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Physical Science Trials Memo

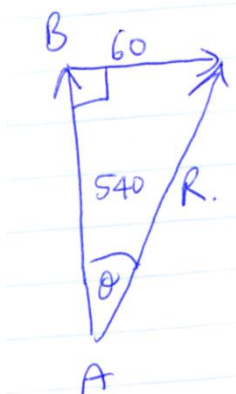
Question 1 – Multiple Choice

- 1.1 B
- 1.2 A
- 1.3 A
- 1.4 D
- 1.5 B
- 1.6 D
- 1.7 C
- 1.8 D
- 1.9 A
- 1.10 C

Question 2

- 2.1 The single vector which has the same effect as the original vectors acting together. ✓✓ (2)

2.2



$$\begin{aligned}
 R &= \sqrt{60^2 + 540^2} \checkmark \\
 &= \sqrt{295200} \\
 &= 543,32 \text{ km} \cdot \text{h}^{-1} \checkmark \text{ OR } 150,92 \text{ m} \cdot \text{s}^{-1}
 \end{aligned}$$

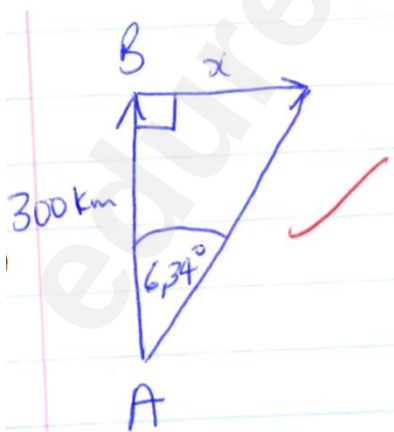
$$\tan \theta = \frac{60}{540} \checkmark$$

-1 no Δ

$$\theta = 6,34^\circ$$

R B 54,3 km. h⁻¹ on a bearing of 6,34° (4)

2.3



$$\begin{aligned}
 \tan 6,34^\circ &= \frac{x}{300} \checkmark \\
 300 \tan 6,34^\circ &= x \checkmark \\
 x &= 33,33 \text{ km} \checkmark
 \end{aligned}$$

-1 no units

(3)
[9]

Question 3

$$3.1 \quad V = \frac{\Delta x}{t} = \frac{0,1}{0,5} \checkmark = 0,2 \checkmark m \cdot s^{-1} \quad (2)$$

$$3.2 \quad V = \frac{\Delta x}{t} = \frac{0,1}{0,4} = 0,25 \checkmark m \cdot s^{-1} \quad (1)$$

$$3.3 \quad Vf = Vi + at \\ 0,25 = 0,2 + a(1,19) \checkmark$$

$$\frac{0,25 - 0,2}{1,19} = a$$

$$a = 0,042 m \cdot s^{-2} \checkmark \quad (2)$$

$$3.4 \quad \text{The length of path travelled.} \checkmark \checkmark \quad (2)$$

$$3.5 \quad \Delta x = \left(\frac{Vi + Vf}{2} \right) t \quad \text{OR} \quad Vf^2 = Vi^2 + 2a\Delta x \\ (0,25)^2 = (0,2)^2 + 2(0,042)\Delta x \\ \frac{(0,25)^2 - (0,2)^2}{2(0,042)} = \Delta x \\ \Delta x = 0,27 m \checkmark \quad (3)$$

$$3.6 \quad \text{Instantaneous speed is over a very short } \checkmark \text{ time period/ at exact point in time. Average speed using the time of the entire } \checkmark \text{ trip.} \quad (2)$$

$$3.7 \quad \text{ave } V = \frac{\Delta x}{t} \\ = \frac{0,27}{1,19} \checkmark \text{ ca from 3.5} \\ = 0,23 m \cdot s^{-1} \checkmark \quad (2)$$

[14]**Question 4**

$$4.1 \quad \text{The rate of change of velocity } \checkmark \checkmark \quad (2)$$

$$4.2 \quad Vf = Vi + at \quad \text{OR} \quad \text{grad} = \frac{\Delta y}{\Delta x} \\ 10,8 \checkmark = 0 + a(1,1) \checkmark \quad = \frac{10,8 - 0}{1,1 - 0} \\ a = 9,82 m \cdot s^{-2} \text{ down} \checkmark \quad = 9,82 m \cdot s^{-2} \text{ down} \quad (4)$$

