NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2014

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 MULTIPLE CHOICE

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

[20]

QUESTION 2 KINEMATICS

[Use of 10 m.s^{-2} instead of 9,8 m.s^{-2} incurs a penalty of –1 for the whole question]

2.1 2.1.1 Distance is the length of the path travelled.
Displacement is the change in position OR the distance (or magnitude of, or length of the path along) the straight line drawn from the starting point to the ending point and in the same direction as this line.
The distance and displacement from A to E will only be the same if the block travels in a straight line in one direction from A to E which it doesn't.
OR The length of the track between A and E (distance) is greater than the straight line joining A and E (displacement). (4)

2.1.2 Average speed $= 8{,}1 \div 3$ (method)
$\mathbf{= 2{,}7\ m.s^{-1}}$ (accuracy) [–1 incorrect or no units] (2)

2.1.3 In the absence of air resistance or any external forces the mechanical energy (of an object) is constant.
OR In a closed (isolated) system, mechanical energy is constant (conserved).
OR If only conservative forces are present, mechanical energy is constant. (2)

2.1.4 $\left(E_k + E_p\right)_A = (E_k + E_p)_D$

$(0+)\left(0{,}4 \times 9{,}8 \times 0{,}8\right) = \left(½\ 0{,}4v^2\right) + \left(0{,}4 \times 9{,}8 \times 0{,}3\right)$

OR $\left(½\ 0{,}4v^2\right) = \left(0{,}4 \times 9{,}8 \times 0{,}5\right)$

$\boldsymbol{v} \mathbf{= 3{,}13\ m.s^{-1}}$ [–1 incorrect or no units]

NB Candidates can divide through by the mass (0,4 kg) and receive full marks. (4)

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

2.1.6 Candidates may use F_{net} instead of $F_{friction}$ in their answer.
It is implied that they did this because they realised that $F_{friction}$ is the net force acting on the block. Any solution which deals exclusively with F_{net} is therefore taken as correct.

Alternative 1: work-energy theorem method

c.o.e of v from Question 2.1.4

$W_{net} = \Delta E_k$
$W_{net} = ½\,mv_f^2 - ½\,mv_i^2$
$F_{net}.\Delta x = 0 - ½\,mv_i^2$

$F_{net}.3 = -(½ \times 0{,}4 \times 3{,}13^2)$ (This expression could be ±)

OR $F_{net}.3 = 1{,}96$ (from calculation in 2.1.4 c.o.e.)

OR $F_{net}.3 = 0{,}4 \times 9{,}8 \times 0{,}5$

$\mathbf{F_{net} = 0{,}65\ N}$ (F_{net} + or − since only magnitude required.)
[–1 incorrect or no units]

OR **Alternative 2: Newton's 2nd law method**

$v_f^2 = v_i^2 + 2a\Delta x$

$0^2 = 3{,}13^2 + 2.a.3$

$a = -1{,}63\ m.s^{-2}$

$F_{net} = m.a$

$= 0{,}4 \times -1{,}63$ (substitution; allow ±1,63)

$\mathbf{F_{net} = -0{,}65\ N}$ [–1 incorrect or no units]

OR **Alternative 3: impulse method**

$\Delta x = \frac{(v_i + v_f).\Delta t}{2}$

$3 = \frac{(3{,}13 + 0).}{2}\Delta t$

$\Delta t = 1{,}916\ s$

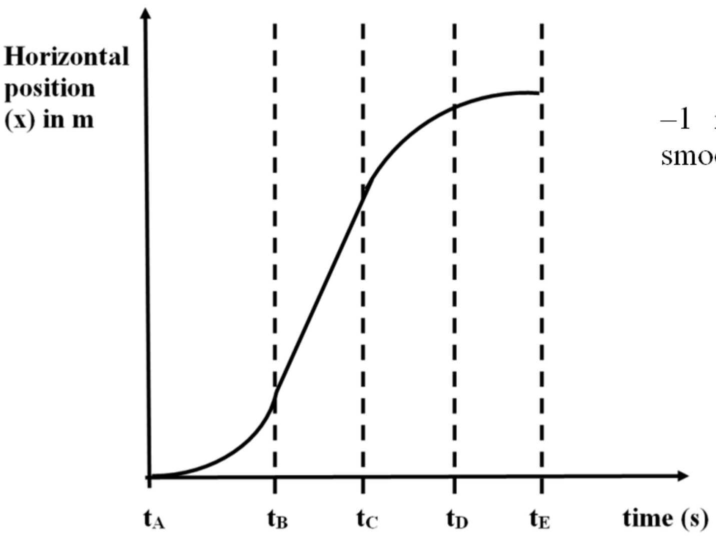
(1 mark out of 4 for Δt only.)

