MARKING GUIDELINES

EXAMINATION	NATIONAL SENIOR CERTIFICATE
GRADE	12
DATE	NOVEMBER 2024
SUBJECT	PHYSICAL SCIENCES
PAPER	1
MARK TOTAL	150
DURATION (HOURS)	3
NUMBER OF PAGES	14

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SOUTH AFRICAN COMPREHENSIVE ASSESSMENT INSTITUTE

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QUESTION 1

1.1	D ✓✓	(2)
1.2	B ✓✓	(2)
1.3	B ✓✓	(2)
1.4	C ✓✓	(2)
1.5	A ✓✓	(2)
1.6	C ✓✓	(2)
1.7	B ✓✓	(2)
1.8	D ✓✓	(2)
1.9	C ✓✓	(2)
1.10	B ✓✓	(2)
		[20]

QUESTION 2

2.1 When a resultant/net force acts on an object, the object will accelerate in the direction of the force ✓with an acceleration directly proportional to the force and inversely proportional to the mass of the object. ✓ (2)

2.2 $f_k = \mu_k N$ ✓any one formula

$f_k = \mu_k[mg - F_{App}\sin 15^o]$

$f_k = [(0,1)(3)(9,8)$ ✓$] – [(0,1)(25)(\sin 15^o$✓$)]$ note negative sign

$f_k = 2,29$ N ✓ (4)

Positive c.o.e.

2.3 $F_{net} = ma$

$F_A \cos 15^o – F_T – F_{fk} = ma$ ✓ any

$(25)\cos 15^o – F_T – 2,29 = (3)a$✓

$24,5 – F_T – 2,29 = (3)a$

$F_T = 21,86 – 3a$

$F_{net} = ma$

$F_T – F_g = ma$ ✓

$F_T – mg = ma$

$F_T – (1,5)(9,8) = (1,5)a$ ✓

$F_T = 1,5a + 14,7$

$F_{T\ 3kg} = F_{T\ 1,5kg}$

$21,86 – 3a = 1,5a + 14,7$ ✓ method

$7,16 = 4,5a$

$a = 1,59\ m.s^{-2}$ ✓ (6)

2.4 2.4.1 INCREASES ✓ (1)

2.4.2 REMAINS THE SAME ✓ (1)

[14]

QUESTION 3

3.1 $6\ m.s^{-1}$ ✓ (1)

3.2 $v_f = v_i + g\Delta t$ ✓

$0 = 6 + (-9,8)t$ ✓

$t = 0,61\ s$ ✓ (3)

3.3 $v_f = v_i + g\Delta t$

$v_f = (6)$ ✓ $+ (-9,8)(1,4)$ ✓

$v_f = -7,72\ m.s^{-1}$

THUS: $v_f = 7,72\ m.s^{-1}$ ✓ (3)

Positive c.o.e.

OR

$v_f = v_i + g\Delta t$

$v_f = (0)$ ✓ $+ (-9,8)(1,4-0,61)$ ✓

$v_f = (-)7,74\ m.s^{-1}$ ✓ (7,74-7,84)

Positive c.o.e.

3.4 Height = area above – area below graph

= ½ b⊥h - ½ b⊥h ✓

= ½ (0,61)(6)✓- ½(1,4 - 0,61)(7,72)✓

= 1,83 – 3,05

= - 1,22 m

THUS: 1,22 m ✓

Positive c.o.e.