4.3 Height = area below graph c.o.e

$$= \frac{1}{2} b \times h \checkmark$$

$$= \frac{1}{2} \times 1,1 \times 10,8 \checkmark$$

$$= 5,94 \text{ m} \checkmark$$

(3)

4.4 Rebound height = area below graph

$$= \frac{1}{2} b \times h$$

$$\frac{1}{2} (2,1 - 1,2/1,1)(8,8 \checkmark)$$

$$\frac{1}{2} (0,9)(8,8)$$

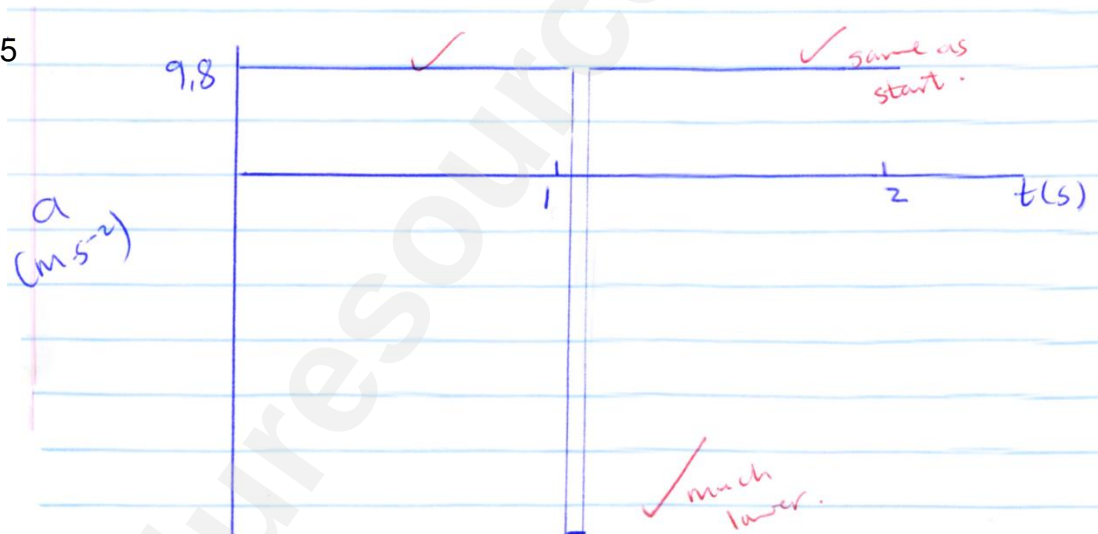
$$= 3,96 \text{ m} \checkmark$$

Displacement = $5,94 - 3,96$

= $1,98 \text{ m} \checkmark$ below $\checkmark$ the release height.

(4)

4.5

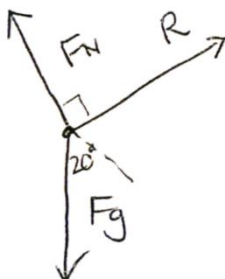


(4)

[17]

Question 5

5.1



Key

F_N = normal $\checkmark$

F_g = weight $\checkmark$

R = friction / resistive force $\checkmark$

$\angle$ of $20^\circ \checkmark$

(4)

$$5.2.1 \quad a = \text{gradient} = \frac{\Delta v}{\Delta t} = \frac{6-0,8}{2-0} \checkmark$$

$$= 2,6 \text{ m} \cdot \text{s}^{-2} \quad (2)$$

$$5.2.2 \quad F_{\text{net}} = ma = 65 \times 2,6 \checkmark$$

$$= 169 \text{ N} \checkmark \quad (2)$$

$$5.2.3 \quad F_{\text{net}} = F_g // -R$$

$$\therefore R = F_g // -F_{\text{net}} \checkmark$$

$$= (65 \times 9,8 \times \sin 20^\circ) \checkmark - 169 \text{ N}$$

$$= 48,87 \text{ N} \checkmark \quad (3)$$

[11]

