DEPARTMENT OF EDUCATION
REPUBLIC OF SOUTH AFRICA

DEPARTEMENT VAN ONDERWYS
REPUBLIEK VAN SUID-AFRIKA

SENIOR CERTIFICATE EXAMINATION - 2005
SENIORSERTIFIKAAT-EKSAMEN - 2005

PHYSICAL SCIENCE P1 : PHYSICS
NATUUR- EN SKEIKUNDE V1 : FISIKA

HIGHER GRADE
HOËR GRAAD

FEBRUARY/MARCH 2005
FEBRUARIE/MAART 2005

304-1/1

Marks: 200
Punte : 200

2 Hours
2 Ure

This question paper consists of 15 pages and 2 data sheets.
Hierdie vraestel bestaan uit 15 bladsye en 2 gegewensblaaie.

PHYSICAL SCIENCE HG: Paper 1
Physics

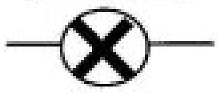
304 1 1 HG

X05

GENERAL INSTRUCTIONS

1. Write your **examination number** (and **centre number** if applicable) in the appropriate spaces on the answer book.
2. Answer **ALL** the questions.
3. Non-programmable calculators may be used.
4. Appropriate mathematical instruments may be used.
5. A data sheet is attached for your use.
6. NOTE: The following circuit diagram symbols are used in this paper:

Resistor :  instead of 

Bulb :  instead of 

7. Marks may be forfeited if instructions are not followed.

QUESTION 1

INSTRUCTIONS

1. Answer this question on the specially printed **ANSWER SHEET.** [NOTE: The answer sheet may be either a separate sheet provided as part of your question paper, or printed as part of the answer book.] Write your **EXAMINATION NUMBER** (and **centre number** if applicable) in the appropriate spaces, if a separate answer sheet is used.
2. Four possible answers, indicated by A, B, C and D, are supplied with each question. Each question has only ONE correct answer. Choose only that answer, which in your opinion, is the correct or best one and mark the appropriate block on the ANSWER SHEET with a cross (X).
3. Do not make any other marks on the answer sheet. Any calculations or writing that may be necessary when answering this question should be done in the answer book and must be deleted clearly by means of a diagonal line drawn across the page.
4. If more than one block is marked, no marks will be awarded for that answer.

PLACE THE COMPLETED ANSWER SHEET INSIDE THE FRONT COVER OF YOUR ANSWER BOOK, IF A SEPARATE ANSWER SHEET HAS BEEN USED.

EXAMPLE:
QUESTION: The symbol for the SI unit of time is ...

A t.
B h.
C s.
D m.

ANSWER:

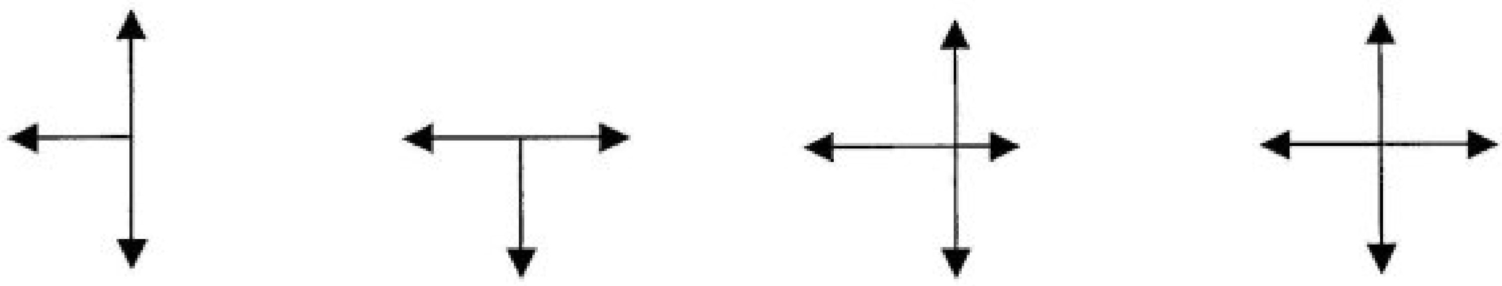
A	B	~~C~~ (X)	D

[NOTE: This layout may vary, depending on the type of answer sheet used by the province.]

QUESTION 1

1.1 A car moves horizontally at a constant velocity of 60 $km.h^{-1}$, in the direction shown.

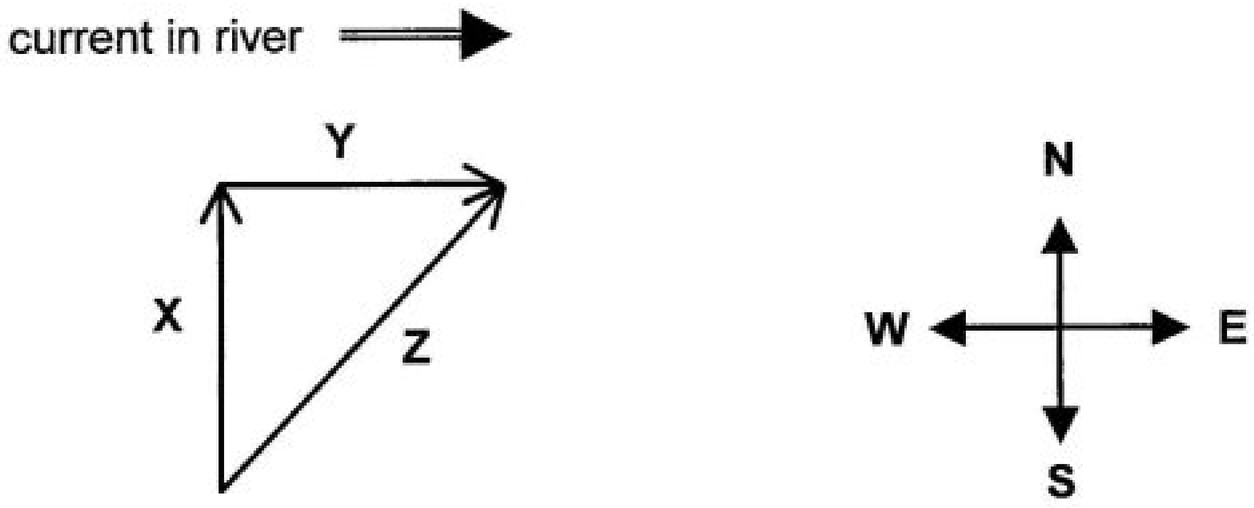
Which ONE of the following vector diagrams indicates all the forces acting on the car?



A B C D

(4)

1.2 A boat is aimed in a northerly direction while crossing a river in which water flows towards the east. The vector diagram below shows three relative velocities.



What is the most appropriate label of the vector marked Z in the diagram?

A Velocity of water relative to river bed.

B Velocity of boat relative to water.

C Velocity of boat relative to river bed.

D Velocity of water relative to boat. (4)

1.3 An acceleration of 5 $m.s^{-2}$ can be explained as follows:

A The velocity changes by 5 $m.s^{-1}$ every second.

B The velocity changes by 5 $m.s^{-1}$ every successive, equal time interval.

C The velocity changes by 5 $m.s^{-1}$ every successive, decreasing time interval.

D The velocity changes by 5 $m.s^{-1}$ every successive, increasing time interval. (4)

1.4 A car accelerates uniformly from rest. After travelling a distance, **d**, in a straight line in **t** seconds, it has a velocity **v**. At what time and distance during its motion did it reach a velocity $\frac{1}{2}\mathbf{v}$?

	Time	Distance
A	$\frac{t}{4}$	$\frac{d}{4}$
B	$\frac{t}{4}$	$\frac{d}{2}$
C	$\frac{t}{2}$	$\frac{d}{2}$
D	$\frac{t}{2}$	$\frac{d}{4}$

(4)

1.5 Soraya, standing on the surface of the earth, drops a ball. After the first second of its motion, it has a displacement **s**. A similar experiment is done on the surface of the moon. What would the displacement during the first second be if the gravitational acceleration on the moon is $\frac{1}{6}$ of that of the earth? (Ignore the effects of friction.)

A $\frac{1}{6}\mathbf{s}$

B $\frac{1}{3}\mathbf{s}$

C $\frac{3}{5}\mathbf{s}$

D $\frac{5}{6}\mathbf{s}$ (4)

1.6 Tammy travels from the ground floor to the fifth floor of a hotel in a lift. Which ONE of the following statements is **always TRUE** about the force exerted by the floor of the lift on Tammy's feet?

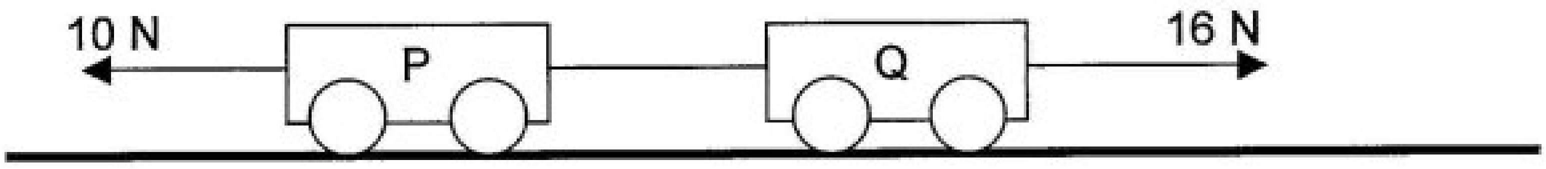
A It is greater than the magnitude of Tammy's weight.

B It is equal in magnitude to the force Tammy's feet exert on the floor.

C It is equal to what it would be in a stationary lift.

