NATIONAL SENIOR CERTIFICATE EXAMINATION
SUPPLEMENTARY EXAMINATION MARCH 2016

PHYSICAL SCIENCES: PAPER I

MARKING GUIDELINES

Time: 3 hours | 200 marks

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QUESTION 1

1.1 B
1.2 C
1.3 A
1.4 A
1.5 A
1.6 D
1.7 D
1.8 C
1.9 A
1.10 B (2 × 10 = 20)
[20]

QUESTION 2

2.1 2.1.1 A vector is a physical quantity that has both magnitude and direction. (2)

2.1.2 horizontal P = 500 cos(50)
horizontal P **= 321,39 N** (2)

2.1.3 $P_{horizontal} = Q_{horizontal}$
321,39 = Q cos(60)
Q = 642,79 N (3)

2.1.4 $F_{up} = F_{down}$
500 sin(50) + Q sin(60) = W_{Simon}
500 sin(50) + 642,78 sin (60) = W_{Simon}
W_{Simon} = 939,69 N

W_{Simon} = mg
939,69 = m (9,8)
m = 95,89 kg (5)

2.2 2.2.1 distance is length of path travelled (2)

2.2.2 distance = 40 + 40 + 40 + 80
distance = 200 m (2)

2.2.3 displacement = $\sqrt{40^2 + 80^2}$
displacement = 89,44 m

$\tan(\theta) = \frac{80}{40}$
$\boldsymbol{\theta = 64,43^{o}}$ **S of E** (5)

2.2.4 average speed = $\frac{total\ distance}{total\ time}$
average speed = $\frac{200}{25}$ (coe from 2.2.2)
average speed = 8 m·s^{-1} (3)
[24]

QUESTION 3

3.1 3.1.1 acceleration is the rate of change of velocity (2)

3.1.2 a = slope of v-t graph
a = $\frac{8}{8}$
a = 1 m·s^{-2} (3)

3.1.3 running at a constant velocity (2)

3.1.4 distance = area under v-t graph
distance = $\frac{1}{2}(8)(8) + (13 - 8)(8) + \frac{1}{2}(17 - 13)(2) + (17 - 13)(6)$
distance = 32 + 40 + 4 + 24
distance = 100 m (4)

3.1.5 they have the same velocity/speed (2)

3.1.6 s = area under graph
100 = $\frac{1}{2}(15)(10) + (t - 15)(10)$
100 = 75 + 10t – 150
t = 17,5 s (4)

3.2 3.2.1 springbok exerts force on ground
ground exerts force on springbok (2)

3.2.2 The action-reaction pairs act on different objects
force of ground on springbok is greater than weight of the springbok
resultant force on springbok is up
by Newton's second law, resultant force produces acceleration (4)

3.2.3 $v^2 = u^2 + 2as$
v^2 = 0 + 2(35)(0,70)
v^2 = 49
v = 7 m·s^{-1} (3)

3.2.4 $v^2 = u^2 + 2as$
0 = 49 + 2(-9,8)s
s = 2,5 m (3)
[29]

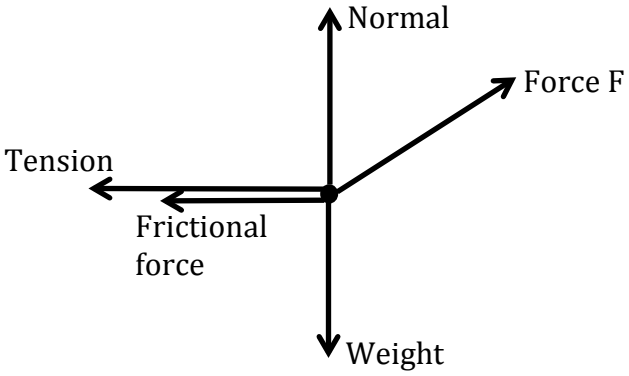
QUESTION 4

4.1 $F_{f\ max} = \mu N$
$F_{f\ max} = \mu mg$
$F_{f\ max}$ = (0,7)(12)(9,8)
$\boldsymbol{F_{f\ max}}$ **= 82,32 N** (3)

