}{2}gt^2$

$300=\frac{1}{2}\times 10\times t^2$

$300=5t^2$

$t^2=60$

$t=\sqrt{60}$

t=7.746 seconds

$R=ut$

$=250\times 7.746$

$=1936.5$

9. An object is projected horizontally at a velocity of **40m/s** from a cliff **20m** high. Calculate:

a) The time taken to hit the ground

$H=\frac{1}{2}gt^2$

$20=\frac{1}{2}\times 10\times t^2$

$20=5t^2$

$t^2=4$

$t=\sqrt{4}$

$t=2s$

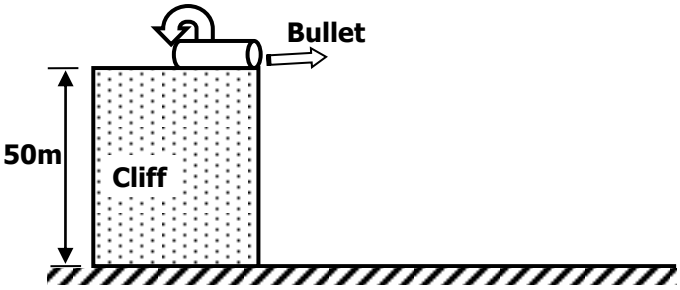
b) The distance from the foot of the cliff when the object hits the ground.

$R=ut$

$=40\times 2$

$=80m$

10. A bullet is fired horizontally at a velocity of 400m/s from a cliff which is 50m tall as shown below.



(i) On the diagram draw the trajectory of the bullet until it comes to rest. (1mk)

(ii) Find the time taken for the bullet to hit the ground. (2mk)

$H=\frac{1}{2}gt^2$

$50=\frac{1}{2}\times 10\times t^2$

$50=5t^2$

$t^2=10$

$t=\sqrt{10}$

$t=3.162$ seconds

(iii) Find the range. (2mk)

$R=ut$

$=400\times 3.162$

$=1264.6m$

11. A ball is thrown horizontally from the top of a vertical tower and strikes the ground at a point **50m** from the bottom of the tower. Given that the height of the tower is **45m**, determine the;-

i) Time taken by the ball to hit the ground

$H=\frac{1}{2}gt^2$

$45=\frac{1}{2}\times 10\times t^2$

$45=5t^2$

$t^2=9$

$t=\sqrt{9}$

$t=3.0$seconds

ii) Initial horizontal velocity of the ball.

$R=ut$

$50=u\times 3$

$=16.67$

iii) Vertical velocity of the ball, just before striking the ground. (Take acceleration due togravity **g =10ms^{-2}**)

$V=u+at$

$=0+10\times 3$

$=30m/s$

12. A ball is thrown horizontally at V=**8m/s** from a tower. It reaches the ground after **4s**. Find:

(i) The horizontal distance d it travels before hitting the ground.(1mk)

$R=ut$

$=8\times 4$

$=32m$

(ii) The height of the tower (2mks)

$H=\frac{1}{2}gt^2$

$H=\frac{1}{2}\times 10\times 4^2$

$=80m$

(iii) The velocity on impact with the ground. (2mks)

$V=u+at$

$V=0+10\times 4$

$=40m/s$

13. A missile is fired horizontally from the top of a cliff **320m** high to a target **56m** away. If the missile hits the target, determine the horizontal velocity of the missile. (3mks)

$H=\frac{1}{2}gt^2$

$320=\frac{1}{2}\times 10\times t^2$

$320=5t^2$

$\sqrt{}\ t^2=\sqrt{64}$

$t=8s$

$R=ut$

$56=u\times 8,\ u=7m/s$

14. A bullet is fired horizontally from a platform **45m** high. If the initial speed is **300ms^{-1}**, determine the maximum horizontal distance covered by the bullet. (3mks

$H=\frac{1}{2}gt^2$

$45=\frac{1}{2}\times 10\times t^2$

$45=5t^2$

$t^2=9$

$t=\sqrt{9}$

$=3s$

$R=ut$

$=300\times 3$

$=900m$

15. A ball rolls off a platform of height **1.8m** at a horizontal speed of **15ms^{-1}**.

(i) How far off the edge of the platform does it land. (4mk)

$H=\frac{1}{2}gt^2$

$1.8=\frac{1}{2}\times 10\times t^2$

$1.8=5t^2$

$t^2=0.36$

$t=\sqrt{0.36}$

$t=0.6s$

$R=ut$

$=15\times 0.6$
$=9.0m$

(ii) The horizontal component of the velocity as it reaches the floor
15m/s since it maintains the same velocity.

(iii) The vertical component of the velocity as it reaches the floor.
$V=u+at$
$=0+10\times 0.6$
$=6m/s$

16. A mass is projected horizontally from height of **5m** above the ground with a velocity of **30m/s**. Calculate:

a) The time taken to reach the ground
$H=\frac{1}{2}gt^2$
$5=\frac{1}{2}\times 10\times t^2$
$5=5t^2$
$t^2=1$
$t=\sqrt{1}$
$t=1.0s$

b) The horizontal distance traveled before hitting the ground
$R=ut$
$=30\times 1$
$=30m$

c) The vertical velocity with which the mass hits the ground
$V=u+at$
$=0+10\times 1$
$=10m/s$

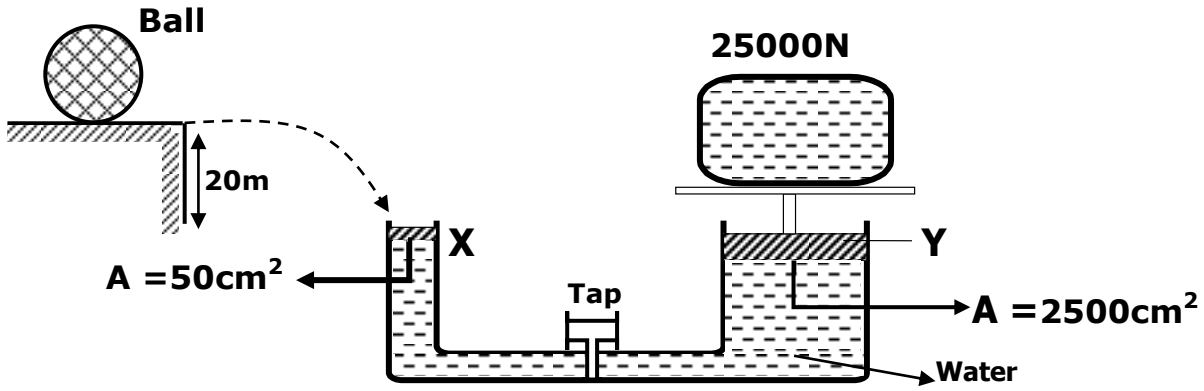
17. A mass is projected horizontally from a height of **80m** above the ground with a horizontal velocity of **30m/s**. Calculate:

(i) The time taken to reach the ground **(2mk)**
$\mathbf{H=\frac{1}{2}gt^2}$
$\mathbf{80=\frac{1}{2}\times 10\times t^2}$
$\mathbf{80=5t^2}$
$\mathbf{t^2=16}$
$\mathbf{t=\sqrt{16}}$
$\mathbf{t=4s}$

(ii) The horizontal distance traveled before hitting the ground **(2mk**
$\mathbf{R=ut}$
$\mathbf{=30\times 4}$
$\mathbf{=120m}$

18. A ball of mass **50kg** is thrown horizontally from the top of a cliff **20m** high with a horizontal velocity of **20m/s**. On reaching the ground it completely covered piston **X** of a hydraulic lift such that no water splashed out. The other piston **Y** has a weight of **25000N**. Assuming the tap was opened when the ball struck the surface of water.

Fig 8



Determine

(i) The time taken by the ball to strike the surface of water at piston (3mk)

$H=\frac{1}{2}gt^2$

$20=\frac{1}{2}\times 10\times t^2$

$20=5t^2$

$t^2=4$

$t=\sqrt{4}$

$t=2.0s$

(ii) The distance from the foot of the cliff to where the ball strikes the surface of water (2mks

$R=ut$

$=20\times 2$

$=40m$

(iii) The vertical velocity with which it struck the surface of water at piston **X** (2mks)

$V=u+at$

$=0+10\times 2$

$=20m/s$

(iv) The force with which the ball struck the surface of water (2mks)

$\frac{F1}{A1}=\frac{F2}{A2}$

$\frac{F1}{50}=\frac{25000}{2500}$

$F1=\frac{25000\times 50}{2500}$

$=500N$

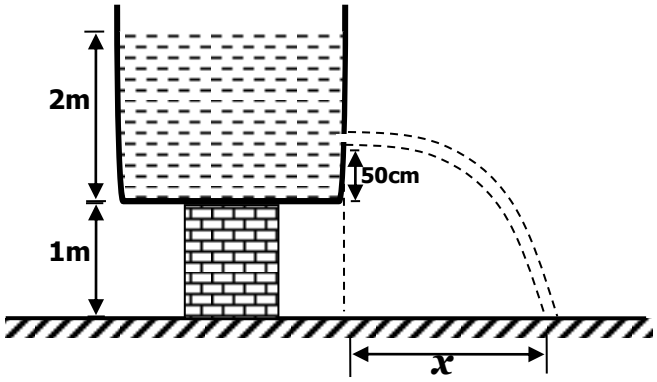
(v) The distance moved by the **25000N** load piston **Y** if the level of water in piston **X** and piston **Y** was initially the same. (2mks)

$P=h\rho g$

$\frac{25000}{0.25}=h\times 1000\times 10$

100000=1000h
=10m

19. A large tank contains water to a depth of **2m**. Water emerges from a small hole on the side of the tank **50cm** above the bottom of the tank as shown below.