D It is greater than it would be in a stationary lift. (4)

1.7 Two trolleys, P and Q, of equal mass, are connected by a light, inelastic rope. A constant force of magnitude 10 N is applied to the left on P while a constant force of magnitude 16 N is applied to the right on Q. The trolleys move on a frictionless, horizontal surface.



The tension in the string between the trolleys is equal to …

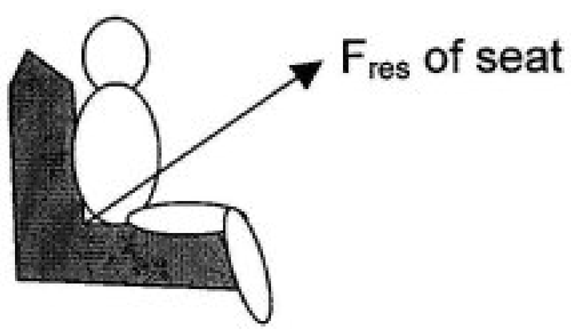
A 26 N.

B 16 N.

C 13 N.

D 6 N. (4)

1.8 Sipho, mass **m**, sits on a seat in a high-speed train which accelerates horizontally at 0,5 **g**, where **g** has the value of the acceleration due to gravity. The seat exerts forces on him such that the resultant force of the seat is as shown in the sketch.



What is the magnitude of the resultant force **of the seat** on Sipho?

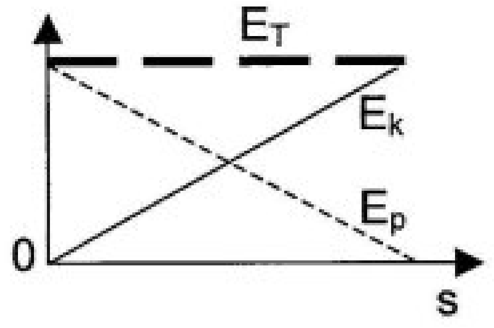
A (1 + 0,5) **mg**

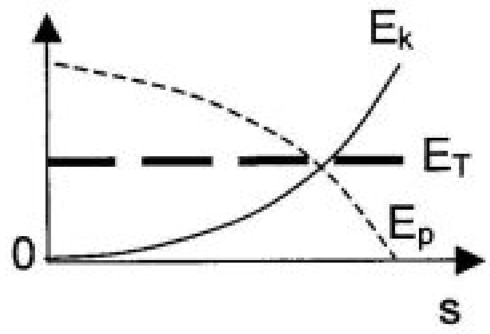
B $\sqrt{1^2 + (0,5)^2}$ **mg**

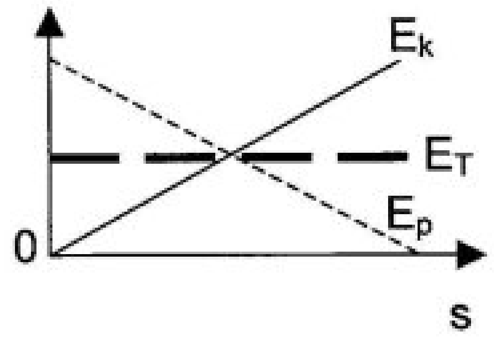
C 1,0 **mg**

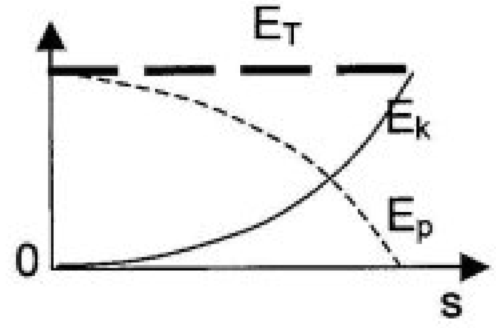
D 0,5 **mg** (4)

1.9 A ball is dropped from rest. Ignore air friction. Which ONE of the following graphs best represents the relationship between each of E_k (kinetic energy), E_p (gravitational potential energy) and E_T (total mechanical energy) as functions of the displacement of the ball?

A


B


C


D


(4)

1.10 An airplane accelerates from rest, along a straight line, and undergoes a displacement **s** during time **t**. The uniform thrust (force) of the engines is **F** and the resultant force on the airplane is $\mathbf{F_{res}}$. Which ONE of the following gives the increase in the kinetic energy of the plane if friction is taken into account?

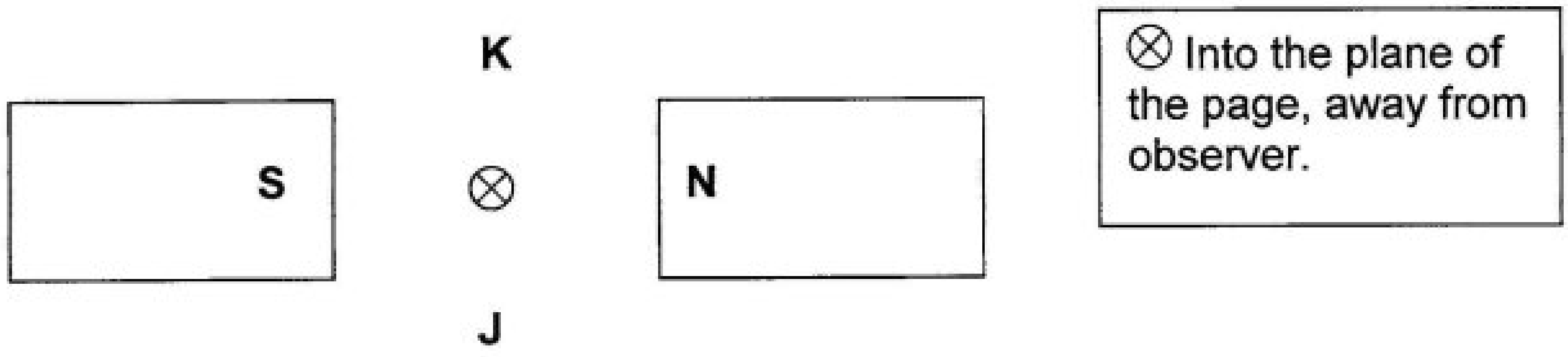
A **F.s**

B $\mathbf{F_{res}.s}$

C **F.t**

D $\mathbf{F_{res}.t}$ (4)

1.11 The south pole of a magnet is placed on the left-hand side and the north pole of another magnet on the right-hand side. A conductor placed between the two magnetic poles, carries conventional current into the plane of the page, as shown in the diagram below.



The conductor would experience a force ...

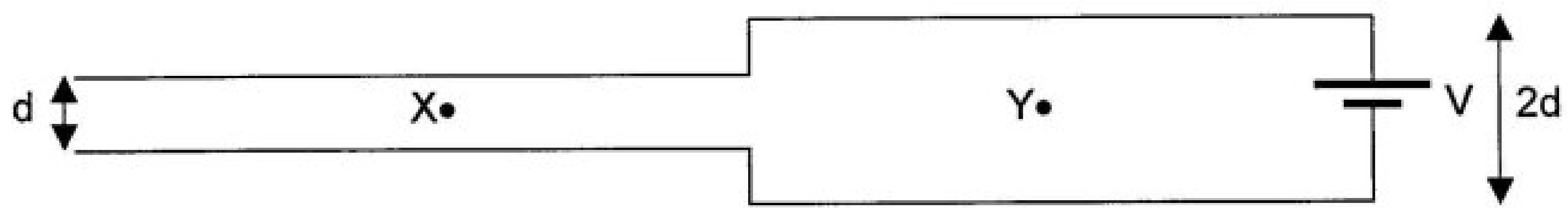
A downwards, towards J.

B upwards, towards K.

C to the right (the north pole of the magnet).

D to the left (the south pole of the other magnet). (4)

1.12 A charged oil drop is stationary at X between two oppositely charged, parallel plates. The distance between the plates is **d** at point X and 2**d** at point Y.



The drop is moved from X to Y. After being released at Y, it would move ...

A downwards with constant velocity.

B upwards with constant acceleration.

C upwards with constant velocity.

D downwards with constant acceleration. (4)

1.13 Potential difference can best be defined as ...

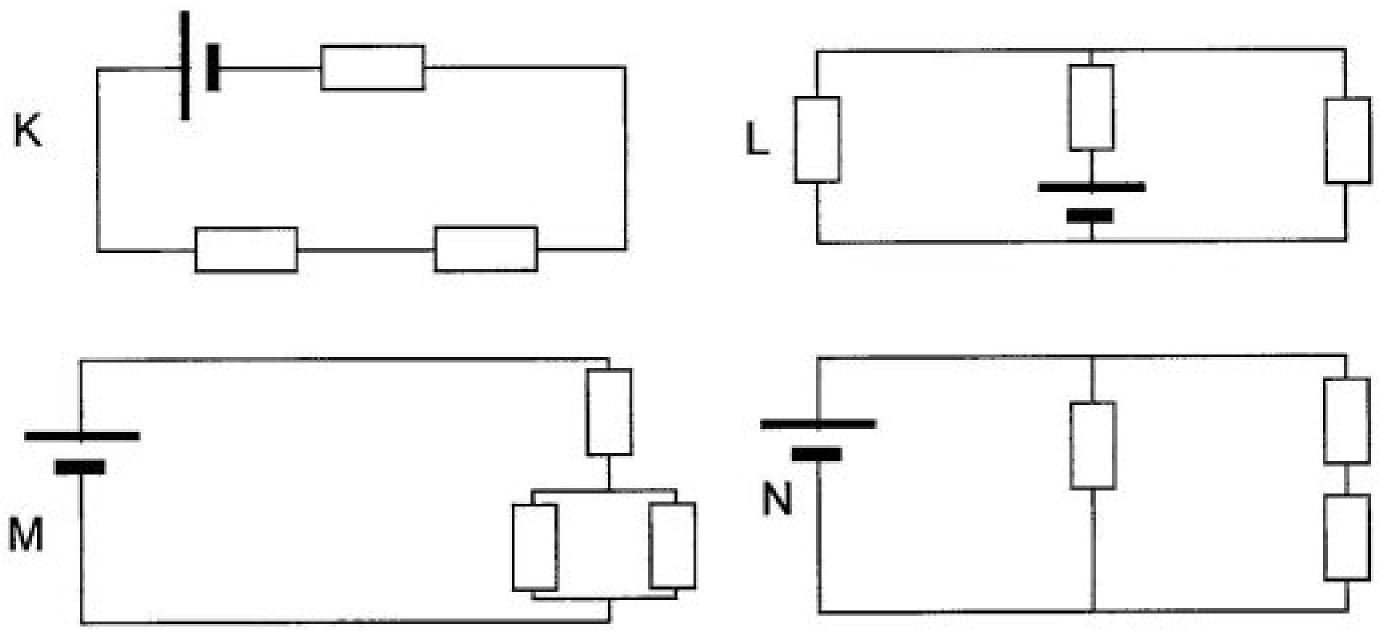
A the work done in moving a positive charge from a point of low potential to a point of high potential in an electric field.