$F_{net} = m.\frac{(v_f - v_i)}{\Delta t}$

$= 0{,}4\frac{(0 - 3{,}13)}{1{,}916}$ (0,4 and Δv; accept ±3,13)

$\mathbf{F_{net} = -0{,}65\ N}$ [–1 incorrect or no units] (4)

2.1.7 ON ANSWER BOOKLET



–1 if the curve is not smooth i.e. it has bumps

(4)

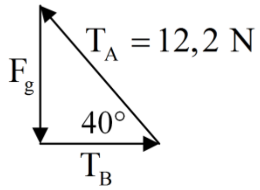
2.2 2.2.1 $T_{AY} = 12,2\sin 40$

$\mathbf{T_{AY} = 7,84\ N}$ [–1 incorrect or no units] (2)

2.2.2 $F_g = T_{Ay}$

$= 7,84\ N$ (c.o.e 2.2.1 and using that as the value of F_g)

OR



$F_g = 12,2\sin 40$
$= 7,84\ N$

$F_g = m.g$

$m = \frac{7,84}{9,8}$ substituting 9,8

$\mathbf{m = 0,8\ kg}$ [–1 incorrect or no units] (4)

2.2.3 $T_B = 12,2\cos 40$

$\mathbf{T_B = 9,35\ N}$ [–1 incorrect or no units]

OR $T_B{}^2 = 12,2^2 - 7,84^2$ (c.o.e.)

$\mathbf{T_B = 9,35\ N}$ [–1 incorrect or no units] (2)

[30]

QUESTION 3 FALLING BODIES

[Use of 10 m.s^{-2} instead of 9,8 m.s^{-2} incurs a penalty of –1 for the whole question]

3.1 3.1.1 In the answer: [–1 incorrect or no units]

Alternative 1

Distance = area under graph

$= \left(\frac{1}{2} \times 0,8 \times 7,84\right)$

$\mathbf{= 3,14\ m}$

Alternative 2

$\Delta y = \frac{(v_i + v_f).}{2}\Delta t$

$\Delta y = \frac{(0 + 7,84).}{2}0,8$

$\mathbf{\Delta y = 3,14\ m}$

Alternative 3

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$

$= \frac{1}{2} \times 9,8 \times 0,8^2$

$\mathbf{\Delta y = 3,14\ m}$

Alternative 4

$v_f{}^2 = v_i{}^2 + 2a\Delta y$

$7,84^2 = 0^2 + 2(9,8)\Delta y$

$\mathbf{\Delta y = 3,14\ m}$

Alternative 5

By the law of conservation of mechanical energy

$(E_P + E_k)_{top} = (E_p + E_k)_{bottom}$

mgh + 0 = 0 + ½ mv^2 (method)

(0,8)(9,8)h = ½ (0,8)(7,84)^2

h = 3,14 m (3)

3.1.2 **Alternative 1**

$v_f = v_i + a\Delta t$

$v_f = 1,53 + 9,8(0,7)$

v_f = **8,39 m.s^{-1}** [–1 incorrect or no units]

Alternative 2

$\Delta x = v_i\Delta t + ½ a\Delta t^2$ (both formulae correct)

$= (1,53)(0,7) + ½ (9,8)(0,7)^2$

$= 3,472,m$

$v_f^2 = v_i^2 + 2a\Delta x$

$= (1,53)^2 + 2 (9,8)(3,472)$

v_f = 8,39 m.s^{-1} [–1 incorrect or no units] (4)

3.1.3 **Alternative 1 – impulse method**

$F_{net} = m.\frac{(v_f - v_i)}{\Delta t}$ OR $F_{net} = \frac{m.\Delta v}{\Delta t}$

$= 5,4\frac{(1,53 - 7,84)}{0,2}$

$\mathbf{F_{net} = -170,37\ N}$

$\mathbf{F_{net} = 170,37\ N\ up}$ [–1 incorrect or no units]

Alternative 2 – Newton's 2nd law method (both formulae correct and present)

$v_f = v_i + a\Delta t$ | $F_{net} = m.a$

$1,53 = 7,84 + a.0,2$ | $= 5,4 \times -31,55$

$a = -31,55\ m.s^{-2}$ | $\mathbf{F_{net} = -170,37\ N}$

$\mathbf{F_{net} = 170,37\ N\ up}$ [–1 incorrect or no units]

