NATIONAL DEPARTMENT OF EDUCATION

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

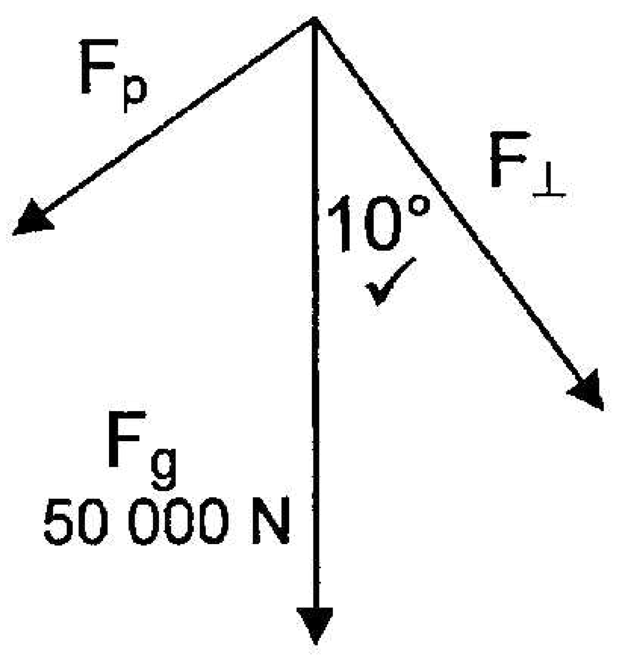
QUESTION 1 / VRAAG 1

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)

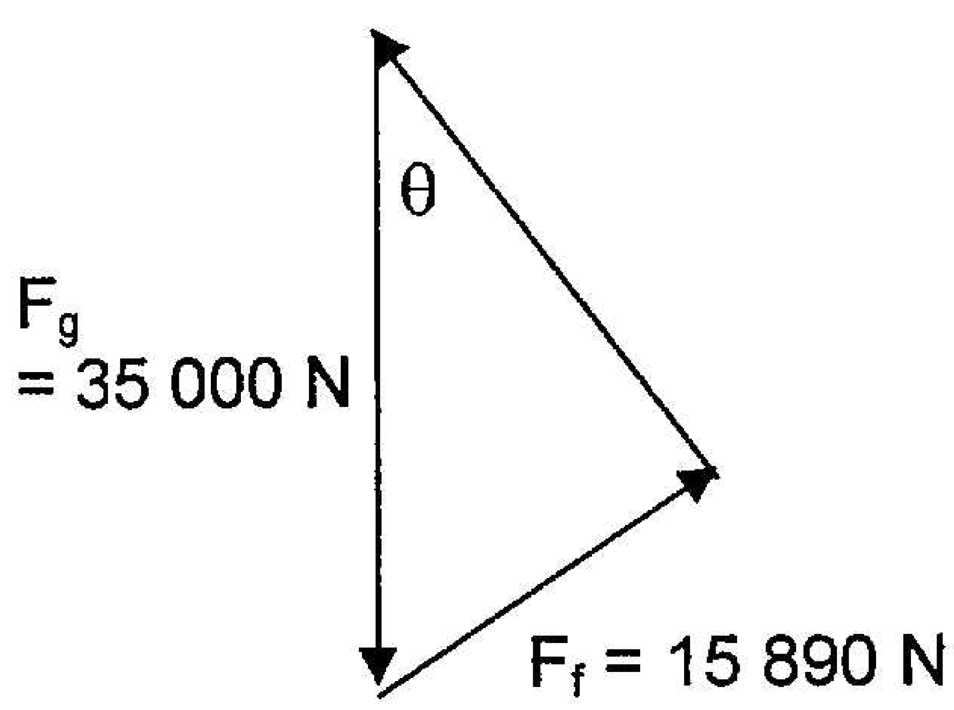
2.2

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

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

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

(4)

3.2

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

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

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

(7)

