SECONDARY SCHOOL IMPROVEMENT PROGRAMME

2021

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

GRADE 12

SUBJECT: PHYSICAL SCIENCE

TEACHER GUIDE

GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

SCI-BONO DISCOVERY CENTRE

SESSION NO: **1**

TOPIC: **MOMENTUM AND IMPULSE**

MEMORANDUM

1.1 B $\boldsymbol{F}_{net} = m\,\boldsymbol{a}$ but m is constant. $\therefore\ \boldsymbol{F} = k\,\boldsymbol{a}$ and $\boldsymbol{F} \propto \boldsymbol{a}$

1.2 D Initial total momentum was zero as trolleys were stationary.

1.3 D $\boldsymbol{F}_{net} = m\,\boldsymbol{a} = \dfrac{m\,\Delta\boldsymbol{v}}{\Delta t} = \dfrac{\Delta(m\,\boldsymbol{v})}{\Delta t} = \dfrac{\Delta\boldsymbol{p}}{\Delta t}$

1.4 B $\dfrac{K}{\boldsymbol{p}} = \dfrac{\frac{1}{2}m\,\boldsymbol{v}^2}{m\,\boldsymbol{v}} = \dfrac{1\,m\,\boldsymbol{v}\,\boldsymbol{v}}{2\ m\,\boldsymbol{v}} = \dfrac{\boldsymbol{v}}{2}$ $\therefore\ \dfrac{2K}{\boldsymbol{p}} = \dfrac{(2)\,\boldsymbol{v}}{2} = \boldsymbol{v}$

1.5 B $\boldsymbol{F}_{net} = m\,\boldsymbol{a} = \dfrac{m\,\Delta\boldsymbol{v}}{\Delta t}$

The air bag takes time to deflate. A longer time (Δt under the line) results in a smaller force.

1.6 C $\boldsymbol{F}_{net} = \dfrac{\Delta\boldsymbol{p}}{\Delta t}$ $\boldsymbol{F}_{net}\,\Delta t = \Delta\boldsymbol{p}$ Impulse $= \boldsymbol{F}_{net}\,\Delta t$

1.7 C Rate of change of momentum $= \dfrac{\Delta\boldsymbol{p}}{\Delta t} = \boldsymbol{F}_{net}$ (Which is the same for both objects)

1.8 B $\sum\boldsymbol{p}_i = \sum\boldsymbol{p}_f$

$(m_1 + m_2)\,\boldsymbol{v}_i = m_1\boldsymbol{v}_{1f} + m_2\boldsymbol{v}_{2f}$

$M\,\boldsymbol{v} = m\,0 + (M - m)\,\boldsymbol{v}_f$

$\boldsymbol{v}_f = \dfrac{M\,\boldsymbol{v}}{M - m}$

1.9 C $\sum\boldsymbol{p}_i = \sum\boldsymbol{p}_f$

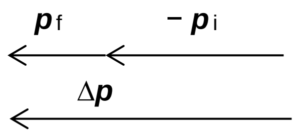
$(m_1 + m_2)\,\boldsymbol{v}_i = m_1\boldsymbol{v}_{1f} + m_2\boldsymbol{v}_{2f}$

$(3m + m)\,\boldsymbol{v} = 3m\,\boldsymbol{v}_{1f} + m\,3\,\boldsymbol{v}$

$3m\ \boldsymbol{v}_{1f} = 4m\,\boldsymbol{v} - 3m\,\boldsymbol{v} = m\,\boldsymbol{v}$

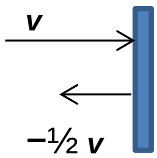
$\boldsymbol{v}_{1f} = \dfrac{m\,\boldsymbol{v}}{3m} = \frac{1}{3}\boldsymbol{v}$

1.10 A $\Delta p = \boldsymbol{p}_f - \boldsymbol{p}_i$



1.11 A Impulse on wall due to ball $= m(\boldsymbol{v}_f - \boldsymbol{v}_i) = m(-\frac{1}{2}\boldsymbol{v} - \boldsymbol{v})$

$= -1\frac{1}{2}\,m\,\boldsymbol{v}$



Impulse exerted on ball due to wall $= 1\frac{1}{2}\,m\,\boldsymbol{v}$

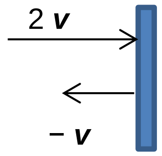
1.12 B $\boldsymbol{p} = m\boldsymbol{v}$ Constant $\boldsymbol{p}$ means constant velocity $\boldsymbol{v}$ which means no acceleration.

1.13 D $\boldsymbol{F} = \frac{\Delta P}{\Delta t}$ So as $\boldsymbol{F}$ changes, $\frac{\Delta P}{\Delta t}$ $\Delta\boldsymbol{p} / \Delta t$ changes exactly the same way.