Question 6

6.1 The perpendicular force exerted by a surface on an object in contact with it
 $\checkmark \checkmark \quad (2)$

$$6.2 \quad F_N = mg = 20 \times 9,8 \checkmark$$

$$= 196 \text{ N} \checkmark \quad (2)$$

$$6.3 \quad F_{f \text{ max}} = \mu_s \times F_N$$

$$= 0,3 \times 196 \checkmark$$

$$= 58,8 \text{ N} \checkmark \quad (2)$$

6.3.1 At exact point when box moves $F_{f \text{ max}} = 58,8 \text{ N} \checkmark$

$$m = \frac{F_g}{g} = \frac{F_{f \text{ max}}}{g}$$

$$= \frac{58,8}{9,8} \checkmark \checkmark$$

$$= 6 \text{ kg} \checkmark \quad (3)$$

$$6.4 \quad F_f = \mu_k \times F_N$$

$$= 0,1 \times 196 \checkmark$$

$$= 19,6 \text{ N} \checkmark \quad (2)$$

$$6.5 \quad F_{\text{net}} = ma$$

$$F_{f \text{ max}} - F_f = (20 + 6) \checkmark a$$

$$58,8 - 19,6 \checkmark = 26a$$

$$\therefore a = 1,51 \text{ m} \cdot \text{s}^{-2} \checkmark \quad (3)$$

6.6 Left $\checkmark$
 As the box accelerates to the right the inertia $\checkmark$ /no net force of the fruit causes it to tend to remain stationary $\checkmark \therefore$ it will fall off the back of the box. (3)

[17]

Question 7

7.1 $p \text{ before} = p \text{ after}$

$$m_1 v_{i1} + m_2 v_{i2} = m_1 v_{f1} + m_2 v_{f2} \checkmark$$

$$0 + (1,2,8) = 0,5 \cdot v_f + 1,24 \checkmark$$

$$9,6 = 0,5 \cdot v_f + 4,8$$

$$\frac{9,6 - 4,8}{0,5} = v_f$$

$$= 9,6 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(3)

7.2 $\Delta p = 1,2(4 - 8) \checkmark$

$$= -4,8 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1}$$

$$\text{ie } 4,8 \text{ kg} \cdot \text{m} \cdot \text{s}^{-1} \checkmark \text{ West } \checkmark$$

(3)

7.3 The net force acting on an object is equal to the rate of change of momentum. $\checkmark \checkmark$

(2)

7.4 $F = \frac{\Delta p}{\Delta t} = \frac{-4,8 \checkmark}{1,5 \times 10^{-3} \checkmark}$

don't need to sub minus

$$= (-)3200 \text{ N} \checkmark$$

(3)

[11]

Question 8

8.1.1 $E_k = \frac{1}{2} m v^2 = 300 \times (9,5)^2 \checkmark$

$$= 27\,075 \text{ J} \checkmark$$

(2)

8.1.2 $E_p = mgh = 600 \times 9,8 \times 4,1 \checkmark$

$$= 24\,108 \text{ J} \checkmark$$

$$\therefore W_{nc} = 27\,075 - 24\,108 \text{ J} \checkmark$$

$$= 2967 \text{ J} \checkmark$$

(4)

8.1.3 $\Delta x = 4,1 / \sin 30$

$$= 8,2 \text{ m} \checkmark$$

$$F_f = \frac{W_{nc}}{\Delta x}$$

$$= \frac{2967 \text{ J} \checkmark}{8,2 \text{ m}} = 361,83 \text{ N} \checkmark$$

(3)

8.2.1 $E_k = \frac{mgh}{4}$ (for 1 kg water)

$$= \frac{1 \times 9,8 \times 120}{4} \checkmark$$

$$= 294 \text{ J} \checkmark$$

$$E_k = \frac{1}{2} M V^2$$

$$294 = 0,5 \cdot V^2 \checkmark$$

$$\therefore V = 24,25 \text{ m} \cdot \text{s}^{-1}$$

(3)

8.2.2 110 kW (output) is 50% therefore input power = 220 kW
= 220 000 W ✓

$$W = P \times t = 220\,000 \times 1$$

$$= 220\,000\text{J}$$

$$\therefore E_K = 220\,000\text{J} = \frac{1}{2}mv^2$$

$$\checkmark 220\,000 = \frac{1}{2}m \cdot (24,25)^2 \checkmark$$

$$\therefore m = 748,22\text{ kg} \checkmark \quad (4)$$

[7]