4.2 Newton's first law states an object continues in a state of rest or uniform velocity unless it is acted upon by a net or resultant force. (2)

4.3 $T = F_{f\ max}$ on 12 kg mass
$\boldsymbol{T}$ **= 82,32 N** (2)

4.4



(5)

4.5 $N = mg - Fsin(20)$ (2)

4.6 $F\cos(20) = T + \mu N$
$F\cos(20) = 82{,}32 + 0{,}7(mg - Fsin20)$
$F(\cos 20 + 0{,}7sin20) = 82{,}32 + 0{,}7(36)(9{,}8)$
$\boldsymbol{F = 279{,}26}$ **N** (4)
[18]

QUESTION 5

5.1 5.1.1 $\Delta p = m(v - u)$
Δp = 2 500 (0 – 25)
Δp = - 62 500
Δp = 62 500 kg·m·s^{-1} (3)

5.1.2 The work done by a net force on an object is equal to the change in the kinetic energy of the object. (2)

5.1.3 $F_{net}\,\mathrm{s} = \Delta E_K$
$F_{net}(1{,}8) = \frac{1}{2}(2500)(25)^2$
$\boldsymbol{F_{net} = 434\,027{,}78}$ **N** (4)

5.1.4 $F_{net}\Delta t = \Delta p$
$434\,027{,}78\,\Delta t = 62\,500$
$\boldsymbol{\Delta t = 0{,}14\ s}$ (3)

5.1.5 $F_{net}\Delta t = \Delta p$
if time taken to stop is decreased,
the resultant force acting on the driver would increase,
bigger force means greater injury (4)

5.2 5.2.1 Law of conservation of (linear) momentum (2)

5.2.2 $(p_{total})\ before = (p_{total})\ after$
1 084(33) + 3 437(-28) = 1 084(-5) + 3 437v
v = -16,02 m·s^{-1}
v = 16,02 m·s^{-1} west (5)

5.2.3 Elastic collision is a collision in which both momentum and **kinetic energy is conserved**. (2)

5.2.4 $E_{K\ before} = \frac{1}{2}(1\,084)(33)^2 + \frac{1}{2}(3\,437)(28)^2$
$E_{K\ before} = 1\,937\,542$ J

$E_{K\ after} = \frac{1}{2}(1\,084)(5)^2 + \frac{1}{2}(3\,437)(16{,}02)^2$
$E_{K\ after} = 454\,587$ J

Inelastic collision as kinetic energy not conserved (5)
[30]

QUESTION 6

6.1 Every particle in the universe attracts every other particle with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centres. (2)

6.2 $F = \frac{Gm_1m_2}{r^2}$

$$3,4\times10^{29} = \frac{(6,7\times10^{-11})(4,5\times10^{30})(9,9\times10^{30})}{(r^2)}$$

$\boldsymbol{r = 9,37 \times 10^{10}\ \text{m}}$ (4)

6.3 $g_E = \frac{GM}{R^2}$

$g_S = \frac{G(95M)}{(9,4R)^2}$

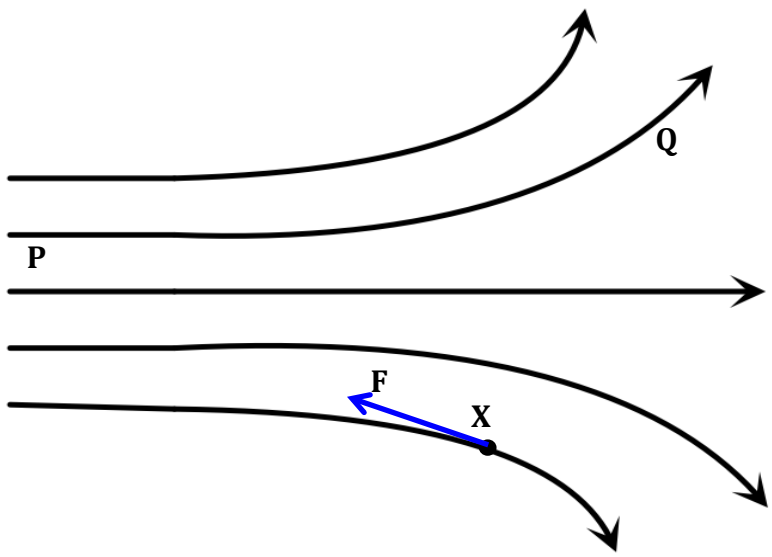
$g_s = 1,075\frac{GM}{R^2}$

$\boldsymbol{g_s = 10,54\ \text{m·s}^{-2}}$ (4)