Gradient = 45°

1.14 D $\Delta\boldsymbol{p} = m(\boldsymbol{v}_f - \boldsymbol{v}_i) = m(-\boldsymbol{v} - 2\boldsymbol{v}) = -3m\boldsymbol{v}$

$= 3m\boldsymbol{v}$ east



MEMORANDUM FOR MOMENTUM STRUCTURED QUESTIONS

2.1.1 The total linear momentum in a closed system ✓ remains constant. ✓

2.1.2 $\sum\boldsymbol{p}_i = \sum\boldsymbol{p}_f$

$(m_1 + m_2)\boldsymbol{v}_i = m_1\boldsymbol{v}_{1f} + m_2\boldsymbol{v}_{2f}$ ✓

$(2m + 4m)(0)$ ✓$= 2m(2) + 4m(\boldsymbol{v}_{2f})$ ✓

$-4m = 4m\boldsymbol{v}_f$

$\boldsymbol{V}_f = -1\ \text{m•s}^{-1}$

$= 1\ \text{m•s}^{-1}$ ✓ in the opposite direction to that of the boys. ✓

2.1.3 Equal to.

First boy jumps off : $\sum\boldsymbol{p}_i = \sum\boldsymbol{p}_f$

$(m_1 + m_2)\boldsymbol{v}_i = m_1\boldsymbol{v}_{1f} + m_2\boldsymbol{v}_{2f}$

$(m + 5m)(0) = 1m(2) + 5m(\boldsymbol{v}_{2f})$

$-2m = 5m\boldsymbol{v}_f$

$\boldsymbol{v}_f = -0{,}4\ \text{m•s}^{-1}$

Second boy jumps off : $\sum\boldsymbol{p}_i = \sum\boldsymbol{p}_f$

$(m_1 + m_2)\boldsymbol{v}_i = m_1\boldsymbol{v}_{1f} + m_2\boldsymbol{v}_{2f}$

$(m + 4m)(-0{,}4) = 1m(2) + 4m(\boldsymbol{v}_{2f})$

$-2m = 2\text{m} + 4m\boldsymbol{v}_f$

$\boldsymbol{V}_f = -1\ \text{m•s}^{-1}$

QUESTION 3

3.1 Momentum is the product of an object's mass and its velocity.

3.2 $\Delta\boldsymbol{p} = 0$. $\boldsymbol{F}_{net} = \frac{\Delta\boldsymbol{p}}{\Delta t} = 0$

3.3 $\boldsymbol{F}_{net}\Delta t = \Delta\boldsymbol{p}$ ✓

$= \boldsymbol{p}_f - \boldsymbol{p}_i$

$= -120 - 50$ ✓

$= -170$

$\boldsymbol{F}_{net}\Delta t = 170\ \text{N·s}$

Ignore the minus sign for magnitude.

3.4 $\sum\boldsymbol{p}_i = \sum\boldsymbol{p}_f$

$-120 + 70$ ✓ $= 50 + p_{Bf}$ ✓

$\therefore\ p_{Bf} = -100$

$\therefore\ p_{Bf} = 100\ kg \cdot m \cdot s^{-1}$ ✓ west ✓

QUESTION 4

4.1 Product of the net force acting on an object and the time the net force acts on the object.

4.2 Change in momentum of the girl = Δp = impulse
= area under graph A ✓ $(\Delta p = F \Delta t)$
= ½ b h
= ½ (0,35)(800) ✓
= 140 $kg \cdot m \cdot s^{-1}$ (or N·s) ; (up) ✓

Change in momentum of the boy = Δp = impulse
= area under graph B
= ½ b h
= ½ (0,4 – 0,2)(1 400) ✓
= 140 $kg \cdot m \cdot s^{-1}$ (or N·s) ; (up) ✓

4.3 girl $\Delta p = m \Delta v$

Both have the same Δp. Girl has less mass m so must have greater change in speed, Δv.

QUESTION 5

5.1 The total linear momentum of a closed system remains constant (is conserved).

5.2 $\sum p_i = \sum p_f$

$m_1 v_{i1} + m_2 v_{i2} = m_1 v_{f1} + m_2 v_{f2}$ ✓

$(45)(5) + (18)(5) = (45)(-1) + 18\, v_f$

$v_f = 20\ m \cdot s^{-1}$ west

5.3 Remains the same. Impulse $= \Delta p = F \Delta t$

F remains the same (Newton III) and Δt remains the same.

5.4 $F_{net} \cdot \Delta t = m v_f - m v_i$

$F_{trolley}\,(0,4) = (18)(20) - (18)(5)$

$F_{trolley} = 675$ N west

5.5 By Newton's First Law, her feet will come to rest on the ground but her upper body will continue to move forwards due to inertia.

QUESTION 6

6.1 Impulse $= F \Delta t$ = area between the graph and the x-axis.

Impulse $= ½\, b\, h + ½\, b\, h + \ell b$ ✓

Impulse $= ½\,(2)(10) + ½\,(2)(-10) + (6)(-10)$ ✓

Impulse = − 60 N•s = 60 N•s in the opposite direction, west. ✓

6.2 Greater than. Area under graph has a bigger height and there is no negative area under the time axis.

6.3 Take original direction of motion, East, as positive.

$$\text{Impulse} = m\boldsymbol{v}_f - m\boldsymbol{v}_i$$
$$-60 = 12\boldsymbol{v}_f - (12)(5{,}5)$$
$$6 = 12\boldsymbol{v}_f$$
$$\boldsymbol{v}_f = 0{,}5\ \text{m•s}^{-1}\ \text{east}$$

QUESTION 7

7.1 Total linear momentum of a closed system remains constant in magnitude and direction.

7.2 $\sum \boldsymbol{p}_i = \sum \boldsymbol{p}_f$

$$m_1\boldsymbol{v}_{i1} + m_2\boldsymbol{v}_{i2} = m_1\boldsymbol{v}_{f1} + m_2\boldsymbol{v}_{f2}\ ✓$$
$$(1\,100)(0) + (1\,300)(20) = (1\,100)(14) + 1\,300\,\boldsymbol{v}_{f2}$$
$$0 + 26\,000 - 15\,400 = 1\,300\,\boldsymbol{v}_{f2}$$
$$\boldsymbol{v}_f = \frac{10\,600}{1\,300} = 8{,}15\ \text{m·s}^{-1}\ \text{west}$$

7.3.1 Crumpling forces are internal forces. Internal forces do not make the principle invalid.

Only external forces make the principal invalid

7.3.2 $\boldsymbol{F}_{net} = m\boldsymbol{a} = \frac{m\Delta\boldsymbol{v}}{\Delta t}$

If Δt is increased, $\boldsymbol{F}_{net}$ (exerted on passenger) decreases.