3.3

$s_{bike} = vt$
$= 24t$

$s_{car} = vt$
$= 15t$

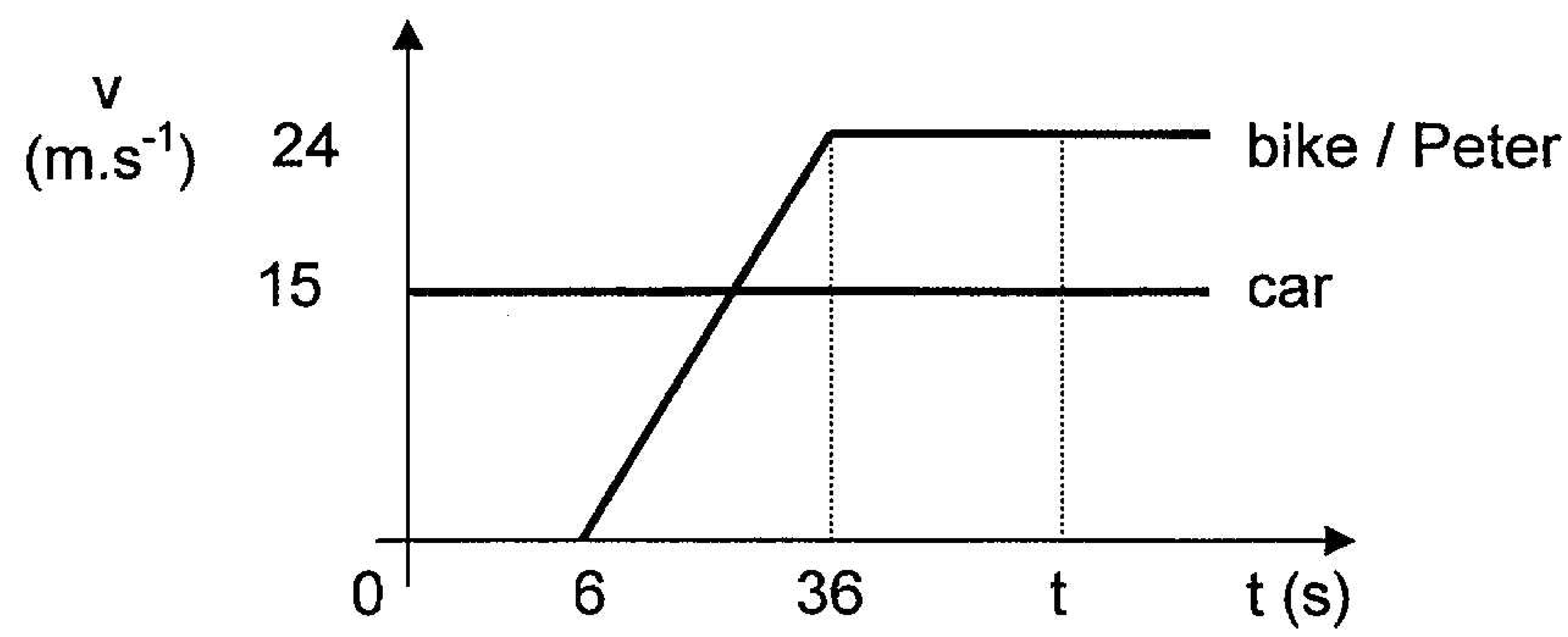
but $s = 180 = 24t - 15t$ ✓ ✓ ✓ ✓
$180 = 9t$
$t = 20\ s$ ✓

OR

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

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

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



$s_{bike} = s_{car}$

$\frac{1}{2}(30)(24) + 24(t - 36) = 15t$ ✓ ✓ ✓ ✓
$9t = 504$
$t = 56\ s$
✓
$\therefore$ Peter requires $(56 - 36) = 20\ s$

$s_{bike} = s_{car}$

$\frac{1}{2}(30)(24) + 24(t - 36) = (36)(15) + 15(t - 36)$ ✓ ✓ ✓ ✓
$9t = 504$
$t = 56\ s$ ✓
$\therefore$ Peter requires $(56 - 36) = 20\ s$

