QUESTION 1: MULTIPLE CHOICE QUESTIONS

1.1 A ✓✓

1.2 B ✓✓

1.3 C ✓✓

1.4 C ✓✓

1.5 A ✓✓

1.6 C ✓✓

1.7 C ✓✓

1.8 B ✓✓

1.9 C ✓✓

1.10 D ✓✓

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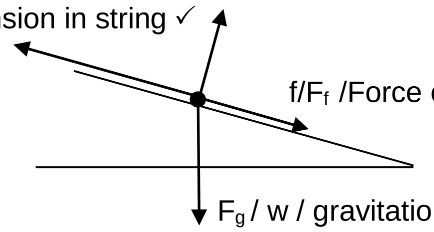
QUESTION 2

2.1



(Accept the components of F_g INSTEAD of F_g but not both F_g and the components. No arrows = ¾; forces not touching dots = 3/4) (4)

2.2 $F_N = mg\cos 30^o = 33,95$ N ✓
$F_f = \mu_k F_N$ ✓ = 0,2 (33,95) = 6,79 N ✓ (3)

2.3

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

Wanneer 'n resulterende (netto) krag op 'n voorwerp inwerk, sal die voorwerp in die rigting van die krag versnel. Hierdie versnelling is direk eweredig aan die krag en omgekeerd eweredig aan die massa van die voorwerp.

OR/*OF*

The net force acting on an object is equal to the rate of change of momentum ✓✓of the object (in the direction of the force). (2 or 0)
Die netto krag wat op 'n voorwerp inwerk is gelyk aan die tempo van verandering in momentum van die voorwerp (in die rigting van die krag). (2 of 0) (2)

2.4 $F_{g//} = mg\sin 30^o = (4)(9,8)\sin 30 = 19,6$ N ✓
$ma = T - (F_f + F_{g//})$ ✓
$(4)(0,43)$ ✓ $= T - (6,79 + 19,6)$ ✓
$T = 28,11$ N ✓ (5)

2.5 $v_f^2 = v_i^2 + 2g\Delta y$ ✓
$v_f^2 = 0^2 ✓ + 2(0.43)(2) ✓$
$\therefore v = 1,31\ m.s^{-1} ✓$ (4)

$W_{nc} = \Delta E_p + \Delta E_k ✓$
$T\Delta x Cos\theta = mg(h_2 - h_{0)} + \frac{1}{2}m(v_f^2 - v_i^2)$
$(28,11)(2)(1) ✓ = (2)(9,8)(2-0) + (0,5)(2)(v_f^2 - 0^2) ✓$
$\therefore v = 1,31\ m.s^{-1} ✓$

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QUESTION 3

3.1 Take down as positive (If down is taken as negative signs must be consistent)

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

$\underline{1,8 = v_i(0,5) + \frac{1}{2}(9,8)(0,5)^2}$ ✓

$v_i = 1,15 \text{ m.s}^{-1}$ ✓ (3)

3.2 $v_f = v_i + a\Delta t$ ✓

$v_f = \underline{(1,15) + (9,8)(0,5)}$ ✓

$v_f = 6,05 \text{ m.s}^{-1}$ ✓ (3)

3.3 $v_f^2 = v_i^2 + 2a\Delta y$ ✓

$\underline{0 = v_i^2 + 2(9,8)(-0,9)}$ ✓

$v_i = \pm 4,2$

$v_i = 4,2 \text{ m.s}^{-1}$ upwards✓ (3)