QUESTION 8

8.1 The total linear momentum of an isolated system✓ remains constant (is conserved).✓

8.2 $\sum \boldsymbol{p}_i = \sum \boldsymbol{p}_f$

$$m_1\boldsymbol{v}_{i1} + m_2\boldsymbol{v}_{i2} = (m_1 + m_2)\boldsymbol{v}_f\ ✓$$
$$(1\,500)(10) + (1\,500)(0) = (3\,000)\boldsymbol{v}_f$$
$$15\,000 = 3\,000\,\boldsymbol{v}_f$$
$$\boldsymbol{v}_f = \frac{15\,000}{3\,000} = 5\ \text{m·s}^{-1}$$

8.3 $\boldsymbol{F} = \frac{m(\boldsymbol{v}_f - \boldsymbol{v}_i)}{\Delta t}$ ✓

= (1 500)(5 − 0) ✓

$$\overline{\quad 0{,}08 \quad}$$

$= \quad 93\ 750\ N$✓

Yes, it can result in a fatal injury because the force is greater than 85 000 N. ✓

8 .4 When the air bag inflates during the collision the contact time of the passenger or driver with the air bag is longer than without air bag✓as the air bag then takes time to deflate once the driver makes contact with the bag.

Thus the force on the passenger or driver is reduced ✓according to the equation.

$\boldsymbol{F}_{net} = \frac{\Delta p}{\Delta t}$ ✓ because $\Delta \boldsymbol{p}$ is constant during the collision.

QUESTION 9

9.1 the total linear miomentum of a closed system remains constant/is conserved.

9.2 $\sum p_i = \sum p_f$

$m_1v_2 + m_2v_2 = (m_1 + m_2)v_c$

$\underline{(68 \times 20)} + (12 \times 0) = \underline{(68 + 12)v_c}$

$\therefore v_c = 17\ m{\cdot}s^{-1}$

9.3

<u>OPTION / *OPSIE* 1</u> $(E_p + E_k)_i = (E_p + E_k)_f$ $(mgh + \frac{1}{2}mv_c^2)_i = (mgh + \frac{1}{2}mv_c^2)_f$ $0 + \underline{\frac{1}{2}(80)(17)^2} = \underline{(80)(9{,}8)h} + 0$ $\therefore h = 14{,}75\ m$ Distance up the incline, d $\sin\theta \ \frac{h}{\Delta x}$ $\sin 25° = \frac{14{,}75}{\Delta x}$ $\therefore \Delta x = 34{,}89\ m$
<u>OPTION / *OPSIE* 2</u> $W_{net} = \Delta E_k$ $W_w = E_{kf} - E_{ki}$ $mg\sin 25°\cos 180° = \frac{1}{2}m(v_f^2 - v_i^2)$

$(80)(9,8)\sin 25°\Delta x\cos 180° = \frac{1}{2}(80)(0^2 - 17^2)$

$\Delta x = 34,89$ m

9.4 Decreases. Friction is a non-conservative force/ opposes motion/removes kinetic energy from the system.

Session 2 : Organic Chemistry

Question 1

1.1 A✓✓

1.2 D✓✓

1.3 C✓✓

1.4 D✓✓

1.5 C✓✓

Question 2

2.1 Organic compounds that consist of hydrogen and carbon only. ✓✓ (2)

2.1.1 B ✓ (1)

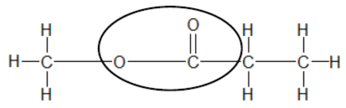
2.2.2 C ✓ (1)

2.2.3 E ✓ (1)

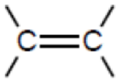
2.3 Organic molecules with the same molecular formula, but different structural formulae✓✓ (2)

2.4 2-methylprop-1-ene ✓✓ (Double bond correctly named ✓ side chain correctly named ✓) (2)

2.5 C_4H_8 ✓ (1)

2.6 

Functional group✓rest of molecule ✓. (2)

2.7  ✓ (1)

2.8 Butanoic acid ✓ (1)

2.9 unsaturated ✓ Compounds with one or more multiple bonds between C atoms✓✓ in their hydrocarbon chains.

ANY ONE

· It does not ONLY have single bonds.

· It does not have single bonds between all C atoms.

· It has double bonds between C atoms.

· It does not contain the maximum number of H atoms bonded to C atoms.