B the force applied in moving a positive charge from a point of low potential to a point of high potential in an electric field.

C the work done in moving a positive unit charge from a point of low potential to a point of high potential in an electric field.

D the force applied in moving a positive unit charge from a point of low potential to a point of high potential in an electric field. (4)

1.14 Consider the circuits represented by the following circuit diagrams, K, L, M and N, containing identical cells and resistors.



Which ONE of the following pairs has the same effective resistance?

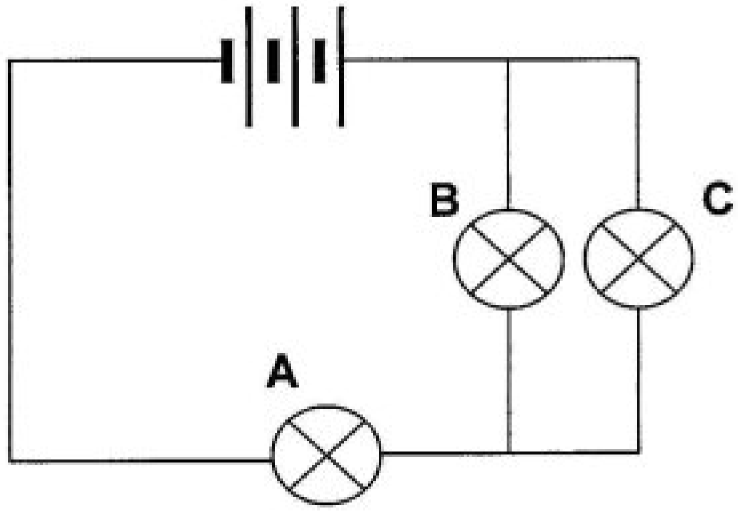
A Circuits K and L

B Circuits M and N

C Circuits K and N

D Circuits L and M (4)

1.15 Three identical bulbs, A, B and C, are connected to a battery. Assume the battery has negligible internal resistance.



Which ONE of the following combinations correctly represents the brightness of bulbs A and B, compared to their original brightness, if bulb C is removed?

	New brightness of bulb A	New brightness of bulb B
A	dimmer	brighter
B	brighter	dimmer
C	brighter	brighter
D	dimmer	dimmer

(4)
(15 x 4) [60]

ANSWER QUESTIONS 2 TO 10 IN THE ANSWER BOOK.

INSTRUCTIONS

1. Start each question on a **NEW PAGE** in the ANSWER BOOK.
2. Leave a line between subsections, for example 2.1 and 2.2.
3. Show ALL the formulae, as well as calculations, including substitutions.
4. Number the answers exactly as the questions are numbered.

QUESTION 2 [START ON A NEW PAGE]

A railway truck, mass 3 500 kg, fully laden with mealies, mass 1 500 kg, rests on a horizontal track with the handbrake engaged (Figure 1). In order to offload the mealies from the truck, the track is tilted at an angle to the horizontal (Figure 2).

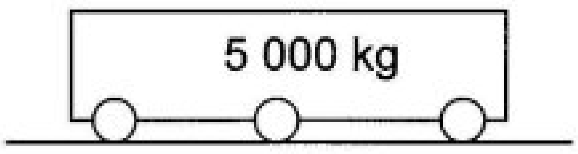


Figure 1

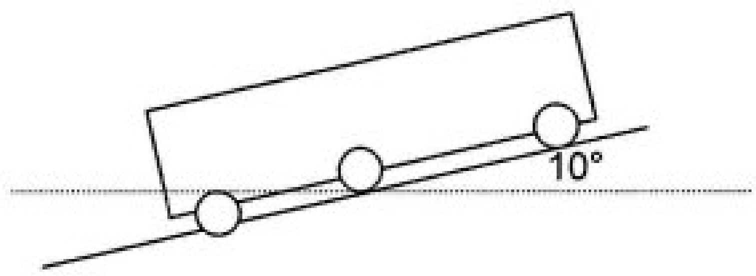


Figure 2

When the track is tilted 10° to the horizontal, the tailgate can be opened and the mealies can be released while the truck remains stationary.

2.1 Draw a labelled force vector diagram (**not a triangle of forces**) which shows the **gravitational force** of the earth acting on the truck and its **components** parallel and perpendicular to the inclined track. Also indicate at least ONE angle in your vector diagram. (4)

2.2 Determine, either by accurate construction (1 cm represents 10 000 N) or by calculation, the magnitudes of the components of the gravitational force (parallel and perpendicular to the inclined track) **before** the tailgate was opened. (5)

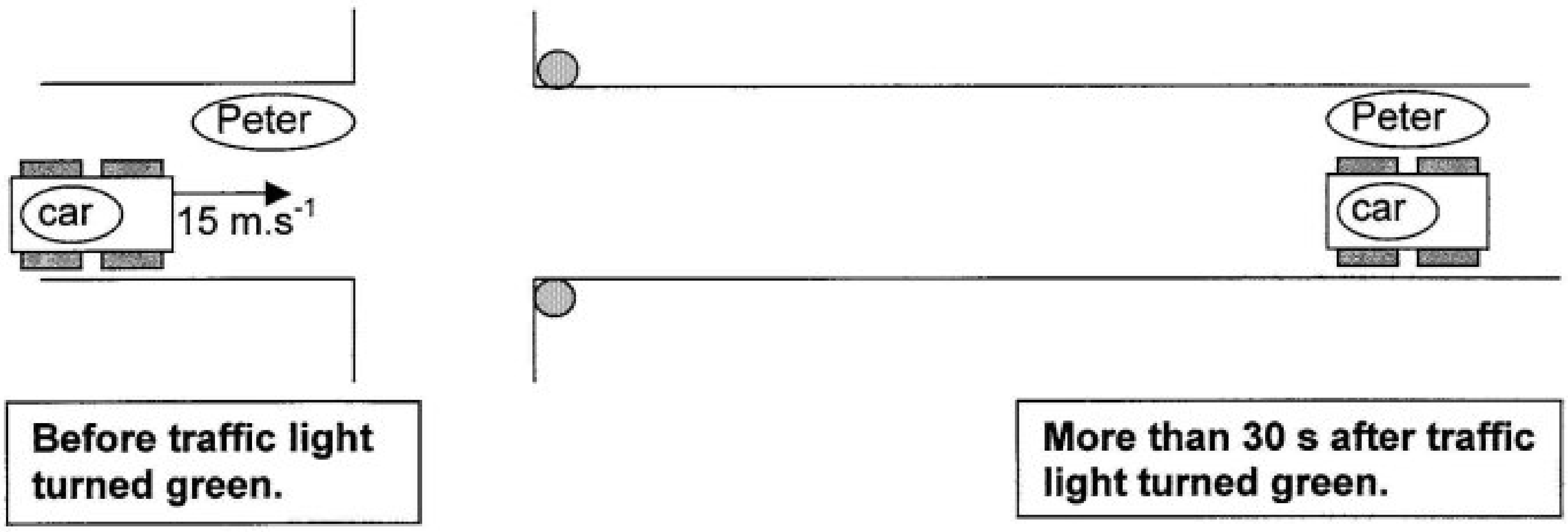
*Specifications from the manufacturers establish that the maximum frictional force between the wheels and the track, that will keep the **empty truck** from starting to slide along the track, with the handbrake on, is 15 890 N.*

2.3 Calculate the maximum angle that the track can be tilted before the empty railway truck, with the handbrake on, begins to slide down the track. (4)

[13]

QUESTION 3 **[START ON A NEW PAGE]**

Peter, a traffic policeman, is waiting on his motorbike at a traffic light for the red light to turn green. The driver of a car, travelling at a constant velocity of 15 m.s^{-1}, does not stop at the traffic light, passes Peter from behind and continues with the same velocity. Six seconds after being passed, the traffic light turns green and Peter starts from rest to follow the car. He accelerates uniformly at 0,8 m.s^{-2} for 30 s, reaches a maximum velocity, which he then maintains until he is alongside the car.