Calculate

(i) The speed at which water emerges from the hole. (2mks)

V=$\sqrt{2gh}$
=$\sqrt{2\times 10\times 1.5}$
=5.477m/s

(ii) The time taken for water to reach the ground. (2mks)

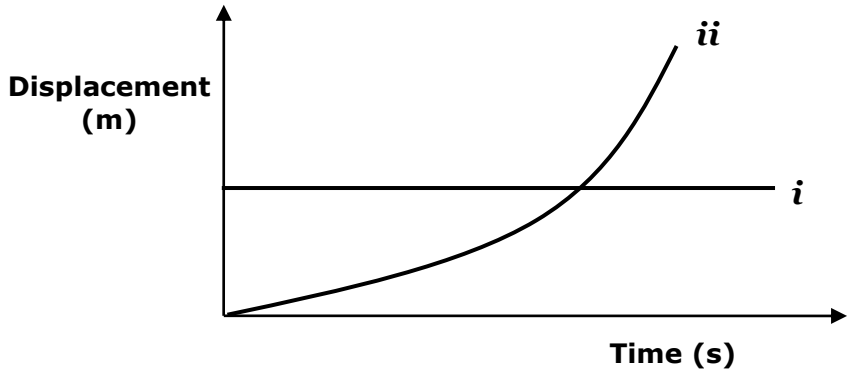
H=$\frac{1}{2}$gt^2
1.5=$\frac{1}{2}\times 10\times$t^2
1.5=5t^2
t^2=0.3
t=$\sqrt{0.3}$
t=0.5477s

(iii) The value of **x.** (2mks)

R=ut
=5.477$\times$ 0.5477
=2.9997m
$\approx$3.0m

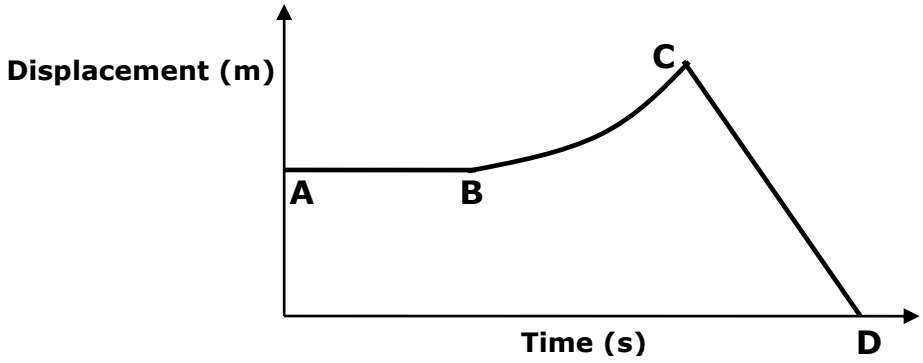
MOTION GRAPHS

1. Describe the motion represented by the following graphs. (2mk)



(i).stationary body
(ii).A body moving with variable velocity.

2. The figure below shows the displacement time graph of the motion of a particle



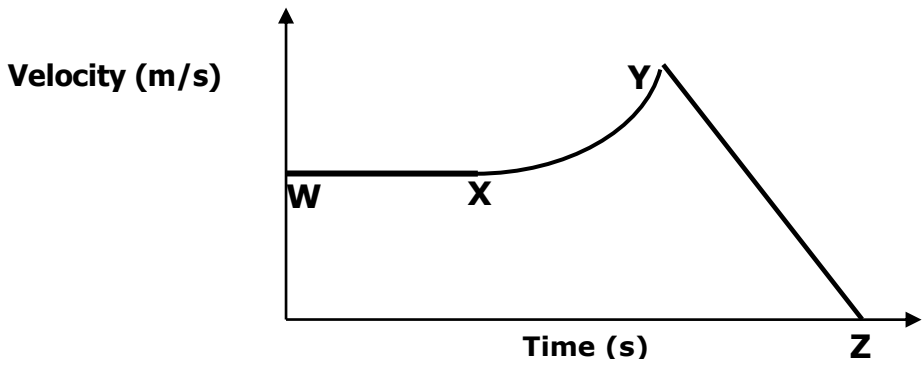
State the nature of the motion of the particle between

(i) **A** and **B**
Particle is at stationary.

(ii)B and **C** (1mk)
A particle moving with variable velocity.

(iii) **C** and **D** (2mk)
A particle moving with velocity decreasing uniformly with time.

3. The figure below shows the displacement time graph of the motion of a particle



State the nature of the motion of the particle between

i) **W** and **X** (1mk)

A body moving with uniform velocity

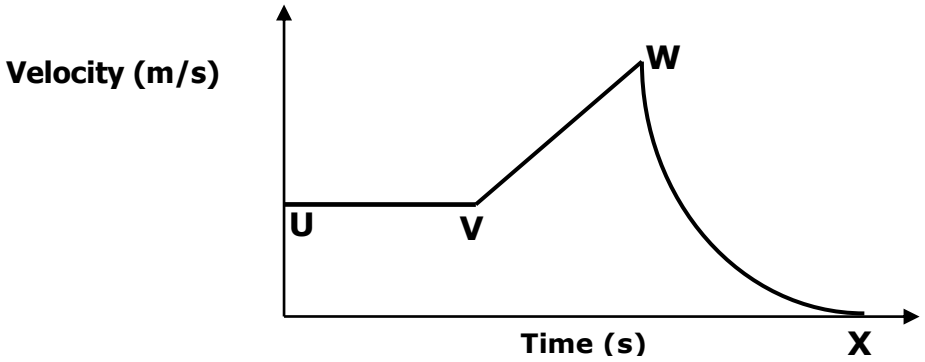
ii) **X** and **Y** (1mk)

A body moving with its velocity changing uniformly

iii) **Y** and **Z** (1mk)

A body moving with decreasing acceleration.

4. The graph shows the velocity time graph of the motion of a body.



State the nature of motion of the body represented by graph between.

(i) **U** and **V**. (1mk)

A body moving with uniform velocity

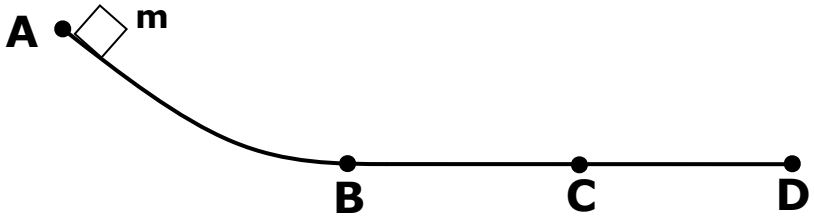
(ii) **V** and **W** (1mk)

A body moving with its velocity changing uniformly

(iii) **W** and **X** (1mk)

A body moving with a decreasing acceleration

5. The figure below shows a section of a curved surface ABCD. Point A is higher than point **B** while **BCD** is horizontal. Part **ABC** is smooth while **CD** is rough. A mass **m** is released from rest at **A** and moves towards **D**.



State the changes in the velocity of m between:

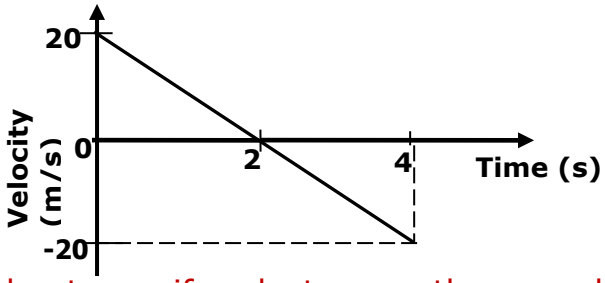
a) **B** and **C** (1mk)

Mass m moves with uniform velocity

b) **C** and **D** (1mk)

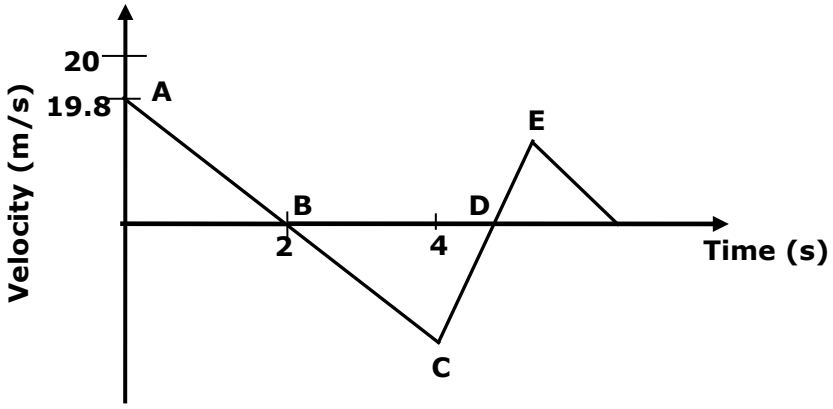
the particle decelerates due to friction

6. Figure is a velocity-time graph for the motion of a particle under gravity. Describe the motion.



The ball decelerates uniformly to zero,then accelerates uniformly in opposite direction.

7. The diagram below shows part of the motion of a tennis ball, which is projected vertically upwards from the ground and allowed to bounce on the ground.



(i) Describe the motion of the ball relating it to different positions of the ball along the following **AB, BC, CDE**.
AB-ball rising to maximum height
BC-ball falling to ground
CDE-Ball rebouncing or changing velocity from the positive to negative.

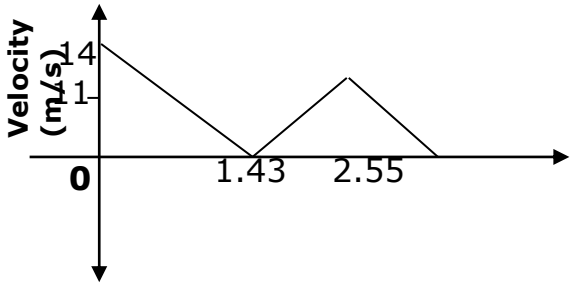
(ii) From the graph, calculate the acceleration due to gravity.
Acceleration=gradient=$\frac{19.8}{2}$
$=9.9\text{m/s}^2$

(iii) How high does the ball rise initially?
Displacement=area=$\frac{1}{2}\times 2\times 19.8 = 19.8m$

(iv) Explain why **E** is not at the same level as **A**
Upon hitting the ground the ball looses some energy.

8. A ball is thrown vertically upwards with a velocity of **14ms^{-1}** .It falls and bounces back with a velocity of **11 ms^{-1}**.

i) Represent this information on a velocity – time graph(until it strikes the ground twice) (2mks)



ii) Determine the total distance covered until the ball strikes the ground twice. (Assumethe ball is thrown from the ground level) (4mks)

v=u-gt

0=14-9.8t

9.8t=14

t_1=1.43s

0=11-9.8t

9.8t=11

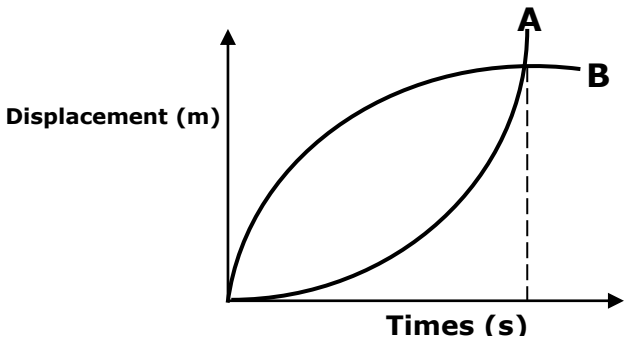
t_2=1.12s

distance covered=area

$=\frac{1}{2}\times 14\times 1.43)+(\frac{1}{2}\times 1.12\times 11)$

=16.17m

9. Figure below shows two graphs representing the motion of two bodies for the same time recorded.

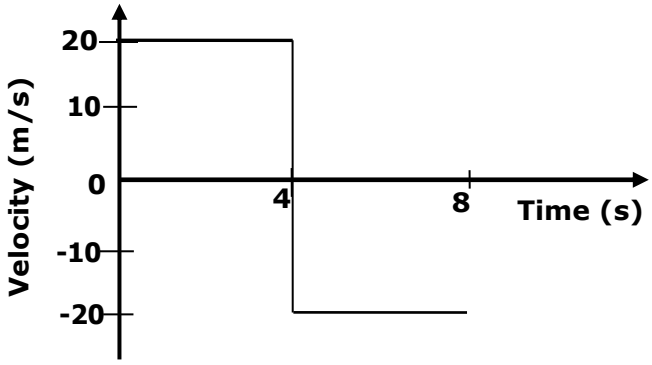


Describe the motion of **A** and that of **B**. (2 mks)

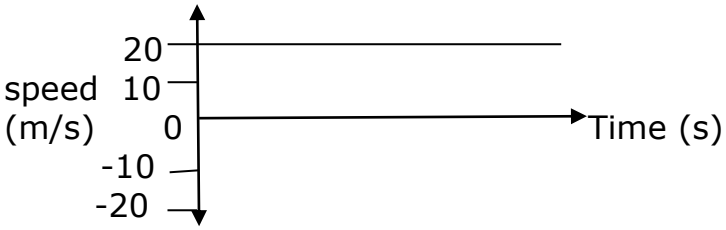
A-A motion of a body with increasing velocity.