(5)

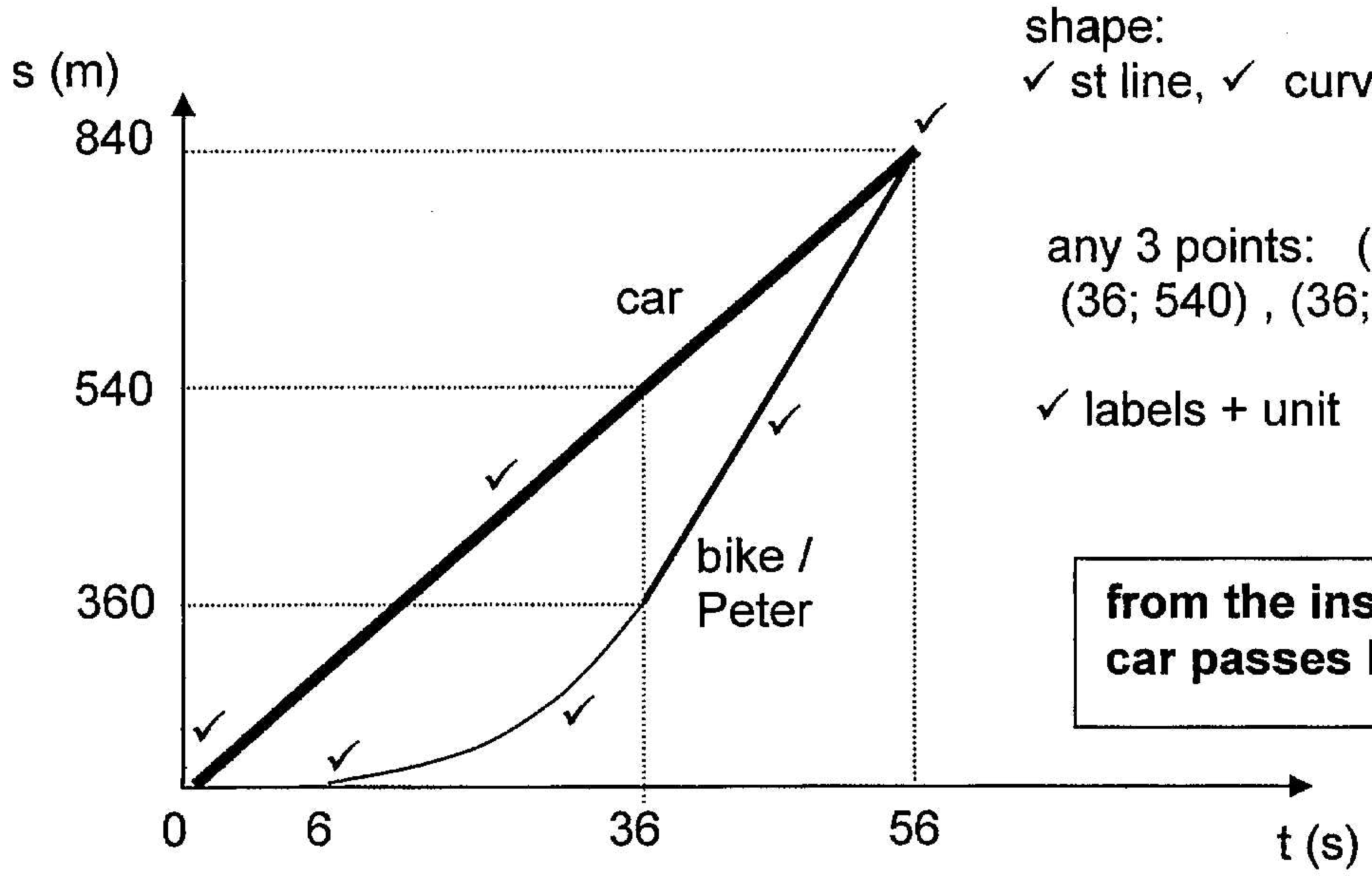
3.4

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

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

(4)

