

KZN 12 Support Papers 2009

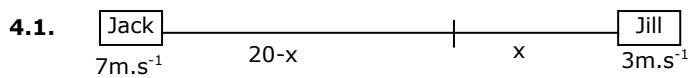


Physical Science Paper 1 Memo

- 1.1. power
- 1.2. elastic
- 1.3. scattering
- 1.4. work (energy)
- 1.5. monochromatic

- 2.1. ... designed to decrease the contact force (... designed to increase the contact time)
- 2.2. ... the rate of change of displacement increases (... the rate of change of velocity is constant)
- 2.3. ... doubled ...
- 2.4. Split ring commutators
- 2.5. ... is proof that light has particle properties

- 3.1. D
- 3.2. A
- 3.3. D
- 3.4. B
- 3.5. B



$$s = vt \qquad s = vt$$

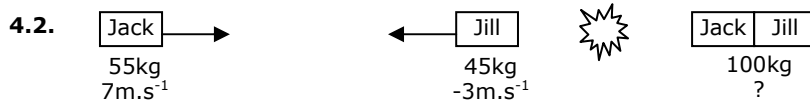
$$20 - x = 7t \text{ (eq.1)} \qquad x = 3t \text{ (eq. 2)}$$

substitute eq. 2 in eq. 1

$$20 - 3t = 7t$$

$$20 = 10t$$

$$t = 2s$$



$$\text{total } p_b = \text{total } p_a$$

$$(mv)_1 + (mv)_2 = (mv)_3$$

$$55(7) + 45(-3) = 100v_3$$

$$v_3 = 2,5m.s^{-1} \text{ rightwards}$$

$$s = vt$$

$$= 2,5(5)$$

$$= 12,5m \text{ to the right from point they collided}$$

- 4.3. F (Newton's Third Law)

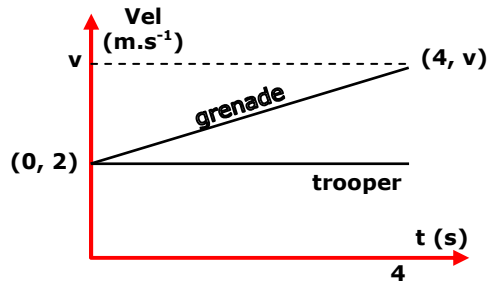
- 5.1. distance paratrooper falls after dropping grenade
- 5.2. distance between grenade and paratrooper at point of explosion
- 5.3. $9,8 \text{ m.s}^{-2}$

5.4. $\text{grad} = \frac{y_2 - y_1}{x_2 - x_1}$

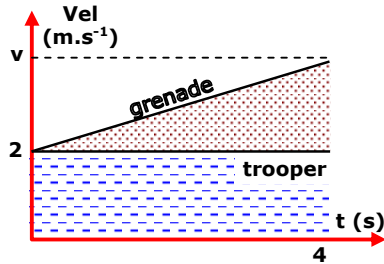
$$9,8 = \frac{v - 2}{4 - 0}$$

$$v - 2 = 9,8(4)$$

$$v = 41,2 \text{ m.s}^{-1} \text{ down}$$



5.5.



Calculate area of Triangle

$$\text{area} = \frac{1}{2}bh$$

$$\text{area} = \frac{1}{2}(4)(39,2) \quad (41,2 - 2 = 39,2)$$

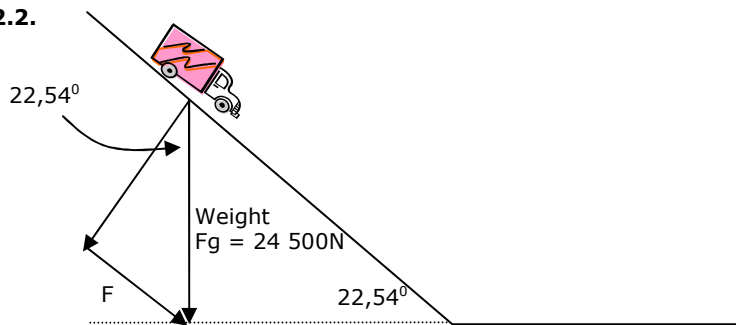
$$\text{area} = 78,4\text{m}$$

He is safe since he is 78,4m away from the explosion which is more than the safety distance of 75m.

