NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2018

PHYSICAL SCIENCES: PAPER I

MARKING GUIDELINES

Time: 3 hours | 200 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

QUESTION 1

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

QUESTION 2

2.1 2.1.1 Velocity is the rate of change of position OR the rate of displacement OR the rate of change of displacement.

2.1.2 s = area under v-t graph

$29,8 = \frac{1}{2}(3,5)v + \frac{1}{2}(14)v$

$\boldsymbol{v} = \mathbf{3,41\ m{\cdot}s^{-1}}$

OR s = area under v-t graph

$29,8 = \frac{1}{2}(17,5)\,v$

$\boldsymbol{v} = \mathbf{3,41\ m{\cdot}s^{-1}}$

2.1.3 a = slope of v-t graph OR $\frac{\Delta v}{\Delta t}$ (for both formulas) **OR** $F_f = \frac{m\Delta v}{\Delta t}$

$a = \frac{0 - 3,41}{14}$ (coe from 2.1.2)

$a = -0,24\ m{\cdot}s^{-2}$

$F_f = ma$

$F_f = (20)(-0,24)$

$F_f = -4,87$

$\boldsymbol{F_f} = \mathbf{4,87\ N\ South}$

OR

$F_f = \frac{(20)(0-3,41)}{14}$

$F_f = -4,87$ N

$F_f = 4,87$ N South

2.2 2.2.1 Stage 1

$v = u + at$

$44 = 0 + a(4)$

$\boldsymbol{a} = \mathbf{11\ m{\cdot}s^{-2}}$

2.2.2 Stage 1

$v^2 = u^2 + 2as$

$44^2 = 0^2 + 2(11)s_1$ (coe from 2.2.1)

$s_1 = 88$ m

Stage 2

$v = u + at$

$280 = 44 + a(8)$

$a = 29,5\ m{\cdot}s^{-2}$

$v^2 = u^2 + 2as$

$280^2 = 44^2 + 2(29,5)s_2$

$s_2 = 1\ 296$ m

Total distance = 88 + 1 296

Total distance = 1 384 m

QUESTION 3

3.1 3.1.1 No, velocity is increasing and friction opposes motion / friction slows objects down.

3.1.2 Yes

3.2 3.2.1 Acceleration is the rate of change of velocity.

3.2.2 $v^2 = u^2 + 2as$ OR $v = u + at$ $s = ut + \frac{1}{2}at^2$ (for both eqns)

$34^2 = 0^2 + 2(0{,}21)s$ $34 = 0 + 0{,}21t$ $s = 0 + \frac{1}{2}(0{,}21)(161{,}91)^2$

$\boldsymbol{s}$ **= 2 752,37 m** $t = 161{,}91$ s $\boldsymbol{s = 2752{,}37}$ **m**

3.2.3 Weight is not the only force acting on the hailstone.

OR

There are upward forces (e.g. drag) acting on the hailstone.

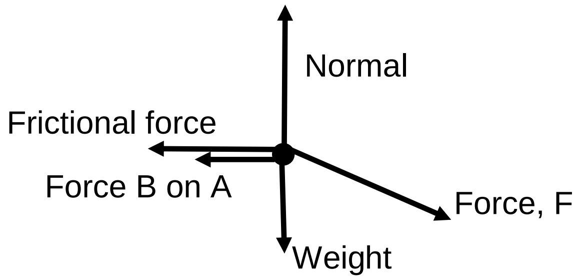
3.2.4 $v^2 = u^2 + 2as$
$0^2 = 34^2 + 2a(0{,}12)$
$a = -4\ 816{,}67$
$\boldsymbol{a}$ **= 4 816,67 m·s^{-2} up**

3.2.5 $F_{net} = F_{ground} - F_g$
$(0{,}7)(4\ 816{,}67)$ (coe) $= F_{ground} - (0{,}7)(9{,}8)$
$\boldsymbol{F_{ground}}$ **= 3 378,53 N**