Alternative 3 – Work-energy theorem method

$\Delta x = ½ (v_i + v_f)\Delta t$

$= ½ (7,84 + 1,53)(0,2)$

$= 0,937$ m

$\Delta E_k = ½mv_f^2 – ½ mv_i^2$

$= ½ (5,4)(1,53)^2 - ½ (5,4)(7,84)^2$

$= - 159,637$ J

$F_{net}.\Delta x = \Delta E_k$

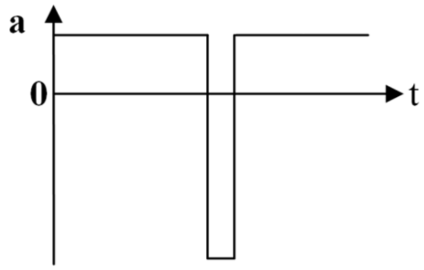
$= \frac{-159,637}{0,937}$

= **-170,37 N**

= **170,37 N up** [–1 incorrect or no units] (5)

3.1.4 The magnitude of the force exerted by the coconut on the roof is EQUAL to the magnitude of the force exerted by the roof on the coconut. This is in accordance with NEWTON'S 3RD LAW. (2)

3.1.5



(–1 if g is negative (graph inverted))

Value of negative acceleration must be greater than positive value. (3)

3.1.6 (a) **Less** than (1)

3.1.6 (b) **Alternative 1**

Velocity of X is less than that of Y since $p = m.v$ and if p is the same for both then an increase in mass must result in a decrease in velocity $(v \alpha 1/m)$.

Therefore

- $E_k = ½\ mv^2$, since the velocity is a squared term it has a greater impact on the kinetic energy than the mass does.

  OR
- $E_k = ½\ p.v$ therefore if p is the same for both but v is smaller for X then E_k for x is smaller.

Alternative 2

$E_k = \frac{p^2}{2m}$ therefore E_k is inversely proportional to mass so the bigger mass has smaller E_k. (4)

3.2 NB. [–1 incorrect or no units] in the final answer.

4th second $v_i = 3\ g\ ;\ v_f = 4\ g$

Alternative 1

$$\Delta y = \frac{(v_i + v_f).}{2}\Delta t$$

$$11,2 \quad = \frac{(3\ g \quad + 4\ g \quad).}{2}(1)$$

$$\mathbf{g = 3,2\ m.s^{-2} \quad g = 3,2\ m.s^{-2}}$$

Alternative 2

$$v_f{}^2 = v_i{}^2 + 2a\Delta y$$

$$(4\ g)^2 \quad = (3\ g)^2 \quad + (g)11,2$$

Alternative 3

$$\Delta y = v_i\Delta t + ½\ a\Delta t^2$$

$$11,2 \quad = 3\ g \quad .1 + ½ \times g \times 1^2$$

$$\mathbf{g = 3,2\ m.s^{-2} \quad g = 3,2\ m.s^{-2}}$$

Alternative 4

$v_f = v_i + g\Delta t$

11,2 = 0 + g (3,5)

(both 11,2 & 3,5 must be correct)

Alternative 5

$\Delta y = v_i\Delta t + ½\ a\Delta t^2$
$= (0 + ½\ g\ (3)^2$
$= 4{,}5\ g$

$\Delta y = v_i\Delta t + ½\ a\Delta t^2$
$= (0 + ½\ g\ (4)^2$
$= 8\ g$

$8\ g – 4{,}5\ g = 11{,}2$
$g = 3{,}2\ m.s^{-2}$

Alternative 6

Using ratios:

On earth at t = 4 s $\Delta x = v_i\Delta t + ½\ a\Delta t^2 = 44.1$ m
At t = 3 s $\Delta x = 78{,}4$ m

Distance = 78,4 – 44,1 = 38,3 m

$\frac{g_{planet}}{g_{earth}} = \frac{distance_{planet}}{distance_{earth}}$ OR equivalent reasoning

$g_{planet} = \frac{11{,}2}{38{,}3} \times 9{,}8$

$=3{,}2 m.s^{-2}$ (5)

[27]

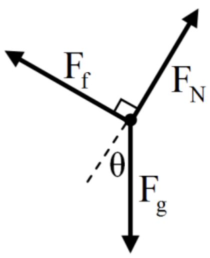
QUESTION 4 SLIDING BOX EXPERIMENT

4.1 The angle (θ) of the incline. (2)

4.2 **The surfaces need to be the same** OR **same materials in contact** so that they have the **same (**co-efficient of) **friction** OR because this will **affect the angle of the incline** (OR dependent variable) at which the box slides OR to **ensure a fair test**. [Must link the control of variables to the effect that these have on the outcome (dependent variable) for full marks.]