Question 9

9.1 The gravitational ✓ force the earth exerts on an object on or near its surface ✓. (2)

$$9.2 \quad F = \frac{G\pi m_2}{r^2} \checkmark$$

$$= \frac{(6,7 \times 10^{-11})(7,35 \times 10^{22})(899 \checkmark)}{(1737 \times 1000 \checkmark)^2}$$

$$\text{OR } g = GM/r^2 = 1467,3\text{ N}$$

$$= 1467,31\text{ N} \checkmark$$

$$\underline{\hspace{1cm} \rightarrow}$$

(4)

$$9.3 \quad F \propto \frac{1}{2}m \times \frac{1}{2} \checkmark$$

$$F \propto \frac{1}{3^2}m \times \frac{1}{9} \checkmark$$

$$\therefore F_{\text{new}} = 1467,3 \times \frac{1}{9} \times \frac{1}{2}$$

$$= \frac{81,52\text{ N}}{\hspace{1cm} \rightarrow} \checkmark$$

(3)

9.4 Force ✓ acting per unit ✓ mass. (2)

$$9.5 \quad g = \frac{F}{M}$$

$$= \frac{1467,31}{899 \checkmark}$$

$$= 1,63\text{ m} \cdot \text{s}^{-2} \checkmark - 1 \text{ no units}$$

OR

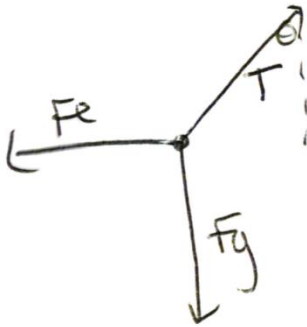
$$g = \frac{(6,7 \times 10^{-11})(7,35 \times 10^{22})}{(1737 \times 1000)^2} \checkmark$$

$$= 1,63 \text{ m} \cdot \text{s}^{-2} \checkmark$$

(2)

Question 10

10.1



T = tension $\checkmark$

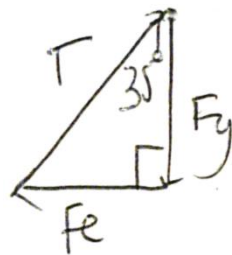
Fe = electrostatic force $\checkmark$

Fg = weight $\checkmark$

$\theta = 35^\circ \checkmark$

(4)

10.2



$$Fg = \frac{2,7}{1000} \times 9,8$$

$$\text{OR } \tan 35^\circ = \frac{R}{0,0027}$$

$$= 0,026 \checkmark \text{ N}$$

$$T^2 = Fe^2 + Fg^2$$

$$Fe = \sqrt{(3,2 \times 10^{-2})^2 \checkmark - (0,026)^2 \checkmark}$$

$$= \frac{0,019 \text{ N left}}{\checkmark \quad \checkmark}$$

(5)

10.3 $Fe = \frac{kQ_1Q_2}{r^2} \checkmark$

$$0,019 \text{ (coe 6.2)} = \frac{(9 \times 10^9)Q^2 \checkmark}{\left(\frac{20,6}{100} \checkmark\right)^2}$$

$$\underline{Q = 2,99 \times 10^{-7} \text{ C} \checkmark}$$

(4)

[13]

Question 11

11.1.1 Diode $\checkmark$

(1)

11.1.2 Work done $\checkmark$ per unit positive charge $\checkmark$

(2)

11.1.3.1 $PD = 12 - 11,3 \checkmark$
 $\underline{0,7 \text{ V} \checkmark}$

(2)

$$11.1.3.2 \quad I_{4\Omega} = \frac{11,3}{4} \checkmark \\ = 2,83 \text{ A} \checkmark \quad (2)$$

$$11.1.4 \quad R_x = \frac{0,7}{2,83} \\ = 0,25 \Omega \checkmark \quad (2)$$

$$11.1.5.1 \quad I_{8\Omega} = \frac{12}{8} = \frac{1,5A}{8} \checkmark \quad (2)$$

$$11.1.5.2 \quad R_{bottom\ branch} = 0,25 + 4 \\ = 4,25\Omega \checkmark$$

$$\frac{1}{R_p} = \frac{1}{4,25} + \frac{1}{8}$$

$$\frac{1}{R_p} = \frac{49}{136}$$

$$R_p = 2,78 \Omega \checkmark$$

$$I_T = \frac{12}{2,78} = \frac{4,32A}{2,78} \checkmark \quad (3)$$

$$11.1.6 \text{ No current} \quad (1)$$

$$11.2.1 \quad R_p = \frac{(2 \times 2)}{2 \times 2}$$

$$= 1\Omega \checkmark$$

$$V = IR \checkmark$$

$$= (1)(1)$$

$$\frac{1V}{1} = \frac{1}{1} \checkmark$$

(3)

$$11.2.2 \quad EMF = I(R + r)$$

$$\frac{EMF}{I} = R + r \checkmark$$

$$\frac{9}{1} = (6 \checkmark + 1) + r \quad \text{coe 11.2.1}$$

$$r = 9 - 7$$

$$\frac{2\Omega}{1} = \frac{2}{1} \checkmark$$

(3)

$$11.2.3 \quad W_{lost\ volts} = (1)^2(2) \checkmark (300) \\ = 600 J \checkmark$$

