MEMO for Physics July 2016

QUESTON 1

1. C	2. B	3. D	4. C	5. A
6. B	7. B	8. A	9. C	10. A

QUESTION 2

2.1 The rate of change of position or rate of displacement (2)

2.2 5 $m.s^{-1}$ upwards. (2)

2.3 Acceleration of the ball. (1)

2.4 Gradient $= \frac{\Delta v}{\Delta t} = \frac{(5 + 14,89)}{2,03} =$ **$9,8\ m.s^{-2}$** (3)

2.5 Using area under the graph:

$(\frac{1}{2} \times 0,51 \times 5) - (\frac{1}{2}(2,03 - 0,51) \times 14,89) = -10,04$

= **10,04 m below his hand**

OR

Using an equation of motion:

u = + 5 a = -9,8 t = 2,03 S = ?

$S = ut + \frac{1}{2}at^2$

$S = (5 \times 2,03) - (\frac{1}{2} \times 9,8 \times 2,03^2) = -10,04$

= **10,04 m below his hand** (4)

2.6 after bounce: u = 10 a = - 9,8 v = 0 t (to max height) = t

$v = u + at$

$t = \frac{v - u}{a} = \frac{10}{9,8} = 1,02\ s$

from graph, time from boy's hand to ground = 2,03 s

$\therefore$ total time = 2,03 + 1,02 = **3,05 s** (5)

2.7 Using area under the graph:

From 2,03 s → 3,05 s

$(\frac{1}{2} \times 1,02 \times 10) = 5,1\ m$

$\therefore$ distance below hand = 10,04 – 5,1 = **4,94 m** (5)