OR To control the variables to ensure a fair (valid) test. (**1 mark only**) (2)

4.3



Names of forces

F_N = normal

F_g = weight/gravitational force OR force due to gravity

F_f = friction

θ or 90° between F_N and F_f

-1 mark if

- One arrowhead missing
- Components of weight and weight are both labelled
- Box in place of dot
- Weight needs to point downwards
- Directions are incorrect

NB

- Symbols are used in place of names (MAX 2 marks)
- No arrowheads are shown on any vectors (MAX 2 marks) (4)

4.4 Tessa is correct. [If this answer is wrong, do not consider the explanation.]

The box will be on the point of sliding when the component of the gravitational force down the slope $\left(F_g \sin\theta\right)$ is equal (OR greater than) in magnitude to the maximum static frictional force up the slope $\left(\mu.F_g \cos\theta\right)$.

$\mu.F_g \cos\theta = F_g \sin\theta$ (OR $\mu.F_g \cos\theta \geq$ OR $> F_g \sin\theta$)

$\mu = \frac{\cancel{F_g} \sin\theta}{\cancel{F_g} \cos\theta}$ (showing that F_g cancels OR that mass (m) cancels)

$\boldsymbol{\mu = \tan\theta}$

As can be seen the angle of the slope at which the box slides **only depends on the co-efficient of friction (μ)** between the surfaces (OR is independent of the mass of the box**)**. [This mark is awarded ONLY if it follows sound reasoning. (5)

4.5 4.5.1 **Alternative 1**

$v_f{}^2 = v_i{}^2 + 2a\Delta x$

$v_f{}^2 = 0^2 + 2(4,2)18$ [–1 for each error]

v = 12,30 m.s^{-1} [–1 incorrect or no units]

Alternative 2

$W_{net} = \Delta E_k$

$F_{net}\,\Delta x = ½\, mv_f^2 - ½\, mv_i^2$

(12)(4,2)(18) = ½ (12)v_f^2 [–1 for each error]

v_f = **12, 3 m.s^{-1}** [–1 incorrect or no units]

Alternative 3

$\Delta x = v_i\Delta t + ½\, a\Delta t^2$	$v_f = v_i + a\Delta t$
$18 = 0 + ½\,(4,2)\Delta t^2$	= 0 + (4,2) (2,9277) (time)
Δt = 2,9277 s	= **12,3 m.s^{-1}** [–1 incorrect or no units]

(4)

4.5.2 **Alternative 1**

When a **net (resultant) force** is applied to an object of mass it accelerates in the direction of the net force. The acceleration is directly proportional to the (net) force and inversely proportional to the mass.

['Net force' must appear in the first sentence else MAX 2 marks.

Do not allow 'indirectly' proportional. Do not allow 'unbalanced force']

Alternative 2

The net force acting on an object is equal to (OR directly proportional to) its **rate of change of momentum**. [Do not allow 'unbalanced force'] (3)

4.5.3 **Alternative 1: Newton's 2nd Law**

$F_{net} = ma$

$= 12 \times 4,2$

$\mathbf{F_{net} = 50,4\ N}$ [–1 incorrect or no units]

Alternative 2: The work-energy theorem

$W_{net} = \Delta E_k$

$F_{net}.\Delta x = ½\ mv^2$

$F_{net} = \frac{\frac{1}{2}(12)(12,3)^2}{18}$

$\mathbf{F_{net} = 50,4\ N}$ [–1 incorrect or no units]

Alternative 3: Impulse method

$\Delta x = v_i\Delta t + ½\ a\Delta t^2$ OR $v_f = v_i + a\Delta t$

$18 = 0 + ½\ (4,2)\Delta t^2$ $\quad$ $12,3 = 0 + (4,2)\Delta t$

$\Delta t = 2,9277\ s$ $\quad$ $\Delta t = 2,9277\ s$

$F_{net}\ \Delta t = m(v_f – v_i)$

F_{net} (2,9277) = (12)(12,3 – 0) (time)

$\mathbf{F_{net} = 50,4\ N}$ (3)

4.5.4 **Alternative 1**

$F_{net} = F_{g//} - F_f$

$F_{net} = mg\sin\theta - F_f$ method (Candidates may use $F_{g//} + F_f$)

$F_f = mg\sin\theta - F_{net}$

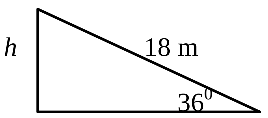
$= 12(9,8)\sin 36 - 50,4$

$= 69,12 - 50,4$ (This step can be implied)

$\mathbf{F_f = 18,72\ N}$ (Ignore the sign as only magnitude is required)

[–1 incorrect or no units]