OR

Height = area under graph

= ½ b⊥h + ½ b⊥h ✓

= ½(0,61)(6)✓+½(1,4-0,61)(-7,72)✓

= 1,83 – 3,05

= - 1,22 m

THUS: 1,22 m ✓ (4)

3.5 $v_f = v_i + g\Delta t$

$(-5) = (5) + (-9,8)t$

$t = 1,02\ s$ ✓

$v_f = v_i + g\Delta t$

$0 = (3) + (-9,8)t$

$t = 0,31\ s$ ✓

$t = 1,4 + 1,02 + 0,31$ ✓ method

$= 2,73\ s$ ✓

OR

$v_f = v_i = g\Delta t$

$(0) = (-5) + (9,8)t$

$t = 0,51$

THUS $0,51 \times 2 = 1,02\ s$ ✓

$v_f = v_i = g\Delta t$

$0 = (-3) + (9,8)t$

$t = 0,31\ s$ ✓

$t = 1,4 + 1,02 + 0,31$ ✓ m

$= 2,73\ s$ ✓

OR

$v_f = v_i = g\Delta t$

$(5) = (-5) + (9,8)t$

$t = 1,02\ s$ ✓

$v_f = v_i = g\Delta t$

$0 = (-3) + (9,8)t$

$t = 0,31\ s$ ✓

$t = 1,4 + 1,02 + 0,31$ ✓ m

$= 2,73\ s$ ✓ (4)

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QUESTION 4

4.1 The total linear momentum of an isolated system remains constant. ✓✓ (2)

4.2 Sum of momentum before = Sum of momentum after

$(m_A v_{iA} + m_B v_{iB})_{before} = (m_A v_{fA} + m_B v_{fB})_{after}$ ✓ formula

$(50)(8) + (80)(-18)$ ✓ $= (50)(-5) + (80)v$ ✓

$400 - 1440 = -250 + (80)v$

$v = -9,88\ m.s^{-1}$

THUS: $9,88\ m.s^{-1}$ ✓ West ✓ (5)

Sum of momentum before = Sum of momentum after $(m_A v_{iA} + m_B v_{iB})_{before} = (m_A v_{fA} + m_B v_{fB})_{after}$ ✓ formula $(50)(-8) + (80)(+18)$ ✓ $= (50)(+5) + (80)v$ ✓ $-400 + 1440 = +250 + (80)v$ $v = 9,88\ m.s^{-1}$ ✓ West ✓

4.3 The total kinetic energy and momentum is conserved ✓✓.

Accept:

- Sum of kinetic energy before the collision is equal to the sum of the kinetic energy after the collision.
- No net loss in kinetic energy in the system because of the collision.
- Both momentum and kinetic energy are conserved. (2)

Positive c.o.e.

4.4 Sum of $E_{ki} = \frac{1}{2}m_A v_{iA}^2 + \frac{1}{2}m_B v_{iB}^2$ ✓

$= \frac{1}{2}(50)(8)^2 + \frac{1}{2}(80)(-18)^2$

$= 14560\ J$ ✓

Sum of $E_{kf} = \frac{1}{2}m_A v_{fA}^2 + \frac{1}{2}m_B v_{fB}^2$

$= \frac{1}{2}(50)(-5)^2 + \frac{1}{2}(80)(-9,88)^2$

$= 4529,58\ J$ ✓

Sum of $E_{ki} \neq$ Sum of E_{kf} ✓

THUS, it is an inelastic collision ✓ (5)

[14]

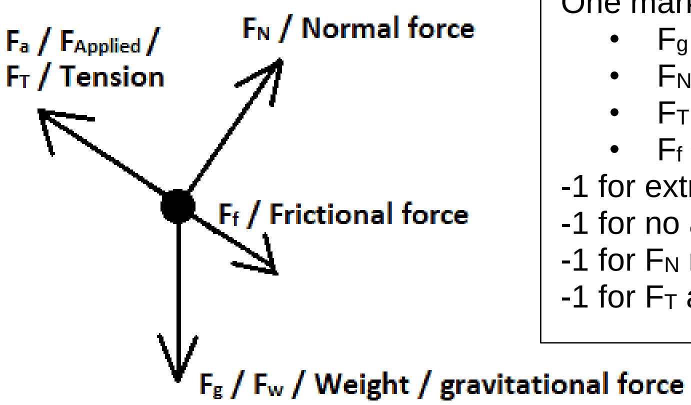
QUESTION 5

5.1 (The product of) $F\Delta x \cos\theta$, where F is the magnitude of the force, Δx the magnitude of the displacement, and θ the angle between the force and the displacement. ✓✓