OR using equation of motion**:**

u = 10 a = - 9,8 v = 0 S = height that ball rises after bouncing

$v^2 = u^2 + 2aS$

$S = \frac{v^2 - u^2}{2a} = \frac{-100}{2 \times 9,8} = 5,1$ m

∴ distance below hand = 10,04 – 5,1 = **4,94 m**

QUESTION 3

3.1 Acceleration is the rate of change of velocity

3.2 u = 30 v = 10 a = -5 S = S

$v^2 = u^2 + 2aS$

$S = \frac{v^2 - u^2}{2a} = \frac{100 - 900}{-10}$ = **80 m**

3.3 v = u + at

10 = 30 - 5t ∴ **t = 4 s**

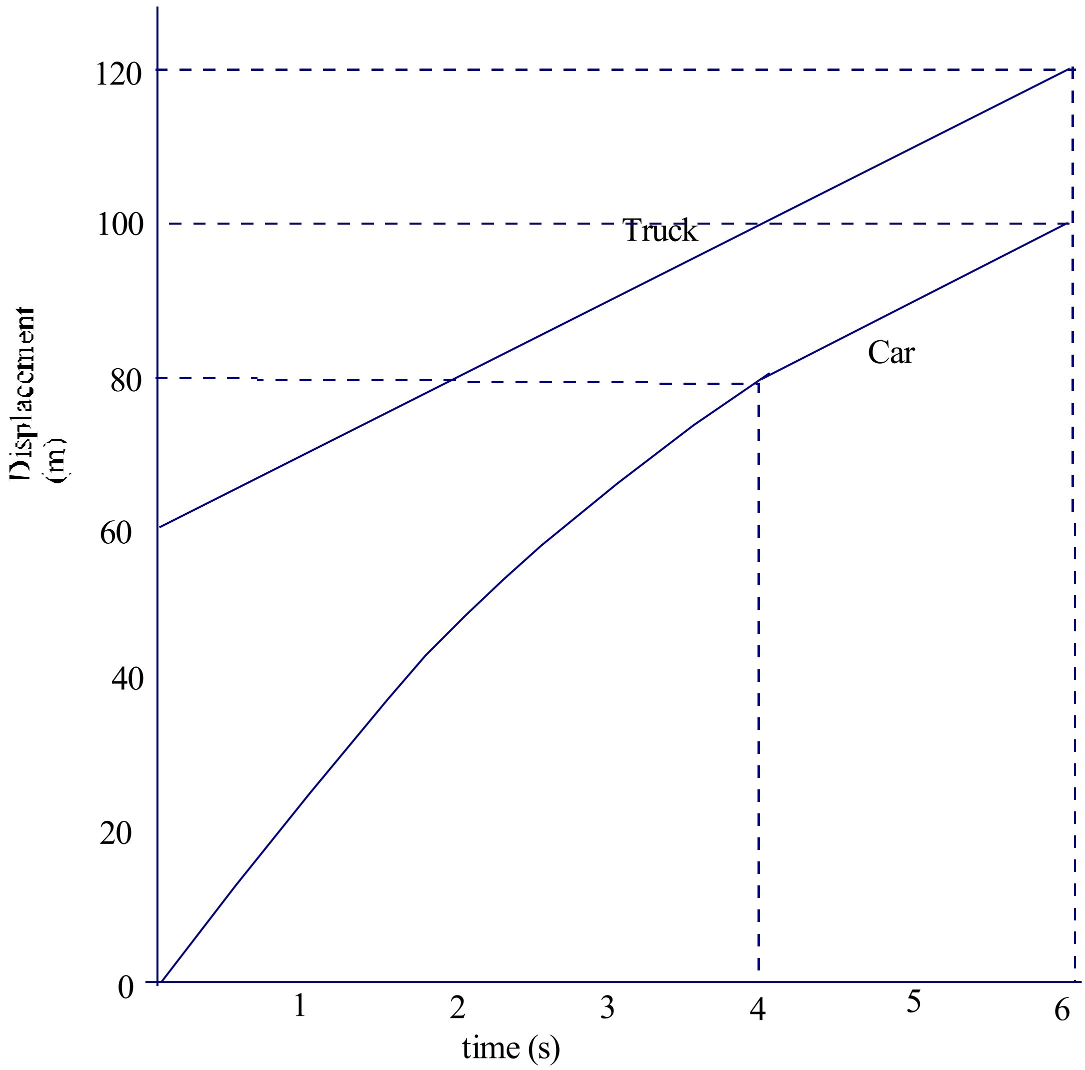
3.4 S = v x t ∴ S = 10 x 4 = **40 m**

3.5 Truck will be 40 + 60 = 100 m from position P

Car will be 80 m from position P

∴ car will be 100 - 80 = **20 m behind the truck**

3.6

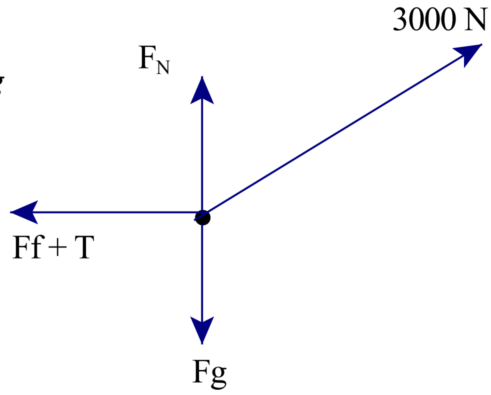


QUESTION 4

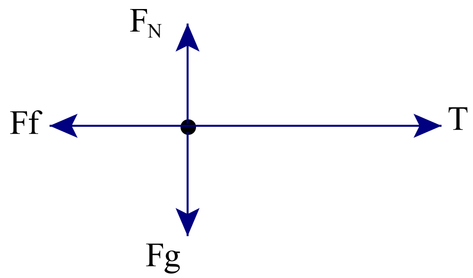
4.1 The resultant force is equal to the rate of change of momentum.

4.2

200 kg log



100 kg log



4.3.1 Ff = μFn = 0,8 x 100 x 9,8 = **784 N**

4.3.2 Ff = μFn = 0,8 x [(200 x 9,8) - (3000 Sin 30^0)]

∴ Ff = 368 N

4.4.1 For 100 kg log:

F_{net} = ma

T – Ff = ma

∴ T - 784 = 100a

For 200 kg log

F_{net} = ma

(3000 cos 30) - (T + 368) = 200a

- T + 2230 = 200a

∴ a = 4,82 $m.s^{-2}$

4.4.2 $T = \mathbf{1266\ N}$

QUESTION 5

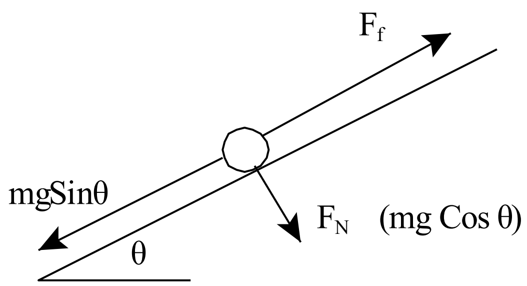
5.1.1 $T_1 \cos 30^0 = 100$ $\therefore \mathbf{T_1 = 115{,}47\ N}$