Alternative 2



$h = (18).\sin 36^o = 10,58\ m$

$E_{mech\ at\ top} + W_{friction} = E_{mech\ at\ bottom}$ OR $W_{nc} = W_f = \Delta E_p + \Delta E_k$

OR $W_{nc} = W_f = E_{p\ top} – E_{k\ bottom}$

OR $W_{nc} = W_f = E_{k\ bottom} - E_{p\ top}$

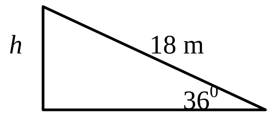
$[E_{pi} + E_{ki}] + [F_f.\Delta x] = [E_{pf} + E_{kf}]$

$[(12)(9,8)(10,58) + 0] + [F_f.(18).\cos 180^o = [0 + ½\ (12)(12,3)^2$

$1244,208 – 18\ F_f = 907,74$

$\mathbf{F_f = 18,69\ N}$ [–1 incorrect or no units]

Alternative 3



$h = (18).\sin 36^o = 10,58$ m

$W_{nc} = \Delta E_P + \Delta E_K$

$F_f.\Delta x = [E_{pf} - E_{pi}] + [E_{kf} - E_{ki}]$

$F_f.(18).\cos 180^o = [0 - (12)(9,8(10,58)] + [½ (12)(12,3)^2]$

$\boldsymbol{F_f}$ **= 18,69 N** [–1 incorrect or no units]

Alternative 4

$W_{net} = \Delta E_k$
$W_g + W_f = E_{k\,top} - E_{k\,bottom}$
$W_g + W_f = 0 - E_{k\,bottom}$

$(12)(9,8)(18 \sin 36^o) + F_f(18) = - ½ (12)(12,3)^2$ [allow ±]

F_f = **18,69 N** [allow ±] [–1 incorrect or no units] (5)

[28]

QUESTION 5 MOMENTUM

5.1 The momentum (of an object) is the product of its mass and its velocity. (2)

5.2 $\Delta p = m(v_f - v_i)$ + →

$-1,5 = 0,25\ (v_f - 4)$ (conversion from g to kg)

$\mathbf{v_f = -2\ m.s^{-1}}$

$\mathbf{v_f = 2\ m.s^{-1}}$ **left** (5)

OR

Δp	v_i (opposite signs)
−1,5	4
+1,5	–4

5.3 **Alternative 1**

NB All masses can be in grams.

Σp before collision $= \Sigma p$ after collision (method OR appropriate formula)

$(0,25 \times 4) + (0,3 \times -6) = (0,25 \times -2) + (0,3 \times v)$ (−1 per error)

c.o.e. from 5.2

$\mathbf{v_B = -1\ m.s^{-1}}$

$\mathbf{v_B = 1\ m.s^{-1}}$ **left**

Alternative 2

$\Delta p = m(v_f - v_i)$ +

$1,5 = 0,3\ (v_B - (-6))$ ⟶

v_B = **– 1 m.s^{-1}**

v_B = **1 m.s^{-1} left**

Δp	v_i	opposite signs
$-1,5$	6	
$+1,5$	-6	

Alternative 3

NB Masses may be in grams.

$\Delta p_A = -\Delta p_B$

$m_A(v_{fA} - v_{iA}) = -m_B(v_{fB} - v_{iB})$

$(0,25)(-2-4) = (0,3)(v_{fB} - (-6))$ [–1 any error]

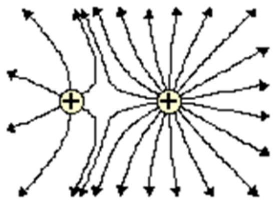
v_{fB} = **–1 m.s^{-1}**

v_{fB} = **1 m.s^{-1} left** (5)

[12]

QUESTION 6 ELECTRIC FIELD

6.1



Shape
Direction
Greater density of lines around charge B (3)

6.2 The force that one charge exerts on another charge is directly proportional to the product of the charges and inversely proportional to the distance between the charges squared.
[Do not accept 'radius squared' OR 'indirectly proportional'.] (2)

6.3 **Alternative 1**

$$F = \frac{kq_1q_2}{r^2}$$

(conversion)

$$F = \frac{9\times10^{9}\times1\times10^{-9}\times9\times10^{-9}}{0,008^2}$$ (conversion)

$\mathbf{F = 1,27\times10^{-3}\ N}$ **away from A/towards B/to the right/repulsion**

[Will accept 'repulsion' as it implies 'pushes away from A' but this is technically <u>not specifying the direction</u> of the force]

Alternative 2

$E = \frac{k\,q_A}{r^2}$ and $F = Eq_B$

Thereafter substitution and manipulations are similar to those in Alternative 1 (5)