Accept:

- The product of the displacement and the component of the force parallel to the displacement. (2)

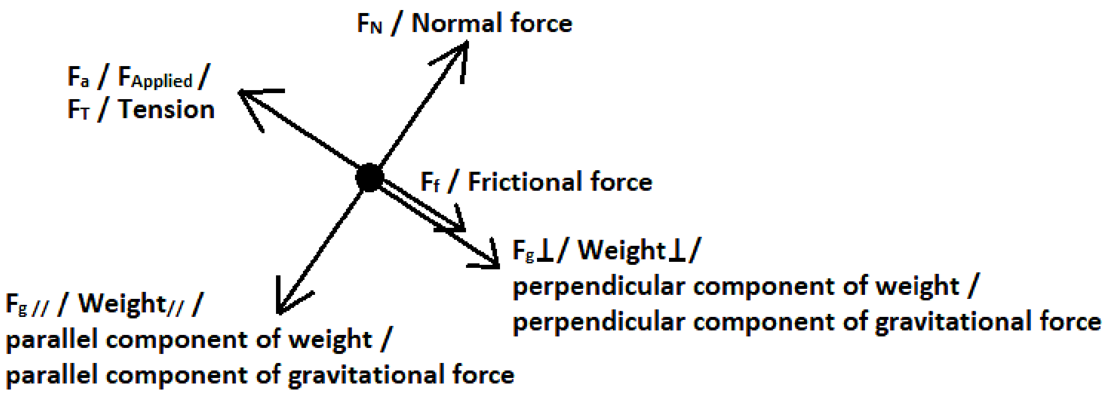
5.2



One mark per force
- F_g (or its components) ✓
- F_N ✓
- F_T ✓ F
- F_f ✓

-1 for extra forces
-1 for no arrows
-1 for F_N not perpendicular
-1 for F_T and F_f not inline and on the slope

OR



Acceptable labels	
w	F_g / F_w / weight / mg / gravitational force
T	F_T / tension
F	F_a / $F_{applied}$
N	F_N / Normal force
f	F_f / Frictional force

(4)

5.3 $W_{net} = W_{motor} + W_f + W_{g//}$

$F_{net}\Delta x\cos\theta = W_{motor} + F_f\Delta x\cos\theta + F_{g//}\Delta x\cos\theta$ ✓ any one

$F_{net}\Delta x\cos\theta = W_{motor} + F_f\Delta x\cos\theta + mg\sin\theta\Delta x\cos\theta$

$(0)(30)\cos0^o = W_{motor} + \underline{(2)(30)\cos180^o}$ ✓ $+ \underline{(15)(9,8)\sin20^o(30)\cos180^o}$ ✓

0 ✓ $= W_{motor} - 60 - 1508,31$

$0 = W_{motor} - 1568,31$

$W_{motor} = 1568,31$ J ✓ (5)

OR

$F_{net} = ma \quad (a=0)$

$F_T - F_f - F_{g//} = \underline{0}$ ✓

$F_T - 2 - (\underline{15 \times 9,8 \times \sin20^o}$ ✓$) = 0$

$F_T - 2 - (50,28) = 0$

$F_T = 52,28$ N

$W_{motor} = F_T\Delta x\cos\theta$ ✓

$W_{motor} = (52,28)(30)\cos0^o$ ✓

$W_{motor} = 1568,31$ J ✓

5.4 Height of slope:

$\Delta y = (30)\sin20^o$

$\Delta y = 10,26$ m

$\Delta E_p = E_{p\ top} - E_{p\ bottom}$ ✓

$\Delta E_p = mgh_{top} - mgh_{bottom}$

$\Delta E_p = (15)(9,8)(10,26) - (15)(9,8)(0)$ ✓

$E_p = 1508,22$ J ✓ (3)