6.1. $E_k = \frac{1}{2}mv^2$
 $= \frac{1}{2}(2500)(12)^2$
 $= 180\,000\text{J}$
 $= 1,8 \times 10^5\text{J}$
 $= 180\text{kJ}$

6.2.1. the increase in E_k comes from the decrease in E_p (drop in E_p is converted to increase in E_k)

6.2.2.



$$\sin 22,54^\circ = \frac{F}{24500}$$

$$F = 9391,54\text{N}$$

$$a = \frac{F_R}{m}$$

$$a = \frac{9391,54}{2500}$$

$$a = 3,75\text{ms}^{-2}$$

6.3.1. The brakes must use up the increase in the E_k (the decrease in E_p).

Energy of brakes is:

$$E_p = mgh$$

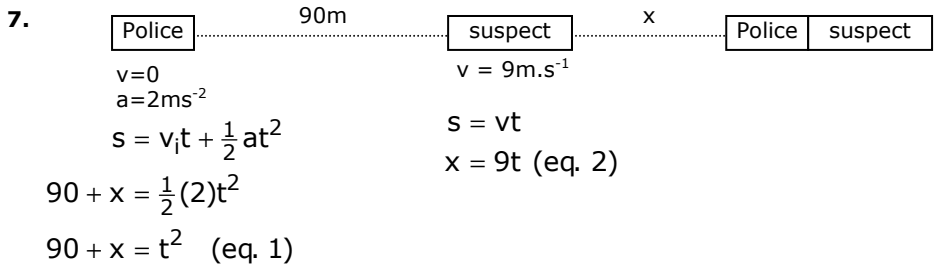
$$= 2500(9,8)(230)$$

$$= 5\,635\,00\text{J}$$

$$= 5,635 \times 10^6\text{J}$$

6.3.2. $t = \frac{S}{v}$
 $= \frac{600}{12}$
 $= 50\text{s}$

6.3.3. $P = Fv = 9391,54(12) = 112\,698,48 \text{ watts}$



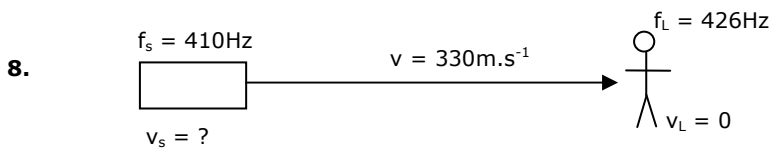
Substitute eq.2 in eq.1

$$90 + 9t = t^2$$

$$t^2 - 9t - 90 = 0$$

$$(t - 15)(t + 6) = 0$$

$t = 15\text{s}$ or
 $t = -6\text{s}$ (NA)



- 8.1. longitudinal
8.2. apparent increase in f when a source approaches a listener
8.3.

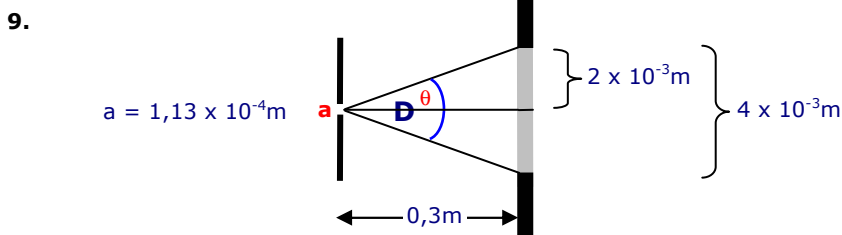
$$f_L = \left(\frac{v - v_L}{v - v_s} \right) f_s$$

$$426 = \left(\frac{330 - 0}{330 - v_s} \right) 410$$

$$426(330 - v_s) = (330)410$$

$$v_s = 12,39\text{m.s}^{-1}$$

- 8.4. $12,39 \times 3,6 = 44,60\text{km.h}^{-1}$
not breaking the speed limit
8.5. lesser than 426Hz



- 9.1. Huygens Principle
9.2. $2 \times 10^{-3}\text{m}$

9.3.1.

$$\tan \theta = \frac{2 \times 10^{-3}}{0,3}$$

$$\theta = 0,38^\circ$$

then

$$D = 0,38^\circ \times 2$$

$$D = 0,76^\circ$$

9.3.2.

$$\sin \theta = \frac{m\lambda}{a}$$

$$\sin 0,38^\circ = \frac{1\lambda}{1,13 \times 10^{-4}}$$

$$\lambda = 7,49 \times 10^{-7}\text{m}$$

9.3.3.

$$c = f\lambda$$

$$3 \times 10^8 = f(7,49 \times 10^{-7})$$

$$f = 4 \times 10^{14}\text{Hz}$$

red light

- 9.4. evenly spaced bands of red and black will form no main central band



10.1. in between the plates

10.2. decrease

10.3.1. $C = \frac{Q}{V}$
 $= \frac{4 \times 10^{-11}}{12}$
 $= 3,33 \times 10^{-12} \text{F}$
 $= 3,33 \text{pF}$

10.3.2. $C = \frac{\epsilon_0 A}{d}$
 $3,33 \times 10^{-12} = \frac{(8,85 \times 10^{-12})(50 \times 10^{-4})}{d}$
 $d = 0,013 \text{m}$

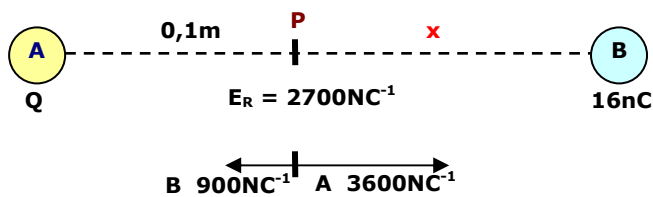
10.4. halved as well

10.5. TV sets contain capacitors which would be fully charged. Should any touch the terminals, the capacitor would discharge causing the person to be shocked.

