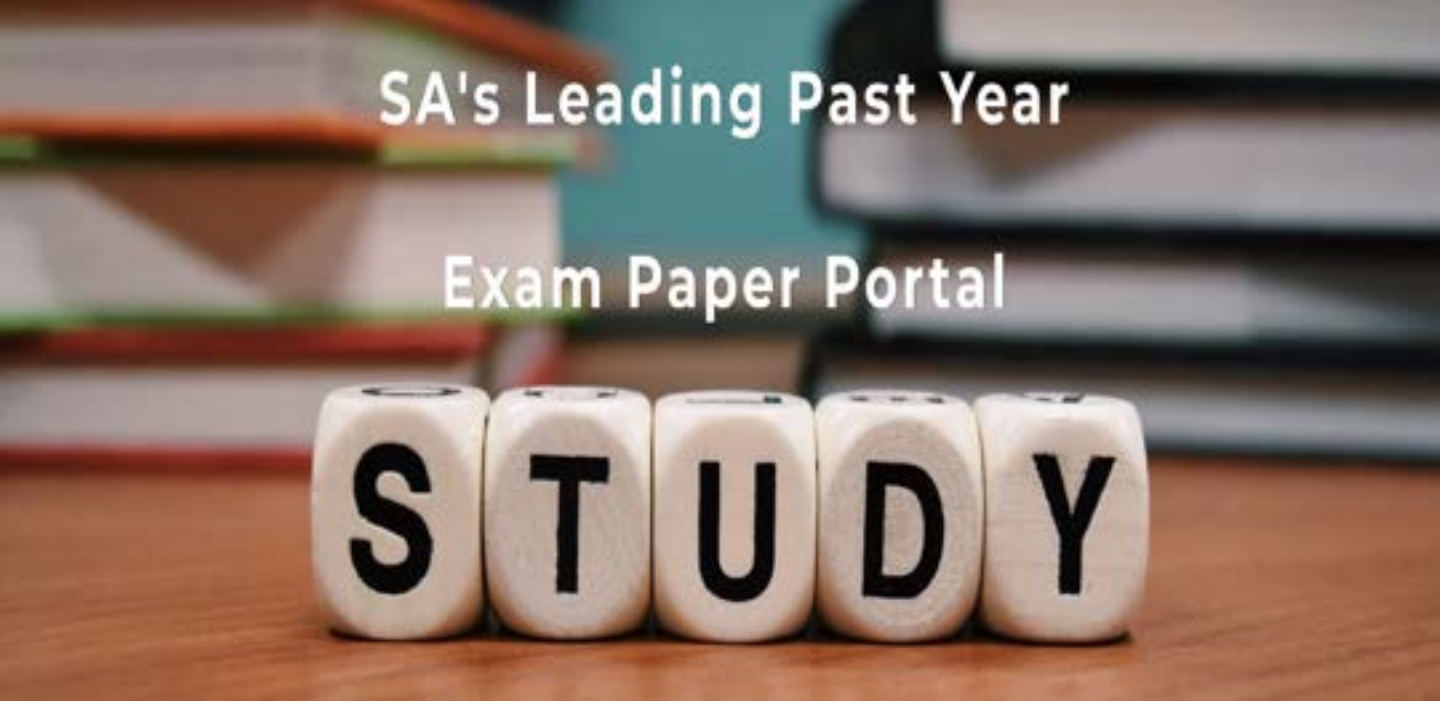

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EDUCATION
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES

COMMON TEST

APRIL 2021

MARKING GUIDELINE

MARKS : 100

TIME : 2 hours

This Marking Guideline consists of 8 pages.

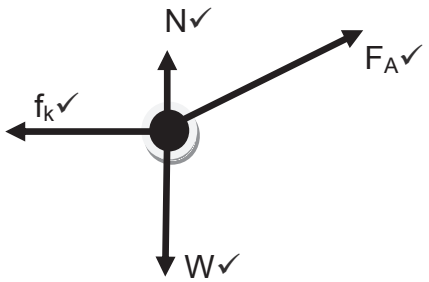
QUESTION 1

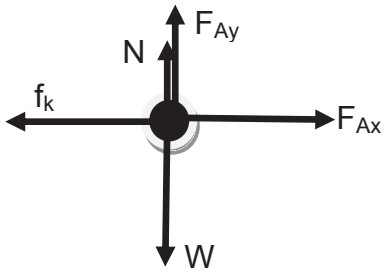
1.1 D✓✓ (2)
1.2 D✓✓ (2)
1.3 C✓✓ (2)
1.4 A ✓✓ (2)
1.5 C✓✓ (2)
1.6 D✓✓ (2)
[12]