$W_g = -\Delta E_p$ ✓	$W_{nc} = \Delta E_k + \Delta E_p$ ✓
$mg\Delta x\cos\theta = -\Delta E_p$	$W_T + W_f = \Delta E_k + \Delta E_p$
$(15)(9,8)(30\sin20^o)\cos180^o = -\Delta E_p$ ✓	$1568,31 + (2)(30)\cos180^o = 0 + \Delta E_p$ ✓
$-1508,22 = -\Delta E_p$	$1568,22 - 60 = \Delta E_p$
$E_p = 1508,22$ J ✓	$E_p = 1508,22$ J ✓

[14]

QUESTION 6

6.1 The change in frequency (or pitch) of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓✓

OR

Apparent change in frequency due to the relative motion between the sound source and the listener (2)

6.2 Q ✓ The wave lengths appear shorter (more compact / closer together) / the frequency appears higher ✓ because the train is moving towards the station. (2)

6.3

$f_L = \frac{v + v_L}{v - v_s} f_s$ ✓

$f_L = \frac{340 + 0}{340 - 30}$ ✓(375) ✓

$f_L = \frac{340}{310}(375)$

$f_L = 411,29$ Hz ✓ (4)

- Accept formula ✓✓ $f_L = \frac{v \pm v_L}{v \pm v_s} f_s$
- Correct substitution and signs ✓Velocities ✓F_s
- Answer and unit ✓

6.4 $v = f\lambda$ ✓

$(340) = (375)\lambda$ ✓

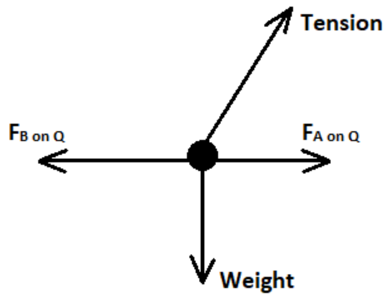
$\lambda = 0,91$ m ✓ (3)

[11]

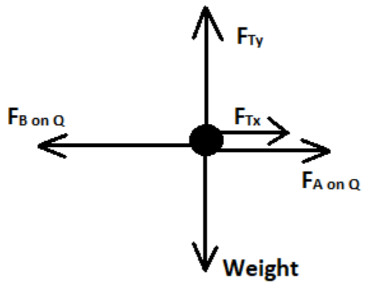
QUESTION 7

7.1 7.1.1 The magnitude of the electrostatic **<u>force</u>** exerted by one point charge (Q_1) on another point charge (Q_2) is <u>directly proportional to the product of the magnitudes of the charges</u> ✓ and <u>inversely proportional to the square of the distance (r) between them.</u> ✓ (2)

7.1.2



OR



One mark per force
- F_T ✓
- F_g (or its components) ✓
- $F_{B\ on\ Q}$ ✓
- $F_{A\ on\ Q}$ ✓

-1 for extra forces
-1 for no arrows

Acceptable labels	
w	F_g / F_w / weight / mg / gravitational force
T	F_T / tension
F	F_a / $F_{applied}$ / $F_{A\ on\ Q}$ / F_{AQ} / $F_{B\ on\ Q}$ / F_{BQ}

(4)

7.1.3 $F_{B\text{ on }Q} = F_{Tx} + F_{A\text{ on }Q}$

$\dfrac{kQ_BQ}{r^2} = \tan\theta F_g + \dfrac{kQ_BQ}{r^2}$ $(F_{Ty} = F_g)$ ✓ any one

$\dfrac{kQ_BQ}{r^2}$ ✓Formula $= \dfrac{\tan\theta mg}{r^2} + \dfrac{kQ_BQ}{}$

$\mathbf{\dfrac{(9\times10^9)(3\times10^{-9})Q}{(6 \times 10^{-2})^2}}$ ✓ $=$ **$\tan10^o(1{,}953\times10^{-8})(9{,}8)$** ✓ $+$ $\mathbf{\dfrac{(9\times10^9)(2\times10^{-9})Q}{(4 \times 10^{-2})^2}}$ ✓ ✓conv both