3.1 Calculate the magnitude of the maximum velocity which Peter attains during the 30 s period of acceleration. (4)

3.2 Calculate the distance that separates Peter and the car, 30 s after Peter started moving. (7)

3.3 Calculate how many more seconds Peter needs in order to be alongside the the car. (5)

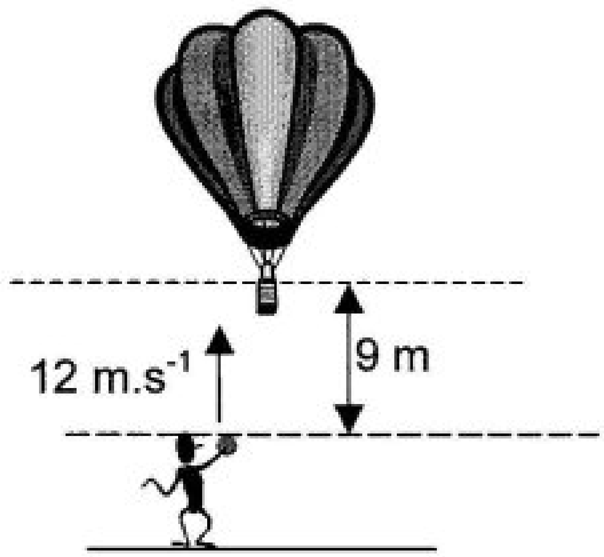
3.4 Calculate Peter's total displacement from **his start** until he is alongside the car. (4)

3.5 Draw a rough displacement-time graph for the motion of the **car and Peter**, on the same set of axes, from the instant the car passes Peter up to the instant when they are alongside each other. Clearly indicate ALL labels **and** the time and displacement values of the car and Peter at the critical points. (7)

[27]

QUESTION 4 [START ON A NEW PAGE]

Leila, in the basket of a hot-air balloon, is stationary at a height of 9 m above the level from where her friend, Bongi, will throw a ball. Bongi intends throwing the ball upwards and Leila, in the basket, needs to **descend** (move downwards) to catch the ball at its maximum height.



Bongi throws the ball upwards with a velocity of 12 m.s^{-1}. Leila starts her descent at the same instant the ball is thrown upwards, by letting air escape from the balloon, causing it to accelerate downwards. Ignore the effect of air friction on the ball.

4.1 Calculate the maximum height reached by the ball. (5)

4.2 Calculate the magnitude of the minimum average acceleration the balloon must have in order for Leila to catch the ball, if it takes 1,2 s for the ball to reach its maximum height. (5)

[10]

QUESTION 5 [START ON A NEW PAGE]

A system of two blocks, in contact with each other, is moving at a constant velocity of 5 m.s^{-1} to the right on a frictionless, horizontal surface.

A retarding force of 2 N is then applied horizontally to the 3 kg block.

5.1 Calculate the magnitude of the acceleration of the system. (3)

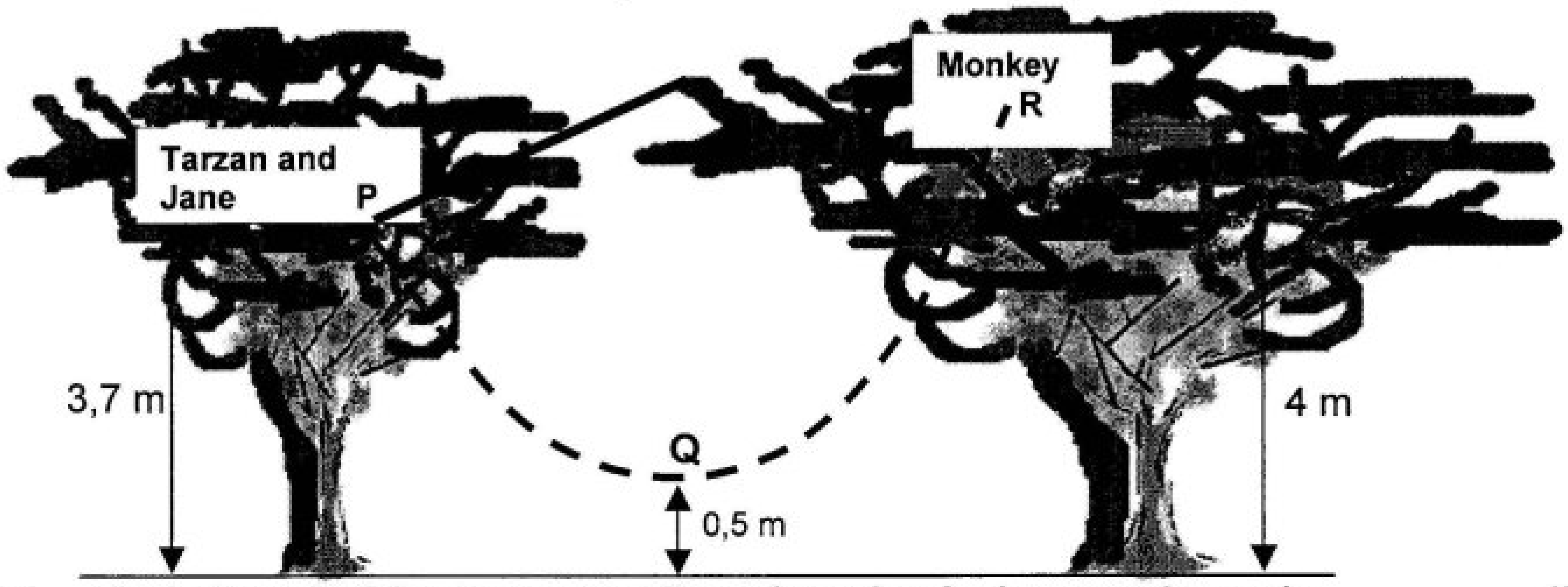
5.2 Calculate the resultant force on the 3 kg block. (3)

5.3 Calculate the magnitude of the force exerted by the 5 kg block on the 3 kg block. (4)

[10]

QUESTION 6 [START ON A NEW PAGE]

Tarzan and Jane are in a tree, at point P, 3,7 m above the ground. Tarzan sees a sick monkey in a tree opposite to them, at point R at a height of 4 m, which he would like to rescue. Tarzan has a mass of 80 kg and Jane has a mass of 50 kg. Ignore air friction.



6.1 State the principle of **conservation of mechanical energy** in words. (3)

6.2 Jane holds on to Tarzan and they swing down from P. Show that the magnitude of the velocity with which they swing through the lowest point, Q, is equal to 8 m.s^{-1}. Point Q is 0,5 m above the ground. (5)

Jane realises that they will not reach the monkey together. She decides to let go at point Q and to give Tarzan a push as she releases. She does this and continues moving horizontally to the right, at point Q, with a velocity of 6,4 m.s^{-1} at that instant.

6.3 Calculate the speed with which Tarzan leaves point Q, after Jane has pushed him. (6)

6.4 Determine, with relevant calculations, whether Tarzan will be able to reach the monkey . (6)

[20]

QUESTION 7 [START ON A NEW PAGE]

A rocket is to be launched vertically upwards. After the fuel in the rocket is ignited, the rocket is held back for 2 s to develop sufficient thrust (force) for the launch.

7.1 How much work is done on the rocket during this 2 s time interval? (2)

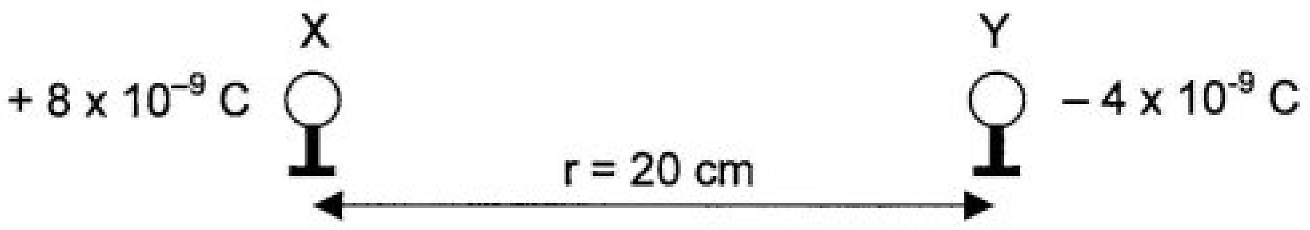
7.2 Draw labelled force diagrams and indicate the directions of the two action-reaction pairs relevant to this situation, **shortly after take-off**. The relative lengths of the vectors should correctly represent the magnitudes of the forces. (6)

7.3 Calculate the magnitude of the force developed by the rocket engine immediately after take-off if the rocket's acceleration is 4,5 m.s^{-2} upwards and its mass is 500 kg. (6)

[14]

QUESTION 8 **[START ON A NEW PAGE]**

Two identical, very small, charged spheres, X and Y, on insulated stands, are placed 20 cm apart, as indicated in the diagram. X has a charge of $+ 8 \times 10^{-9}$ C and Y has a charge of $- 4 \times 10^{-9}$ C.