OR $F_{net} = ma$
$F_{net} = (0{,}7)(4\ 816{,}67)$
$F_{net} = 3\ 371{,}67$ N
$F_{net} = F_{ground} - F_g$
$F_{ground} = 3\ 371{,}67 + 6{,}86$
$\boldsymbol{F_{ground}}$ **= 3 378,53 N**

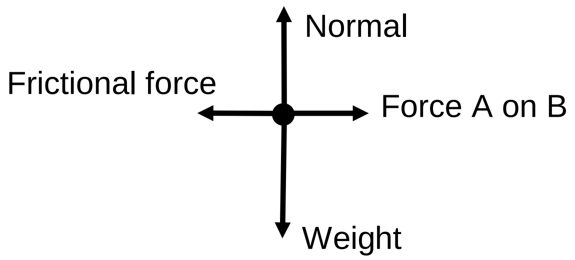
QUESTION 4

4.1



diagrams updated (lengths of arrows changed)

4.2



4.3 When a net force acts on an object, the object accelerates in the direction of the net force. The acceleration is directly proportional to the net force and inversely proportional to the mass of the object.

OR

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

4.4 $F \cos 36 - (45 + f_{B\ on\ A}) = ma$

OR

$134 \cos 36 - 45 - f_{B\ on\ A} = 23a$

4.5 When object A exerts a force on object B, object B simultaneously exerts an oppositely directed force of equal magnitude on object A.

4.6 $f_{A\ on\ B} - 45 = 31\ a$

$f_{A\ on\ B} = f_{B\ on\ A} = \text{f}$

$a = \dfrac{f - 45}{31}$

$134 \cos 36 - 45 - f = \dfrac{23(f - 45)}{31}$

***f* = 55,56 N**

OR

$F_{net} = ma$

$134 \cos 36 - 2(45) = 54a$

$a = 0{,}34$

$f - 45 = 31a$

***f* = 55,56 N**

4.7 The force that opposes the motion of an object.

4.8 Box A experiences the same normal force as box B even though mass of box A is smaller, due to the vertical component of F

$\therefore\ Ff = \mu F_N$ greater than expected

QUESTION 5

5.1 5.1.1 v = slope of x-t graph (or $v = \frac{\Delta s}{\Delta t}$)

$v = \frac{10,2 - 4,8}{5 - 2}$

$\boldsymbol{v = 1,8\ m \cdot s^{-1}}$

5.1.2 Newton's third law

5.1.3 $(p_{total})_{before} = (p_{total})_{after}$

(0,9)(2,4) + 0 = (0,9 + m)(1,8) (coe)

m = 0,3 kg

5.1.4 Momentum is a vector and perpendicular directions are conserved independently.

OR

Momentum is a vector and velocity of m has no horizontal component.

5.2 5.2.1 In the absence of air resistance or any external forces, the mechanical energy of an object is constant.

5.2.2 hammer: $mgh = \frac{1}{2}mv^2$

$(600)(9,8)(3,5) = \frac{1}{2}(600)v^2$

$\boldsymbol{v = 8,28\ m \cdot s^{-1}}$

OR

$v^2 = u^2 + 2as$

$v^2 = 0 + 2(9,8)(3,5)$

$\boldsymbol{v = 8,28\ m \cdot s^{-1}}$

5.2.3 **Work done by a net force** on an object is equal to the **change in the kinetic energy** of the object.

5.2.4 $W = \Delta E_K$

$F_{net}(0,16) = 0 - \frac{1}{2}(600)(8,28)^2$

$F_{net}(0,16) = (-)20\ 567,52$

$\boldsymbol{F_{net}}$ **= (–)128 547 N**

OR

$v^2 = u^2 + 2as$

$0 = 8,28^2 + 2a(0,16)$

$a = 214,25\ m \cdot s^{-2}$

$F_{net} = ma$ (both eqn)