6.4 No. of electrons $= q \div e^-$

$$= \frac{1\times10^{-9}}{1,6\times10^{-19}}$$ (c.o.e. if no conversion of units)

= **6,25 × 10^{9}**

OR 1×10^{-9} C × 6,25 × 10^{18} e^- / C = **6,25 x 10^{9}** (2)

6.5 6.5.1 The single vector which has the same effect as the original vectors acting together OR the **vector sum** of all the vectors acting at the position (2)

6.5.2 The force per unit (coulomb) positive charge. (2)

6.5.3 **Alternative 1**

$E_A = E_B$ OR $\frac{\not{k}Q_A}{r_A^2} = \frac{\not{k}Q_B}{r_B^2}$

$\frac{1}{x^2} = \frac{9}{(8-x)^2}$ OR $\frac{1x10^{-9}}{x^2} = \frac{9\ x\ 10^{-9}}{(0{,}008-x)^2}$

$\frac{1}{x} = \frac{3}{(8-x)}$ (square root of both sides)

x = 2 mm from A

Alternative 2

$E_A = E_B$

$Q_A = 9\ Q_B$

$\therefore r_B = 3\ r_A$

$r_A : r_B = 1 : 3$

$\therefore\ r_A = ¼r_B = ¼ \times 8$

$\mathbf{r_A = 2\ mm}$ (4)

[20]

QUESTION 7 ELECTRIC CIRCUIT

7.1 7.1.1 emf is the **total energy** supplied per **coulomb (unit)** of charge by the **cell**.
(Maximum power per unit current supplied by the cell) (2)

7.1.2 **Alternative 1**

$V_{30\Omega} = I.R = 0{,}2 \times 30$

$= 6\,V$

$I_{20\,\Omega} = \frac{V}{R}$

$= \frac{6}{20}$

$= 0{,}3\,A$

$A_1 = (0{,}2 + 0{,}3)$ $\mathbf{= 0{,}5\,A}$ (method; adding 0,2 A)

Alternative 2

Ratio of resistances (method)

20 Ω: 30 Ω

Correct currents: 0,3 :0,2

$A_1 = (0{,}2 + 0{,}3)$ method: adding 0,2 A)

$\mathbf{= 0{,}5\,A}$

Alternative 3

$\frac{2}{5} \times I_{total} = 0{,}2\,A$

$I_{total} = 0{,}2 \times \frac{5}{2}$

$\mathbf{= 0{,}5\,A}$

Alternative 4

<u>Finding R_p by valid method</u>

$I_{total} = \frac{V}{R_p}$

$= \frac{6}{12}$

$= \mathbf{0{,}5\ A}$ (4)

7.1.3 $R_X = \frac{V}{I}$

$= \frac{5,5}{0,5}$ (c.o.e. from 7.1.2)

$\mathbf{R_X = 11\ \Omega}$ (3)

7.1.4 **Alternative 1**

$R_P = \frac{20 \times 30}{(20+30)}$ OR $\frac{1}{R_P} = \frac{1}{20} + \frac{1}{30}$

$= 12\,\Omega$ $R_P = 12\ \Omega$

$R_T = (12+11)$ [–1 no inversion of R_P]

c.o.e. from 7.1.3

$\mathbf{R_T = 23\ \Omega}$

Alternative 2

$R_T = \frac{6+5,5}{0,5}$ c.o.e. from 7.1.2

= **23 Ω** (3)

7.1.5 **Alternative 1**

$emf = I(R_{ext} + r)$

$12 = 0,5(23 + r)$ (c.o.e. from 7.1.2 and 7.1.4)

$\mathbf{r = 1\ \Omega}$

Alternative 2

$V_{ext} = (6 + 5,5) = 11,5\ V$

Lost volts $= 12 - 11,5 = 0,5\ V$

Lost volts $= I.r$

$0,5 = 0,5.r$ (c.o.e. from 7.1.2)

$\mathbf{r = 1\ \Omega}$ (4)

7.1.6 (a) Increase (1)

7.1.6 (b) The total resistance of the circuit increases therefore **current (**through battery) **decreases**. **Less volts will be lost** OR **Ir decreases** therefore the reading on the voltmeter will increase, since $V_1 = Emf - I.r\left(I.r = \text{'lost' volts}\right)$ OR emf = V_{ext} + V_{lost} (4)

[If only emf = IR + Ir then only 1 mark
If 'moving the lower current through the **internal resistance** of the battery' OR reference to emf and/or internal resistance being constant.]

