**Grade 12** **Physical Sciences**

**MEMO** **Aug 2015** **Paper 1**

## Question 1

1 C✓✓

2 B

3 A

4 A

5 D

6 B

7 D

8 D

9 A

10 C **[20]**

## Question 2

2.1 Distance is the length of path travelled✓.
Susie travels the greater distance.✓ (2)

2.2 Displacement is a change in position.✓
Neither✓ (2)

2.3 From A to B: $t = s/v = 240/1,5$ ✓$= 160s$✓
∴ time from B to C = (3 x 60) – 160 ✓$= 20s$✓
∴ v between B and C = $s/t = 100/20$ ✓$= 5\ m.s^{-1}$✓ (6)

2.4 $v = s/t = 340/180$ ✓✓$= 1,89\ m.s^{-1}$✓ (3)

2.5 Distance from A to C: $s^2 = 240^2 + 100^2$
∴ s = 260m✓
$V = s/t = 260/180 = 1,44 m.s^{-1}$✓✓
tan Θ = 100/240✓
∴ Θ = 22,62˚ w.r.t. the bridge ✓ (5)

**[18]**

**Question 3**

3.1 

Label: Weight / Gravitational force (1)

3.2.1 Choosing up as positive:

$v = u + at$ ✓

$0 = 10$✓ $+ (-9,8)$✓$t$

$\therefore t = 1,02s$ ✓ (4)

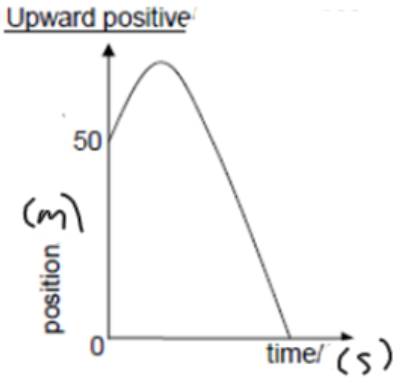
3.2.2 $v^2 = u^2 + 2as$✓

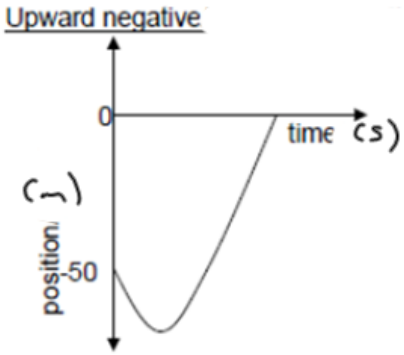
$0^2 = 10^2 + 2(-9,8).s$✓

$\therefore s = 5,1m$✓

$\therefore$ height above ground $= 50 + 5,1 = 55,1m$ ✓ (4)

3.3




Axes correctly labelled = 1✓

Graph ends on x-axis ✓

Shape of graph✓ (3)

3.4

**Option 1**

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

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

$\therefore v_i = 14,51\ m{\cdot}s^{-1}$

From maximum height

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$14,51^2$✓ $= (0)^2 + 2(9,8)\Delta y$ ✓

$\therefore \Delta y = 10,74\ m$

Height/ $= 55,1 - 10,74$

$= 44,36\ m$ ✓

**Option 2**

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

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

$\therefore v_i = 14,51\ m{\cdot}s^{-1}$

Downwards from top of tower to top of window:

$v_f^2 = v_i^2 + 2a\Delta y$ ✓

$14,51^2$✓ $= (10)^2 + 2(9,8)\Delta y$ ✓

$\therefore \Delta y = 5,64\ m$

Height/ $= 50 - 5,64$

$= 44,36\ m$ ✓

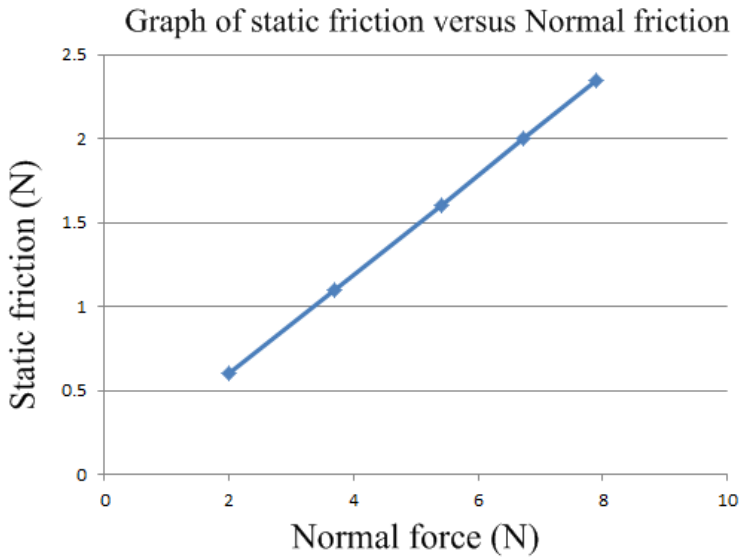
**Question 4**

4.1 place block on surface
- Attach string to block and spring balance✓
- Pull until block just starts to move✓
- Record reading
- Repeat!!✓
- Add mass pieces to block and repeat above steps✓
- Continue until 790g achieved (4)

4.2 Static friction force ✓ (1)

4.3 mass of block OR normal force ✓ (1)

4.4




- Heading✓
- Axes labelled✓
- Suitable scale✓
- Points plotted✓✓
- Straight line ✓

(6)

4.5 Choose value: f = 2,4; N = 8;✓ f = μN; 2,4 = μ x 8;✓ μ = 2,4 / 8 = 0,3✓ (3)

4.6 Once block has started moving ✓measure force needed to keep block moving ✓at the same speed as per method above. (2)

4.7 smaller ✓ (1)

4.8 grip when walking (or alternative) ✓✓ (2)

4.9 starting to pull something eg roller, box ✓✓ etc (2)

**[22]**

**Question 5**

5.1 $E_P = mgh = (0,6 + 0,002)(9,8)(0,086) = 0,507$ J (5)

5.2 $E_{MECH}$ at top = $E_{MECH}$ at bottom
$(E_K + E_P)_{TOP} = (E_K + E_P)_{BOTTOM}$
$\therefore 0 + 0,507 = ½(0,6 + 0,002)v^2 + 0$
$0,507 = 0,301v^2$
$\therefore v^2 = 0,507 / 0,301$
$\therefore v = 1,3$ m.s$^{-1}$ (4)

5.3 The total (linear) momentum is conserved in a closed (isolated) system. (3)

5.4 Total p before = total p after
$m_1u_1 + m_2u_2 = (m_1 + m_2)v$
$\therefore (0,002)u_1 + (0,6)(0) = (0,002 + 0,6)(1,3)$
$\therefore 0,002.u_1 = 0,7826$
$\therefore u_1 = 391,3$ m.s$^{-1}$ (5)

5.5 $E_K = ½mv^2 = ½ \times 0,002 \times 391,3^2 = 153,1$ J (3)

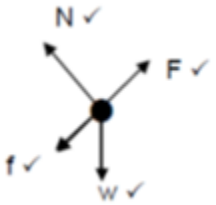
5.6 Collision is inelastic since $E_K$ is not conserved.
OR $E_K$ lost as heat and sound (3)
($E_K$ before is greater than $E_K$ after the collision)

**[22]**

**Question 6**

6.1 Power is the rate at which work is done or the rate at which energy is transferred✓✓ (2)

6.2




W = force of earth on truck / weight / gravitational force
N = Normal force
F = Force of engine
F = force of friction (4)

6.3 The work done by a net force on an object is equal to the change in the kinetic energy of the object ✓✓ (2)

6.4 $W_F = 8,5 \times 10^4 + (5000)(9,8)(55)$ ✓✓$= 2,78 \times 10^6$ J ✓ (3)