3.4 $v_f = v_i + a\Delta t$ ✓

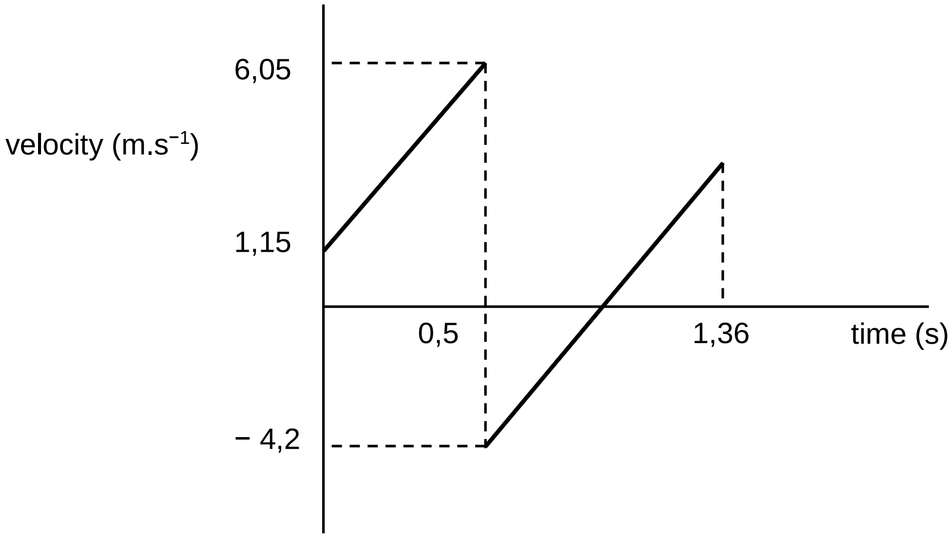
$\underline{0 = (-4,2) + (9,8)(\Delta t)}$ ✓

$\Delta t = 0,43 \text{ s}$ ✓

$t = 0,5 + 2(0,43) = 1,36 \text{ s}$ ✓ (4)

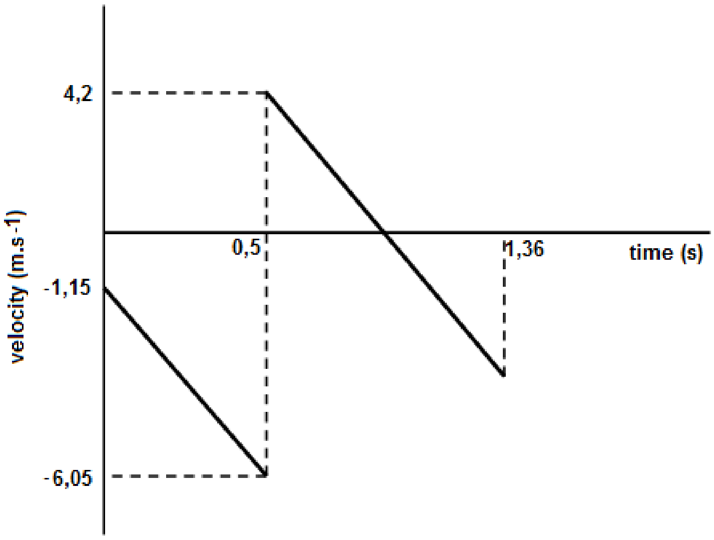
3.5 **DOWN AS POSITIVE:**

- Axes correctly labelled ✓
- Graph correctly drawn ✓ (Lines must be parallel)
- Values of velocities and time t, correctly marked ✓✓✓✓



UPWARD AS POSITIVE:

- Axes correctly labelled ✓
- Graph correctly drawn ✓ (Lines must be parallel)
- Values of velocities and time t, correctly marked ✓✓✓✓



(6)

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QUESTION 4

4.1 The total (linear) momentum remains constant/is conserved ✓in an isolated/a closed system/the absence of external forces. ✓
Die totale lineêre momentum bly konstant/behoue ✓ in 'n geïsoleerde sisteem/geslote sisteem/die afwesigheid van eksterne kragte. ✓ (2)

4.2

To the right as positive/*Na regs as positief:*	**To the right as negative/*Na regs as negatief:***
$\Sigma p_{before/voor} = \Sigma p_{after/na}$ ✓ $\underline{(2)(5) + (9)(0)}$ ✓ = $\underline{(2)v_{f1} + (9)(1)}$ ✓ $\therefore v_{f1} = 0,5\ m.s^{-1}$ right ✓	$\Sigma p_{before/voor} = \Sigma p_{after/na}$ ✓ $\underline{(2)(-5) + (9)(0)}$✓ = $\underline{(2)v_{f1} + (9)(-1)}$✓ $v_{f1} = -0,5\ m.s^{-1}$ $\therefore v_{f1} = 0,5\ m.s^{-1}$ right ✓