7.2 7.2.1 When the kettle is connected to a voltage (potential difference) of 240 V, its power (consumption) is 1 800 W (or $J.s^{-1}$).
[NB Candidates must make the connection between the power consumption ONLY being 1 800 W WHEN the kettle is connected to 240 V.]
1mark assigned if candidate

- interprets 1 800 Was 1 800 $J.s^{-1}$ OR
- refers to rate of energy transfer as 1 800 W ($J.s^{-1}$) OR
- states that electrical energy is transferred to heat. (2)

7.2.2 $P = V.I$

$1\,800 = 240.I$

$\mathbf{I = 7{,}5\ A}$ (3)

7.2.3 $\text{Cost} = 1{,}8\ \text{kW} \times 15/60 \times 1{,}40$

$\mathbf{= R0{,}63 \quad (63\ c)}$

OR $W = Pt$

$= 1\,800 \times 15 \times 60$

$= 1\,620\,000\ J$

$\text{Cost} = \frac{1\,620\,000}{3\,600\,000} \times 1{,}40$

$=$ **R 0,63 (63 c)** (3)

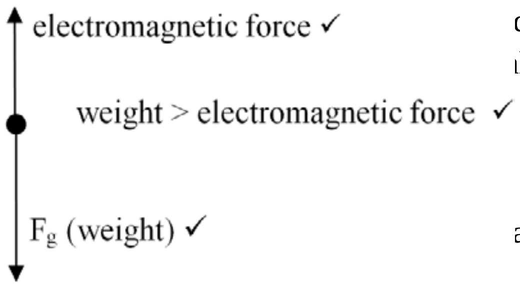
[29]

QUESTION 8 ELECTRODYNAMICS

8.1 The induced current flows in a direction so as to set up a magnetic field to oppose the change in magnetic flux OR the effect causing it OR the motion of the magnet. (2)

8.2 South (2)

8.3



d force symbol or name that makes sense.

l force or thrust]

–1 if diagram is incorrect

–1 if extra forces are shown

avity OR gravitational force but not 'gravity'.

(3)

8.4 Magnetic flux linkage is the product of the number of turns on the coil and the flux through the coil (OR number of turns on the coil times the flux through the coil). (2)

8.5 As the magnet falls through the coil there is a **CHANGE in magnetic flux** (linkage) OR **change in the number of magnetic field** lines cutting through the coils

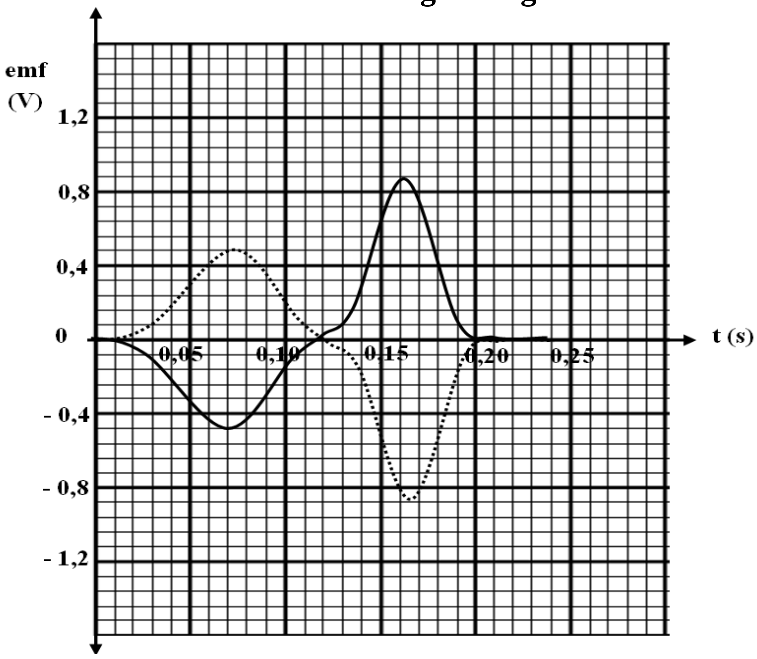
[NB The **magnetic field lines are cutting through the coils** of the conductor OR **change in magnetic field ONLY 1 mark**] (2)

8.6 The induced emf is directly proportional to the rate of change of (magnetic) flux (linkage). OR is equal to rate of change of (magnetic) flux linkage. (2)

8.7 The magnet is **moving faster** as it exits the coil therefore the RATE of change of magnetic flux (linkage) is greater which results in a greater induced emf (according to Faraday's Law of electromagnetic induction.) (2)

8.1 8.8.1 Inversion of graph about the x-axis
Amplitude should be the same (allow a little leeway, e.g. 1 block)