QUESTION 2

2.1.1 A body will remain in its state of rest or motion at constant velocity unless a non-zero resultant/net force acts on it. ✓✓ (2)

2.1.2





CRITERIA FOR MARKING
• Mark is awarded for label and arrow. • Do not penalise for length of arrows. • Deduct 1 mark for any additional force. • If force(s) do not make contact with body/dot : *Max:3/*4 • If arrows missing but labels are there: *Max:3/*4

Acceptable Labels	
N	Normal/F_N/F_{Normal}
f_k	Friction/F_f/$f_{kinetic}$
F_A	F/120 N/$F_{applied}$
W	Fg/Fgravity/Gravitational force/490 N

(4)

2.1.3 Sum of all forces acting on the box is zero/ No net force acting on the box✓ (1)

2.1.4 $F_{net} = ma$
$F_{net} = 0$ ✓
$N + F_{Ay} = W$

$N + 120\sin 60^o = 50(9,8)$ ✓

$N = 386,08$ N✓ (3)

2.1.5 INCREASES✓, If the angle of the applied force decreases, the vertical component of the applied force will also decrease✓. This will affect the normal force since the sum of the normal force and vertical component of the applied force must be equal to the weight of the object✓. (3)

2.2.1 Each body in the universe attracts every other body with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres. ✓✓ (2)

OR

Each particle in the universe attracts every other particle with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between them. ✓✓

2.2.2 $\_\_\_\_^{2}$✓

$$\frac{\qquad\qquad\qquad\qquad}{\checkmark\qquad\qquad\checkmark}$$

$F = 3{,}55 \times 10^{26}$ N✓ (4)

[19]

QUESTION 3

3.1 The total linear momentum of a closed system remains constant (is conserved)✓✓

OR

The total linear momentum before collision is equal to the total linear momentum after the collision.✓✓ (2)

3.2 $\Sigma p_f = \Sigma p_i$

$(m_1 + m_2)v = m_1v_{i1} + m_2v_{i2}$ ✓

$(92 \times 10^3 + 65 \times 10^3)v$ ✓$= 65 \times 10^3\,(0{,}8) + 92 \times 10^3\,(1{,}3)$✓

$v = 1{,}09$ m•s^{-1}✓

∴ the velocity of the cars is 1,09 m•s^{-1} (4)

POSITIVE MARKING FROM Q. 3.2

3.3

$\Sigma K_f = ½ (m_1 + m_2)v^2$✓ $= ½ (65 \times 10^3 + 92 \times 10^3)\ 1{,}09^{\ 2}$✓ $= 93265{,}85$ J $\Sigma K_f \neq \Sigma K_i$✓ ∴Collision is Inelastic ✓	$\Sigma K_i = ½\ m_1\ v_{i1}^{\ 2} + ½ m_2\ v_{i2}^{\ 2}$ $= ½ (65 \times 10^3)(0{,}8)^2 + ½(92 \times 10^3)(1{,}3)^2$✓ $= 98540$ J

(5)

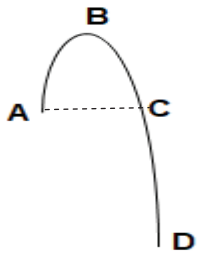
[11]

QUESTION 4

4.1 Motion upon which the only force acting is the force of gravity. ✓✓ (2)

4.2 15 m•s^{-1} ✓upwards✓ (2)

4.3 **StoneTrajectory**



OPTION 1:From A to D

UPWARDS POSITIVE	**UPWARDS NEGATIVE**
$v_f^2 = v_i^2 + 2a\Delta y$✓	$v_f^2 = v_i^2 + 2a\Delta y$✓
$-45^2 = 15^2 + 2(-9,8)\Delta y$✓	$45^2 = -15^2 + 2(9,8)\Delta y$✓
$\Delta y = -91,84$ m	$\Delta y = 91,84$ m
∴ Height above the ground when the stone is released is 91,84 m✓	∴ Height above the ground when the stone is released is 91,84 m✓