<u>Other formulae/*Ander formules*:</u>	**<u>Notes/*Aantekeninge:*</u>**
$m_1v_{i1} + m_2v_{i2} = m_1v_{f1} + m_2v_{f2}$ or/*of* $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$ or/*of* $m_1v_{i1} + m_2v_{i2} = (m_1 + m_2)v_{f2}$	If no formula/principle – Max. $\frac{3}{4}$ *Indien geen formule/beginsel – Maks.* $\frac{3}{4}$

4.3

Option 1: (Wooden block)	**Option 2: (Wooden block)**
$F_{net}\Delta t = m\Delta v$ ✓ OR $F_{net}\Delta t = \Delta p$ $F_{net}(0,6)$ ✓ $= 2(0,5 – 5)$ ✓ $F_{net} = -15\ N$ $\therefore$ magnitude of $F_{net} = 15\ N$✓	$v_f = v_i + a\Delta t$ $0,5 = 5 + a(0,6)$ ✓ $a = -7,5\ m{\cdot}s^{-2}$ $F_{net} = ma$ $= (2)(-7,5)$ ✓ $= -15\ N$ $\therefore$ magnitude of $F_{net} = 15\ N$✓ ✓For both equations;
OPTION 3: (Crate)	**OPTION 4: (Crate)**
$F_{net}\Delta t = m\Delta v$ ✓ OR $F_{net}\Delta t = \Delta p$ $F_{net}(0,6)$ ✓ $= 9(1 – 0)$ ✓ $F_{net} = 15\ N$ $\therefore$ magnitude of $F_{net} = 15\ N$✓	$v_f = v_i + a\Delta t$ $1 = 0 + a(0,6)$ ✓ $a = 1,67\ m{\cdot}s^{-2}$ $F_{net} = ma$ $= (9)(1,67)$ ✓ $= 15\ N$ $\therefore$ magnitude of $F_{net} = 15\ N$✓ ✓For both equations;

(4)

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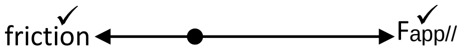
QUESTION 5

5.1



✓ = relative size of arrows correct. (3)

5.2 Non-conservative force = FRICTION ✓ (1)

5.3 The <u>net/total work done on an object</u> ✓is <u>equal to the change in the object's kinetic energy</u> ✓OR <u>the work done on an object by a resultant/net force</u> is <u>equal to the change in the object's kinetic energy</u>. (2)

5.4

<u>OPTION 1/*OPSIE 1*</u>

$W_{net} = \Delta E_k$ ✓

$F_{app||}\Delta x\cos\theta + f\Delta x\cos\theta = \frac{1}{2} m(v_f^2 - v_i^2)$

$(45)\cos 30^0$✓ $\underline{(3,5)\cos 0^0}$ ✓+ $\underline{f(3,5)\cos 180^0}$ ✓= $\underline{\frac{1}{2}(25)(10,8^2 - 12^2)}$✓

f = 136,69 N ✓

<u>OPTION 2/*OPSIE 2*</u>

$W_{net} = \Delta E_k$ ✓

$F_{applied}\Delta x\cos\theta + f\Delta x\cos\theta = \frac{1}{2} m(v_f^2 - v_i^2)$

(45)✓ $\underline{(3,5)\cos 30^0}$ ✓+ $\underline{f(3,5)\cos 180^0}$ ✓= $\underline{\frac{1}{2}(25)(10,8^2 - 12^2)}$✓

F = 136,69 N ✓

<u>OPTION 2/*OPSIE 2*</u>

$W_{nc} = \Delta E_k + \Delta E_p$ ✓

$f\Delta x\cos\theta + F_{app||}\Delta x\cos\theta = \frac{1}{2} m(v_f^2 - v_i^2) + mg(h_f - h_i)$