B-A motion of body with decreasing velocity

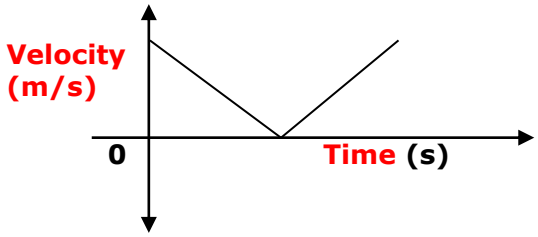
10. The figure below shows the velocity – time graph for the motion of a body.



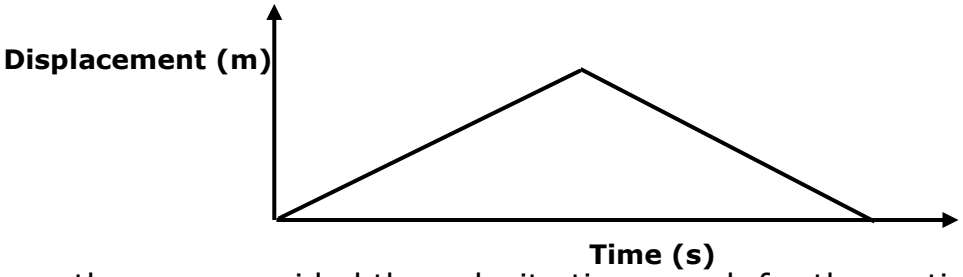
Sketch the speed time graph for the same motion. (1mk)



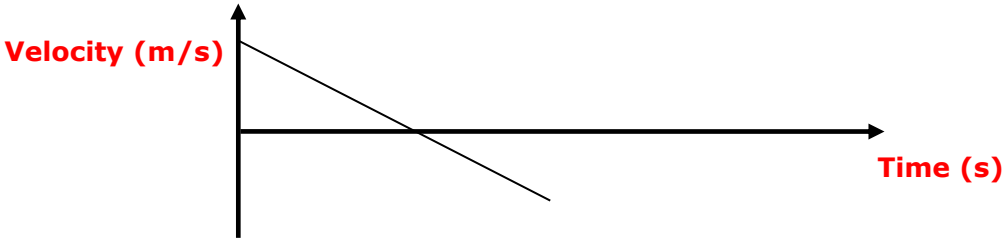
11. A table tennis ball is dropped from a certain height on a hard surface. On the axis below, sketch its velocity – time graph.



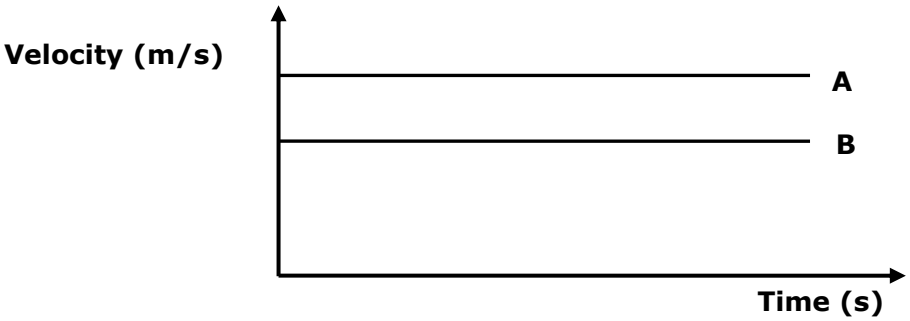
12. The figure shows the displacement time graph for the motion of an object



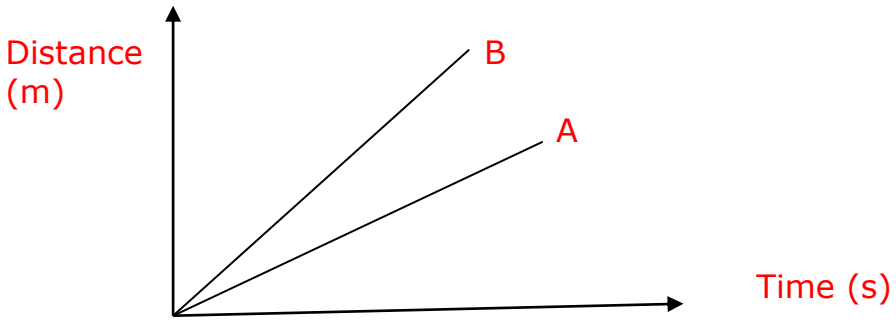
Sketch on the axes provided the velocity time graph for the motion of the object (1mk)



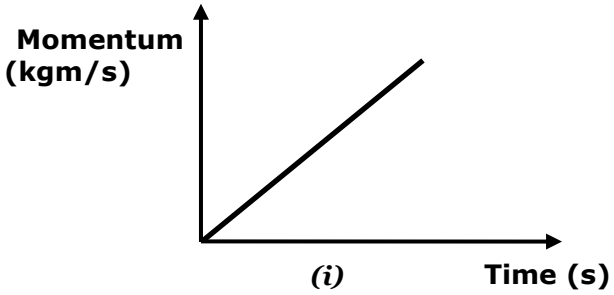
13. Fig Below shows a velocity time graph for a moving object.

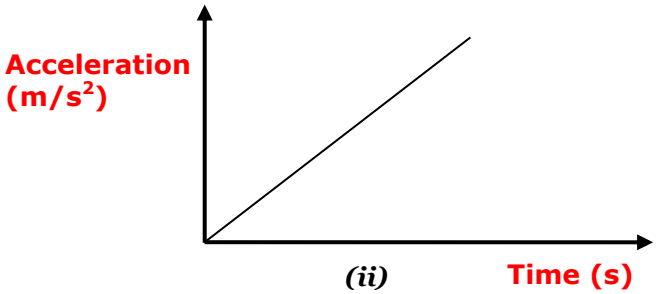


Draw two other graphs on fig above for displacement against time and label them **A** and **B** respectively. (2mk)



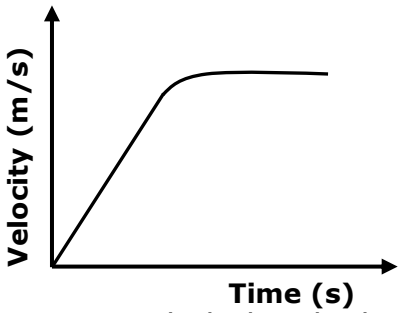
14. Figure **(i)** shows the momentum-time graph for a certain motion.

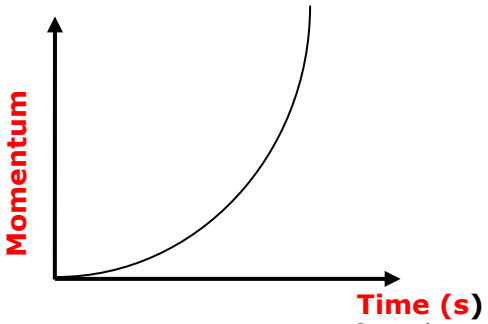




On the axes provided in figure **(ii),** sketch the acceleration time graph for the same motion. (1mk)

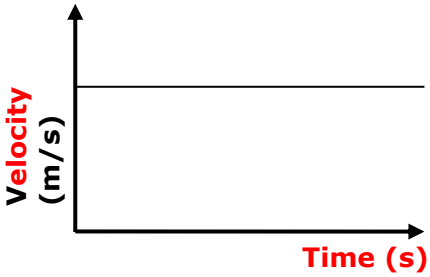
15. Fig shows the velocity-time graph for a small metal sphere falling through a viscous fluid.



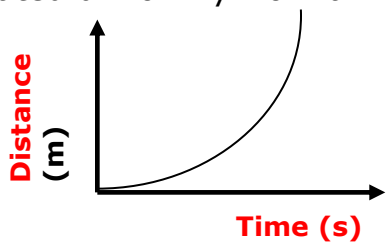


On the axes provided sketch the graph of momentum against time for the same mass (1mk)

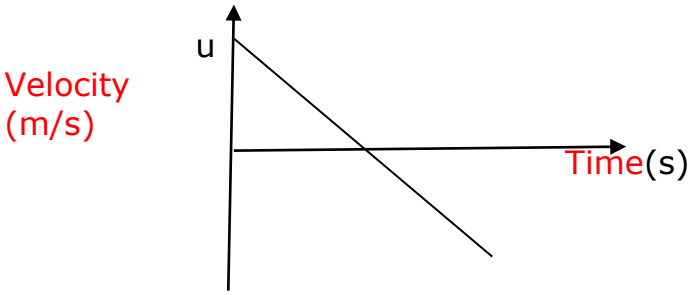
16. On the axis provided, sketch a velocity — time graph for a trolley which is in motion on a frictionless horizontal surface. (1 mark)



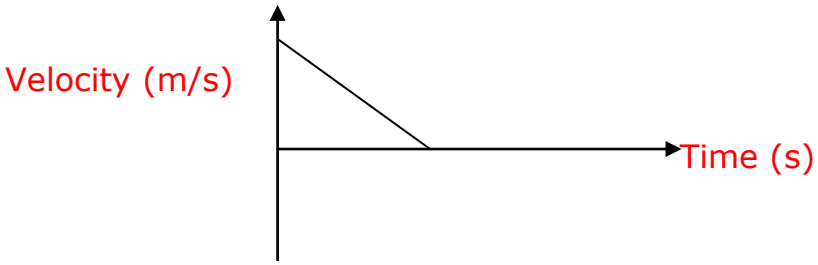
17. On the axes below, sketch a distance-time graph for a body which is accelerated uniformly from a fixed point (1mk)



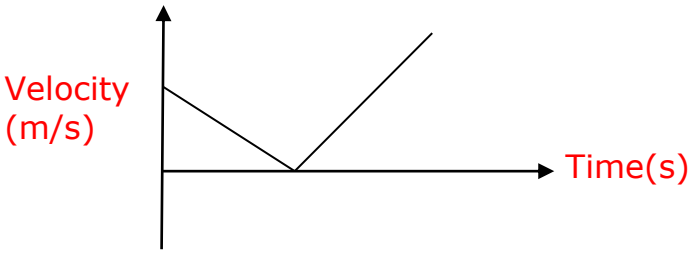
18. Sketch a velocity- time graph showing the motion of a ball vertically upwards with an initial velocity of u.



