NATIONAL SENIOR CERTIFICATE EXAMINATION
SUPPLEMENTARY EXAMINATION – MARCH 2019

PHYSICAL SCIENCES: PAPER I

MARKING GUIDELINES

Time: 3 hours | 200 marks

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QUESTION 1 MULTIPLE CHOICE

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

QUESTION 2 KINEMATICS

2.1 2.1.1 acceleration is rate of change of velocity.

2.1.2 9,8 $m.s^{-2}$ down

2.1.3 $v_f = v_i + g\Delta t$
$0 = 15 + (-9,8).\ \Delta t$ (subst)
$\Delta t = 1,53$ s

2.1.4 $\Delta x = v_i\Delta t + ½\ g\Delta t^2$
$=15(1,53) + ½\ (-9,8)(1,53)^2$ up is +
$= 11,47$ m
OR Option 2:
Area under the v/t graph = Δx
Area of a triangle = $\frac{1}{2}b\ h = \frac{1}{2} \times 1.53 \times 15 = 11,48$ m
$\Delta x = 11,48$ m

2.1.5 $v_f^2 = v_i^2 + 2g\Delta x$
$(-34)^2 = 15^2 + 2(-9,8)\Delta x$ (signs correctly substituted)
$\Delta x = -47,5$ m (magnitude)

2.1.6 see Answer Sheet memo

2.1.7 see Answer Sheet memo

2.1.8 t = 2,2 s

2.1.9 A is above B

2.1.10 displacement is given by area under graph.
Area UNDER AXIS (displacement down for B) > area Under X-axis for A

2.1.11 Take down as +

Ball A: $\Delta x = v_i\Delta t + ½ g\Delta t^2$

$\Delta x = -15\ \Delta t + ½(9,8)\Delta t^2$ (1)

Ball B : $\Delta x = v_i\Delta t + ½ g\Delta t^2$

$\Delta x = 1,5\ \Delta t^2$ (2)

Subst 2 into 1: (method)

$1,5\ \Delta t^2 = -15\Delta t + 4,9\ \Delta t^2$

$3,4\ \Delta t^2 – 15\Delta t = 0$

$\Delta t\ (3,4\Delta t – 15) = 0$

$\Delta t = 4,41$ s

2.1.12 see Answer Sheet memo

2.2 2.2.1 speed is rate of change of distance

2.2.2 speed = distance/time = 400 /105 = 3,8 $m.s^{-1}$

2.2.3 3,8 $m.s^{-1}$ west

QUESTION 3 NEWTON'S LAWS

3.1 3.1.1 $F_h = 200 \cos 30^o = 173,21$ N right

$F_v = 200 \sin 30^o = 100$ N down

3.1.2 $F_N = mg + F_v$ or implied

$= 40(9,8) + 100 = 492$ N

3.1.3 $F_{fs\ (max)} = \mu_s F_N$

$= 0,4\ (492) = 196,8$ N

3.1.4 Her foot will not slip because $F_h < F_{fs(max)}$

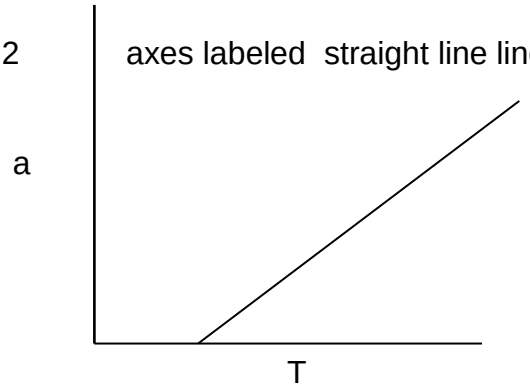
3.2 3.2.1 $F_{net} = F_T – F_f$ (on child skateboard) (or implied)

$F_{net} = ma$

$55(2) = F_t – 80$

$F_t = 190$ N

3.2.2 axes labeled straight line line cuts x-axis (not through origin)



3.2.3 The child continues to move forward when the T is removed and also continues to move forward when the board strikes the stone as the child does not experience a net force.