$F_{net} = (600)(214,25)$

$\boldsymbol{F_{net}}$ **= 128 547 N**

5.2.5 $P = \frac{W}{t}$

$P = \frac{mgh}{t}$

$180 = \frac{(600)(9,8)(3,5)}{t}$

$\boldsymbol{t = 114,33\ s}$

OR

$P = \frac{W}{t}$

$P = \frac{F_g s}{t}$

$180 = \frac{(5880)(3,5)}{t}$

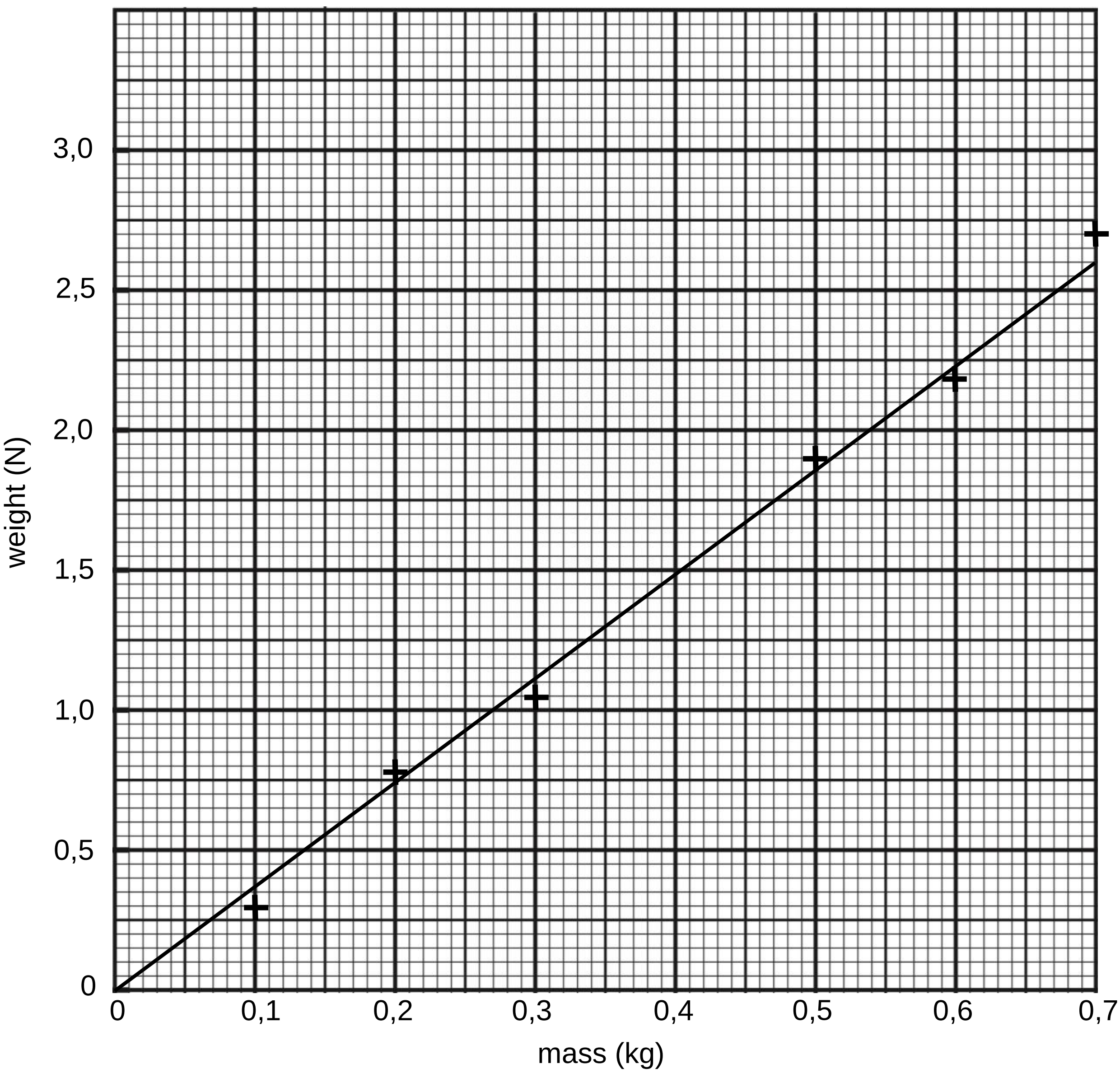
$\boldsymbol{t = 114,33\ s}$

QUESTION 6

6.1 Weight is the gravitational force that the earth exerts on an object (on or near its surface) while mass is the quantity of matter in a body.