Or

$W_{NET} = \Delta E_K$
$W_F + W_f + W_w = K_f - K_i$
$W_F - 8,5 \times 10^4 - (5000)(9,8)(55) = 0$
$W_F = 2,78 \times 10^6$ J

| **OPTION 1/*OPSIE 1*** | **Notes/*Aantekeninge:*** |
|---|---|
| $W_{net} = \Delta K$ ✓<br>$W_F + W_f + W_w = K_f - K_i$<br>$W_F - 8,5 \times 10^4$ ✓$+ (5\,000)(9,8)(55)\cos 180°$✓ $= 0$✓<br>$\therefore W_F = 2,78 \times 10^6$ J✓ | Accept/*Aanvaar*:<br>$W_{net} = \Delta E_k$<br>$W_{net} = E_{kf} - E_{ki}$ |
| **OPTION 2/*OPSIE 2*** | **Notes/*Aantekeninge:*** |
| $W_{net} = \Delta K$ ✓<br>$W_F + W_f - \Delta E_p = K_f - K_i$<br>$W_F - 8,5 \times 10^4$✓ $- (5\,000)(9,8)(55)$ ✓ $= 0$✓<br>$\therefore W_F = 2,78 \times 10^6$ J ✓ | Accept/*Aanvaar*:<br>$W_{net} = \Delta E_k$<br>$W_{net} = E_{kf} - E_{ki}$ |

6.5

$$P = \frac{W}{\Delta t} \checkmark$$
$$= \frac{2,78 \times 10^6}{60} \checkmark$$
$$= 4,63 \times 10^4 \text{ W} \checkmark$$

(3)

6.6 Smaller than ✓
Weight does positive work on the truck ✓ (2)

**[16]**

**Question 7**

7.1.1 II✓

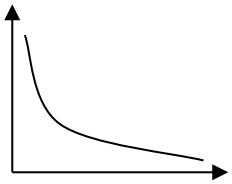
7.1.2 III✓

7.1.3 I✓

7.1.4 I✓ (4)

7.2 Newton's Law of Universal Gravitation ✓
Every particle in the universe attracts every other particle with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres✓✓ (3)

7.3



✓✓ (2)

7.4 $F = G.m_1.m_2/r^2$ ✓
$= (6,67x10^{-11}x110x4x10^{15})/ 9000^2$ ✓✓
= 0,362 N✓ (4)

7.5 Man pulls comet ✓✓ (2)

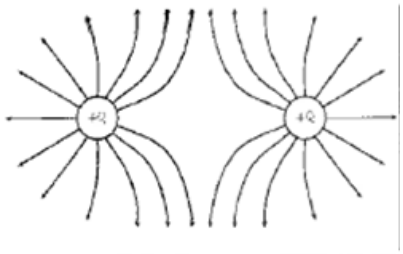
**[15]**

**Question 8**

8.1 To ensure charge does not leak to the ground / insulated. ✓ (1)

8.2 $$\text{Net charge/}\textit{Netto lading} = \frac{Q_R + Q_S}{2} = \frac{+8+(-4)}{2} \checkmark = 2\ \mu C \checkmark$$ (2)

8.3



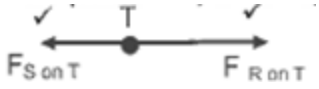
Correct direction of lines ✓

Shape of electric field ✓

No field lines crossing ✓

(3)

8.4




(2)

8.5

**OPTION 1/**

$F = k\frac{Q_1Q_2}{r^2}$ ✓

$F_{ST} = (9\times10^9)\frac{(1\times10^{-6})(2\times10^{-6})}{(0,2)^2}$ ✓ ✓ $= 0,45\ N / 4,5 \times 10^{-1}\ N$ left/

**OR**

$F_{TS} = \frac{1}{4}F_{RT} = \frac{1}{4}(1,8) = 0,45\ N$

$F_{RT} = 9\times10^9 \times \frac{(2\times10^{-6})(1\times10^{-6})}{(0,1)^2}$ ✓ $= 1,8\ N$ right

**OR**

$F_{RT} = 4F_{ST} = 4(0,45) = 1,8\ N$ right

$F_{net} = F_{ST} + F_{RT} = 1,8 + (-0,45)$ ✓

$= 1,35\ N$ or towards sphere S or right. ✓

(6)

8.6 The force per unit positive charge ✓✓ (2)

8.7

**OPTION 1/**

$E = \frac{F}{q}\checkmark = \frac{1,35}{1\times10^{-6}}\checkmark = 1,35 \times 10^6\ N\cdot C^{-1}\checkmark$