3.2.4 Newton's first law

QUESTION 4 MOMENTUM, WORK, ENERGY AND POWER

4.1 4.1.1 The work done by a net force is equal to the change in kinetic energy

4.1.2 slope = $\frac{\Delta y}{\Delta x} = \frac{\Delta Ek}{\Delta x}$

But $\Delta Ek = W_{net}$

$\frac{\Delta Ek}{\Delta x}$ = Wnet/ Δx but $W_{net}/\Delta x = F_{net}$

4.1.3 C: $\frac{180-88}{15-10}$ = 18,4 N method gradient

4.1.4 $F_f = F_{applied} - F_{net}$ = 20 – 18,4 = 1,6 N

4.1.5 B

4.1.6 The net force (gradient) will be smallest when force of friction is the largest.
B has smallest gradient

4.1.7 region A

Option 1: $v_f^2 = v_i^2 + 2a\Delta x$
$= 0 + 2(1)(5) = 10$
$\Delta E_k = ½ mv_f^2$
60 = ½ m (10)
m = 12 kg

Option 2:

Slope of the graph = $\frac{60-0}{5-0}$ = 12 N

F_{net} = slope of the graph = 12 N
F_{net} = ma
12 = m × 1
m = 12 kg

4.2 4.2.1 Power is the rate of doing work

4.2.2 v = 60 × 1000/3600 = 16,67 $m.s^{-1}$

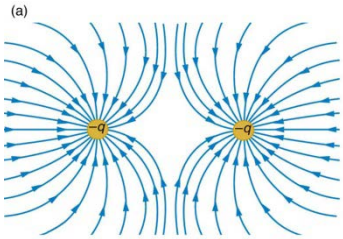
4.2.3 It means that the car engine converts energy at a rate of 60 000 Joules per second

4.2.4 $P = Fv$
$60\ 000 = F(16{,}67)$
$F = 3600$ N

4.3 $v = 19{,}44\ m.s^{-1}$
$m_c v_{ic} + 0 = (m_c + m_v)\ v_f$
$1500\ (19{,}44) = 7(1500) + m_v\ (7)$
$m_v = 2666{,}67$ kg

QUESTION 5 FIELDS

5.1 5.1.1 direction of arrows
Shape

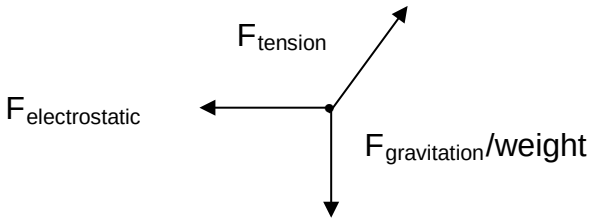


5.1.2 gravitational force experienced by an object at or near the surface of the earth

5.1.3 $mg = 0{,}002 \times 9{,}8 = 0{,}0196$ N down

5.1.4 A vector quantity is one which has both magnitude and direction

5.1.5



5.1.6 The force of attraction or repulsion or attraction between two charges is directly proportional to the product of the charges and inversely proportional to the square of the distance between them

5.1.7 $F_{Tv} = F_g = 0{,}0196 = F_T \sin 70°$
$\therefore F_T = 0{,}0196/\sin 70° = 0{,}0208$ N (or 0,021 N)
$F_{Th} = F_{electrostatic}$
$F_{electrostatic}\ 0{,}0208 \cos 70^o = 7{,}11 \times 10^{-3}$ N
$F_{electrstatic} = \frac{kQ1Q2}{r^2}$
$7{,}11 \times 10^{-3} = 9 \times 10^9\ Q^2 / 0{,}01^2$
$Q = 8{,}89 \times 10^{-9}$ C

5.2 $g_{earth} = \frac{GM_{earth}}{r_{earth}^2}$ $g_{saturn} = \frac{G94M_{earth}}{(9r_{saturn})^2}$ $= 94/81\ g_{earth} = 11{,}37\ m.s^{-2}$

QUESTION 6 ELECTRIC CIRCUITS

6.1 rate of flow of charge.