3.5

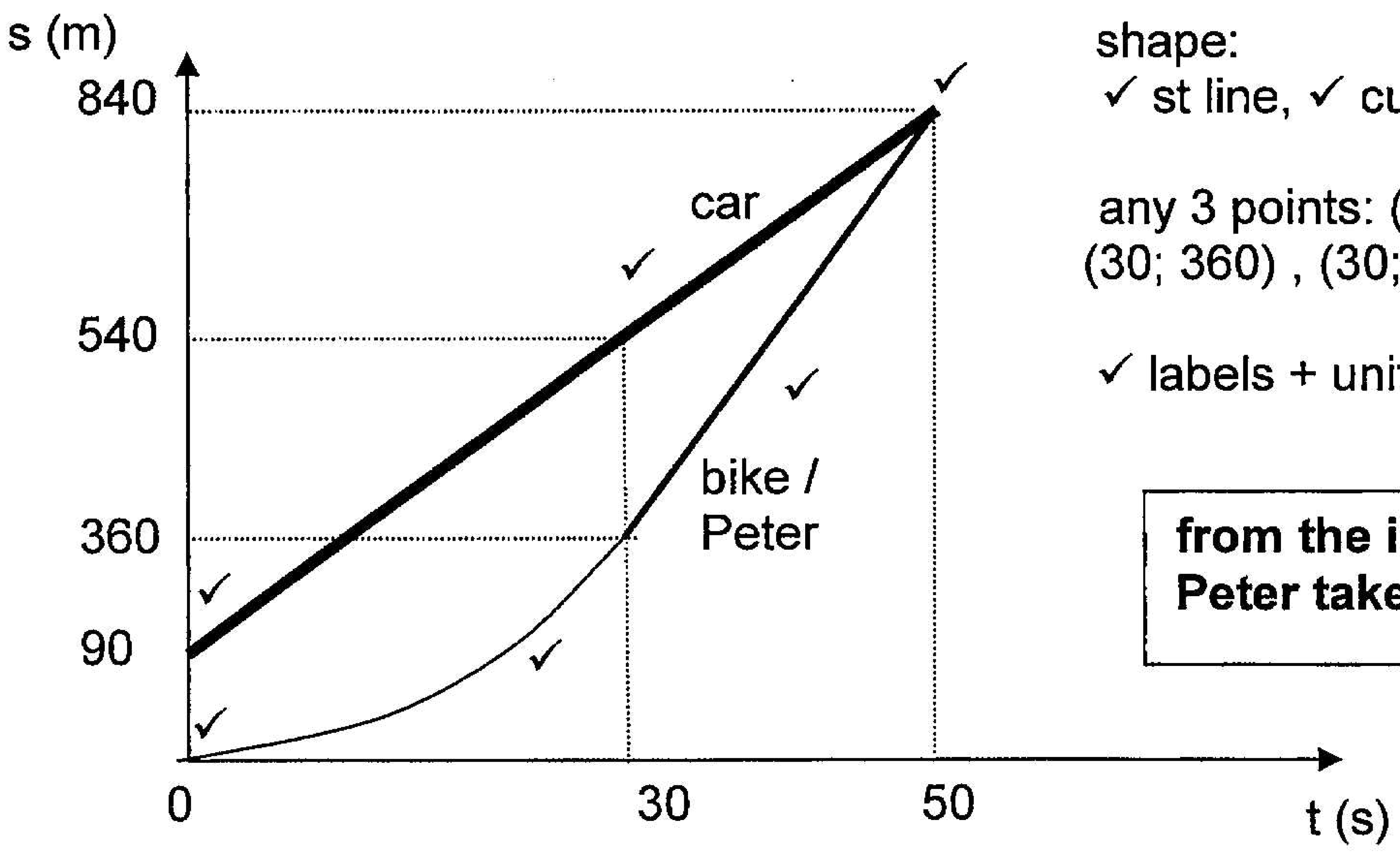


shape:
✓ st line, ✓ curve, ✓ st line

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

$\therefore s = ut + \frac{1}{2}at^2$ ✓

$= (-12)(1,2) + \frac{1}{2}(10)(1,2)^2$ ✓✓✓

$= -7,2$ m $= 7,2$ m, up ✓

$s = \left(\frac{u+v}{2}\right)t$ ✓

$= \left(\frac{-12+0}{2}\right)(1,2)$ ✓✓✓

$= -7,2$ m $= 7,2$ m, up ✓

(5)