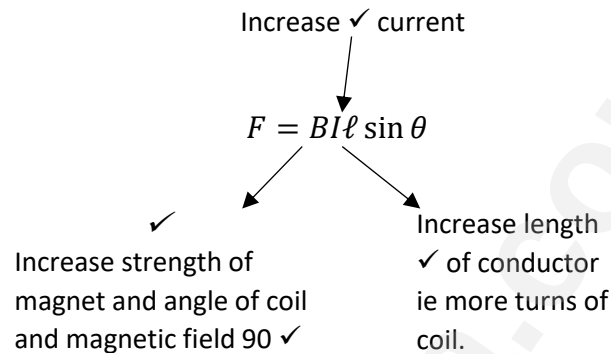
(2)

Question 12

12.1 Anti clockwise ✓ (1)

12.1.2 Split ring commutator ✓ (1)

12.1.3



- 1 no formula (4)

12.2.1 AC in the outer ring creates a magnetic field that changes direction ✓. This changing ✓ magnetic flux induces a current in object according to faraday's Law of EMI ✓ (3)

12.2.1 According to Lenz's Law ✓ direction of induced ✓ current is such so as to oppose motion ✓ that caused it. (3)

$$12.3.1 \frac{N_s}{N_p} = \frac{V_s}{V_p}$$

$$N_s = (6)(8000 / 240) \checkmark$$

$$= 200 \checkmark \quad (2)$$

$$12.3.2 \quad P = VI$$

$$= (240)(0,05) \checkmark$$

$$= \frac{12 \text{ W}}{\quad} \checkmark$$

(2)

$$12.3.3 \quad 90 = \frac{P_s}{P_p \times 100}$$

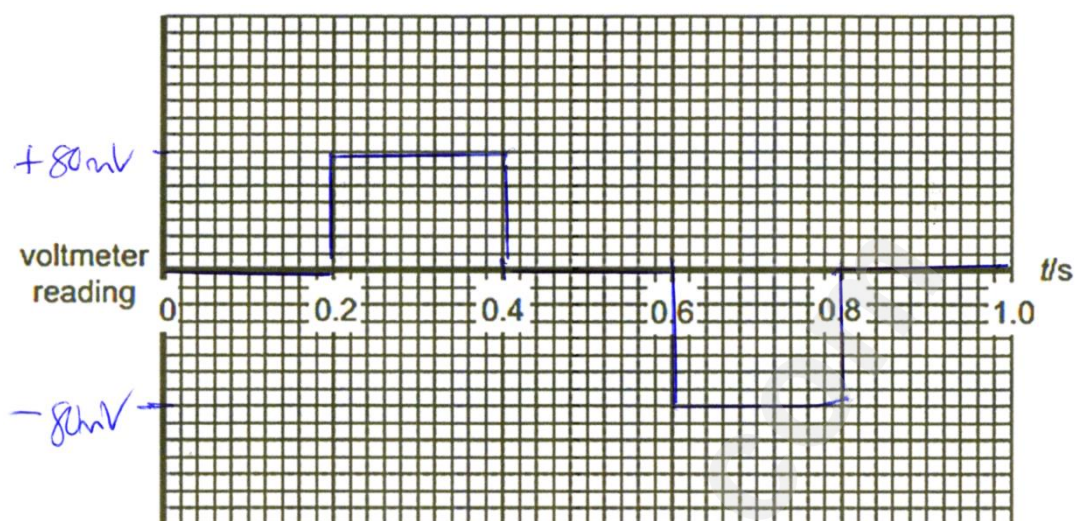
$$P_s = \frac{90 \times 12}{100} \checkmark$$

$$10,8 \text{ W} \checkmark$$

$$I = \frac{P}{V} = \frac{10,8}{6 \checkmark} = \frac{1,8 \text{ A}}{\quad} \checkmark$$

(4)

12.4



Min zero $\left. \begin{array}{l} 0-0,2 \\ 0,4-0,6 \\ 0,8-1 \end{array} \right\} \checkmark$ half marks for one correct time frame and change in direction