· Each C atom in B is not bonded to four other atoms. (2)

2.10 alkenes ✓ (1)

[18]

Question 3

3.1.1 Different functional group/homologous series✓ (1)

3.1.2 Boiling point ✓ (1)

3.2 Higher✓ Between the particles of propan-1-ol there are hydrogen bonds and between the particles of propanal there are London forces (induced dipole forces)✓.Hydrogen bonds are stronger than London forces✓ Hydrogen bonds require more energy to overcome than London forces. ✓ (4)

3.3.1 A propanal ✓ (1)

3.3.2 B - propan-1-ol ✓ (1)

3.3.3 C ethanoic acid ✓ (1)

3.4 HIGHER, ✓the van der Waals forces increases with increasing molecular mass or the longer the carbon chain/greater the surface area, the greater stronger the London forces will become. (2)

Question 4

4.1

4.1.1 H ✓ (1)

4.1.2 E✓ (1)

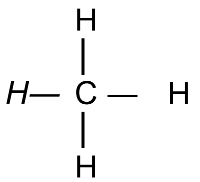
4.1.3 B ✓ (1)

4.2

4.2.1 3-chloro✓hexane ✓ (2)

4.2.2 <u>Carbon-carbon double bond</u> ✓ (1)

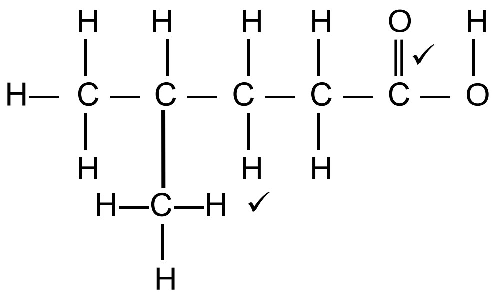
4.2.3



(2)

4.2.4 <u>Responsible for some fruity flavours/ fragrances</u> (in wines, food, cosmetics)✓
Play a <u>role in insect communication</u> ✓ (1)
Some esters <u>have anaesthetic properties</u> ✓
<u>Medicine preparation</u> ✓
<u>Plexiglas</u> is a transparent plastic of <u>long chain esters (polyesters)</u>

4.2.5



(2)

Question 5

5.1.1 Different functional group/homologous series✓ (1)

5.1.2 Boiling point ✓ (1)

5.2 Higher, ✓ between the particles of propan-1-ol there are hydrogen bonds and between the particles of propanal there are London forces (induced dipole forces) ✓ .Hydrogen bonds are stronger than London forces✓ Hydrogen bonds require more energy to overcome than London forces. ✓ (4)

5.3.1 A-propanal ✓ (1)

3.3.2 B - propan-1-ol ✓ (1)

5.3.3 C-ethanoic acid ✓ (1)

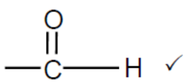
5.4 HIGHER, ✓the strength of London forces increases with increase in molecular mass✓

OR

HIGHER, ✓ the longer the carbon chain/greater the surface area, the greater stronger the London forces will become. ✓ (2)

Question 6

6.1.1 B



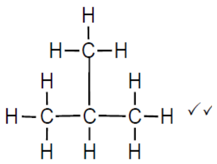
6.1.2 (1)

6.1.3 C_nH_{2n-2} ✓ (1)

6.1.4 4-ethyl-5-methylhept-2-yne / 4-ethyl-5-methyl-2-heptyne (3)

6.1.5 Butan-2-one / 2-butanone / Butanone✓✓ (2)

6.2.1 Alkanes ✓ (1)



6.2.2

2-methylpropane/ methyl propane✓✓ (4)

6.2.3 Chain ✓ (1)

6.3.1 Halo-alkanes / Alkyl halides ✓ (1)

6.3.2 Substitution / halogenation / bromination ✓ (1)

[16]

Question 7

7.1

7.1.1 B ✓ (1)

7.1.2 E ✓ (1)

7.1.3 F✓ (1)

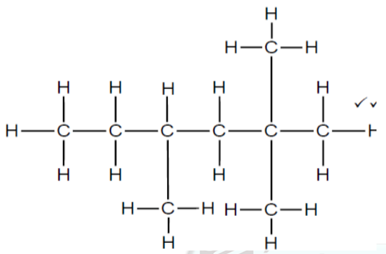
7.2

7.2.1 2-bromo✓-3-chloro✓-4-methylpentane✓ (3)

7.2.2 Ethene✓ (1)

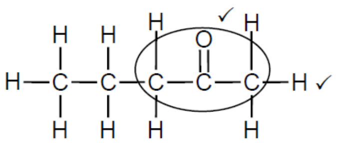
7.3

7.3.1



(2)

7.3.2



(2)

7.4

7.4.1 (Compounds with) the same molecular formula but different functional groups / different homologous series. (2)

7.4.2 B & F✓ (1)

[14]