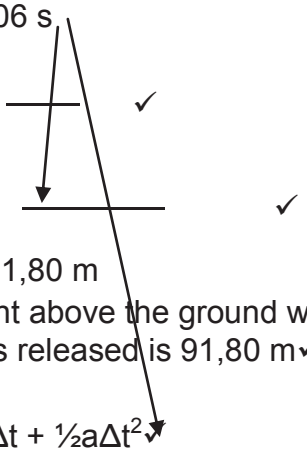
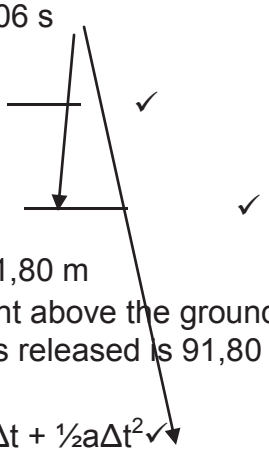
OPTION 2:From A to D

UPWARDS POSITIVE	**UPWARDS NEGATIVE**
$v_f = v_i + a\Delta t$	$v_f = v_i + a\Delta t$
$-45 = 15 + (-9,8)\ \Delta t$	$45 = -15 + (9,8)\ \Delta t$
$\Delta t = 6,12$ s	$\Delta t = 6,12$ s
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓
$\Delta y = (15)(6,12) + \frac{1}{2}(-9,8)(6,12)^2$✓	$\Delta y = (-15)(6,12) + \frac{1}{2}(9,8)(6,12)^2$✓
$\Delta y = -91,73$ m	$\Delta y = 91,73$ m
∴ Height above the ground when the stone is released is 91,73 m✓	∴ Height above the ground when the stone is released is 91,73 m✓

OPTION 3:From A to D

UPWARDS POSITIVE	**UPWARDS NEGATIVE**
$v_f = v_i + a\Delta t$	$v_f = v_i + a\Delta t$
$-45 = 15 + (-9,8)\ \Delta t$	$45 = -15 + (9,8)\ \Delta t$
$\Delta t = 6,12$ s	$\Delta t = 6,12$ s
——— ✓	——— ✓
——— ✓	——— ✓
$\Delta y = -91,80$ m	$\Delta y = -91,80$ m
∴ Height above the ground when the stone is released is 91,80 m✓	∴ Height above the ground when the stone is released is 91,80 m✓

OPTION 3:From C to D

UPWARDS POSITIVE	UPWARDS NEGATIVE
$v_f = v_i + a\Delta t$	$v_f = v_i + a\Delta t$
$-45 = -15 + (-9,8)\ \Delta t$	$45 = 15 + (9,8)\ \Delta t$
$\Delta t = 3,06$ s	$\Delta t = 3,06$ s
 ✓ ✓	 ✓ ✓
$\Delta y = -91,80$ m	$\Delta y = 91,80$ m
∴ Height above the ground when the stone is released is 91,80 m✓	∴ Height above the ground when the stone is released is 91,80 m✓
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓
$\Delta y = \underline{(-15)(3,06) + \frac{1}{2}(-9,8)(3,06)^2}$✓	$\Delta y = \underline{(15)(3,06) + \frac{1}{2}(9,8)(3,06)^2}$✓
$\Delta y = -91,78$ m	$\Delta y = 91,78$ m
∴ Height above the ground when the stone is released is 91,78 m✓	∴ Height above the ground when the stone is released is 91,78 m✓

(3)

4.4

OPTION 1:From A to D

UPWARDS POSITIVE	UPWARDS NEGATIVE
$v_f = v_i + a\Delta t$✓	$v_f = v_i + a\Delta t$✓
$\underline{-45 = 15 + (-9,8)\ \Delta t}$✓	$\underline{45 = -15 + (9,8)\ \Delta t}$✓
$\Delta t = 6,12$ s✓	$\Delta t = 6,12$ s✓