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

down +

$s = ut + \frac{1}{2}at^2$ ✓

$1,8 = 0 + \frac{1}{2}a \times 1,2^2$ ✓✓✓

$a = 2,5$ m.s^{-2} ✓

OR

up +

$s = ut + \frac{1}{2}at^2$ ✓

$-1,8 = 0 + \frac{1}{2}a \times 1,2^2$ ✓✓✓

$a = -2,5$ m.s^{-2} = $2,5$ m.s^{-2}, down ✓

(5)

[10]

QUESTION 5 / VRAAG 5

5.1

Left +

$F_{res} = ma$ ✓

$2 = (5+3)\,a$ ✓

$a = 0{,}25\ m.s^{-2}$ ✓

Right +

$F_{res} = ma$ ✓

$-2 = (5+3)\,a$ ✓

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

$= 0{,}25\ m.s^{-2}$ ✓

(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 +

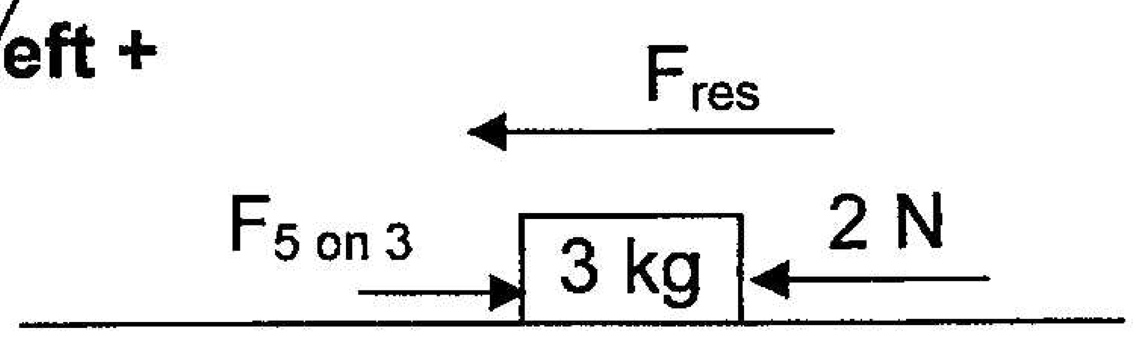
F_{res} (on 3 kg) $= ma = 3 \times (-0{,}25)$ ✓ $= -0{,}75$ N

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

(3)

5.3

Left +

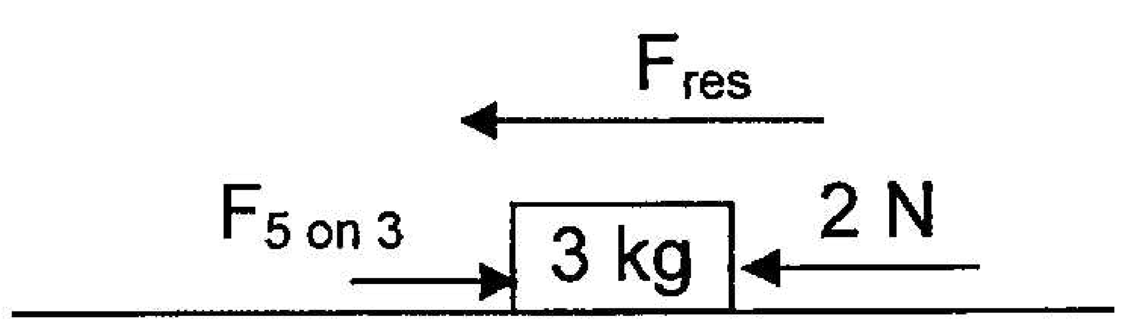


$F_{res} = F_{app} + F_{5\ on\ 3}$ ✓

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

(4)