Question 8

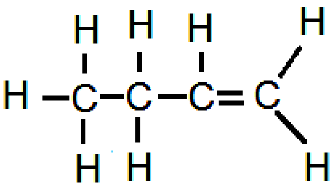
8.1.1 UV light, mild heat

8.1.2 2-chlorobutane

8.2

8.2.1 Elimination

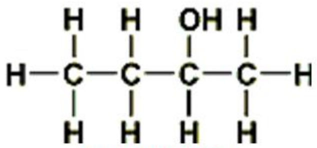
8.2.2



8.3

8.3.1 Secondary Alcohol, the hydroxyl group will be attached to the second carbon.

8.3.2



butan-2-ol

8.4

8.4.1Esters

8.4.2 H_2SO_4 or sulphuric acid

8.4.3 Calculate the number of moles of each

Compound B ($C_4H_{10}O$)= $\frac{7,4}{74}$

= 0,1 mol

Ethanoic acid ($C_2H_4O_2$) =$\frac{3}{44}$

= 0,07mol

Reaction

$C_4H_{10}O + C_2H4O2 \rightarrow C_6H_2O_2 + H_2O$

Ratio

m($C_6H_2O_2$)= Mn

= 82x0,07

= 5,74 g

Percentage yield= $\frac{actual\ yield}{theoritical\ yield}$

=$\frac{2,5}{5,74}$ x100

=43,5%

8.5

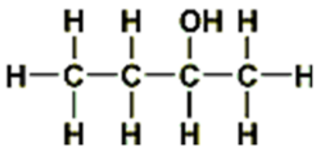
8.5.1 Thermal cracking

Question 9

9.1.1 Ketone

9.1.2 3, 5-dichloro-4-methyloctane

9.1.3



butan-2-ol

9.2.1 Act as a catalyst

9.2.2 Water/ H_2O

9.2.3 Calculation of Empirical

H= $\frac{6,67}{1}$ =6, 67

C=$\frac{40}{12}$ = 3, 33

O=$\frac{53,33}{16}$ = 3, 33

Divide by the small number

H= 2, C= 1, O= 1

Empirical formula **H_2CO**

9.2.4 Molar mass = 60g.mol^{-1}

Molar mass of **H_2CO=** 30g.mol^{-1}

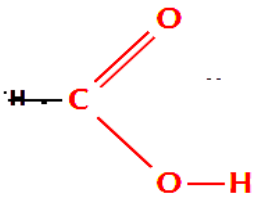
Therefore $\frac{60}{30} = 2$

Multiply the empirical formula by 2

2x **H_2CO**

Molecular formula

$C_2H_4O_2$

9.2.5 

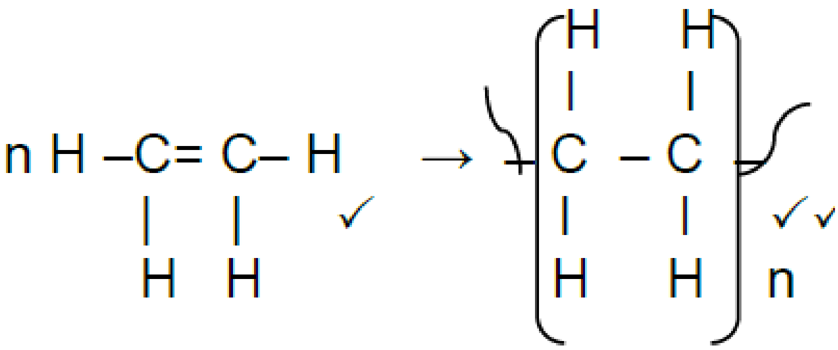
9.2.6 Ethylmethanoate

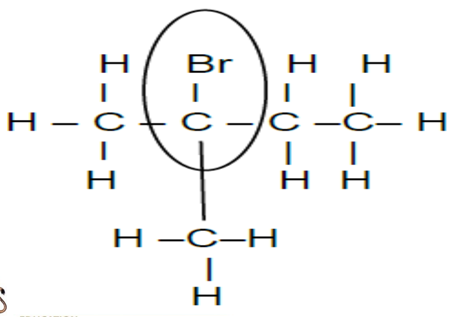
Question 10

10.1.1 Cracking ✓ (1)

10.1.2 addition ✓(polymerisation) (1)

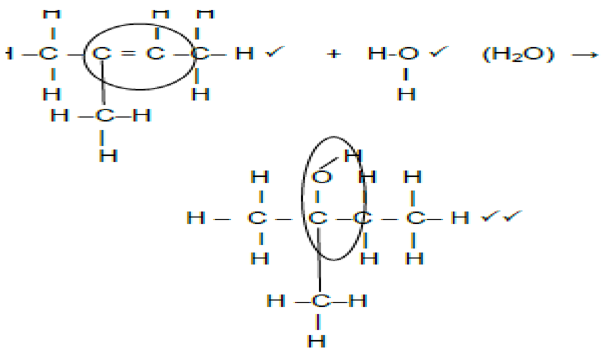
10.1.3





10.2.1

10.2.2 addition ✓/hydrobromination /hydrohalogenation



10.2.3 2-methylbutan-2-ol (2)

10.2.4 Substitution (hydrolysis) (1)

10.2.5 use dilute potassium hydroxide /aqueous potassium hydroxide

NaOH/strong base OR water

(mild) heat **OR** hot ethanolic dilute base (2)

Question 11

11.1.1 Family of organic molecules that are identified by the same functional group and obey the same general formula (differ by a CH_2 unit) (2)

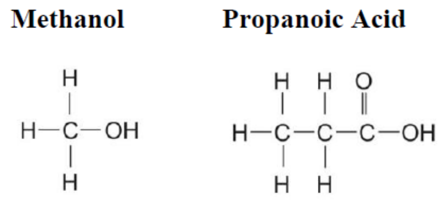
11.1.2 A molecule made up of C and H atoms only and have a double or triple bond between the atoms in the chain (not all the bonds to the C atoms are singularly occupied)

11.2.1 (a) Alkenes
(b) Carboxylic acids
(c) Alkenes

11.2.2 (a) Chlorine (accept chloro) or halo
(b) Hydroxyl
(c) Carboxyl

11.2.3 G: Pentanoic acid (2)
H: 2 – methylpropene

11.2.4 (a)



(b) Esterification/elimination (1)

(c) To act as a dehydrating agent

To act as a catalyst

11.2.5 (a) n = mM

= 108 44

N = 2,46 mol of C_3H_8 (2)