5.1.2 $T_1 \sin 30^0 = T_2$ $\therefore \mathbf{T_2} = 115{,}47 \sin 30 = \mathbf{57{,}7\ N}$

5.2 Friction force, $F_f = \mu F_N$

$\therefore F_f = 0{,}8 \times m \times 9{,}8 \times \cos\theta$

$= 7{,}84\ m \cos\theta$ 1



Also: $F_f = m \times 9{,}8 \times \sin\theta$ 2

Equate . . . . 1 and 2

$7{,}84\ \cancel{m} \cos\theta = 9{,}8\ \cancel{m} \sin\theta$

$\therefore \dfrac{7{,}84}{9{,}8} = \dfrac{\sin\theta}{\cos\theta}$

$\dfrac{7{,}84}{9{,}8} = \tan\theta$

$\theta = 38^0$

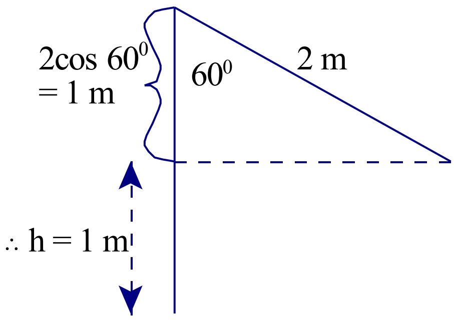
QUESTION 6

6.1 *In the absence of air resistance or any external forces, the mechanical energy of an object is constant.*

6.2 $\frac{1}{2}\,\cancel{(m+M)}\,v^2 = \cancel{(m+M)}\,gh$

$\therefore v^2 = 2 \times 9{,}8 \times 1$

$v_{\text{bullet-and-block}} = \mathbf{4{,}43\ m.s^{-1}}$



6.3 *The total linear momentum of an isolated system remains constant.*

6.4 $mv_{\text{bullet}} = (m + M)\, v_{\text{bullet-and-block}}$

$0{,}1 \times v = (0{,}1 + 2{,}9)\, 4{,}43$

$\therefore$ **velocity of bullet = 132,9 m.s^{-1}**

6.5 Bullet: $E_k = \frac{1}{2} mv^2 = \frac{1}{2} \times 0{,}1 \times 132{,}9^2 = 883{,}1\ \text{J}$

Bullet-and-block = $E_k = \frac{1}{2} mv^2 = \frac{1}{2} \times (0{,}1 + 2{,}9) \times 4.43^2 = 29{,}4\ \text{J}$

$883{,}1 \neq 29{,}4$

$\therefore$ **kinetic energy is not conserved**

6.6 Inelastic collision

6.7 Part of the kinetic energy converts into internal energies of the bullet and the pendulum.

QUESTION 7

7.1 $V = \frac{W}{Q}$

$\therefore V = \frac{0{,}05}{5 \times 10^{-6}}$

$= \mathbf{10\ 000\ V}$

7.2 $E = \frac{F}{Q}$ and $F = ma$

$\therefore ma = EQ$

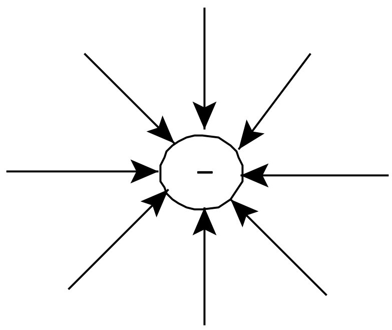
$\therefore a = \frac{EQ}{m}$

$= \frac{1,8x10^{5} \text{ x } 1,6x10^{-19}}{9,1x10^{-31}}$

$= \mathbf{3,16x10^{16}\ m.s^{-2}}$

7.3.1 COULOMB'S LAW: The force between two charges is directly proportional to the product of the changes and inversely proportional to the square of the distances between them.