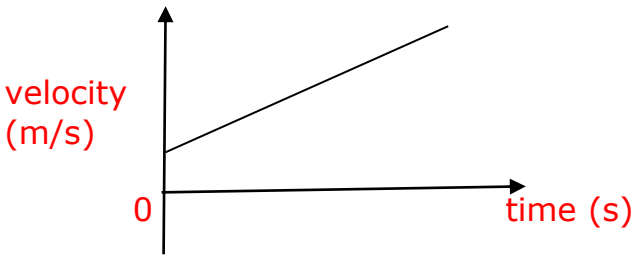
19. Sketch a velocity time graph for a body thrown vertically upwards to a maximum height (2mks)



20. A body is projected vertically upwards from the top of a building. Assuming that it lands on the base of the building, sketch the velocity time graph for the motion. (2mk)



21. Draw axes and sketch a graph of velocity (v versus time (t) for uniformly accelerated motion given that when t = 0, v is greater than zero.



AREA UNDER CURVE

1. A body moves at a constant speed of 20m/s over a period of 10s. This speed is maintainedfor 50s before the car is brought to rest with uniform deceleration in 15 s.

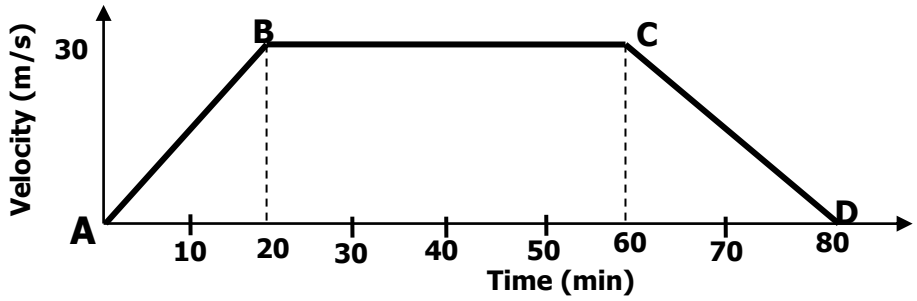
a) On the axes below , sketch a velocity time graph for the motion of the body. (3mks)

b) Calculate

i) The average speed for the whole journey. (Give your answer correct to 1d.p) 4mks)

(ii) The acceleration when the speed changes from 20m/s to 25m/s (2mks)

2. The following figure shows the velocity-time graph for the journey of a car in 80 minutes.



i) Determine the acceleration of the car between **A** and **B** and between **C** and **D**.
(2mks)

Acceleration between A and B, $a = \frac{30-0}{20\times60} = 0.025\ m/s^2$

Accelerationbetween C and D , $a = \frac{0-30}{20\times60} = -0.025\ m/s^2$

ii) Determine the distance covered by the car during the whole journey(2mks)

Distance covered is equal to the area under the graph

Distance $= \frac{1}{2} \times 30(40 \times 60 + 80 \times 60)$

Distance = 108000 m

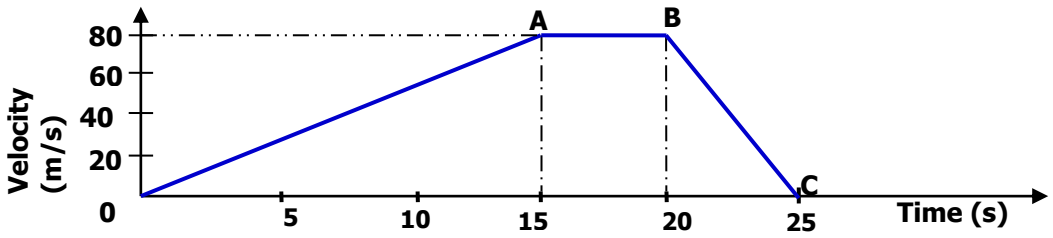
iii) Determine the average velocity of the car. (2mks)

Average velocity = $\frac{total\ distance\ coverd}{total\ time\ taken}$

Average velocity = $\frac{108000}{4800}$

Average velocity = 22.5 m/s

3. The figure below shows a graph of velocity against time for a moving body



(i) Describe the motion between **O** and **B** (2mks)

The body is moving with its velocity changing uniformly. The acceleration of the body is uniform

(ii) Determine the acceleration between **B** and **C** (2mks)

Acceleration between B and C, a = $\frac{0-80}{5}$ = -16 m/s^2

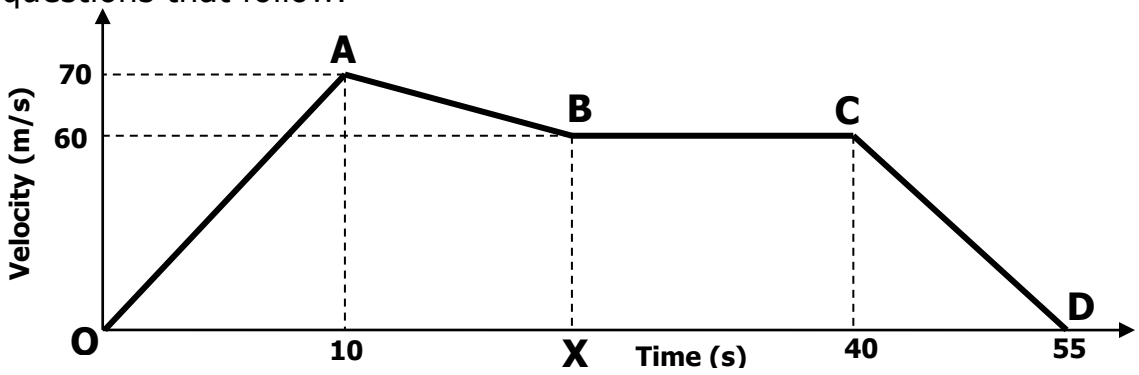
(iii) Calculate the distance covered by the body during the whole journey. (3mk)

Distance covered is equal to the area under the graph

Distance = $\frac{1}{2} \times 80(5 + 25)$

Distance = 1200 m

4. The diagram below shows a velocity – time graph. Use it to answer the questions that follow.



a) Describe the motion of the body from

(i) O – A..... (1mk)

The body is moving with its velocity changing uniformly. The acceleration of the body is uniform

(ii) A - B..... (1mk)

The body is moving with its velocity changing uniformly. The deceleration of the body is uniform

(iii) B - C. ..... (1mk)

The body is moving with uniform velocity. The acceleration of the body is zero

(iv) C - D. ..... (1mk)

The body is moving with its velocity changing uniformly. The deceleration of the body is uniform

b) If the acceleration between points **A** and **B** is **-1.25m/s^2**, determine the value of **x.** (2mk)

$a = \frac{v-u}{t}$

$-1.25 = \frac{60-70}{t}$

t = 8 sec

x = 10 + 8 = 18s

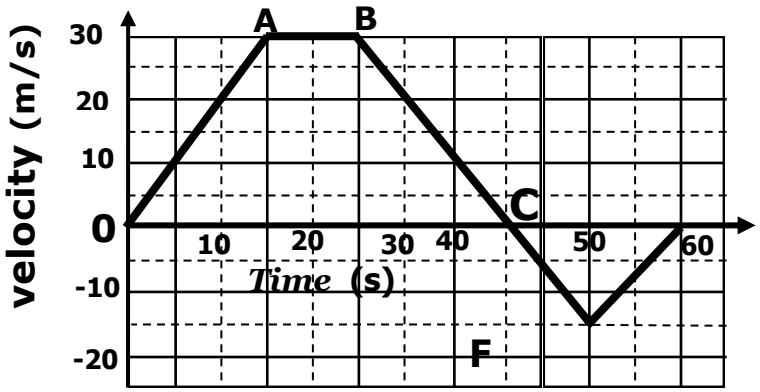
c) Calculate the distance covered by the body during the whole journey.

Distance covered is equal to the area under the graph

Distance = $\left(\frac{1}{2} \times 10 \times 70\right) + \left(\frac{1}{2} \times 10 \times 8\right) + (60 \times 30) + \left(\frac{1}{2} \times 60 \times 15\right)$

Distance = 2640 m

5. The figure below shows a velocity – time graph for a motor-cycle



(a) State the nature of the motion of the particle between

(i) O and**A** ..... (1mk)

The body is moving with its velocity changing uniformly. The acceleration of the body is uniform

(ii) Aand **B** ..... (1mk)

The body is moving with uniform velocity. The acceleration of the body is zero

(iii)B and **C** ..... (1mk)

The body is moving with its velocity changing uniformly. The deceleration of the body is uniform

(b) Determine the ***displacement*** of the motorcycle. (4mks)

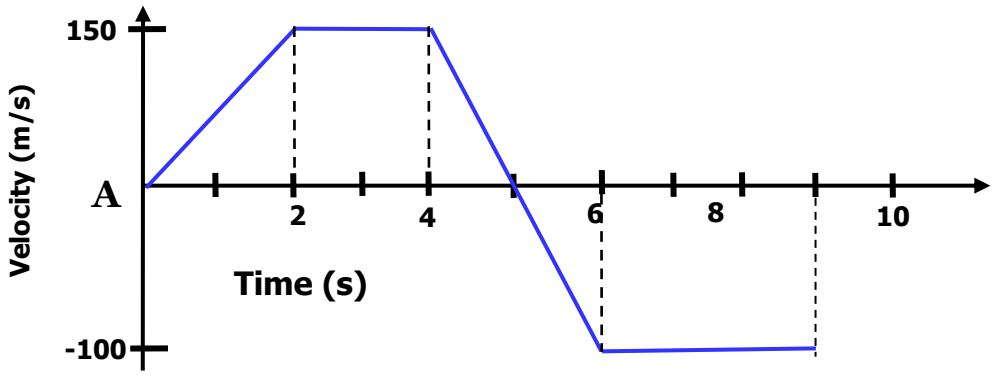
Displacement is equal to the area under the graph

Displacement = $\frac{1}{2} \times 30(10 + 40) + \left(\frac{1}{2} \times 20 \times -15\right)$

Displacement = 750 m – 150m

Displacement = 600m

6. The figure below shows a velocity – time graph for a motor-cycle



Determine the displacement of the motorcycle. (3mks)

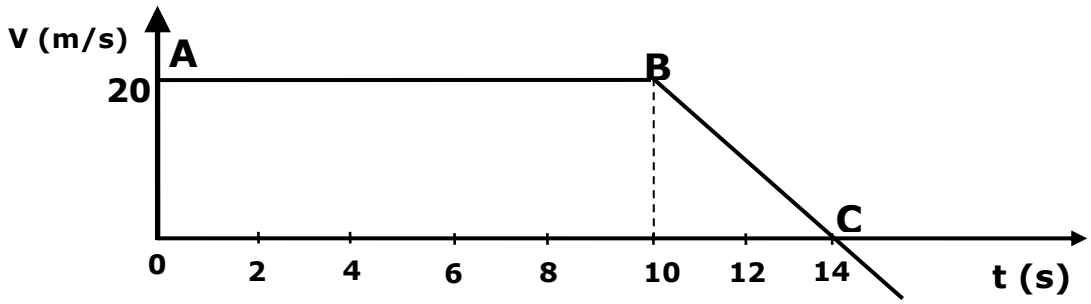
Displacement is equal to the area under the graph