8.1 State **Coulomb's law** in words. (4)

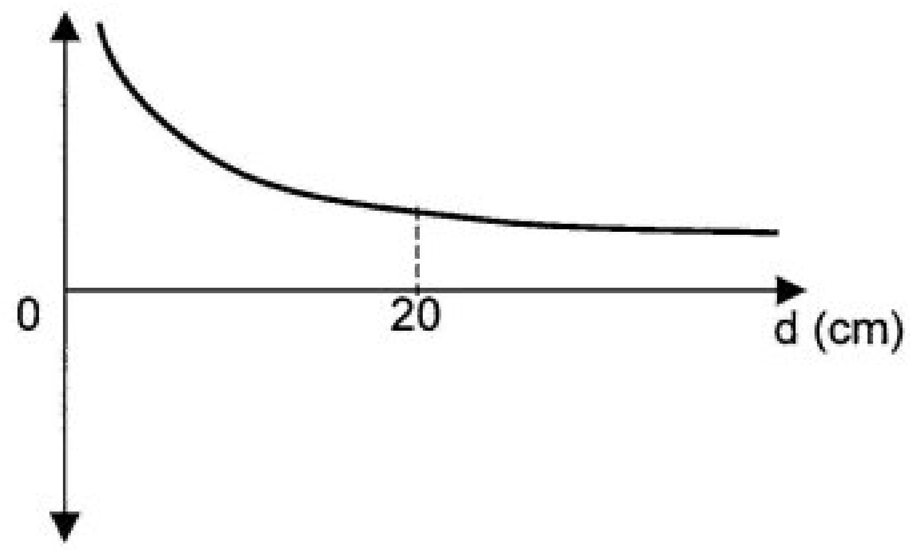
8.2 Calculate the magnitude of the electrostatic force which X exerts on Y. (5)

The charged sphere Y is brought closer towards X and is made to touch X. Sphere Y is then moved back to its original position which is 20 cm from X.

8.3 Calculate the new charges on X and Y after they have made contact and have been separated again. (3)

8.4 Is the new force which X exerts on Y, **bigger** or **smaller** than the original force and by what factor? (3)

8.5 The system of axes below shows the graph of the magnitude of the force the spheres exerted on each other as sphere Y was moved closer towards sphere X before contact.

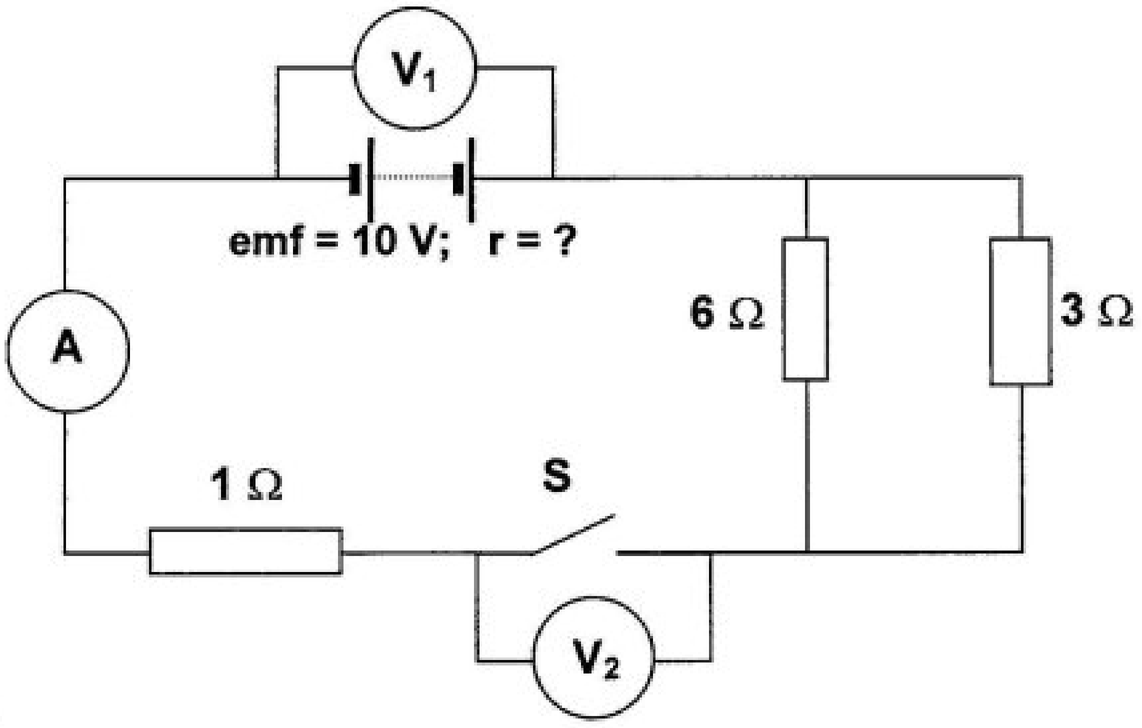


Redraw the above axes and graph in your answer book. Then add the graph which shows the variation of the force the spheres exert on each other as a function of the distance as they are moved apart, after contact, back to their original positions. The graph should clearly indicate the difference in the magnitude of the forces when X and Y are 20 cm apart. Label the vertical axis such that the nature of the forces, before and after contact, is clear. (5)

[20]

QUESTION 9 **[START ON A NEW PAGE]**

In the circuit represented below, the battery has an emf of 10 V and an unknown internal resistance. Voltmeter V_1 is connected across the battery and voltmeter V_2 is connected across the open switch S. The resistance of the connecting wires and ammeter can be ignored.



Switch S is open.

9.1 What is the reading on V_1? (2)

9.2 What is the reading on V_2? (2)

When switch S is closed, the reading on V_1 drops to 7,5 V.

9.3 What is the reading on V_2? (2)

9.4 Calculate the reading on the ammeter. (8)

9.5 Calculate the internal resistance of the battery. (5)

[19]

QUESTION 10 **[START ON A NEW PAGE]**

A car lamp is marked '12 V, 60 W'.

Calculate the quantity of electrical charge that passes through any point in the lamp in 2 minutes when operating according to the above-mentioned specifications. **[7]**

TOTAL QUESTION 1	:	**60**
TOTAL QUESTIONS 2 – 10	:	**140**
GRAND TOTAL	:	**200**

DEPARTMENT OF EDUCATION
DEPARTEMENT VAN ONDERWYS

SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

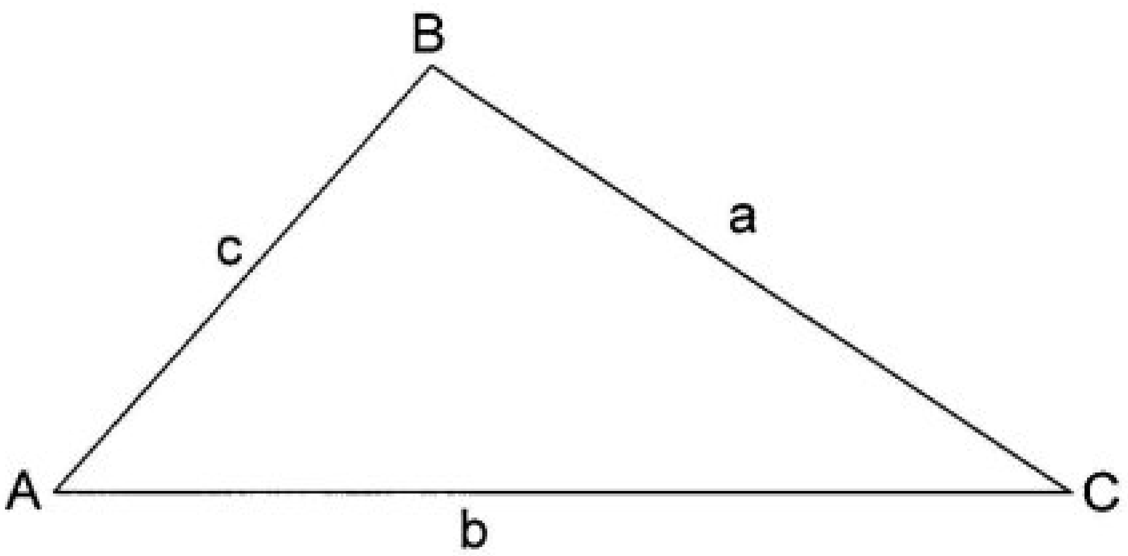
DATA FOR PHYSICAL SCIENCE
PAPER I (PHYSICS)

GEGEWENS VIR NATUUR- EN SKEIKUNDE
VRAESTEL I (FISIKA)

TABLE 1: PHYSICAL CONSTANTS
TABEL 1: FISIESE KONSTANTE

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Acceleration due to gravity Swaartekragversnelling	***g***	$10\ m.s^{-2}$
Gravitational constant Swaartekragkonstante	***G***	$6{,}7 \times 10^{-11}\ N.m^2.kg^{-2}$
Charge on electron Lading van elektron	e^-	$-1{,}6 \times 10^{-19}\ C$

MATHEMATICAL AIDS/WISKUNDIGE HULPMIDDELS



$$\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$$

$$c^2 = a^2 + b^2 - 2ab\cos C$$

TABLE 2: FORMULAE
TABEL 2: FORMULES

MOTION/BEWEGING

$v = u + at$	$s = ut + \frac{1}{2}at^2$
$v^2 = u^2 + 2as$	$s = \left(\frac{u+v}{2}\right)t$

FORCE/KRAG

$F_{res} = ma$	$p = mv$
$F = \frac{Gm_1m_2}{r^2}$	$F\,\Delta t = \Delta p = mv - mu$

WORK, ENERGY AND POWER/ARBEID, ENERGIE EN DRYWING

$W = Fs$	$E_p = mgh$
$P = \frac{W}{t}$	$E_k = \frac{1}{2}mv^2$

ELECTROSTATICS/ELEKTROSTATIKA

$F = \frac{kQ_1Q_2}{r^2}$ $(k = 9 \times 10^9\ N.m^2.C^{-2})$	$V = \frac{W}{Q}$
$E = \frac{F}{q}$	$W = QEs$
$E = \frac{kQ}{r^2}$ $(k = 9 \times 10^9\ N.m^2.C^{-2})$	$E = \frac{V}{d}$