10.6.1. both supply electricity

10.6.2. batteries produce electricity from chemical reactions
 capacitors release electrons from oppositely charged plates

11.



11.1. 3600NC^{-1} rightwards

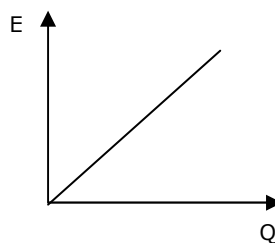
11.2. $E = \frac{kQ}{r^2}$
 $3600 = \frac{(9 \times 10^9)Q}{(0,1)^2}$
 $Q = +4 \times 10^{-9} \text{C}$

11.3. $E_B = 900 \text{NC}^{-1}$ left

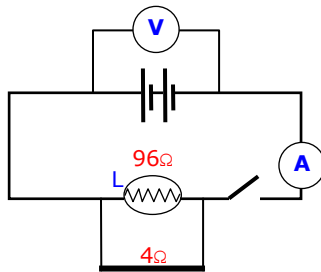
$E = \frac{kQ}{r^2}$
 $900 = \frac{(9 \times 10^9)(16 \times 10^{-9})}{x^2}$
 $x = 0,4 \text{m}$

11.4.1. towards A (leftwards)
 electron is negative, hence moves opposite to direction of electric field)

11.4.2. $E = \frac{kQ}{r^2}$
 $E \propto Q$ (k, r constant)



12.



12.1. $V_{//} = 24V$ $R_{//} = 3,84\Omega$ therefore $I = \frac{V}{R} = \frac{24}{3,84} = 6,25A$

12.2. $V_L = 6V$ $R = \frac{V}{I} = \frac{6}{6,25} = 0,96\Omega$ (total) each cell = $\frac{0,96}{2} = 0,48\Omega$

12.3. $P = VI = 24(6) = 144\text{watts}$

12.4. increases: $R_{//}$ increases, therefore $V_{//}$ increases $P = \frac{V^2}{R}$ $P \propto V^2$ therefore P increases

13.1. AC generator

13.2. mechanical to electrical

13.3. slip rings

13.4. brushes

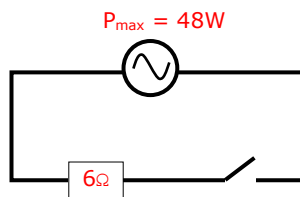
13.5. maximum

13.6. electron flow: A to B

13.7.1. changing magnitude of current as a result of different positions of the loop in the magnetic field
changing direction of current as a result of up and down movement of loop in the magnetic field

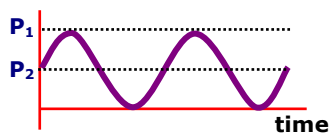
13.7.2. replace slip rings with split rings
DC (but of non-constant magnitude)

14.



14.1. alternating current : current of changing direction and magnitude

14.2.



$P_1 = 48W$

$P_2 = 24W$

14.3. $P_{av} = \frac{V_{rms}^2}{R}$

$24 = \frac{V_{rms}^2}{6}$

$V_{rms} = 12V$

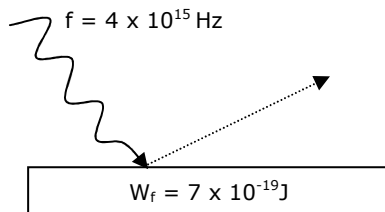
14.4. $P_{max} = I_{max}^2 R$

$48 = I_{max}^2 (6)$

$I_{max} = 2,83A$

best fuse would be 3A

15.



15.1. minimum amount of energy needed to eject an electron from the surface of a metal by the action of light

15.2. $E = hf$

$$E = (6,63 \times 10^{-34})(4 \times 10^{15})$$

$$E = 2,652 \times 10^{-18} \text{ J}$$

Then ...

$$E_k = (2,652 \times 10^{-18}) - (7 \times 10^{-19})$$

$$E_k = 1,95 \times 10^{-18} \text{ J}$$

15.3. $E_k = \frac{1}{2}mv^2$

$$(1,95 \times 10^{-18}) = \frac{1}{2}(9,11 \times 10^{-31})v^2$$

$$v = 2,07 \times 10^6 \text{ m.s}^{-1}$$

15.4.1. E_k would increase

15.4.2. no effect

15.5.1. smaller

15.5.2. increased

16. $n=2$ $E_2 = -0,52 \times 10^{-18} \text{ J}$

$n=1$ ● $E_1 = -2,3 \times 10^{-18} \text{ J}$

16.1. $\Delta E = (-0,52 \times 10^{-18}) - (-2,3 \times 10^{-18})$
 $\Delta E = 1,8 \times 10^{-18} \text{ J}$

16.2.1. spontaneous emission

16.2.2. stimulated emission