Max $\checkmark \left\{ \begin{array}{l} 0,2-0,4 + \\ 0,6-0,8 - \end{array} \right\} \checkmark$ (3)
[23]

Question 13

13.1 A – infrared $\checkmark$
C – ultraviolet $\checkmark$ (2)

13.2 $E = hf$
 $-13,6 - (-1,5 \checkmark) = hf$
 $-12,1 \checkmark \text{ eV} = hf$
 $1,936 \times 10^{-1} J = 6,6 \times 10^{-34} f$
 $f = 2,93 \times 10^{15} \text{ Hz} \checkmark$ (4)

13.3 A free electron has energy of zero $\checkmark$
, so an electron releases energy as it moves to a lower level. $\checkmark$ (2)

$$13.4 \quad \left. \begin{array}{l} A - 0,65 \text{ eV} / 1,58 \times 10^{14} \\ B - 1,9 \text{ eV} / 4,61 \times 10^{14} \\ C - 10,2 \text{ eV} / 2,47 \times 10^{18} \end{array} \right\} \quad \checkmark$$

$$\begin{aligned} e &= hf \\ &= 6,6 \times 10^{-34} \times 5,1 \times 10^{14} \\ &= 3,37 \times 10^{-19} \text{ J} \\ &= 2,1 \text{ eV} \checkmark \end{aligned}$$

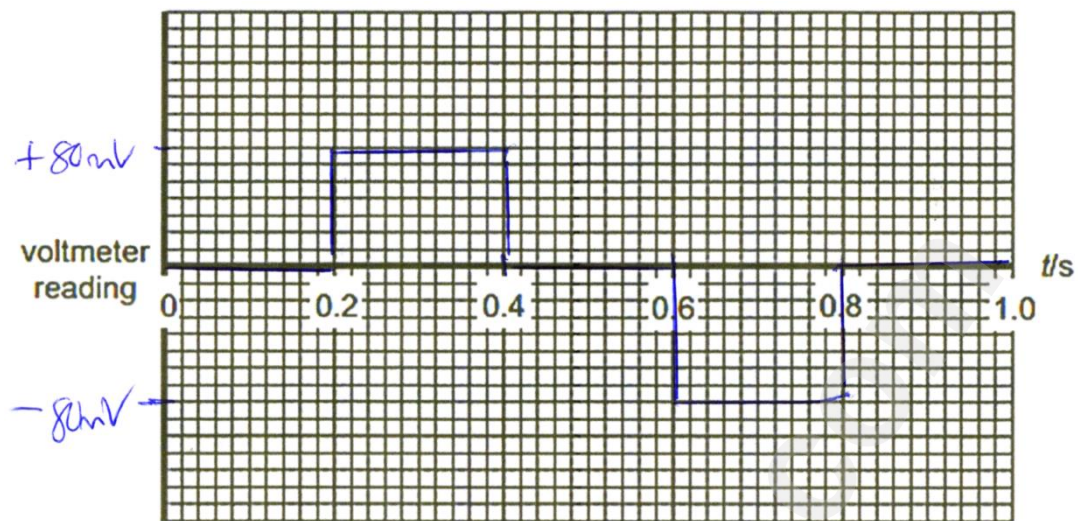
Only C $\checkmark$ can emit electrons from caesium. (3)

$$\begin{aligned} 13.5 \quad E &= hf + Ek \\ 12,1 \times 1,6 \times 10^{-19} \checkmark &= (6,6 \times 10^{-34} \times 5,1 \times 10^{14}) + Ek = 3,37 \times 10^{-19} + Ek \\ 1,936 \times 10^{-18} - 3,366 \times 10^{-19} &= Ek \end{aligned}$$

$$\begin{aligned} 1,5994 \times 10^{-18} &= Ek = \frac{1}{2}mv^2 \\ \sqrt{\frac{1,5994 \times 10^{-18}}{\frac{1}{2} \times 9,1 \times 10^{-31}}} &= V = 1,87 \checkmark \times 10^6 \text{ m} \cdot \text{s}^{-1} \end{aligned} \quad (3)$$

[14]

Question 12.4



Min zero $\left. \begin{array}{l} 0-1,2 \\ 0,4-0,6 \\ 0,8-1 \end{array} \right\} \checkmark$

Max $\checkmark \left\{ \begin{array}{l} 0,2-0,4 + \\ 0,6-0,8 - \end{array} \right. \checkmark$

(3)