Displacement = $\frac{1}{2} \times 150(2 + 5) + \frac{1}{2} \times -100(4 + 3)$

Displacement = 525 m – 350m

Displacement = 175m

7. The figure below shows a velocity-time graph for the motion of a body of mass 2kg.



a) Use the graph to determine the:

i) Displacement of the body after 8 seconds (3mks)

Displacement is equal to the area under the graph

Displacement = 8 × 20

Displacement after 8 seconds = 160 m

ii) Acceleration after point **B** (3mks)

Acceleration between B and C, a = $\frac{v-u}{t}$

Acceleration between B and C, a = $\frac{0-20}{4}$ = -5 m/s^2

iii) Force acting on the body in part (a) (ii) (3mks)

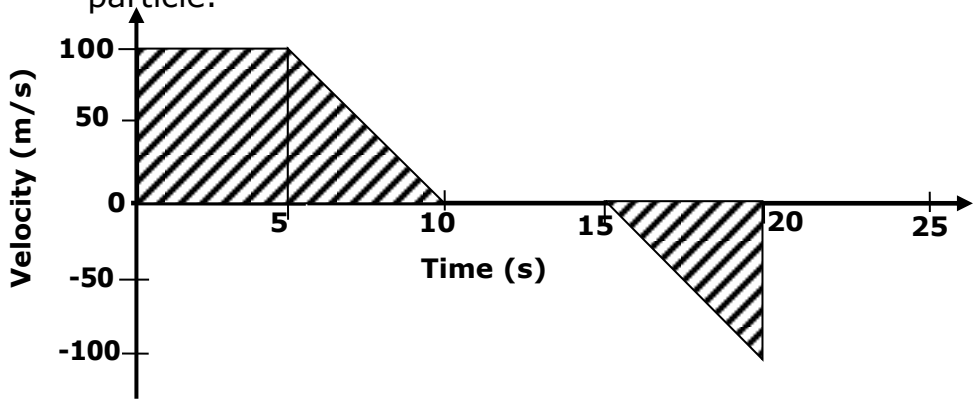
F =ma

F = 2kg × -5m/s^2

F = - 10 N

b) Sketch a displacement-time graph for the motion from point **A** to **C**(2mks)

8. The Figure below shows a velocity – time graph describing the motion of a particle.



(i) What does the shaded area represent? (1 mk)

It represents the total distance covered by the particle during its motion

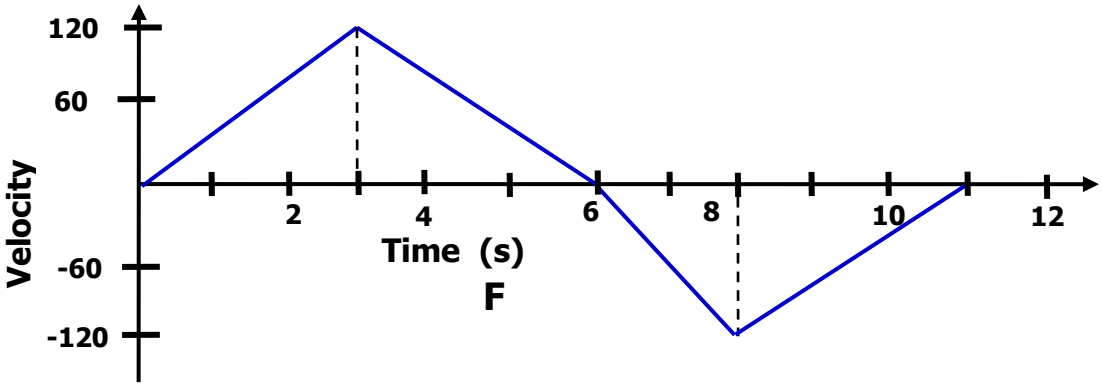
ii) Calculate the distance covered by the body during the whole journey. (3mks)

Distance covered is equal to the area under the graph

Distance = $\frac{1}{2} \times 100(10 + 5) + \left(\frac{1}{2} \times 100 \times 5\right)$

Distance = 1000 m

9. The figure below shows a velocity time graph for a racing car.



Determine the total displacement of the car?

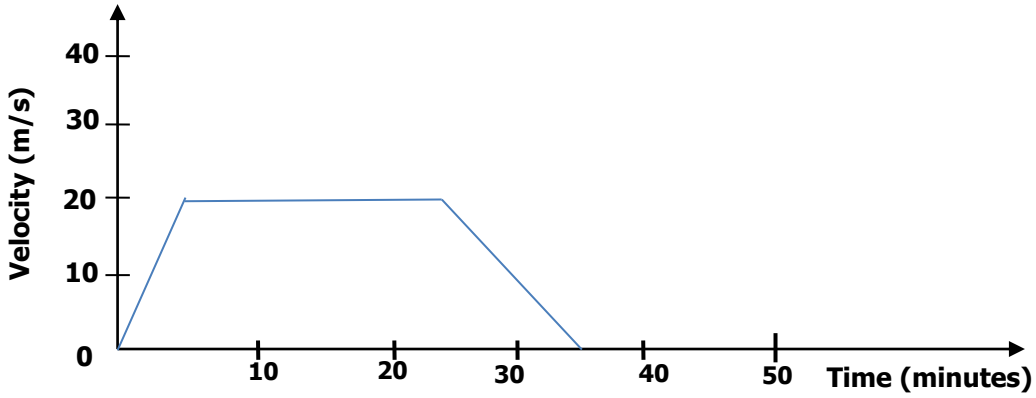
Displacement is equal to the area under the graph

Displacement $= \frac{1}{2} \times 150(2+5) + \frac{1}{2} \times -100(4+3)$

Displacement = 525 m – 350m

Displacement = 175m

16. A car starting from rest accelerates uniformly for **5 minutes** to reach **20m/s**. It continues at this speed for the next **20 minutes** and then decelerates uniformly to come to a stop in **10 minutes**. On the axes provided, sketch a velocity – time graph for the motion of the car. (1mk)



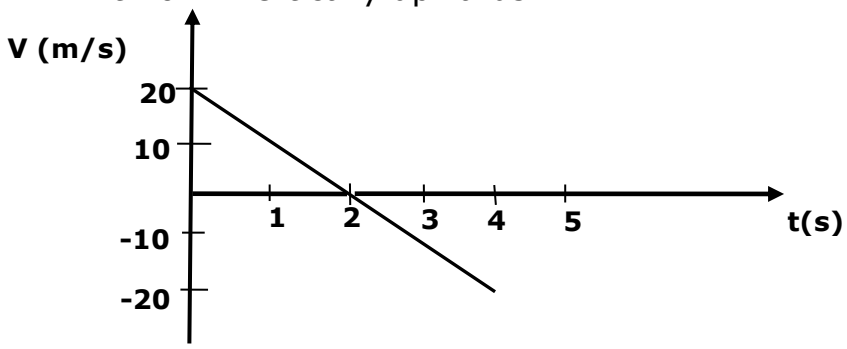
Estimate the total distance covered over the same time (4mks)

Distance covered is equal to the area under the graph

Distance $= \frac{1}{2} \times 20(20 \times 60 + 35 \times 60)$

Distance = 33000 m

17. The graph bellows shows how the velocity varies with time for a body thrown vertically upwards.



Determine the total distance moved by the body. (3mks)

Distance covered is equal to the area under the graph

Distance $= \left(\frac{1}{2} \times 20 \times 2\right) + \left(\frac{1}{2} \times 20 \times 2\right)$

Distance = 40 m

18. A rocket was launched vertically upwards with uniform acceleration of $100ms^{-2}$ for **20**s. After this the rocket was acted upon only by a constant gravitational force.

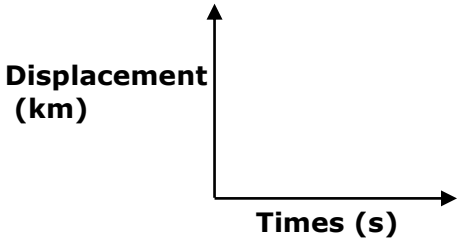
(i) Calculate the maximum height reached by the rocket (3 mks)

$H = \frac{1}{2}gt^2$

$= \frac{1}{2} \times 100 \times 20 \times 20$

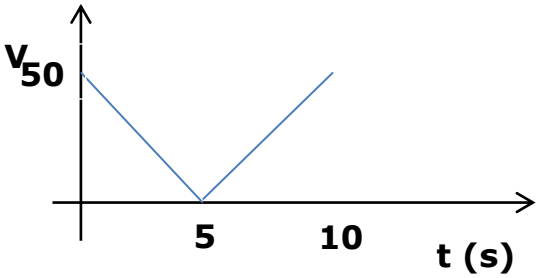
=20000m

(ii) Draw to scale, on the axes provided below, the displacement – time graph for the motion of the rocket. (2 mks)



19. An object is fired vertically upward from the ground level with a velocity of $50ms^{-1}$ and reaches a maximum height, h. It falls back to the ground and bounces to a height of **4m**.

a) Sketch a velocity time graph to represent the motion of the object from the time it is fired till it bounces to the height of **4m**. (2mk)



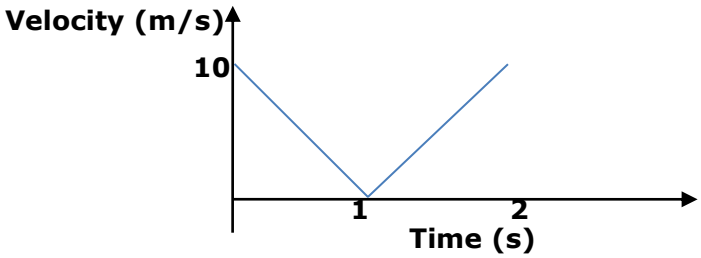
b.) Calculate the maximum height reached h. (2mk)

Maximum height reached = $\frac{u^2}{2g}$

$h = \frac{50^2}{2\times10}$, $h = 125$ m

20. A body is thrown vertically upwards with an initial velocity of **10m/s**. It moves for **2s**.

(i) On the axes below, sketch a labeled velocity time graph indicating the necessary values on the axes (2mks)



(ii) Using the sketch in (i) above, determine the total distance covered by the body during the period (2mks)

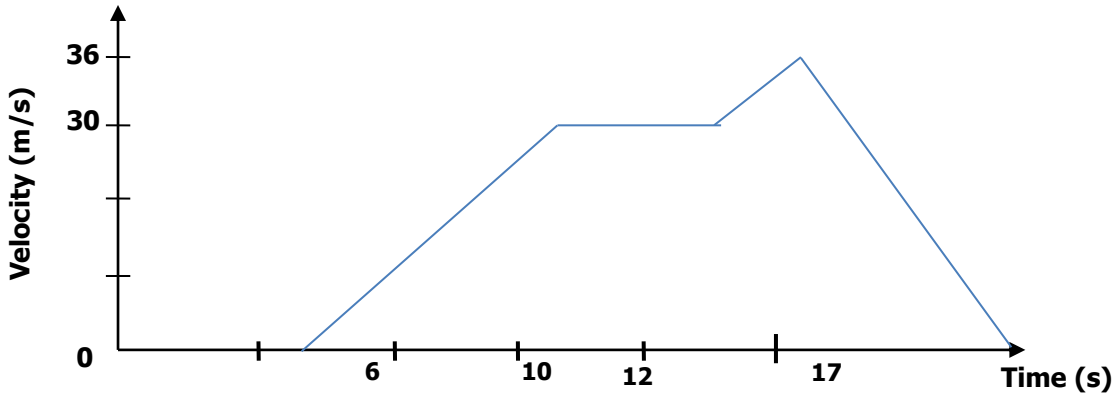
Distance covered is equal to the area under the graph

Distance $= \left(\frac{1}{2}\times 10\times 1\right) + \left(\frac{1}{2}\times 10\times 1\right)$

Distance = 10 m

21. A car starts from rest and accelerates uniformly at **5ms^{-2}**for **6** seconds. It then travels at constant velocity for the next **4** seconds before accelerating again at **3ms^{-2}** for **2**more seconds. The car is then brought to rest in another**5** seconds.