Right +



$F_{res} = F_{app} + F_{5\ on\ 3}$ ✓

$-0{,}75$ ✓ $= -2$ ✓ $+ F_{5\ on\ 3}$ $\therefore F_{5\ on\ 3} = 2 - 0{,}75 = 1{,}25$ 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:

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

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

(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)

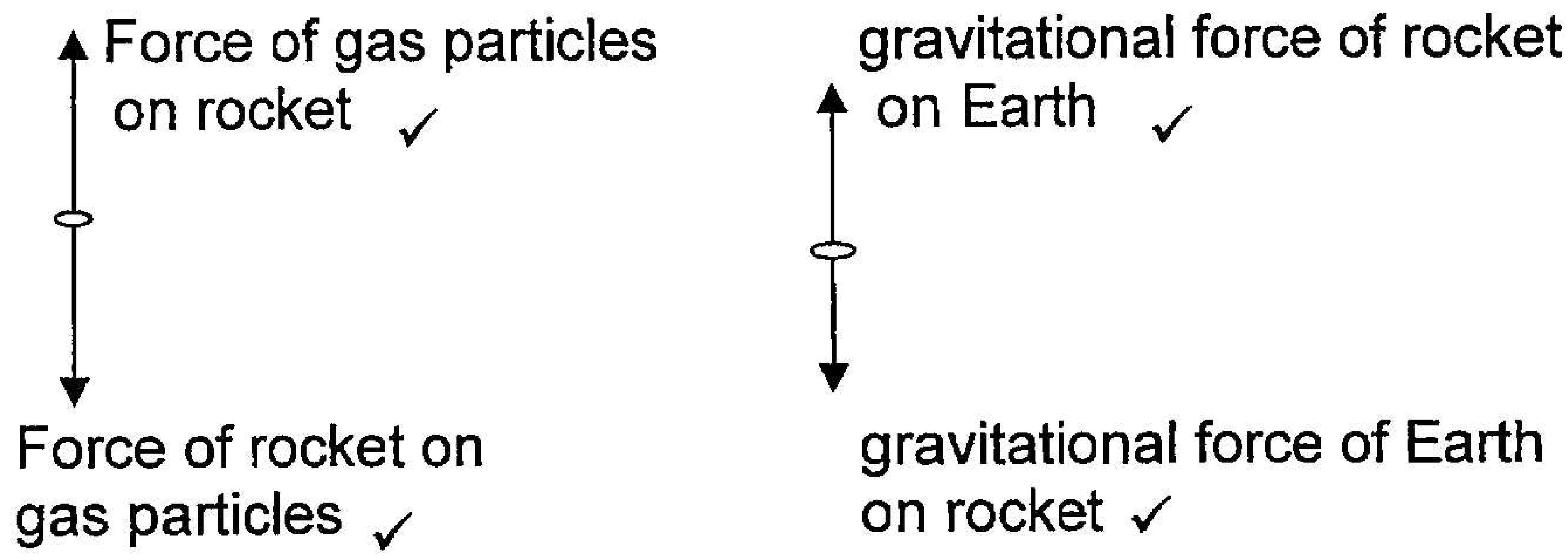
[20]

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**

$F_{res} = F_{app} + F_g$ ✓ ✓✓ ✓✓

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

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

$F_{app} = 7\,250$ N ✓

(6)

[14]