6.4 The magnitude of an electric field at a point is the force per unit positive charge. (2)

6.5 6.5.1 strength at P greater than strength at Q
as field lines closer together at P (2)

6.5.2 arrow opposite to E field
tangent to E line



(2)
[16]

QUESTION 7

7.1 7.1.1 Potential difference is the work done per unit positive charge. (2)

7.1.2 $V = RI$
$3 = 6\,I$
$\boldsymbol{I = 0,5\ \text{A}}$ (3)

7.1.3 $q = It$
$q = (0{,}5)(10 \times 60)$
$\boldsymbol{q = 300\ \text{C}}$ (3)

7.2 7.2.1 emf is the total energy per coulomb of charge supplied by the cell (2)

7.2.2 $V = emf - Ir$
$10 = 12 - 2r$
$\boldsymbol{r = 1\ \Omega}$ (3)

7.2.3 $V = RI$
$10 = 20\,I$
$\boldsymbol{I = 0,5\ \text{A}}$ (3)

7.2.4 I through $R_1 = 2{,}0 - 0{,}5 = 1{,}5$ A

$P = I^2R$
$5{,}85 = (1{,}5)^2R_1$
$\boldsymbol{R_1 = 2,6\ \Omega}$ (4)

7.2.5 $V_{R1} = IR_1$
$V_{R1} = (1{,}5)(2{,}6)$
$V_{R1} = 3{,}9$ V

$V_{R2} = 10 - 3{,}9$
$V_{R2} = 6{,}1$ V
$V_{R2} = IR_2$
$6{,}1 = 1{,}5R_2$
$\boldsymbol{R_2 = 4,07\ \Omega}$ (4)

7.2.6 open S, circuit resistance increases
so I through battery decreases
by $V = emf - Ir$
V increases (4)
[28]

QUESTION 8

8.1 mechanical energy to electrical energy (2)