**OPTION 2**

$E_R = \frac{kQ}{r^2}\checkmark = \frac{(9\times10^9)(2\times10^{-6})}{(0,1)^2}\checkmark = 1,8 \times 10^6\ N\cdot C^{-1}$ right

$E_S = \frac{kQ}{r^2} = \frac{(9\times10^9)(2\times10^{-6})}{(0,2)^2} = 4,5 \times 10^5\ N\cdot C^{-1}$ left

$E_{net} = 1,8 \times 10^6 - 4,5 \times 10^5 = 1,35 \times 10^6\ N\cdot C^{-1}\checkmark$

**OPTION 3/**

$E = \frac{F}{q}\checkmark = \frac{1,8}{1\times10^{-6}}\checkmark = 1,8 \times 10^6\ N\cdot C^{-1}$

$E = \frac{F}{q} = \frac{0,45}{1\times10^{-6}} = 4,5 \times 10^5\ N\cdot C^{-1}$

$E_{net} = 1,8 \times 10^6 - 4,5 \times 10^5 = 1,35 \times 10^6\ N\cdot C^{-1}\checkmark$

(3)

**[19]**

**Question 9**

9.1

$$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2}$$
$$= \frac{1}{4} + \frac{1}{16}$$
$$R = 3,2\ \Omega$$

(3)

9.2 Current through a conductor is directly proportional to the potential difference across the conductor at constant temperature✓✓ (2)

9.3.1

$$V_1 = IR$$
$$= 6 \times 3,2$$
$$= 19,2\ V$$

(4)

9.3.2

$$I = \frac{V}{R}$$
$$= \frac{19,2}{4}$$
$$= 4,8\ A$$

(4)

9.3.3

Current through 6 Ω resistor
$= 6 - 4,8$
$= 1,2\ A$

$$V_2 = IR$$
$$= 1,2 \times 6$$
$$= 7,2\ V$$ (4)

(4)

9.4

$$E = IR + Ir.$$
$$24 = 19,2 + 6r$$
$$\therefore r = \frac{24 - 19,2}{6}$$
$$= 0,8\ \Omega$$

(4)

**[21]**

**Question 10**

10.1 The induced current flows in a direction so as to set up a magnetic field to oppose the change in magnetic flux✓✓ (2)

10.2 Yes ✓ (1)

10.3 The product of the number of turns on the coil and the flux through the coil✓✓ (2)

10.4 As the magnet falls through the coil there is a **CHANGE in magnetic flux** (linkage) OR **change in the number of magnetic field** lines cutting through the coils ✓✓
(2)
[NB The **magnetic field lines are cutting through the coils** of the conductor OR **change in magnetic field ONLY 1 mark**]

10.5 The emf induced is directly proportional to the rate of change of magnetic flux ✓✓ (2)
(flux linkage)

10.6 South or S✓ (1)

10.7 B to A✓ (2)

**[12]**

**Question 11**

11.1 In series ✓ (Accept diagram of cells in series)
(1)

11.2 P = VI = 24 x 6 = 144W ✓✓✓ (3)

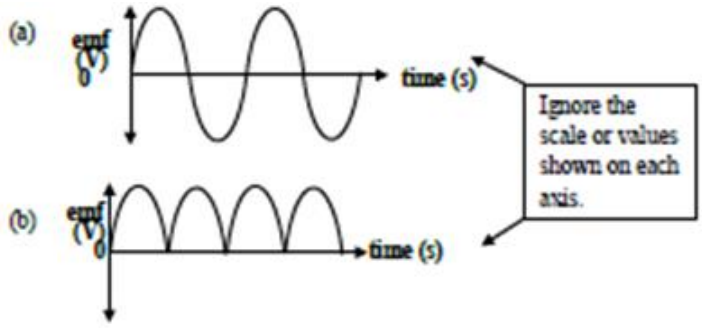
11.3.1 A component that only allows current to flow in one direction (2)

11.3.2 A rectifier changes a.c. to d.c. (2)

11.3.3 When W is positive current flows through **diode B** through the load **from Y to Z** and through **diode D** to X ✓✓✓ (3)
(no current passes through diodes A and C which are in reverse bias)

11.3.4 Step-down✓ (1)

11.3.5




(2)

(2)

**[16]**