$7500Q = 3{,}37 \times 10^{-8} + 11250Q$

$-3{,}37 \times 10^{-8} = 3750Q$

$Q = -8{,}99 \times 10^{-12}$ C ✓ THUS $8{,}99 \times 10^{-12}$ C (7)

VERTICAL

$F_{net} = 0$

$T_y = F_g$

$T\sin80^o = (1{,}953\times10^{-8})$

$\sin80^o = (1{,}914\times10^{-8})$

$T_y = 1{,}943\times10^{-7}$

HORIZONTAL

$F_{net} = 0$

$F_{B\text{ ob }Q} - F_{B\text{ ob }Q} - T_x = 0$

$F_{B\text{ ob }Q} - F_{B\text{ ob }Q} - T_x = 0$

$\dfrac{kQ_BQ}{r^2}$ ✓Formula $- \dfrac{kQ_BQ}{r^2} - T_x = 0$ ✓ any for equilibrium

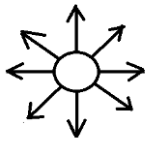
$\dfrac{(9\times10^9)(3\times10^{-9})Q}{(6 \times 10^{-2})^2}$ ✓ ✓con both $- \dfrac{(9\times10^9)(2\times10^{-9})Q}{(4 \times 10^{-2})^2}$ ✓ $= 1{,}943\times10^{-7}\sin80^o$ ✓

$7500Q - 11250Q = 3{,}37 \times 10^{-8}$

$3750Q = -3{,}37 \times 10^{-8}$

$Q = -8 \times 10^{-12}$ C ✓ THUS 8×10^{-12} C

7.2 7.2.1



✓Direction ✓Shape (-1 if the lines do not touch / not evenly spread) (2)

7.2.2 $F_{g\ on\ Q} = mg$

$F_{g\ on\ Q} = (1,5 \times 10^{-3})(9,8)$ ✓

$F_{g\ on\ Q} = 1,47 \times 10^{-2}$ N down

$F_{A\ on\ Q} = F_{g\ on\ Q}$ ✓

$E = \frac{F}{q_Q}$ ✓

$1687715,27$ ✓ $= \frac{1,47 \times 10^{-2}}{q_Q}$ ✓

$(1687715,27)q_Q = 1,47 \times 10^{-2}$

$q_Q = 8,71 \times 10^{-9}$ C ✓ (6)

[21]

QUESTION 8

8.1 The potential difference across a conductor is directly proportional to the current in the conductor ✓ at constant temperature. ✓ (2)

8.2 $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓

$\frac{1}{R_p} = \frac{1}{2} + \frac{1}{4}$ ✓

$\frac{1}{R_p} = \frac{3}{4}$

$R_p = \frac{4}{3}$

$R_p = 1{,}33\ \Omega$ ✓ (3)

Positive c.o.e.

8.3 $R_T = \frac{emf}{I}$ ✓

$(1{,}33+0{,}1) = \frac{3}{I}$ ✓

$I = 2{,}10\ A$ ✓

OR

$emf = I(R+r)$ ✓

$3 = I(1{,}33+0{,}1)$ ✓

$I = 2{,}10\ A$ ✓ (3)

Positive c.o.e.

8.4 $V = IR$ ✓

$V = (2{,}10)(1{,}33)$ ✓

$V = 2{,}79\ V$ ✓

OR

$emf = IR+Ir$ ✓

$3 = V + (2{,}10)(0{,}1)$ ✓

$V = 2{,}79\ V$ ✓ (3)

Positive c.o.e.

8.5 Halve ✓ **OR** reduce ✓

Explanation: Two paths for current to flow. The current will split into the two available paths. ✓ (2)

Positive c.o.e.