(b) C_3H_8 : O2

1 : 5

$n(O_2)$ = × 5 2, 46 1

$n(O_2)$ = 12,30 mol

V = m nV

= 12,30 × 22,4

V = 275,52 dm3

(c) C_3H_8 : CO_2

1 : 3 Carry over

$n(CO_2)$ = 2,46 × 3

= **7,38 mol of CO2**

m = nM

= 7,38 × 44

m = **324,72 g of CO2**

SESSION 3 : VERTICAL PROJECTILE

MULTIPLE CHOICE QUESTIONS

1.1 B
1.2 A
1.3 A
1.4 C
1.5 C

STRUCTURED QUESTIONS

QUESTION 1

1.1 **Using Q as reference**

$(E_P + E_K)_{top} = (E_P + E_K)_Q$

$(mgh + \frac{1}{2} mv^2) = (mgh + \frac{1}{2} mv^2)$

$(0,5)(9,8)h + 0 = 0 + \frac{1}{2}. 0,5.(10)^2$

h = 5,10m.

OR

Using ground as reference

$(E_P + E_K)_{top} = (E_P + E_K)_Q$

$(mgh + \frac{1}{2} mv^2) = (mgh + \frac{1}{2} mv^2)$

$(0,5)(9,8)h + 0 = (0,5)(9,8)(1,5) + \frac{1}{2} (0,5)(10)^2$

h = 6,6m

Height above Q: (6,6 – 1,5 = 5,10m)

OR

$V_f^2 = v_i^2 + 2g\Delta t^2$

$(0)^2 = (-10)^2 + 2(9,8)\Delta y$

$0 = 100 + 19,8\Delta y$

$\Delta y = 5,10m$

OR

$\Delta y = v_i\Delta t + \frac{1}{2} g\Delta t^2$

$= (-10)(1) + \frac{1}{2} (9,8)(1)^2$

= 5,10m

1.2 In an isolated system (in the absence of frictional forces), the sum of the Gravitational potential energy and kinetic energy remains constant.

OR

In an isolated system, the total mechanical energy is conserved.

1.3 $(E_P + E_K)_{branch} = (E_P + E_K)_Q$

$(mgh + ½ mv^2) = (mgh + ½ mv^2)_Q$

$(0,5)(9,8)(2) + ½ (0,5)v^2 = 0 + ½ (0,5)(10)^2$

$V = 7,75 m.s^{-1}$

OR

$(E_P + E_K)_{branch} = (E_P + E_K)_Q$

$(mgh + ½ mv^2) = (mgh + ½ mv^2)$

$(0,5)(9,8)(3,5) + ½ (0,5)v^2 = (0,5)(9,8)(1,5) + ½ (0,5)(10)^2$

$V = 7,75 m.s^{-1}$

1.4 $W_{net} = \Delta E_K = ½ m[(v_f)^2 – (v_i)^2]$

$= ½ (0,5) [(5)^2 – (7,75)^2]$

$= - 8,77 J$

1.5 Down as positive

$V_f^2 = v_i^2 + 2g\Delta y$

$(0)^2 = (-5)^2 + 2(9,8)\Delta y$

$0 = 25 + 19,6\Delta y$

$\Delta y = - 1,28$ m

$\Delta y = 1,28$m.

Height above Q = 1,28 + 2,1

= 3,38m.

Height above ground = 4,85m is less than 4,9m.

OR: Isha's height above top of branchs is 4,9 – 3,6 = 1,3m

1,3m is greater than 1,28m. Isha wont be able to catch the parkage.