OPTION 2:From A to B and then C - D

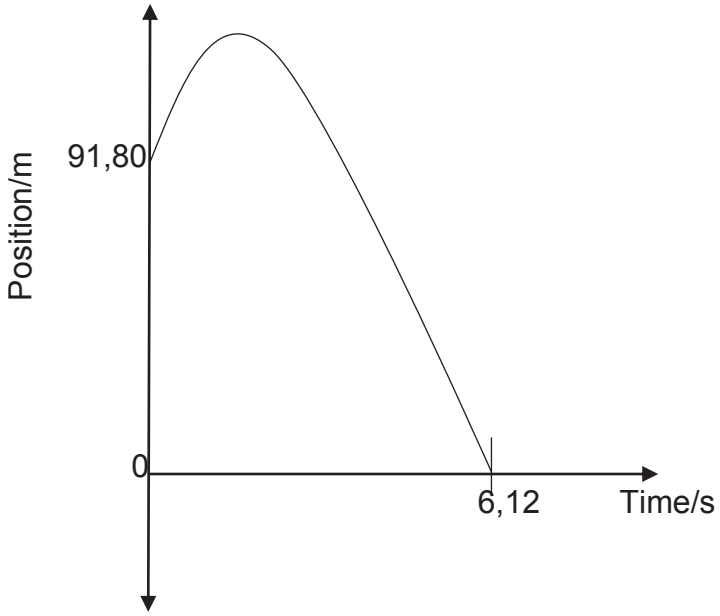
UPWARDS POSITIVE	UPWARDS NEGATIVE
$v_f = v_i + a\Delta t$ ✓	$v_f = v_i + a\Delta t$ ✓
$0 = 15 + (-9,8)\ \Delta t$	$0 = -15 + (9,8)\ \Delta t$
$\Delta t = 1,53$ s ✓	$\Delta t = 1,53$ s
$v_f = v_i + a\Delta t$	$v_f = v_i + a\Delta t$
$-45 = -15 + (-9,8)\ \Delta t$	$45 = 15 + (9,8)\ \Delta t$
$\Delta t = 3,06$ s	$\Delta t = 3,06$ s
$\Delta t = \underline{2(1,53) + 3,06}$✓	$\Delta t = \underline{2(1,53) + 3,06}$✓
$\Delta t = 6,12$ s✓	$\Delta t = 6,12$ s✓

OPTION 3:POSITIVE MARKING FROM 7.2
From A to D

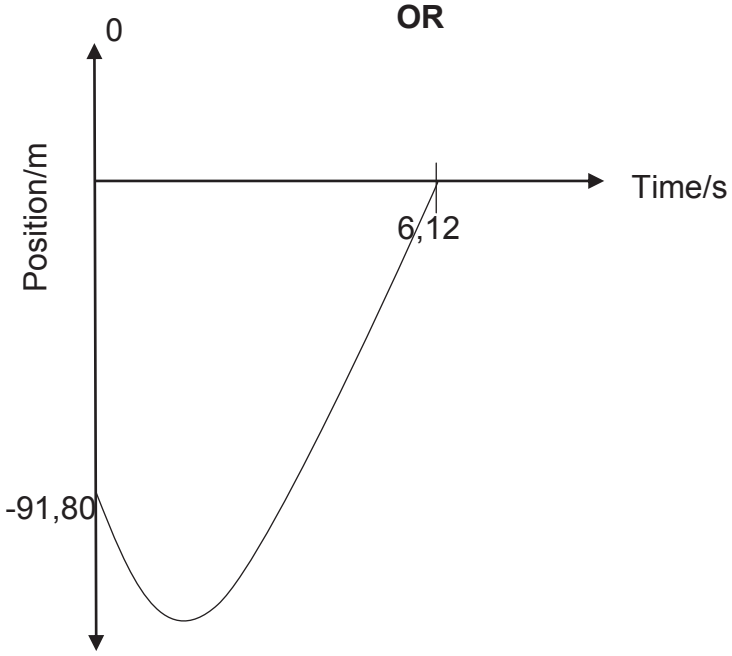
UPWARDS POSITIVE	UPWARDS NEGATIVE
$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓	$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓
$\underline{-91,73 = (15\Delta t + \frac{1}{2}(-9,8\Delta t^2}$✓	$\underline{91,73 = (-15\Delta t + \frac{1}{2}(9,8\Delta t^2}$✓
$\Delta t = 6,12$ s✓	$\Delta t = 6,12$ s✓

(3)

4.5 **POSITIVE MARKING FROM 7.2 AND 7.3**



OR



NOTE: LEARNERS MAY CHOOSE HEIGHT WHEN THE BALL IS RELEASED AS THE REFERENCE POINT

Criteria for marking	
Correct shape	✓
Indication of height (9,73 – 9,84 m)	✓
Indication of the correct end time	✓
Correct choice of the zero point of reference	✓

(4)
[14]

QUESTION 5

5.1.1 2,4-dimethyl✓hexane✓ (2)

5.1.2 1-chloro✓-2-methylpropane✓ (2)

5.1.3 Esters ✓ (1)

5.2.1 Compound that consists of carbon and hydrogen only. ✓✓ (2)

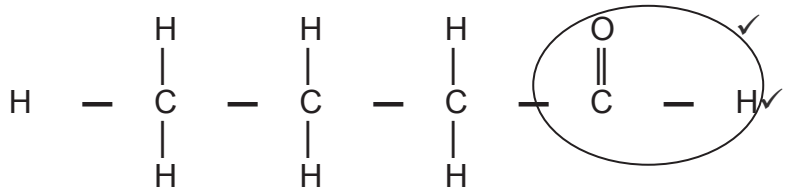
5.2.2 Unsaturated✓. Contains a multiple bond/triple bond between carbon atoms in the carbon chain. ✓ (2)