$\underline{f(3,5)\cos 180^0}$✓+ $\underline{(45)\cos 30^0(3,5)\cos 0^0}$ ✓= $\underline{\frac{1}{2}(25)(10,8^2 - 12^2)}$✓ + 0]✓

f = 136,69 N ✓

<u>OPTION 4</u> (Equations of motion = 4/6 max)

- $a = -3,91\ m.s^{-2}$
- $F_{net} = -97.71$ N
- $f = F_{net} - F_{applied//} = 136,68$ N

(6)

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QUESTION 6

6.1 An (apparent) change in observed/detected frequency (pitch), (wavelength) ✓as a result of the relative motion between a source and an observer ✓ (listener). (2)

6.2 To the left. ✓ (1)

6.3 The wavelength is smaller / has decreased. ✓ (**NOT closer together**.) (1)

6.4 The pitch will be higher /increased ✓ as the source approaches and will drop/decrease ✓ suddenly as the source passes and will increase back to the normal frequency as the source slows down and stops. ✓ (3)

6.5 $f_L = \frac{v \pm v_L}{v \pm v_S} f_S$ ✓

$1{,}003 f_S ✓ = \frac{1470 + 0}{1470 - v_S} f_S ✓$

$\therefore\ v_s = 4{,}4\ m.s^{-1}$ ✓ (4)

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QUESTION 7

7.1.1 The electric field at a point is the electrostatic force experienced ✓per unit positive charge placed at that point. ✓ (2)

7.1.2

$E_M = \frac{kQ}{r^2}$ ✓

$E_M = \frac{(9 \times 10^9)(3 \times 10^{-9})}{(30 \times 10^{-3})^2}$ ✓

$E_M = 30\ 000\ N.C^{-1}$ to the right ✓

$E_N = \frac{(9 \times 10^9)(5 \times 10^{-9})}{(10 \times 10^{-3})^2}$ ✓

$E_N = 450\ 000\ N.C^{-1}$ to the left ✓

Take right as positive

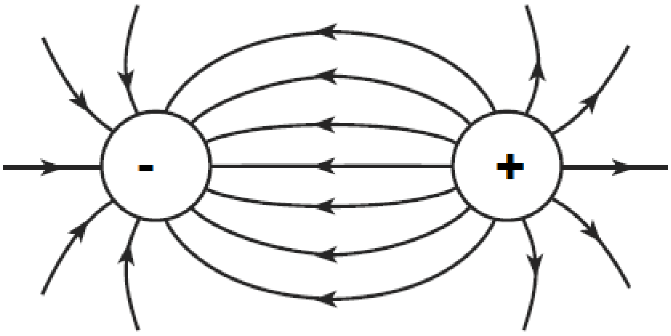
$E_{net} = 30\ 000\ N.C^{-1} - 450\ 000\ N.C^{-1}$

$E_{net} = -420\ 000\ N.C^{-1}$

$E_{net} = 420\ 000\ N.C^{-1}$ to the left ✓

(6)

7.2.1



Criteria:

Correct shape as shown. ✓
Direction from positive to negative. ✓
Field lines start on spheres and do not cross. ✓

(3)

7.2.2 $F = \frac{(9x10^9)✓(4x10^{-9})(6x10^{-9})✓}{(0,1)^2✓}$

$= 2,16x10^{-5}\ N$

$\therefore magnitude\ of\ F = 2,16x10^{-5}\ N$✓ (4)

7.2.3 $\frac{Q_1 + Q_2}{2} = \frac{4x10^{-9} + 6x10^{-9}}{2}$✓ $= 1\ x\ 10^{-9}\ C$✓ (2)

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QUESTION 8

8.1.1 $P = I^2R$ ✓

$(2) = I^2(8)$ ✓

$I = 0,5$ A ✓ (3)

8.1.2 V across 8 Ω and 2 Ω

$R_{(series)} = 8\ \Omega + 2\ \Omega = 10\ \Omega$ ✓

$V = IR = (0,5)(10)$ ✓

$V = 5V$ = reading on V_2 ✓ (3)

8.1.3 For R_1

$V = (10,8) - (5) = 5,8$ V ✓

$V = IR$

$5,8 = I(2,9)$ ✓

$I = 2A$ = current through battery ✓ (3)