(i) Sketch a velocity-time graph for this motion. (2mks)



For the acceleration of **5ms^{-2}** the final velocity is

u = 0, a = 5, t = 6 , v = u + at

v = 0 + 5×6

v = 30m/s

For the acceleration of **3ms^{-2}** the final velocity is

u = 30, a = 3, t = 2 , v = u + at

v = 30 + 3×2

v = 36m/s

(ii) From the graph, calculate the total distance travelled. (3mks)

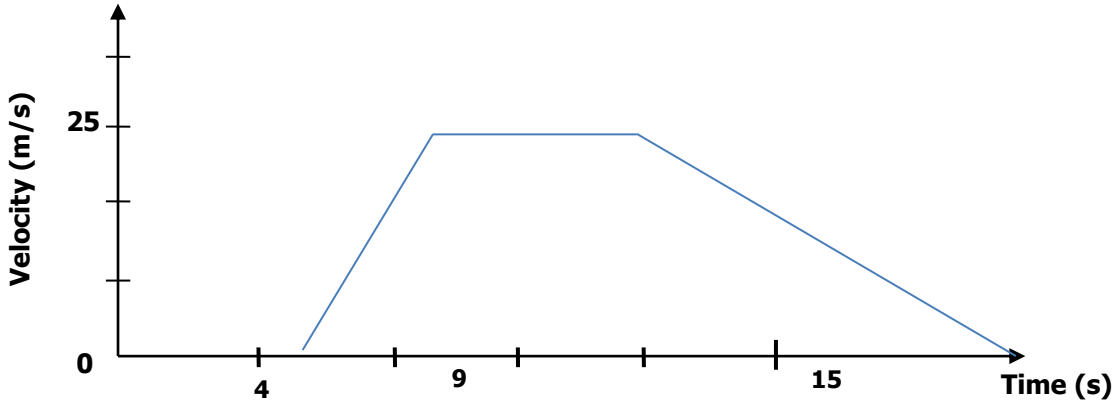
Distance covered is equal to the area under the graph

Distance = $\left(\frac{1}{2}\times 30\{10+4\}\right)+\left(\frac{1}{2}\times 2\{30+36\}\right)+\left(\frac{1}{2}\times 5\times 36\right)$

Distance = 366 m

22. A body starts from rest and acquires a velocity of **25m/s**in **4s**. It moves with this constant speed for another **5** seconds. Finally the body undergoes uniform retardation to rest in**6s**

i)Represent the motion graphically and determine the total distance covered (4mk)



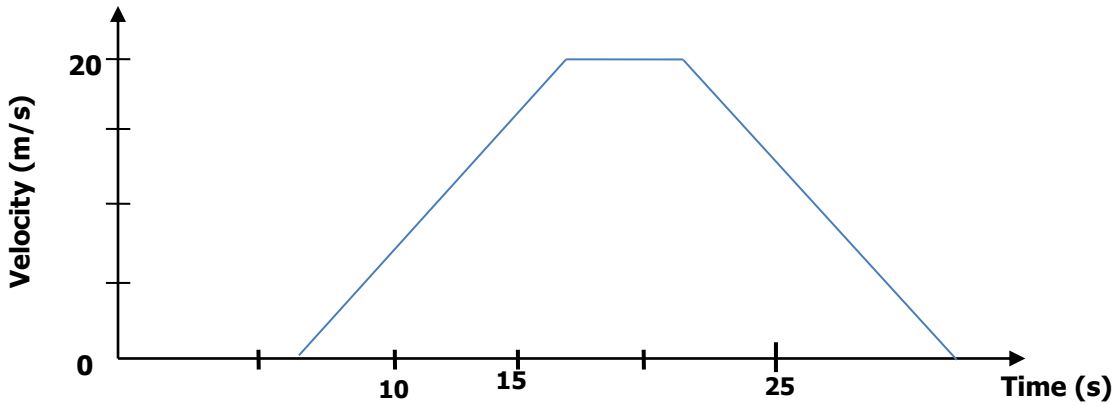
Distance covered is equal to the area under the graph

Distance = $\left(\frac{1}{2} \times 25\{15 + 5\}\right)$

Distance = 250 m

23. A body starts moving from rest and **10** seconds later it acquires a speed of **20m/s**. It moves with this constant speed for **5** seconds. Finally the body undergoes uniform retardation to rest in **10** seconds

a) Represent the motion graphically on the grid provided (1mk)



b) Determine the total distance covered (2mk)

Distance covered is equal to the area under the graph

Distance = $\left(\frac{1}{2} \times 20\{25 + 5\}\right)$

Distance = 300 m

c) Calculate the average speed of the body (2mk)

$$\text{average speed} = \frac{total\ distance\ travelled}{total\ time\ taken}$$

$$\text{average speed} = \frac{300}{25}$$

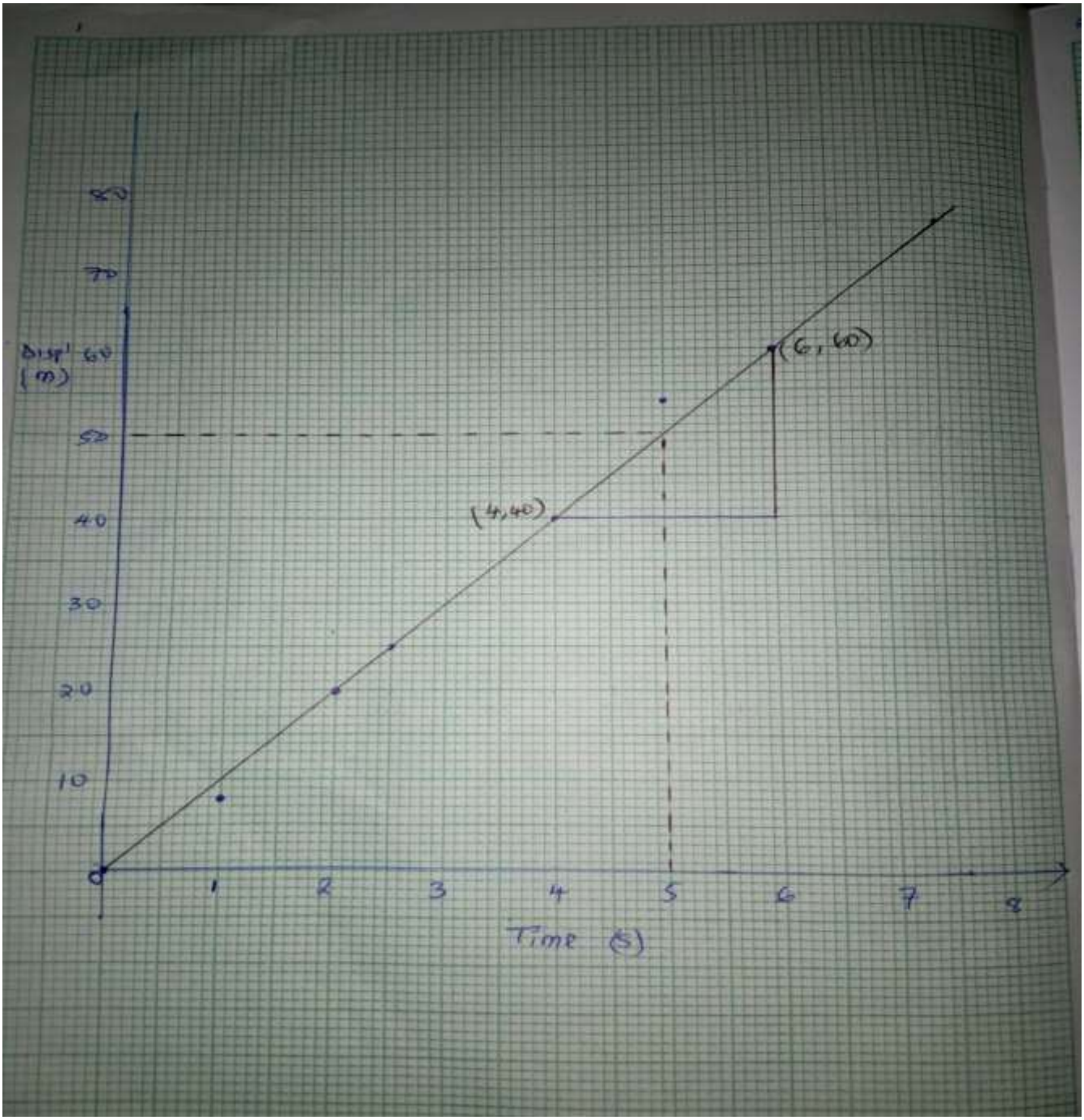
$$\text{average speed} = 12\ \text{m/s}$$

PLOTING

1. The data provided in table shows the variation of displacement covered, by a train accelerating uniformly along a straight rail track, with time.