CURRENT ELECTRICITY/STROOMELEKTRISITEIT

$Q = It$	emf/emk $= I(R + r)$
$R = r_1 + r_2 + r_3 + \ldots$	$F = \frac{kI_1 I_2 \ell}{d}$ $(k = 2 \times 10^{-7}\ N.A^{-2})$
$\frac{1}{R} = \frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \ldots$	$W = VIt = I^2Rt = \frac{V^2t}{R}$
$R = \frac{V}{I}$	$P = VI = I^2R = \frac{V^2}{R}$

NATIONAL DEPARTMENT OF EDUCATION

PHYSICAL SCIENCE (HG) – PAPER 1 / *NATUUR -en SKEIKUNDE (HG) – VRAESTEL 1*

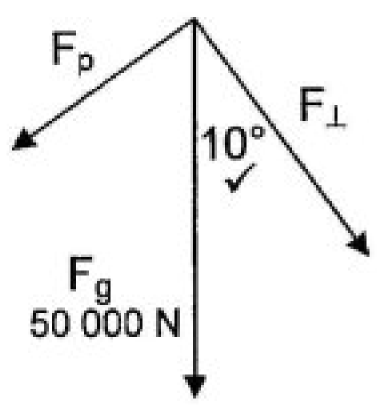
QUESTION 1 / VRAAG 1

1.1	D	1.2	C	1.3	A	1.4	D	1.5	A
1.6	B	1.7	C	1.8	B	1.9	A	1.10	B
1.11	B	1.12	D	1.13	C	1.14	D	1.15	A

[15 x 4 = 60]

QUESTION 2 / VRAAG 2

2.1



NOT W for weight
(If arrows missing : -1 max)
✓ orientation of 3 forces
✓ F_g : force of earth on truck / force of gravity / weight
✓ { F_p : parallel component of weight
{ $F_\perp$: perpendicular component of weight

(4)

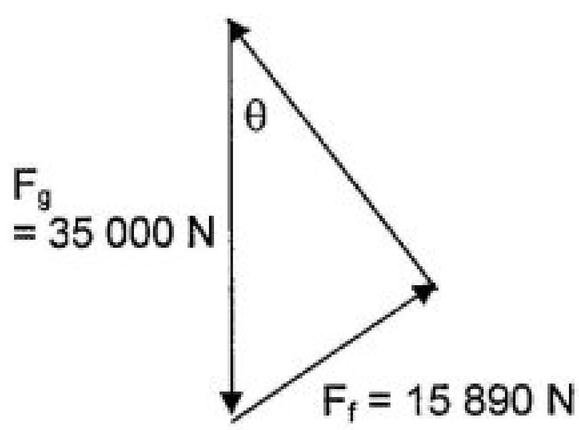
2.2

$F_p = F_g.\sin 10^\circ$
$= 50\,000 \times \sin 10^\circ$ ✓✓
$= 8\,682{,}41\ \text{N}$ ✓

$F_\perp = 50\,000 \times \cos 10^\circ$ ✓
$= 49\,240{,}39\ \text{N}$ ✓

(5)

2.3



$\sin\theta = \frac{15\,890}{35\,000}$ ✓ ✓✓
$\sin\theta = 0{,}454$
$\theta = 27^\circ$ ✓

(4)

[13]

QUESTION 3 / VRAAG 3

3.1

$$v = u + at \checkmark$$
$$= 0 \checkmark + (0,8)(30) \checkmark$$
$$= 24\ m.s^{-1} \checkmark$$

(4)

3.2

$$s_{bike} = ut + \frac{1}{2}at^2 \checkmark$$
$$= 0 \checkmark + \frac{1}{2}(0,8)(30)^2 \checkmark$$
$$= 360m \checkmark$$

$$s_{car} = ut + \frac{1}{2}at^2 \checkmark$$
$$= (15)(36) + 0 \checkmark$$
$$= 540m$$

Separating distance: $s = s_{car} - s_{bike}$
$$= 540 - 360$$
$$= 180m \checkmark$$

(7)

3.3

$$s_{bike} = vt = 24t \qquad s_{car} = vt = 15t$$

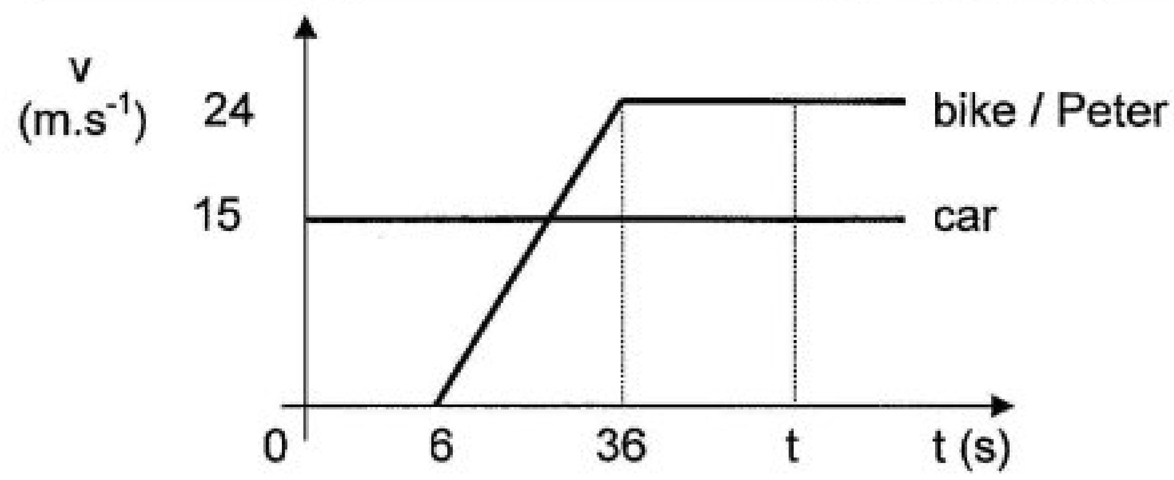
but $s = 180 = 24t - 15t$ ✓✓✓ ✓
$$180 = 9t$$
$$t = 20s \checkmark$$

OR

$$v_{car} = 24 m.s^{-1}$$
$$v_{bike} = 15 m.s^{-1}$$

$\therefore$ bike catches up at 9 m every second. ✓✓

$$\therefore t = \frac{180 \checkmark}{9 \checkmark} = 20\,s \checkmark$$



$$s_{bike} = s_{car}$$
$$\frac{1}{2}(30)(24) \checkmark + 24(t-36) \checkmark = 15t \checkmark\checkmark$$
$$9t = 504$$
$$t = 56\,s$$

$\therefore$ Peter requires $(56-36) = 20\,s$ ✓

$$s_{bike} = s_{car}$$
$$\frac{1}{2}(30)(24) \checkmark + 24(t-36) \checkmark\checkmark = (36)(15) + 15(t-36) \checkmark$$
$$9t = 504$$
$$t = 56\,s \checkmark$$

$\therefore$ Peter requires $(56-36) = 20\,s$

(5)

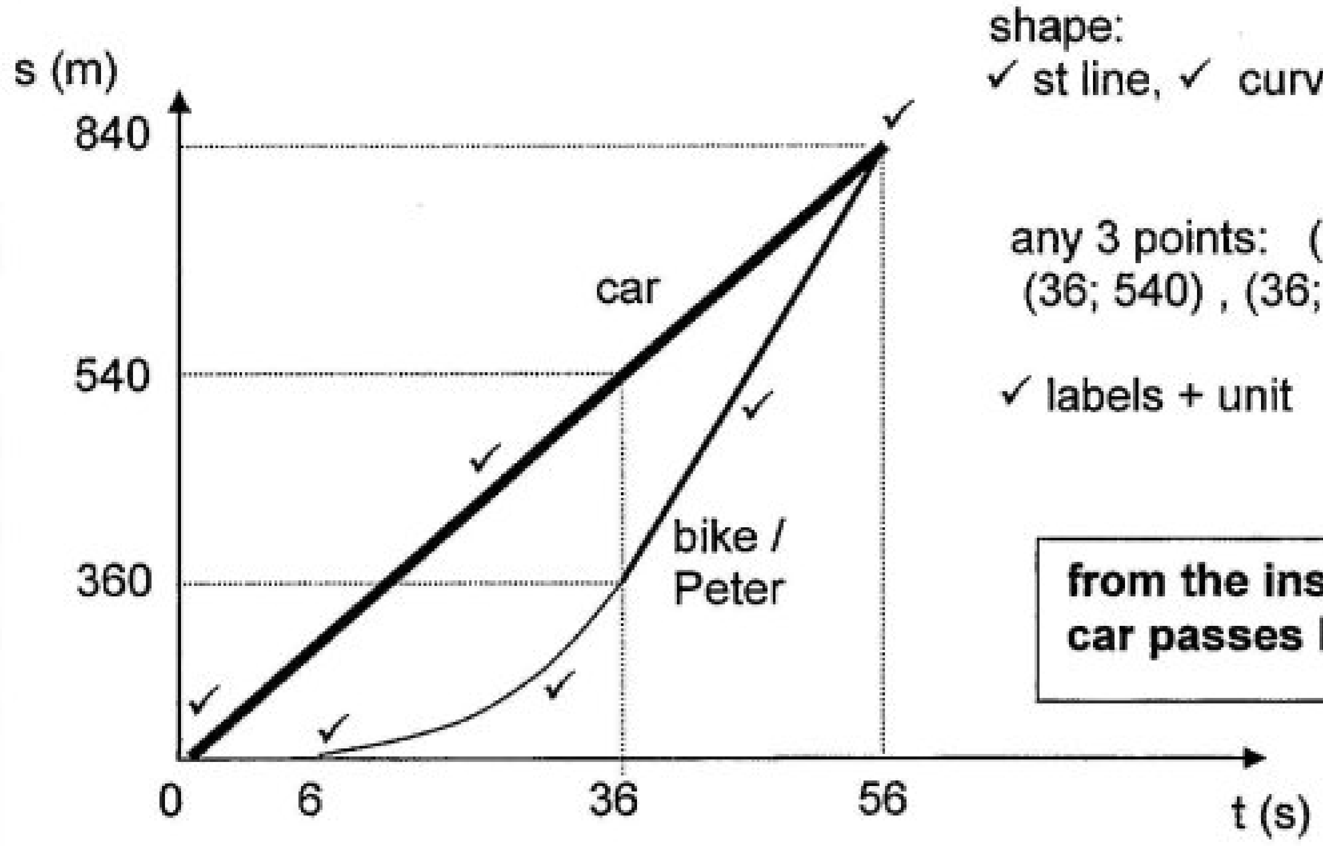
3.4

$$\text{Total } s_{bike} = s_{acceleration} + s_{uniform} \checkmark$$
$$= 360 \checkmark + (24 \times 20) \checkmark$$
$$= 840\,m \checkmark$$

$$s_{Peter} = s_{car} = ut \checkmark$$
$$= (15 \times 56) \checkmark \checkmark$$
$$= 840\,m \checkmark$$