QUESTION 2

2.1 Gravitational acceleration

2.2 $v_f = v_i + g\Delta t$

$0 = v_i + 9{,}8\ (0{,}2)$

$V_i = -\ 1{,}96\text{m.s}^{-1}$

2.3 Area of graph between t=0s and t=0,2s:

Area of a triangle: ½ bh

= ½ . 0,2. 1,96

= 0,196m

2.4 $v_f^2 = v_i^2 + 2g\Delta y$

$= (0)^2 + 2(9{,}8)(30{,}02)$

$= 588{,}39$

$V_f = 24{,}26\text{m.s}^{-2}$

2.6 Down as positive:

$V_f^2 = v_i^2 + 2g\Delta y$

$(0)^2 = (24{,}26)^2 + 2(a)(1{,}5)$

$a = -\ 196{,}18\text{m.s}^{-2}$

2.7 $F_g + F_{water} = F_{net}$

$300(9{,}8) + F_{water} = 300(-196{,}18)$

$F_{water} = 55914\text{N}$

QUESTION 3

3.1 $V_f^2 = v_i^2 + 2g\Delta y$

$= 0 + 2 \times 9{,}8 \times 3000$

$= 58800$

$v_f = 242{,}48\ m.s^{-1}$

3.2. $\Delta y = v\Delta t + ½g\Delta t^2$

$\Delta y = 0 + ½\,(9{,}8)(5)^2$

$\Delta y = 122{,}5$ m

$3000 – 122{,}5 = 2877{,}5$ m

QUESTION 4

4.1

<u>First 3 s:</u>
Take up as + ve

$F = T_{SCALE} – W$
$= 80 – 60$
= <u>20 N upwards</u>

<u>Next 5 s:</u>
Take up as + ve

$F = T_{SCALE} – W$
$= 60 - 60$
= <u>0 N</u>

<u>Last 2 s:</u>
Take down as + ve

$F = W - T_{SCALE}$
$= 60 - 30$
= <u>30 N downwards</u>

4.2.1 $F_{net} = ma$
$20 = (6)(a)$
a = <u>$3.33\ m.s^{-2}$ upwards</u>

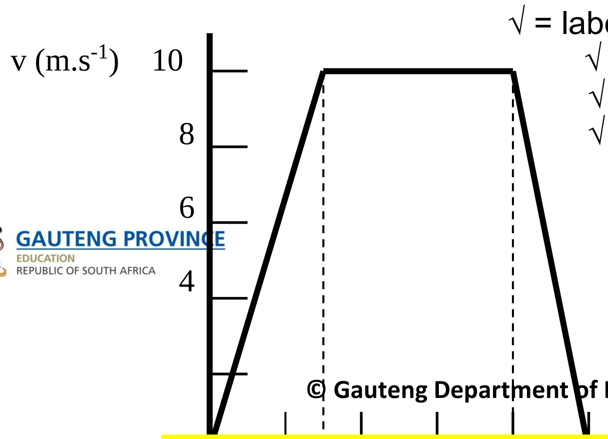
4.2.2 $F_{net} = ma$
$30 = (6)(a)$
a = <u>$5\ m.s^{-2}$ downwards</u>

4.3 $v_f = v_i + a\Delta t$
$= (0) + (3.33)(3)$
= <u>$10\ m.s^{-1}$</u>

4.4 $v_f = v_i + a\Delta t$
$= (10) + (-5)(2)$
= <u>$0\ m.s^{-1}$</u>

4.5 Scale: v-axis 1cm = 2 $m.s^{-1}$
t-axis 1cm = 2 s

√ = use of an appropriate scale
√ = labeling both axis with correct units
√ = line from 0-3s
√ = line from 3-8s
√ = line from 8-10s



2

0

2 4 6 8 10 t (s)

QUESTION 5

5.1 Using the graph or information from the graph, determine:

5.1.1 100 m.s^{-1}

5.1.2 Gradient method = $\frac{\Delta v}{\Delta t} = \frac{100}{20} = 5 m.s^{-1}$

Or equations of motion:

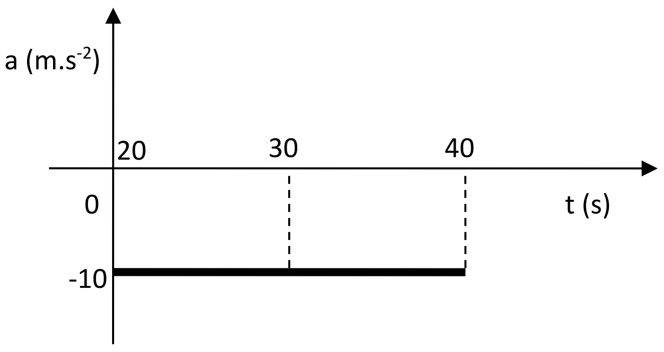
5.1.2 $a = \frac{v - u}{t} = \frac{100 - 0}{20} = 5 m.s^{-1}$

5.1.3 Area method = ½ base × height = ½ (30 × 100) = ½ (3000) = 1500m

5.2 The force of friction is EQUAL to the force of Earth on rocket

Therefore the object falls with a **constant velocity** as there is **no resultant force** acting on the rocket. (if they say Terminal velocity only)

5.3



✓ Axes correct

✓ Values on axes

✓✓Line str and negative.

QUESTION 6

6.1 downwards positive

$v_f = v_i + at$

$20 = V_i + 9,8 \times 2,4$

$V_i = -3,52\ m.s^{-1}$

$= 3,52$ m. upwards

6.1.2 $V_f^2 = v_i^2 + 2a\Delta y$

$0 = (3,52)^2 + 2 \times 9.8 \times \Delta y$

$\Delta y = -0,63$ m

$= 0,63$ m upward

6.1.3 Time values 2,4 s on x axis✓Initial velocity indicated ✓Shape of graph✓

QUESTION 7

7.1 The distance between successive images of both balls increases systematically.

7.2 The bigger Styrofoam ball will experience a bigger influence of air resistance than the smaller compact ball because of its bigger surface area.

7.3 $T = \frac{1}{f}$

$= \frac{1}{20} = 0,05$ s

7.4

(a) $\bar{v} = \frac{\Delta y}{\Delta t}$

$= \frac{0,1345\ m}{0,05\ s}$

$=$ $\underline{2,69\ m.s^{-1}\ \text{downwards}}$

(b) $\bar{v} = \frac{\Delta y}{\Delta t}$

$= \frac{0,1835\ m}{0,05\ s}$

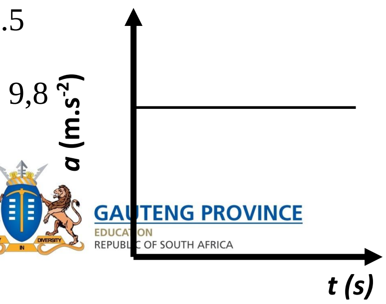
$=$ $\underline{3,67\ m.s^{-1}\ \text{downwards}}$

(c) $a = \frac{\Delta v}{\Delta t}$

$= \frac{3,67\ m.s^{-1} - 2,69\ m.s^{-1}}{2(0,05\ s)}$

$=$ $\underline{9,8\ m.s^{-2}\ \text{downwards}}$

7.5



✓ labelling axis

✓ line drawn parallel to time axis indicating $9,8\ m.s^{-2}$

QUESTION 8

8.1

8.1.1 **0 m.s^{-2}** ✓✓ (2)