8.6 $P = \frac{V^2}{R}$ ✓

$P = \frac{(2{,}79)^2}{4}$ ✓

$P = 1{,}95\ W$ ✓

OR

$I = \frac{V}{R_2}$

$= \frac{2{,}79}{4}$

$= 0{,}70\ A$

$P = VI$ ✓

$= (2{,}79)(0{,}70)$ ✓

$= 1{,}95\ W$ ✓

OR

$P = I^2R$ ✓

$P = (0{,}7)^2(4)$ ✓

$P = 1{,}96\ W$ ✓ (3)

[16]

QUESTION 9

9.1 9.1.1 Alternating current motor ✓

Slip rings ✓ (2)

9.1.2 <u>Electrical</u> energy to <u>mechanical</u> energy ✓ (1)

9.1.3 More coils ✓ / more windings on the coil

Rotate faster ✓

(2)

9.2 9.2.1 1,75 rotations (1 ¾) ✓ (1)

9.2.2 $f = \frac{\text{number of rotations}}{\text{time}}$

Positive c.o.e.

$f = \frac{1,75}{1,4}$

$f = 1,25$ Hz ✓✓

OR f= 1/T
OR f = rotations per second
f = 1,25 Hz ✓✓

(2)

9.2.3 $I_{rms} = \frac{I_{max}}{\sqrt{2}}$ ✓ Both equations

$I_{rms} = \frac{18}{\sqrt{2}}$

$I_{rms} = 12,73$ A

$P_{ave} = V_{rms} I_{rms}$

$2160,35 = V_{rms} (12,73)$

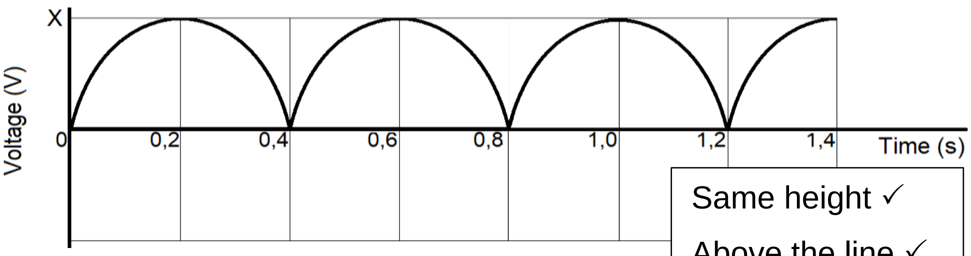
$V_{rms} = 169,71$ V (without rounding 169,73 V)

$V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓

$169,71$ ✓ $= \frac{V_{max}}{\sqrt{2}}$

$V_{max} = 240,01$ V ✓ (without rounding 240,04 V) (4)

9.2.4



Same height ✓
Above the line ✓

(2)

[14]

QUESTION 10

10.1 10.1.1 The minimum energy that an electron in the metal needs to be emitted ✓ from the metal surface. ✓ (2)

10.1.2 $W_o = hf_o$ ✓

$W_o = (6,63 \times 10^{-34})(1,15 \times 10^{15})$ ✓

$= 7,62 \times 10^{-19}$ J ✓ (3)

10.2 10.2.1 $E = \frac{hc}{\lambda}$ ✓

$= \frac{(6,63 \times 10^{-34})(3 \times 10^{8})}{(440 \times 10^{-9})}$ ✓

$= 4,52 \times 10^{-19}$ J ✓

$f = \frac{c}{\lambda}$ $= \frac{(3 \times 10^{8})}{(440 \times 10^{-9})}$ $= 6,82 \times 10^{14}$ Hz $E = hf$ ✓ $= (6.63 \times 10^{-34})(6,82 \times 10^{14})$ ✓ $= 4,52 \times 10^{-19}$ J ✓

(3)

10.2.2 Energy does not depend on intensity✓ (brightness),
Energy depends on frequency. ✓ (OR E∝f)
Blue light has a higher frequency than red light ✓ thus it causes electrons to have a higher average energy when radiated. (3)

[11]

GRAND TOTAL: [150]