(4)

3.5

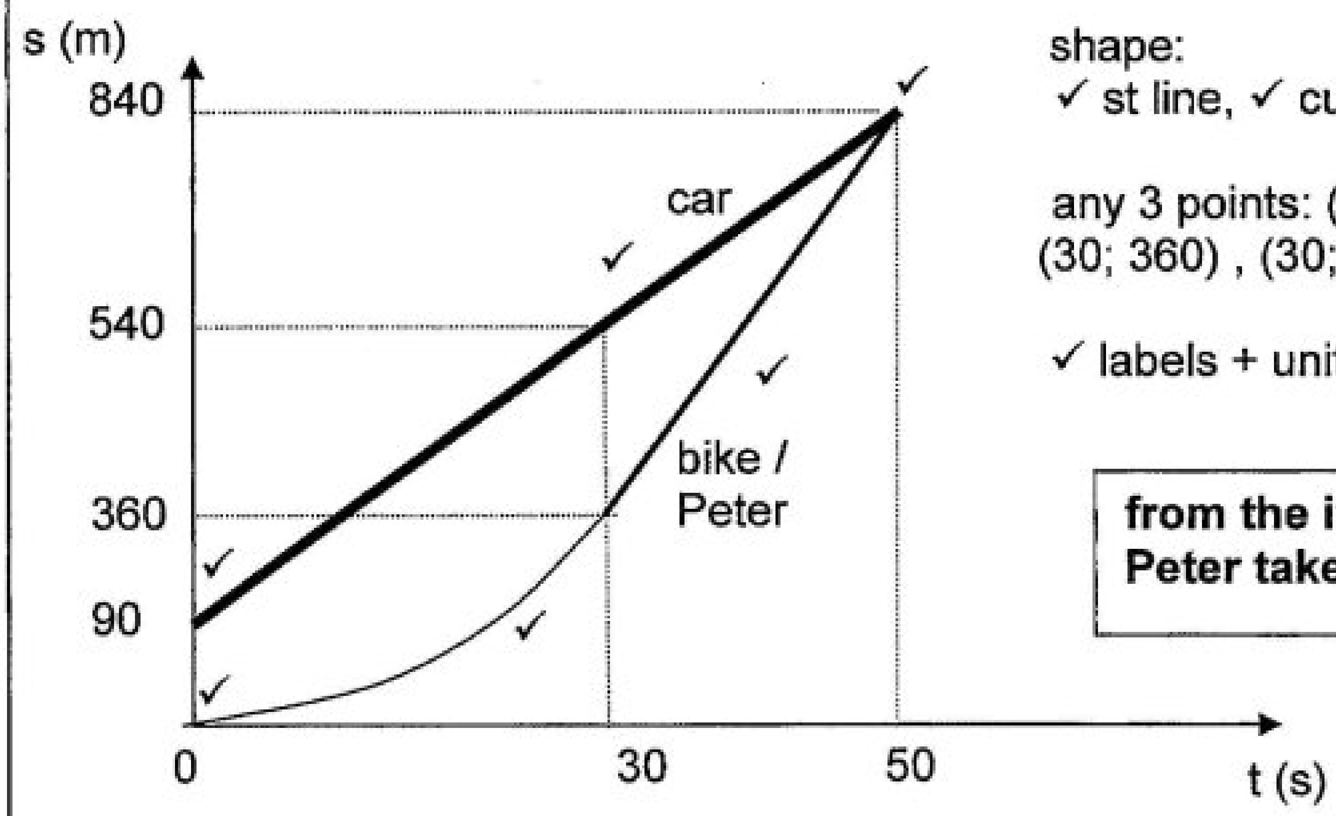


shape:
✓ st line, ✓ curve, ✓ st line

any 3 points: (0; 0), (0; 6), (36; 540) , (36; 360) , (56; 840)

✓ labels + unit

from the instant the car passes Peter



shape:
✓ st line, ✓ curve, ✓ st line

any 3 points: (0; 0) , (0; 90), (30; 360) , (30; 540) , (50; 840)

✓ labels + units

from the instant Peter takes off

(7)

[27]

QUESTION 4/ VRAAG 4

4.1

down +
$v^2 = u^2 + 2as$ ✓
$0 = (-12)^2 + 2 \times 10 \times s$ ✓✓✓
$s = -7{,}2$ m or $7{,}2$ m up ✓

u & g opp. sign

up +
$v^2 = u^2 + 2as$ ✓
$0 = (12)^2 + 2(-10) \times s$ ✓✓✓
$s = 7{,}2$ m up ✓

down + ve
$v = u + at$
$0 = (-12) + 10t$
$t = 1{,}2$ s

$\therefore s = ut + \frac{1}{2}at^2$ ✓
$= (-12)(1{,}2) + \frac{1}{2}(10)(1{,}2)^2$ ✓✓✓
$= -7{,}2 \text{ m} = 7{,}2 \text{ m, up}$ ✓

$s = \left(\frac{u+v}{2}\right)t$ ✓
$= \left(\frac{-12+0}{2}\right)(1{,}2)$ ✓✓✓
$= -7{,}2 \text{ m} = 7{,}2 \text{ m, up}$ ✓

(5)

4.2 The distance through which the balloon has to descend is $9 - 7{,}2 = 1{,}8$ m

down +
$s = ut + \frac{1}{2}at^2$ ✓
$1{,}8 = 0 + \frac{1}{2}a \times 1{,}2^2$ ✓✓✓
$a = 2{,}5 \text{ m.s}^{-2}$ ✓

OR

up +
$s = ut + \frac{1}{2}at^2$ ✓
$-1{,}8 = 0 + \frac{1}{2}a \times 1{,}2^2$ ✓✓✓
$a = -2{,}5 \text{ m.s}^{-2} = 2{,}5 \text{ m.s}^{-2}$, down ✓

(5)

[10]

QUESTION 5 / VRAAG 5

5.1

Left +

$F_{res} = m a$ ✓

$2 = (5+3) a$ ✓

$a = 0,25 \text{ m.s}^{-2}$ ✓

Right +

$F_{res} = m a$ ✓

$-2 = (5+3) a$ ✓

$a = -0,25 \text{ m.s}^{-2}$

$= 0,25 \text{ m.s}^{-2}$ ✓

(3)

5.2

Left +

F_{res} (on 3 kg) $= ma = 3 \times 0,25$ ✓

$= 0,75$ N ✓ in the opposite direction / to the left ✓

Right +

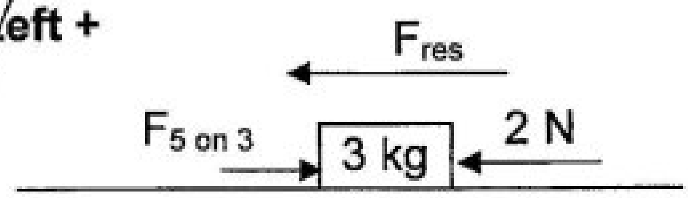
F_{res} (on 3 kg) $= ma = 3 \times (-0,25)$ ✓ $= -0,75$ N ✓

$= 0,75$ N in the opposite direction / to the left ✓

(3)

5.3

Left +

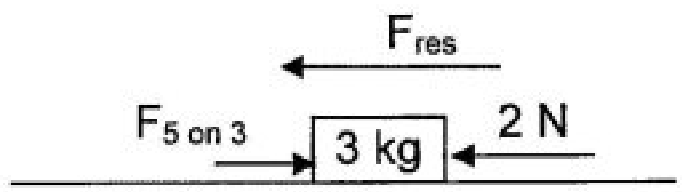


$F_{res} = F_{app} + F_{5 \text{ on } 3}$ ✓

$0,75$ ✓ $= 2$ ✓ $+ F_{5 \text{ on } 3}$ $\therefore$ $F_{5 \text{ on } 3} = 0,75 - 2 = -1,25$ N towards right ✓

(4)

Right +



$F_{res} = F_{app} + F_{5 \text{ on } 3}$ ✓

$-0,75$ ✓ $= -2$ ✓ $+ F_{5 \text{ on } 3}$ $\therefore$ $F_{5 \text{ on } 3} = 2 - 0,75 = 1,25$ N towards right ✓

(4)

[10]

QUESTION 6 / VRAAG 6

6.1

In an isolated ✓ system, the sum of the gravitational potential energy and the kinetic energy ✓ remains constant. ✓

(3)