8.2 The greater the number of loops in the coil, the greater the emf induced. (2)

8.3 Number of loops (2)

8.4 Area of coil
OR Magnetic field (2)

8.5 See Graph
Heading
Y-axis title and unit
X-axis title
Scale
Plotting points
Line of best fit (7)

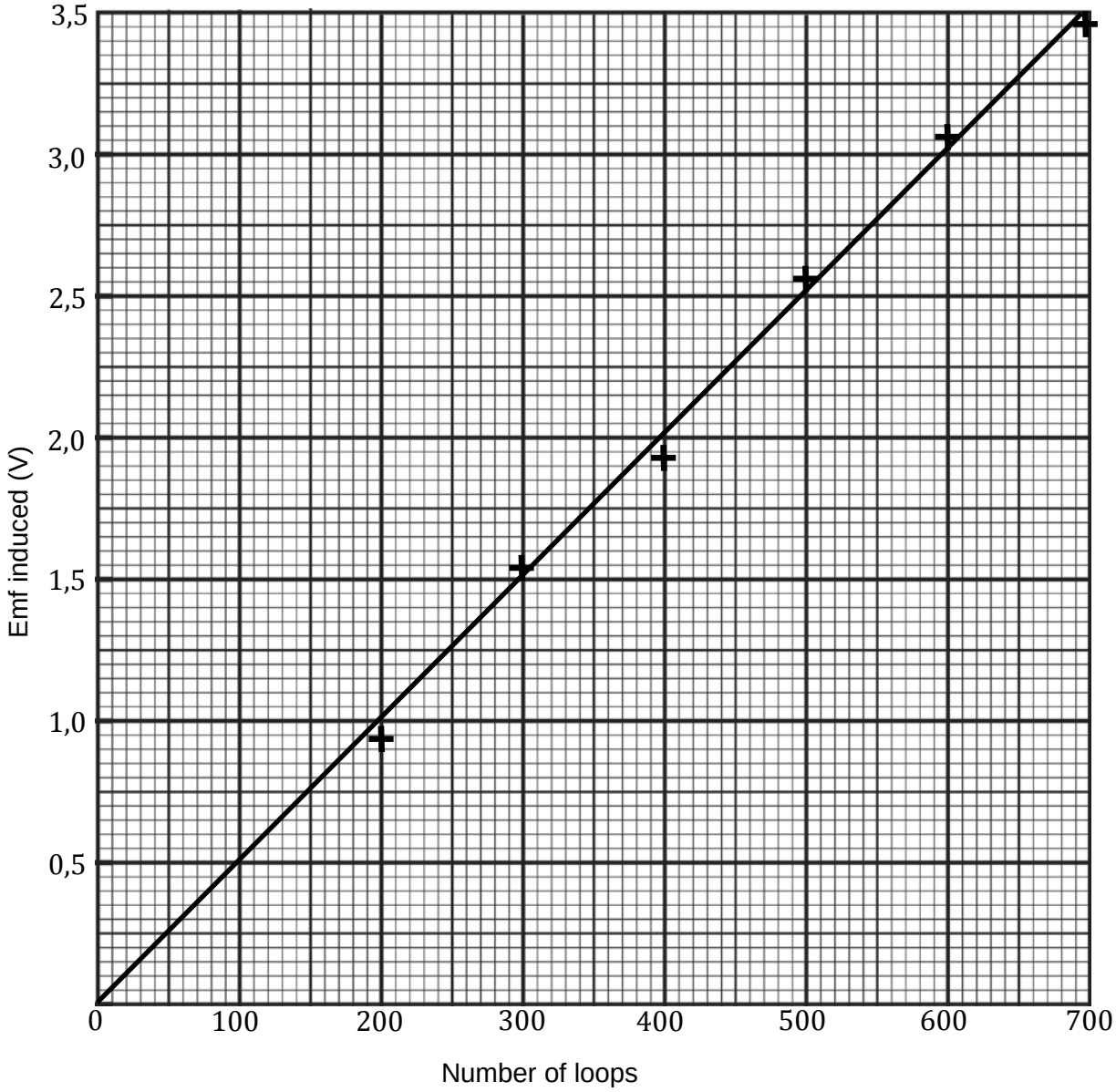
8.6 gradient = $\frac{\Delta y}{\Delta x}$

gradient = $\frac{values\ from\ graph}{values\ from\ graph}$ (shown on graph)

gradient = 0,005 (4)

8.7 $emf = \frac{\Delta\phi}{\Delta t}N$
plotting emf on y axis and N on x axis means
$gradient = \frac{\Delta\phi}{\Delta t}$
$\frac{\Delta\phi}{\Delta t} = 0{,}005$ Wb.s^{-1} (2)

Graph of emf induced vs number of loops



[21]

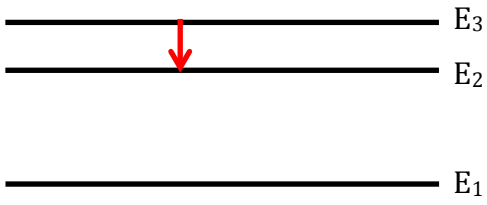
QUESTION 9

9.1 A process that occurs when light of sufficient energy shines on a metal and electrons are ejected. (2)

9.2 9.2.1 3 (2)

9.2.2 $E_3 \longrightarrow E_1$ (2)

9.2.3 show $E_3 \longrightarrow E_2$ and direction



(2)

9.2.4 $E = \frac{hc}{\lambda}$

$E = \frac{(6,6\times10^{-34})(3\times10^{8})}{618\times10^{-9}}$

$\boldsymbol{E} = 3,2\times10^{-19}\ \mathbf{J}$ (4)

9.2.5 electrons can't possess any more energy than allowed in an energy level when they move to a lower energy level, the difference in energy between the levels has to be discarded (2)

[14]

Total: 200 marks

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