8.1.2 **9,8 m.s^{-2}** ✓✓ (2)

8.2 Velocity **increases**

Mass decreases, from Newton II, $m \propto \frac{1}{a}$. Therefore **acceleration increases.** Since F $\propto$ a, ***F*R upwards increases**

8.3

Δy = ?	
t =	
v_i = –5 m.s^{-1}	
V_f = 0 m.s^{-1}	
g = 9,8 m.s^{-2}	

$V_f^2 = V_i^2 + 2a\Delta y$

$0^2 = (-5)^2 + 2(9,8)\Delta y$

$\Delta y = -1,28$ m

$\therefore \Delta y = 1,28$ m upwards

$\therefore$ **Maximum height (P) is 101,25 m**

8.4

Δy =	
t = ?	
v_i = –5 m.s^{-1}	
V_f = 0 m.s^{-1}	
g = 9,8 m.s^{-2}	

$V_f^2 = V_i^2 + at$

$0 = -5 + 9,8t$

$\therefore$ ***t* = 0,51 s** ☚

8.5

Δy	= 100 m
Δt	= ?
V_i	= –5 m.s^{-1}
V_f	=
g	= 9,8 m.s^{-2}

$\Delta y = v\Delta t + \frac{1}{2} g t^2$

$100 = (-5)t + \frac{1}{2}(9{,}8)(t)^2$

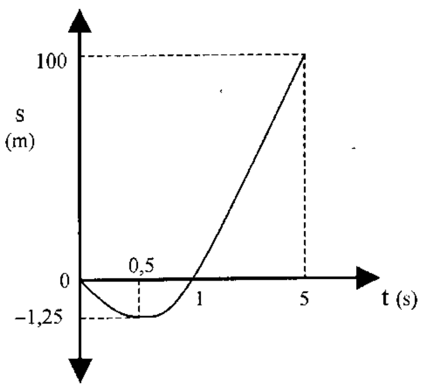
$100 = -5t + 5t^2$

$0 = t^2 - t - 20$

$0 = (t + 4)(t - 5)$ $\quad [t \neq -4]$

$\therefore \boldsymbol{t} = \mathbf{5\ s}$

8.6



Note: down is taken as positive

QUESTION 9

Positive downwards

9.1

Option 1	Option 2
$\vec{v}_f^2 = \vec{v}_i^2 + 2\vec{g}\Delta\vec{y}$ $\vec{v}_f^2 = 0^2 + (2)(9{,}8)(150)$ $\vec{v}_f^2 = 2940$ $\vec{v}_f = 54{,}22\ m \cdot s^{-1}$ downwards	$\vec{v}_f = \vec{v}_i + \vec{g}\Delta t$ $\Delta t = \sqrt{\frac{2\Delta y}{g}}$ $\Delta t = \sqrt{\frac{2x150}{9{,}8}} = 5{,}53s$ v_f = 0+ 9,8 x5,53 v_f = 54,22 m.s^{-1} downwards

9.2

Option 1	Option 2
When the two objects meet their position is the same $y_A = y_B$ $y_{Ai} + v_{iA}\Delta t + \frac{1}{2}g\Delta t^2 = y_{Bi} + v_{iB}\Delta t + \frac{1}{2}g\Delta t^2$	150 = $\lvert\Delta y_A\rvert + \lvert\Delta y_B\rvert$ 150 = the addition of the absolute values of the displacements of A and B. 150 = $\lvert v_{iA}\Delta t + \frac{1}{2}g\Delta t^2\rvert + \lvert v_{iB}\Delta t + \frac{1}{2}g\Delta t^2\rvert$

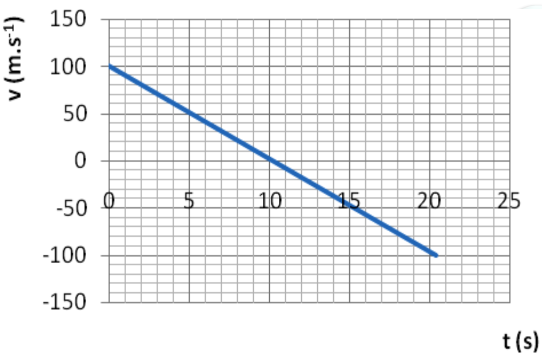
Level zero at the projecting point of A (reference point). $0+100\Delta t+\frac{1}{2}x9{,}8x\Delta t^2=150+0\Delta t+\frac{1}{2}x9{,}8x\Delta t^2$ $100\Delta t=150$ $\Delta t = 1{,}5\ s$	$150 - v_{iB}\Delta t+\frac{1}{2}g\Delta t^2 = v_{iA}\Delta t+\frac{1}{2}g\Delta t^2$ $100\Delta t=150$ $\Delta t = 1{,}5\ s$

9.3

Option 1	Option 2
$\vec{v}_f = \vec{v}_i + \vec{g}\Delta t$ $100 = -100 + 9{,}8\ \Delta t$ $\Delta t = 20{,}41\ s$	$\Delta y = v_{iA}\Delta t+\frac{1}{2}g\Delta t^2$ $0=-100\Delta t+\frac{1}{2}9{,}8\Delta t^2$ $0=-100\Delta t+4{,}9\Delta t^2$ $100\Delta t=4{,}9\Delta t^2$ $\Delta t = 20{,}41$ s

9.4

Positive upwards



Positive downwards