8.1.4 $\mathcal{E} = IR + Ir$ ✓

(12) ✓ $= (10,8)$ ✓ $+ (2)r$

$r = 0,6\ \Omega$ ✓ (4)

8.2 Become zero.✓

All current will flow through the conductor and no current will flow through R_2/R_3 (R_2/R_3 will be short circuited) ✓ (2)

[15]

QUESTION 9

9.1 Electromagnetic induction. ✓ (1)

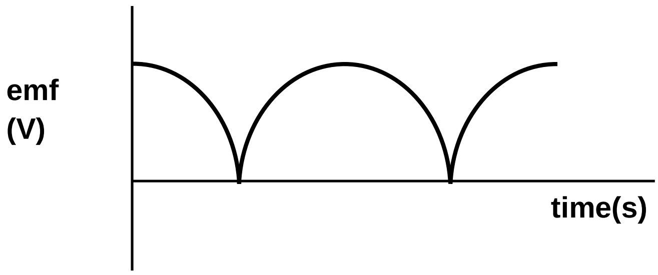
9.2 Split ring commutator .✓ (1)

9.3 The commutator converts the alternating current (AC) from the armature (coil) to direct current (DC) in the external circuit. ✓ (1)

9.4 Y to X ✓ (1)

9.5 Decrease ✓
In the horizontal position the coil cuts the maximum number of field lines per second ie the rate of change of flux is a maximum and the emf is a maximum.✓
In the vertical position the rate of change of flux is a minimum and the emf is a minimum.✓ (3)

9.6 Axes labelled ✓.
Shape of graph✓



(2)

[9]

QUESTION 10

10.1 $V_{rms} = \frac{V_{max}}{\sqrt{2}}$ ✓

$V_{max} = (210)\sqrt{2}$ ✓

$= 296,98 \text{ V}$ ✓ (3)

10.2 $P_{ave} = \frac{V^2_{rms}}{R}$ ✓

$R = \frac{230^2}{1800}$ ✓

$R = 29,39\ \Omega$

During cutback

$P_{ave} = \frac{V^2_{rms}}{R}$

$P_{ave} = \frac{210^2}{29,39}$ ✓

$P_{ave} = 1500,57 \text{ W}$ ✓ (4)

[7]

QUESTION 11

11.1 Photo-electric effect ✓/ *Foto-elektriese effek* (1)

11.2 The minimum frequency of light needed to emit electrons from the surface of a metal ✓✓
Die minimum frekwensie van lig benodig om elektrone vanaf die oppervlakte van 'n metal vry te stel (2)

11.3 $E = W_o + E_{k(max/maks)}$
$5,6 \times 10^{-19} = (6,63 \times 10^{-34})(7,2 \times 10^{14}) + E_{k(max/maks)}$ ✓
$\therefore E_{k(max/maks)} = 8,26 \times 10^{-20}$ J ✓ (3)

11.4
11.4.1 Remains the same✓ / *Dieselfde bly* (1)

11.4.2 Increases ✓ / *Toeneem* (1)

11.5

<u>OPTION 1/*OPSIE 1*</u> $c = f.\lambda$ ✓ $3 \times 10^8 = f(6,22 \times 10^{-9})$ ✓ $f = 4,82 \times 10^{14}$ Hz ✓ No, the frequency of light source is below the threshold frequency of the metal✓ *Nee, die frekwensie van die ligbron is laer as die drumpelfrekwensie van die metal*
<u>OPTION 2/*OPSIE2*</u> $E = \frac{hc}{\lambda}$ ✓ $= \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{(622 \times 10^{-9})}$ ✓ $= 3,19 \times 10^{-19}$ J $W_0 = hf_o$ $= (6,63 \times 10^{-34})(7,2 \times 10^{14})$ $= 4,77 \times 10^{-19}$ J ✓ No, E light source < W_0 ✓ *Nee. E van ligbron < W_o*

(4)
[12]

GRAND TOTAL/*GROOTTOTAAL*: 150