6.2 Graph – on answer sheet
Heading
y-axis title and unit
x-axis title and unit
scale (plotted points > $\frac{1}{2}$ graph paper)
plotted points (accurate and visible to within half a small square)
line of best fit

Graph to show weight vs mass



6.3 Gradient $= \frac{\Delta y}{\Delta x}$

Gradient $= \frac{\text{values from } y\text{-axis}}{\text{values from } x\text{-axis}}$ (values must be from LOBF on graph)

Gradient = 3,76 N·kg^{-1} or 3,76 m·s^{-2} (accept 3,56 – 3,96)

6.4 $w = mg$

$\therefore g =$ gradient

$\boldsymbol{g}$ **= 3,76 m·s^{-2}**

6.5 Mars

6.6 $g = \frac{GM}{r^2}$

$0{,}58 = \frac{(6{,}7 \times 10^{-11})M}{(1{,}19 \times 10^{6})^2}$

$M = 1{,}23 \times 10^{22}$ kg

QUESTION 7

7.1 7.1.1 Resistance is a material's opposition to the flow of electric current.

7.1.2 Emf is the total energy supplied per coulomb of charge by the cell.

7.1.3 $emf = I_1(r + 2R)$

OR

$6 = 0{,}6(r + 2R)$

7.1.4 $emf = I_2(r + \frac{R}{2})$

OR

$6 = 1{,}5(r + \frac{R}{2})$

7.1.5 $6 = 0{,}6(r + 2R)$

$10 = r + 2R$

$r = 10 - 2R$ (method)

$6 = 1{,}5(10 - 2R + \frac{R}{2})$

$6 = \frac{3}{2}R$

$\boldsymbol{R}$ **= 4 Ω**

7.1.6 Power is the rate at which work is done.
OR the rate at which energy is transferred.

7.1.7 $P = I^2R$ OR $V = RI$ $P = \frac{V^2}{R}$ (for both eqns)

$P = \left(\frac{1,5}{2}\right)^2 (4)$ $V = (2)(1,5)$ $P = \frac{3^2}{4}$ coe

$\boldsymbol{P = 2,25}$ **W** $V = 3$ V $\boldsymbol{P = 2,25}$ **W**

7.1.8 Circuit resistance decreases, current increases.
As *V* = *emf* – *Ir,* voltmeter reading decreases.

7.2 7.2.1 Potential difference is the work done per unit positive charge.