QUESTION 8 / VRAAG 8

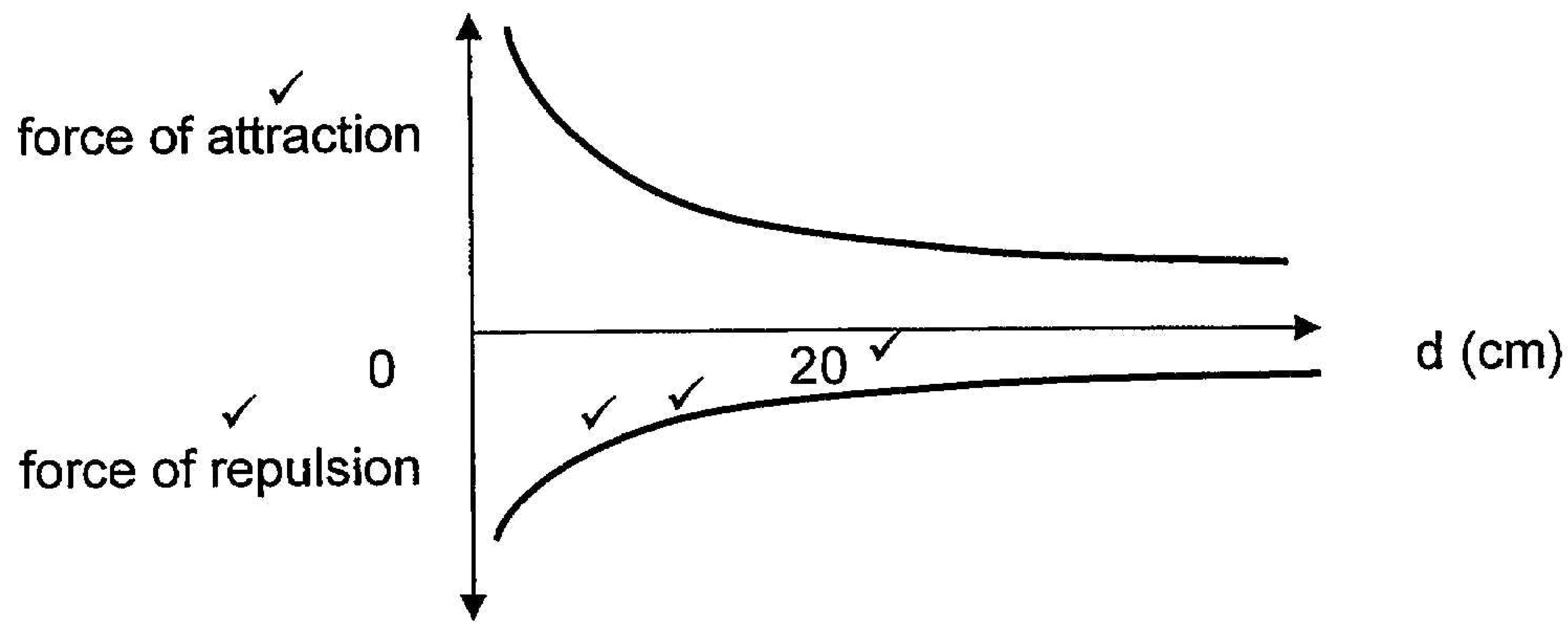
8.1 The force of attraction or repulsion which one charge exert on the other is ✓✓ directly proportional to the product of the charges and is inversely ✓✓ proportional to the square of the distance between them. (4)

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

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

(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

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

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

$R_P = 2\ \Omega$ ✓

OR $R_p = \frac{\text{product}}{\text{sum}}$ ✓

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

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

$I = \frac{V}{R}$ ✓

$= \frac{7,5}{3} = 2,5\ A$ ✓✓✓

(8)

9.5

Emf $= V_{cir} + V_{lost}$ ✓

$10 = 7,5 + 2,5\, r$ ✓✓✓

$r = 1\ \Omega$ ✓

$V_{lost} = Ir$ ✓

$2,5 = 2,5r$ ✓✓✓

$r = 1\ \Omega$ ✓

(5)

[19]

QUESTION 10 / VRAAG 10

10.1

$P = VI$ ✓

$60 = 12I$ ✓ ✓

$I = 5\ A$ ✓

$Q = It$; ✓

$Q = 5 \times 120$ ✓

$= 600\ C$ ✓

[7]

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