6.2 $P = I^2R = 2{,}31^2 . 10 = 53{,}36$ W

6.3 emf = IR + Ir
30 = 2,31 R + 2,31(1)
R_{ext} = 11,99 Ω (=11,987 ohms) hence R = 1,99 Ω

6.4 0 V

6.5 Option 1:
V_2 = IR = 2,31(11,987) = 27,69 V
Option 2:
V_2 = Emf – Ir
= 30 – (2.31 × 1)
= 27.69 V

6.6 resistance is opposition to the flow of charge.

6.7 6.7.1 decrease

6.7.2 As circuit R increases I decreases I = V/R
As I decreases P decreases since $P = I^2R$ and R is constant

6.8 6.8.1 Rparallel = product /sum = (5 × 10)/(5 + 10)
(or $\frac{1}{R\,parallel} = \frac{1}{5} + \frac{1}{10}$ $R_{parallel}$ = 3,33 Ω
Emf = I(R+r)
30 = I (13,33 + 1)
I = 2,09 A

6.8.2 $V_1 = R_{parallel} \times I = 3{,}33 \times 2{,}09 = 6{,}97$ V

QUESTION 7 ELECTRODYNAMICS

7.1 7.1.1 magnetic flux linkage is the product of the number of turns on the coil and the flux through the coil.

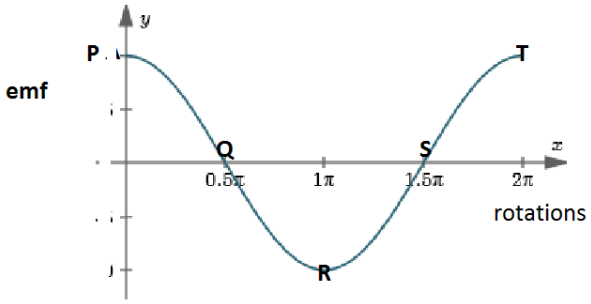
7.1.2 $\varphi = BA\cos\theta$ and Area of P = πr^2 Area of Q = $\pi(2r)^2 = 4\pi r^2$

$\varphi_P = B\ \pi r^2$ $\varphi_Q = 2B\,4\pi r^2$

$\frac{\varphi_P}{\varphi_Q} = B\pi r^2 / 2B\,(4\pi r^2) = \frac{1}{8} = 0{,}125$

7.2 7.2.1 There is a changing magnetic flux linkage through the coil.

7.2.2 cos shape (may start with negative emf) P Q R S T correct axes labelled
(one mark only if sine graph)



7.3 7.3.1 electrical energy to kinetic (mechanical) energy
7.3.2 Flemmings left hand motor rule
7.3.3 anti-clockwise
7.3.4 split ring commutator – it allows the armature/coil to continue to turn/rotate in one direction
It does this by changing the direction of current in the coil every half turn.

QUESTION 8 PHOTONS AND ELECTRONS

8.1 The work function is the minimum amount of energy needed to emit an electron from the surface of a metal.
8.2 frequency of incident radiation
8.3 Gradient = $\frac{\Delta y}{\Delta x} = \frac{J}{s^{-1}}$ = J.s = N.m.s
8.4 $W_o = hf_o = (6{,}6 \times 10^{-34})(1{,}05 \times 10^{15}) = 6{,}93 \times 10^{-19}$ J therefore zinc
8.5 $\frac{1}{2} m_e v_e^2 = hf - W_o$
$(0{,}5)(9{,}1 \times 10^{-31})(2{,}77 \times 10^5)^2 = (6{,}6 \times 10^{-34})(3 \times 10^8) / (475 \times 10^{-9}) - W_o$
$3{,}49 \times 10^{-20} = 4{,}17 \times 10^{-19} - W_o$
$W_o = 3{,}82 \times 10^{-19}$ J hence metal is sodium.

Total: 200 marks

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