7.3.2



7.3.3 Charge on P = $-4x10^{-6}$C

$\therefore$ number of electrons = $\frac{-4x10^{-6}}{-1,6x10^{-19}}$

$= \mathbf{2,5x10^{13}}$ **electrons**

7.3.4 When spheres touch, charge on each sphere = $\frac{(-4x10^{-6}) + (+2x10^{-6})}{2}$

$= 1x10^{-6}$C

$F = \frac{kQ_1Q_2}{r^2}$

$= \frac{9x10^{9} \text{ x } (1x10^{-6})^2}{(1x10^{-2})^2}$

$= \mathbf{90\ N}$

QUESTION 8

8.1.1 Current through a conductor is directly proportional to the potential difference across the conductor at constant temperature

8.1.2 Energy $= \frac{V^2 t}{R}$ $V^2 = \frac{18\,000 \times 40}{50}$ $\therefore$ **V = 120 V**

8.1.3 $I = \frac{V}{R}$ $I = \frac{120}{40}$ = **3 A**

8.1.4 Current in 60 Ω resistor $= \frac{120}{60} = 2$ A $\therefore$ Reading on A = 2 + 3 = **5 A**

8.1.5 E = ir + iR

200 = (5 x 6) + $V_{external\ circuit}$

200 – 30 = V = 170 V

$V_{//} = 120$

$V_{across\ R}$ = 170 - 120 = 50 V

$\therefore$ $R = \frac{V}{I} = \frac{50}{5}$ = **10 Ω**

8.2 P = iV $\therefore$ P = 3 x 120 = 360 W

$\therefore$ cost $= \frac{360}{1000} \times 2 \times 1{,}60$ = **R1.15**

8.3
- resistance breaks
- resistance of circuit increases
- current in circuit decreases
- reading on A decreases

QUESTION 9

9.1.1 The induced current flows in a direction so as to set up a magnetic field to oppose the change in magnetic flux.

9.1.2 B to A

9.1.3 Galvanometer needle moves to opposite side, then returns to centre zero when magnet stops moving.

9.1.4 Bigger deflection of galvanometer needle.

9.1.5 Move the magnet in and out of the solenoid.

9.2.1 Slip rings

9.2.2 x to y

9.2.3.1 horizontal (parallel to the magnetic field)

9.3.2.2 vertical between the magnets (at right angles to the magnetic field)

9.3.2.3 vertical

9.3.3.3 vertical

9.2.4 $\frac{4\,500}{60} = 75$ Hz

9.2.5 Exchange the slip rings for a split ring commutator.

9.3.1 No

DC will not produce the required <u>change in magnetic flux</u> in order to <u>induce</u> an emf in the secondary coil.

9.3.2 $\frac{N_s}{N_p} = \frac{V_s}{V_p}$

$\frac{3600}{1400} = \frac{V_s}{110}$

$V_s = 282{,}86$ V

$\mathbf{I} = \frac{V}{R} = \frac{282{,}86}{4000\checkmark} = \mathbf{0{,}071\ A}$

QUESTION 10

10.1.1 $3{,}04 \times 10^{-19}$ J is the minimum energy required to just release a photoelectron from a caesium atom.

10.1.2 Energy of a photon depends on its frequency. If frequency is low, then energy is low, and therefore photon may not have enough energy to overcome the work function. So no photoelectrons are released and ammeter shows no reading.

10.1.3 $hf = w + Ek$

$\therefore Ek = hf - w = (6{,}6 \times 10^{-34} \times 6{,}1 \times 10^{14}) - 3{,}04 \times 10^{-19} = \underline{\mathbf{9{,}86 \times 10^{-20}\ J}}$

10.2.1 $6{,}5 \times 10^{14}$ Hz. (At threshold frequency, kinetic energy of photoelectron is zero.)

10.2.2 At threshold frequency, $hf = w \therefore 6{,}6 \times 10^{-34} \times 6{,}5 \times 10^{14} = \mathbf{4{,}3 \times 10^{-19}\ J}$

Calcium