6.2 **Using ground as reference point:**

$$(E_p + E_k)_{0,5\,m} = (E_p + E_k)_{3,7\,m}$$
$$(mgh + \frac{1}{2}mv^2)_{0,5\,m} = (mgH + 0)_{3,7\,m} \quad ✓$$
$$(130)(10)(0,5) ✓ + \frac{1}{2}(130)v^2 ✓ = (130)(10)(3,7) ✓ + 0 ✓$$
$$v^2 = 64$$
$$v = 8\ m.s^{-1}$$

Using Q as reference point:

$$(E_p + E_k)_Q = (E_p + E_k)_{3,2\,m}$$
$$(mgh + \frac{1}{2}m v^2) = mgH + 0 \quad ✓$$
$$0 ✓ + \frac{1}{2}(130)v^2 ✓ = (130)(10)(3,2) ✓ + 0 ✓$$
$$v^2 = 64$$
$$v = 8\ m.s^{-1}$$

$$(E_k)_{gained} = (E_p)_{lost}$$
$$\frac{1}{2}mv^2 = mg\Delta h \quad ✓$$
$$\frac{1}{2}(130)v^2 ✓✓ = (130)(10)(3,2) ✓✓$$
$$v^2 = 64$$
$$v = 8\ m.s^{-1}$$

(5)

6.3

$$m_1v_1 + m_2v_2 = (m_1 + m_2)u \quad ✓$$
$$80\ v ✓ + (50 \times 6,4) ✓ = 130 \times 8 ✓✓$$
$$v = 9\ m.s^{-1} ✓$$

(6)

6.4 **Using ground as reference point:**

section QR

$$(E_p + E_k)_{4m} = (E_p + E_k)_{0,5m}$$
$$80 \times 10 \times h ✓ + 0 ✓ = (80 \times 10 \times 0,5) ✓ + \frac{1}{2} \times 80 \times 9^2 ✓$$
$$h = 4,55\ m ✓$$

Yes, Tarzan gets hold of the monkey ✓

(6)

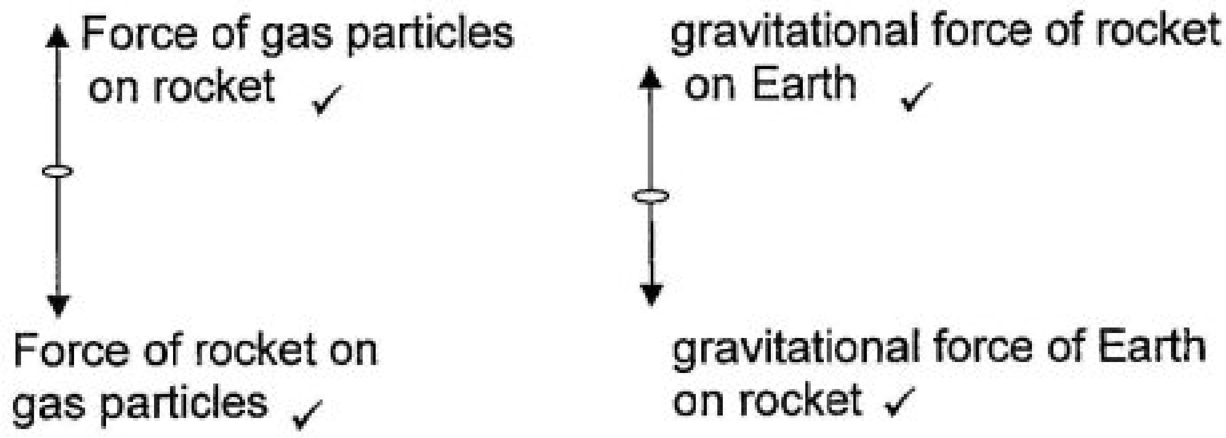
[20]

option 2: use Q as the reference point

QUESTION 7 / VRAAG 7

7.1 0 J / zero joules / no work done ✓✓ (2)

.2



✓ equal length of each action-reaction pair

✓ F_g on rocket shorter than F_{gas} on rocket

(6)

7.3 **Up + ve**

$$F_{res} = F_{app} + F_g \checkmark$$

✓✓ ✓✓

$$(500)(4,5) = F_{app} + (500)(-10)$$

$$2250 = F_{app} + (-5\,000)$$

$$F_{app} = 7\,250 \text{ N} \checkmark$$

(6)

[14]

QUESTION 8 / VRAAG 8

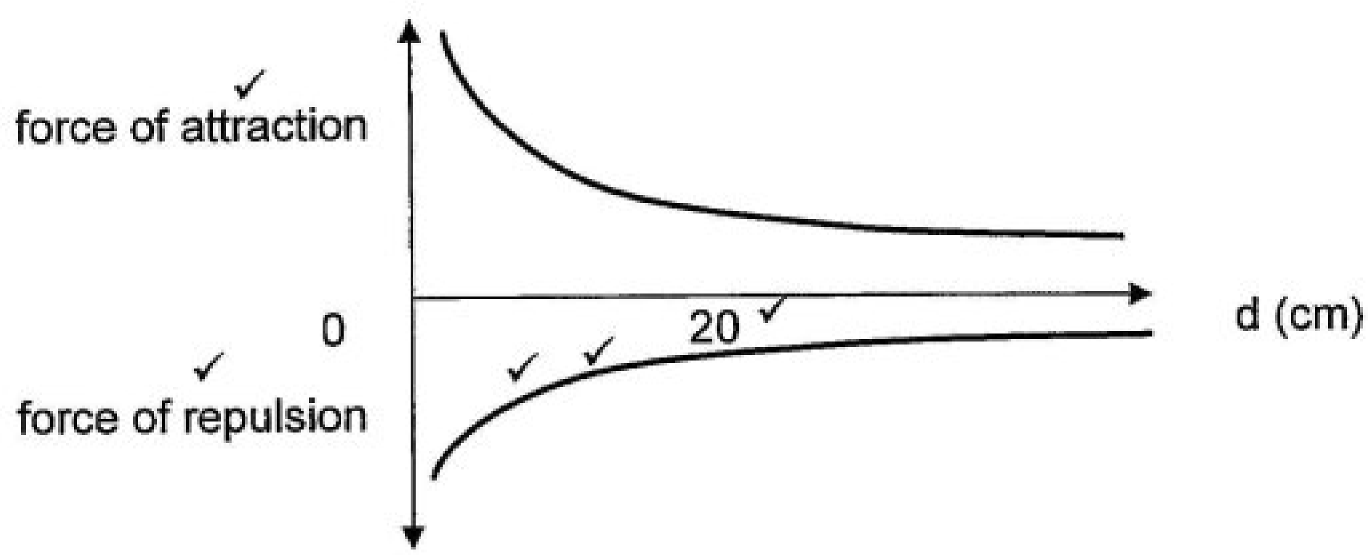
8.1 The force of attraction or repulsion which one charge exert on the other is ✓✓ directly proportional to the product of the charges and is inversely ✓✓ proportional to the square of the distance between them. (4)

8.2
$$F = \frac{kq_1 q_2}{r^2} \checkmark$$
$$= \frac{(9 \times 10^9)(8 \times 10^{-9}) \checkmark (-4 \times 10^{-9}) \checkmark}{(0,2)^2 \checkmark}$$
$$= -7,2 \times 10^{-6} \text{ N} \checkmark$$
(5)

8.3
$$Q_{new} = \frac{[8 + (-4)] \times 10^{-9} \checkmark}{2 \checkmark}$$
$$= 2 \times 10^{-9} \text{ C} \checkmark$$
(3)

8.4 Smaller ✓ by a fraction of one eight $\frac{1}{8}$ ✓✓ / 8 times smaller ✓✓✓ (3)

8.5



✓ label of force of attraction (above axis)
✓ label of force of repulsion (below axis)
✓ Shape below axis
✓ Location blow axis
✓ at 20 cm $F_{repulsion} < F_{attraction}$

(5)

[20]

QUESTION 9 / VRAAG 9

9.1 10 V ✓✓ (2)

9.2 10 V ✓✓ (2)

9.3 zero or 0 V ✓✓ (2)

9.4

$$\frac{1}{R_P} = \checkmark \frac{1}{R_1} + \frac{1}{R_2}$$

$$= \frac{1}{6}\checkmark + \frac{1}{3}\checkmark = \frac{1}{2}$$

$$R_P = 2\,\Omega \ \checkmark$$

OR

$$R_p = \frac{\text{product}}{\text{sum}} \ \checkmark$$

$$R_P = \frac{6 \times 3 \ \checkmark}{6+3 \ \checkmark} = 2\,\Omega \ \checkmark$$

$$R_{ext} = 2 + 1 = 3\,\Omega$$

$$I = \frac{V}{R} \ \checkmark$$

$$= \frac{7{,}5 \ \checkmark}{3 \ \checkmark} = 2{,}5\ \text{A} \ \checkmark$$

(8)

9.5

$$\text{Emf} = V_{cir} + V_{lost} \ \checkmark$$

$$10 \checkmark = 7{,}5 \checkmark + 2{,}5 \checkmark r$$

$$r = 1\,\Omega \ \checkmark$$

$$V_{lost} = Ir \ \checkmark$$

$$2{,}5 \checkmark\checkmark = 2{,}5r \ \checkmark$$

$$r = 1\,\Omega \ \checkmark$$

(5)

[19]

QUESTION 10 / VRAAG 10

10.1

$P = VI$ ✓

$60 = 12 I$ ✓ ✓

$I = 5\ A$ ✓

$Q = It$; ✓

$Q = 5 \times 120$ ✓

$= 600\ C$ ✓

[7]

TOTAL Q 1 60
QUESTIONS 2- 10 140
GRAND TOTAL 200