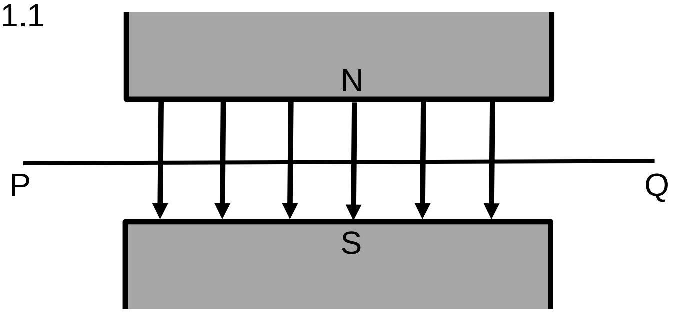
7.2.2 neither

7.2.3 bulb A

7.2.4 bulb

QUESTION 8

8.1 8.1.1



Direction
Parallel lines

8.1.2 P to Q

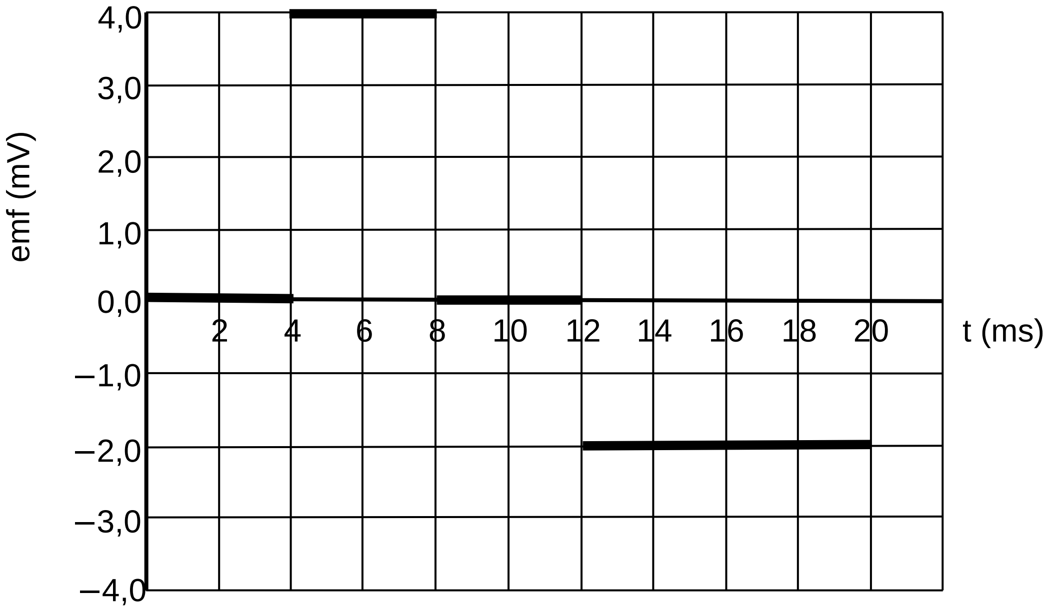
8.2 8.2.1 Lenz's law states the induced current flows in a direction so as to set up a magnetic field to oppose the change in magnetic flux.

8.2.2 diagram b, clockwise
diagram d, anticlockwise

8.2.3 Zero induced current in (c) as the rate of change of magnetic flux is zero.

8.3 8.3.1 The emf induced is directly proportional to the rate of change of magnetic flux (flux linkage).

8.3.2



QUESTION 9

9.1 9.1.1 Work function is the **minimum** amount of energy needed to emit an electron (from the surface of a metal)

9.1.2 $f_0 = 6{,}90 \times 10^{14}$ Hz

$W_0 = hf_0$
$W_0 = (6{,}6 \times 10^{-34})(6{,}90 \times 10^{14})$
$\boldsymbol{W_0 = 4{,}55 \times 10^{-19}}$ **J**

9.1.3 Sketch line parallel to line of best fit
and *x* intercept $8{,}9 \times 10^{14} - 9{,}1 \times 10^{14}$ Hz

9.2 9.2.1 $E = \frac{hc}{\lambda}$

$E = \frac{(6{,}6 \times 10^{-34})(3 \times 10^{8})}{6{,}58 \times 10^{-7}}$

$\boldsymbol{E} = \mathbf{3{,}0 \times 10^{-19}}$ **J**

OR

$c = f\lambda$

$3 \times 10^{8} = f(6{,}58 \times 10^{-7})$

$f = 4{,}56 \times 10^{14}$ Hz

$E = hf$ (for both formula)
$E = (6{,}6 \times 10^{-34})(4{,}56 \times 10^{14})$
$\boldsymbol{E} = \mathbf{3{,}0 \times 10^{-19}}$ **J**

9.2.2 Wavelength inversely proportional to energy difference ($\lambda \propto \frac{1}{\Delta E}$)

Highest ΔE therefore smallest wavelength
∴ Line P

9.2.3 Emission lines are unique to each element.
So can be used to identify substances.

Total: 200 marks