Time(s)	**0**	**1**	**2**	**2.5**	**4**	**5**	**6**	**7.5**
Displacement(m)	**0**	**8**	**20**	**25**	**40**	**54**	**60**	**75**

(a) On the grid provided, plot a graph of displacement against time (5mk



(b) From the graph determine:

(i) The velocity of the train. (3mk)

$$\frac{60-40}{6-4}$$

=10m/s

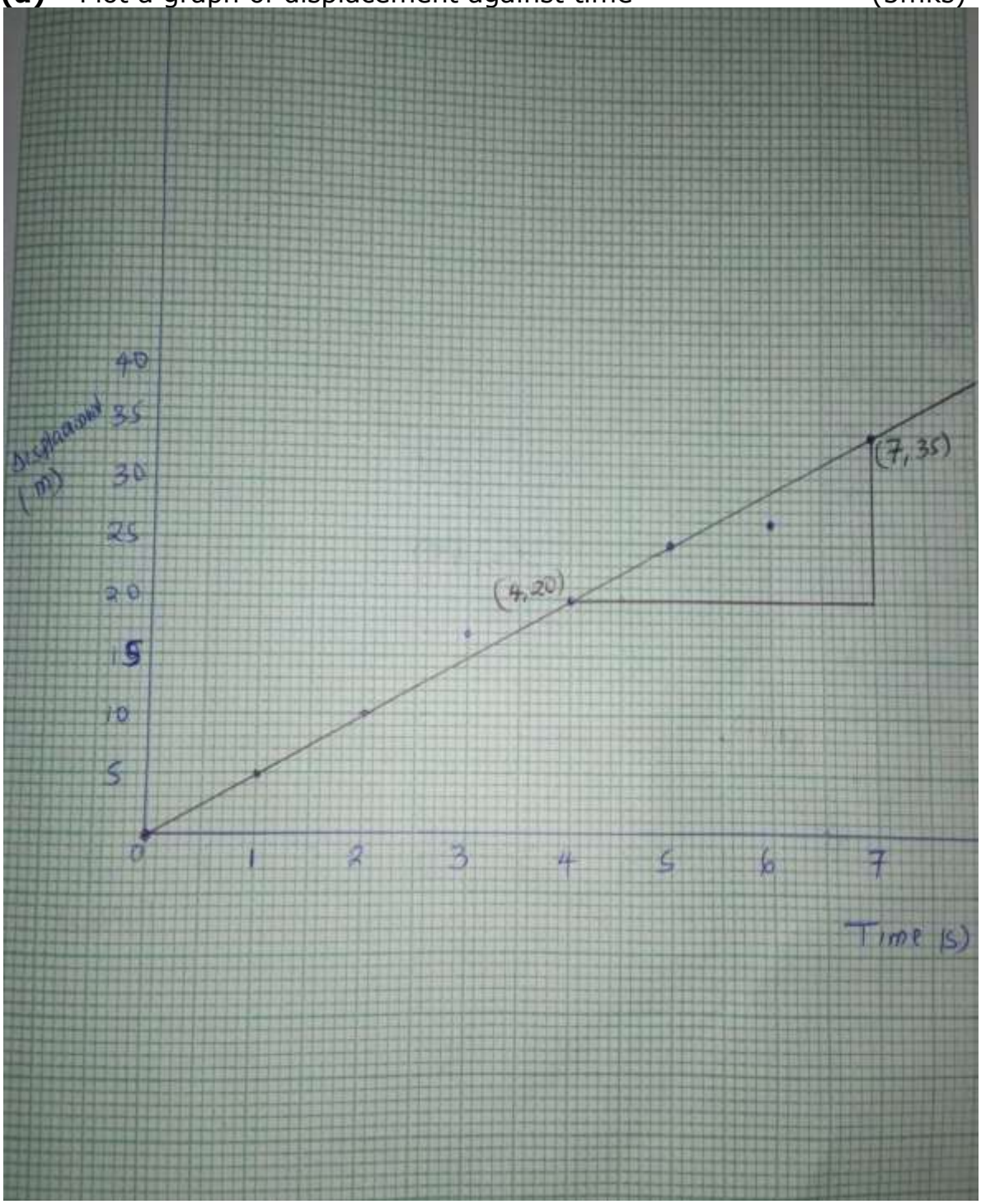
(ii) The time when displacement was **50m.** **(1mk)**

5 second

2. The data provided in table shows the variation of displacement covered, by a train accelerating uniformly along a straight rail track, with time.

Time(s)	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Disp (m)	**0**	**5**	**10**	**17**	**20**	**25**	**27**	**35**

(a) Plot a graph of displacement against time (5mks)



(b) From the graph determine the velocity of the train.

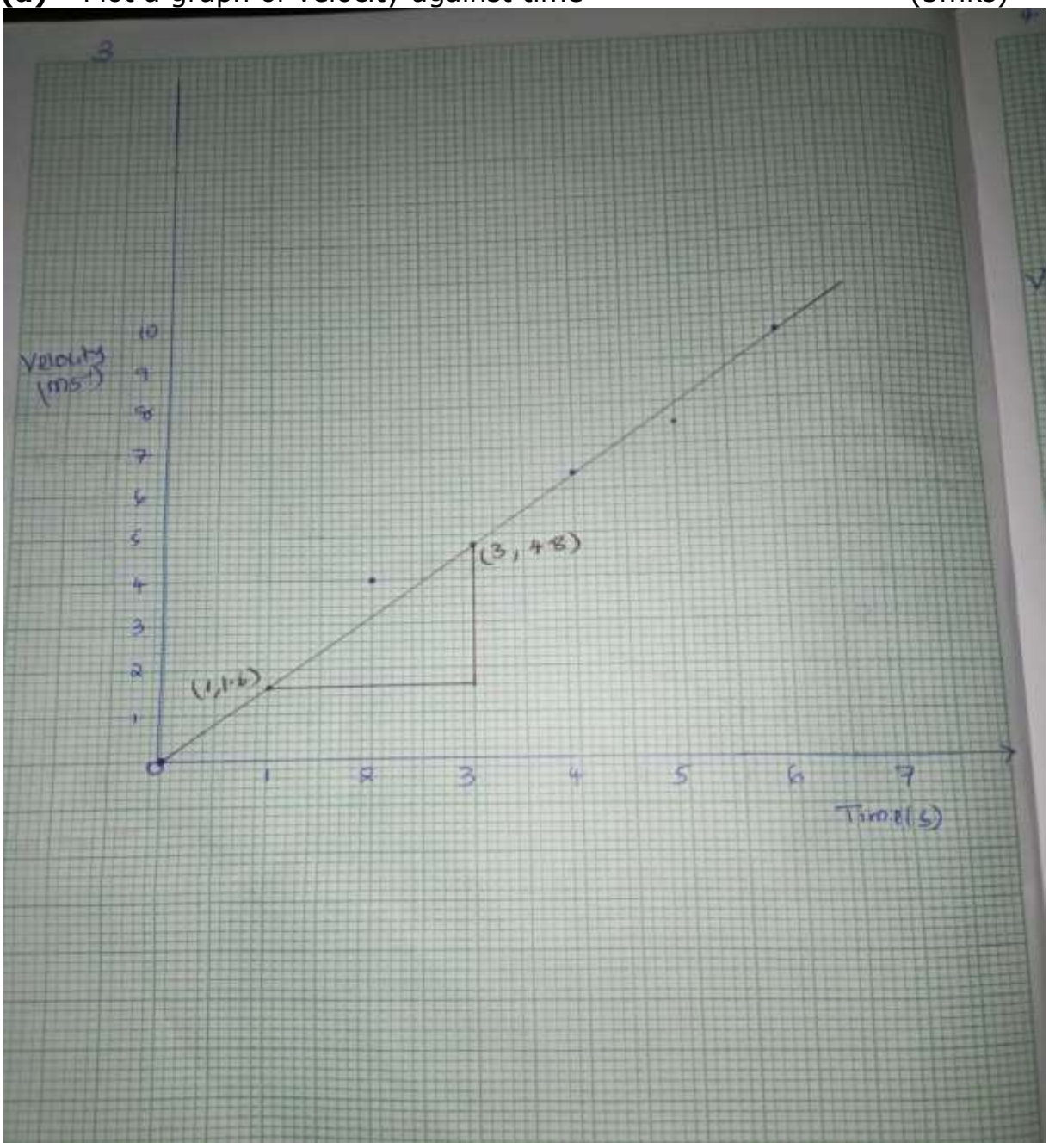
$$\frac{35-20}{7-4}$$

$$=5\text{m/s}$$

3. The data below shows how velocity of a lorry varies with time.

Velocity Ms^{-1}	**0**	**1.6**	**4.0**	**4.8**	**6.4**	**7.5**	**9.6**
Time (S)	**0**	**1**	**2**	**3**	**4**	**5**	**6**

(a) Plot a graph of velocity against time (5mks)



(b) From the graph determine the acceleration of the lorry.

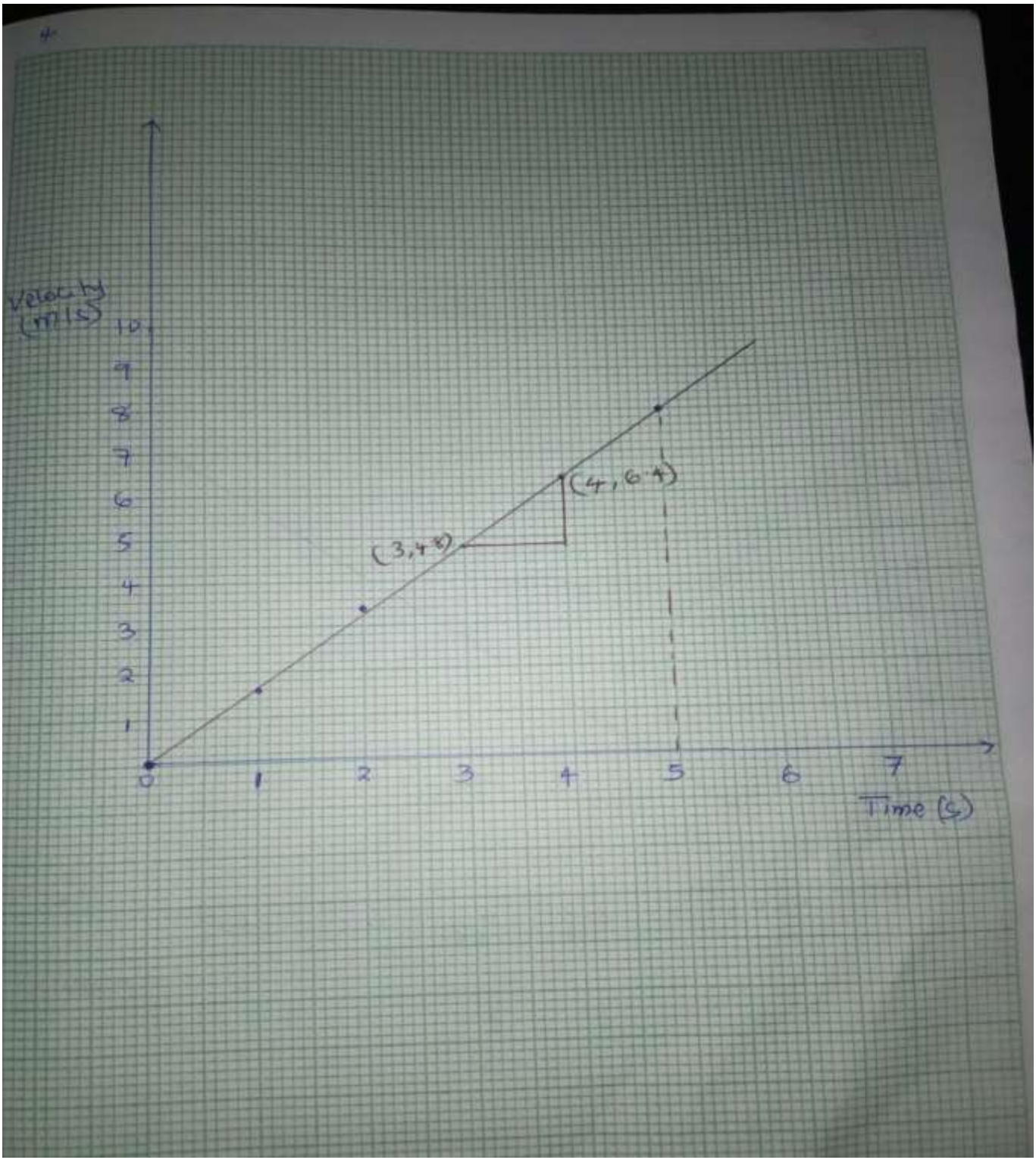
$$\frac{4.8-1.6}{3-1}$$

$$=1.6\text{m/s}^2$$

4. In an experiment, an object is dropped from a height h metres to a surface on the moon.The variation of vertical velocity (Ms^{-1}) to time (s) from release is shown in the below.