5.2.3 C_nH_{2n-2}✓ (1)

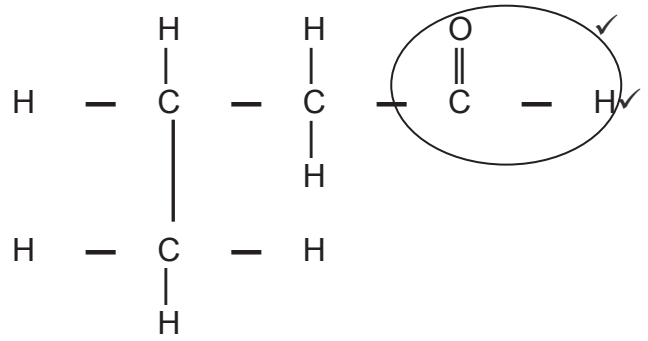
5.3 pentan-2-ol✓✓ OR pentan-3-ol✓✓ (2)

5.4.1 Compounds with same molecular formula but different functional groups. ✓✓ (2)

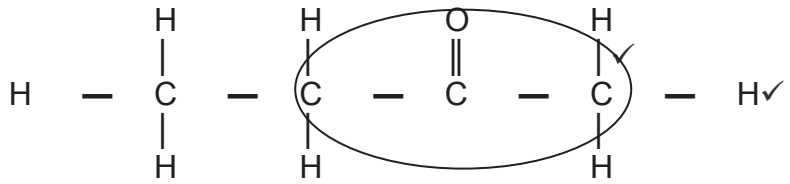
5.4.2



OR



OR



- Whole structure correct: 2/2
- Only functional group correct 1/2
- More than one functional group 0/2

(2)

5.4.3 **POSITIVE MARKING FROM Q5.4.2**

butan-2-one✓✓ OR butanal✓✓ OR 2 - Methylpropanal (2)

[18]

QUESTION 6

6.1 The temperature at which the vapour pressure of a substance equals the atmospheric pressure. ✓✓ (2)

6.2 163 °C✓✓ (2)

6.3 ✓
The acid (A) has TWO sites for hydrogen bonding✓ while the alcohol (B) has only one site. ✓
The carboxylic acid molecules require more energy to overcome the intermolecular forces✓
Carboxylic acid will have a higher boiling point. ✓ (4)

6.4 Butanoic acid. ✓✓ (2)

6.5 LOWER✓.

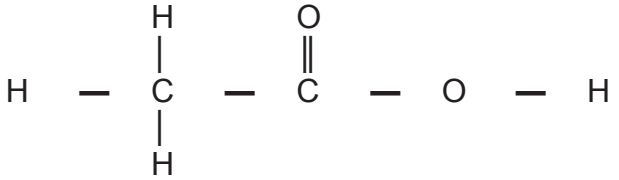
$CH_3(CH_2)_2CH_2OH$ or butan-1-ol has a shorter carbon chain/smaller surface area than compound B✓. Strength of the intermolecular forces in $CH_3(CH_2)_2CH_2OH$ or butan-1-ol is weaker than that in compound B. ✓
Therefore lesser energy needed to separate the molecules. ✓ **OR**
Compound B has a longer carbon chain/ larger surface area than $CH_3(CH_2)_2CH_2OH$ or butan-1-ol ✓The intermolecular forces between molecules of compound B are therefore stronger✓and require more energy to separate the molecules. ✓ (3)

[13]

QUESTION 7

7.1.1 Hydrolysis✓ (1)
7.1.2 Dehydrohalogenation✓ (1)
7.2.1 Esterification✓ (1)
7.2.2 Addition/hydration✓ (1)
7.3.1 Heat✓
Concentrated strong base in ethanol✓ (2)
7.3.2 Propene/Prop-1-ene✓ (1)
7.4 Water/H_2O✓ (1)
7.5.1 The carbon to which the hydroxyl (OH) group is bonded to, is bonded to ONE other carbon atom.✓✓ (2)
7.5.2 sulphuric acid/H_2SO_4✓ (1)

7.5.3



- Whole structure correct: 2/2
- Only functional group correct 1/2
- More than one functional group 0/2

(2)

[13]