Velocity Ms^{-1}	**0.0**	**1.6**	**3.2**	**4.8**	**6.4**	**8.0**
Time (S)	**0**	**1**	**2**	**3**	**4**	**5**

(i) Plot a graph of vertical velocity against time. (5mks)



(ii) From the graph, determine the height above the surface (h) from which the object is dropped if it only took 5 seconds to reach the ground.. (3mks)

$$\frac{1}{2}vt$$

$$=\frac{1}{2}\times 8\times 5$$

$$=20\text{m}$$

(iii) From the graph, determine the acceleration due to gravity at the moon's surface. (2mks)

$$\frac{6.4-4.8}{4-3}$$

$$=1.6\text{m/s}^2$$

(iv) If the object rebounds from the surface losing 20J of its kinetic energy, Calculate the speed at which it leaves the surface. (3mks)

$$E=mgh$$
$$20=m\times 1.6\times 20$$
$$20=32m$$
$$M=0.625\text{kg}$$

$$20=\frac{1}{2}mv^2$$
$$20=0.5\times 0.625\times v^2$$

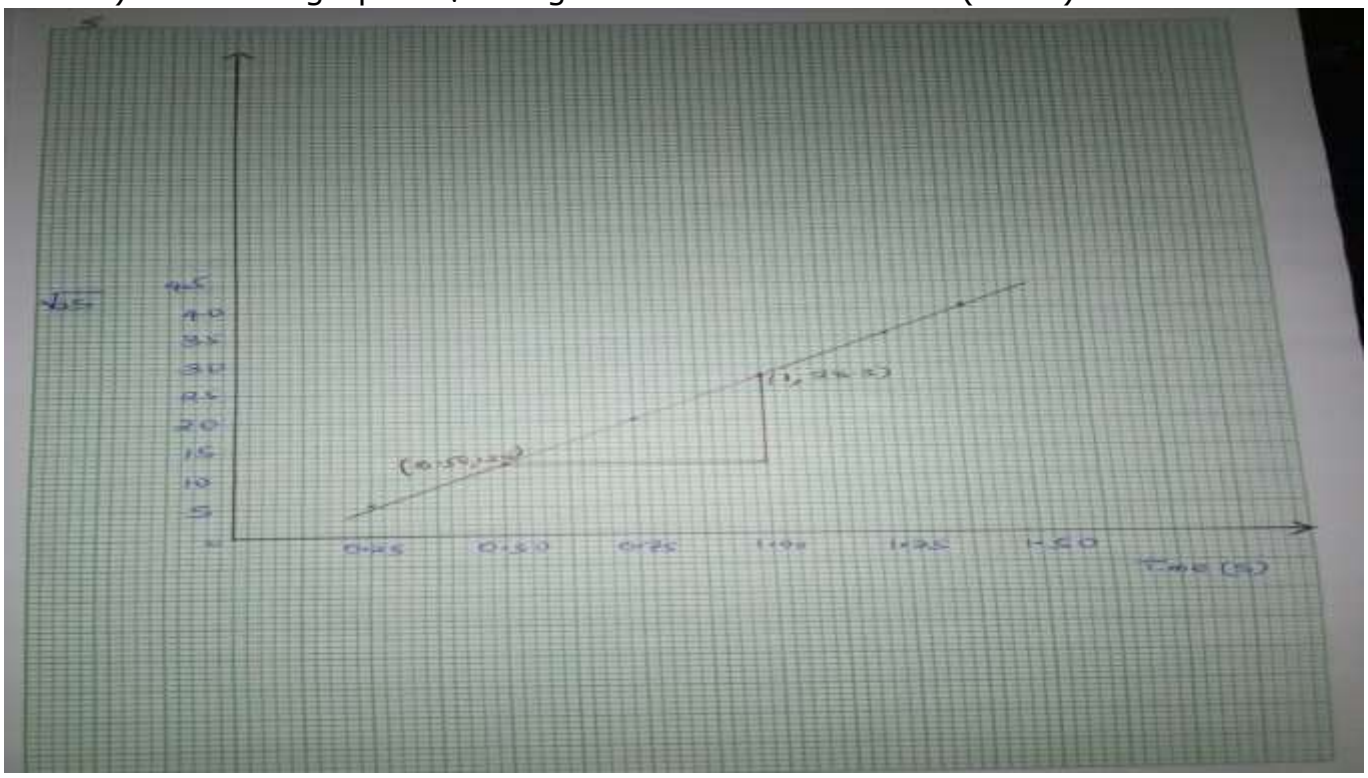
$$40=0.625v^2$$
$$V^2=64$$
$$V=8\text{m/s}$$

5. A trolley initially at rest is acted upon by a steady force. Its motion was timed. The followingtable gives observations of distance (s) traveled in (mm) and time (t) in second it takes to travel through this distance, it also shows the corresponding values of the square root of 2s.

S (mm)	**15**	**78**	**208**	**400**	**630**	**820**
t (s)	**0.25**	**0.50**	**0.75**	**1.00**	**1.25**	**1.40**
$\sqrt{2S}$	**5.5**	**12.5**	**20.4**	**28.3**	**35.5**	**40.5**

i) Complete the table (1mk)

ii) Plot a graph of $\sqrt{2S}$ against t (5mks)



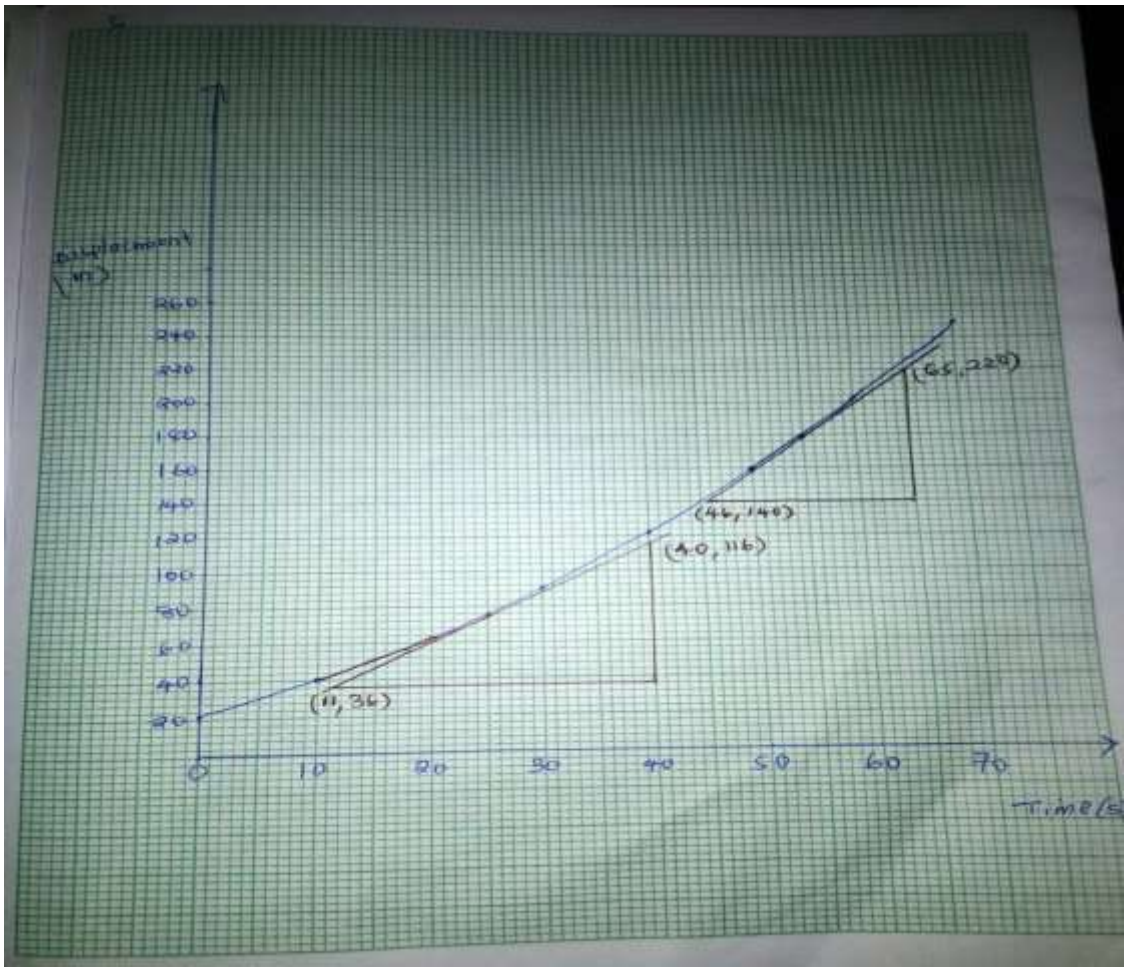
iii) Given that **S = Ut + ½ at².** Use your graph to calculate the average acceleration of the trolley.
(3mks)

$$\text{gradient}=\frac{28.3-12.5}{1-0.5}$$
$$=31.6\text{m/s}^2$$
$$\frac{1}{2}a=31.6\text{m/s}^2$$
$$=63.2\text{m/s}^2$$

6. The data provided in table shows the variation of displacement covered, by a train accelerating uniformly along a straight rail track, with time.

Time(s)	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**
Displacement(m)	**22.5**	**40.0**	**62.5**	**90.0**	**122.5**	**160.0**	**202.5**	**250.**

(a) On the grid provided, plot a graph of displacement (y – axis) against time (5mks)



(b) From the graph determine:

(i) The velocity at the **25th** second (3mks)

$$\frac{116-36}{40-11}$$

$$=2.759\text{m/s}$$

(ii) The velocity at the **55th** second (2mks)

$$\frac{220-140}{65-46}$$

$$=4.211\text{m/s}$$

(iii) The acceleration of the train (3mk)

$$\frac{4.211-2.759}{55-25}$$

$$=0.0484\text{m/s}^2$$


THE END