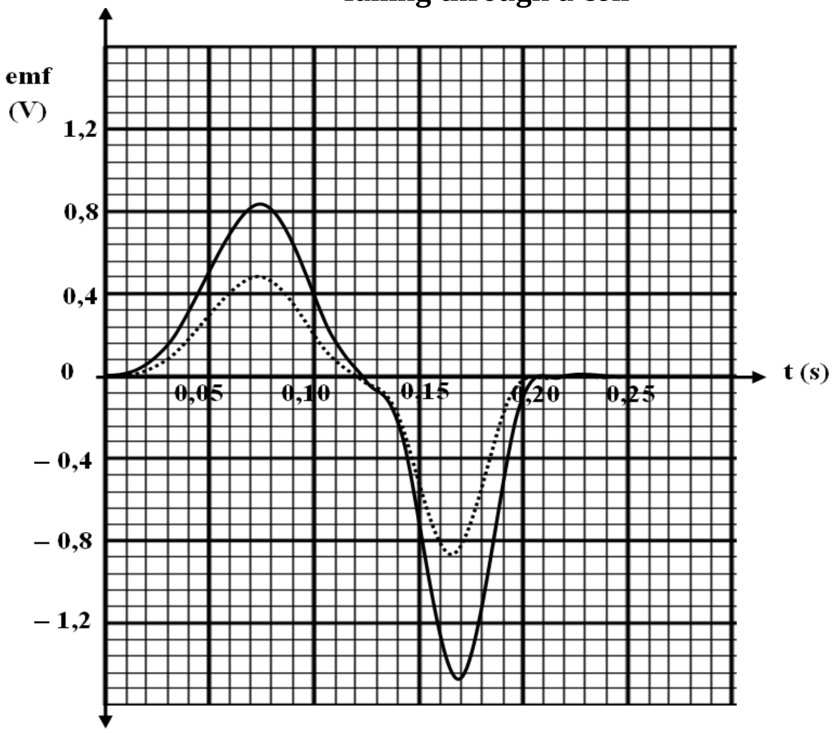
Graph of induced emf vs. time for a magnet falling through a coil



(2)

8.8.2 Greater induced emf.
If inverted –1.

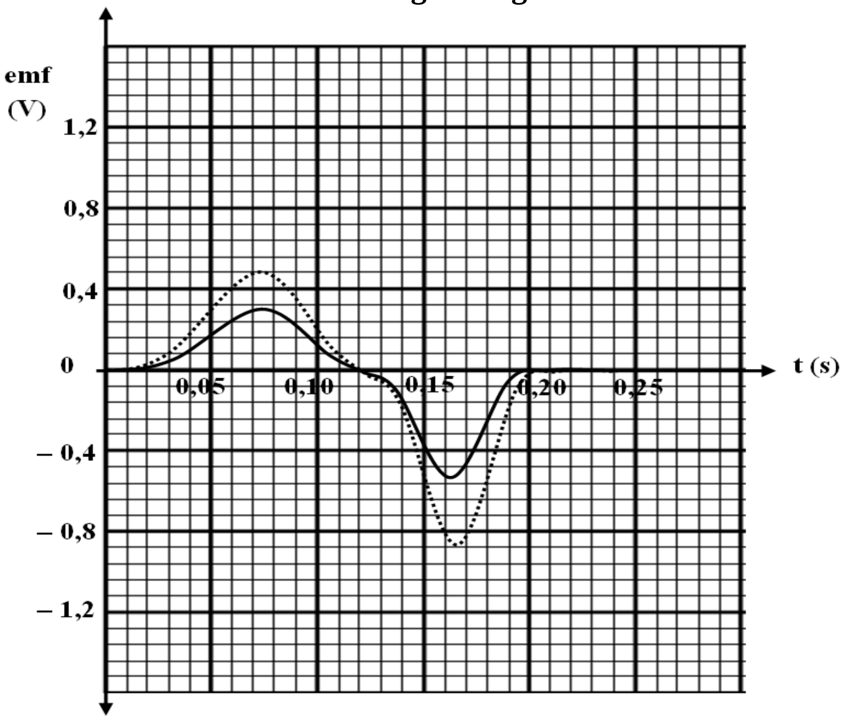
Graph of induced emf vs. time for a magnet falling through a coil



(2)

8.8.3 Smaller induced emf.
If inverted –1.

Graph of induced emf vs. time for a magnet falling through a coil



(2)
[21]

QUESTION 9 PHOTONS AND ELECTRONS

9.1 $\pm 11,8 \times 10^{-19}$ J (Accept any value from 1,8 to 12 × 10^{-19} J) (1)

9.2 As the wavelength of the incident radiation increases the maximum kinetic energy of the emitted electrons decreases.
Do not accept an answer which states that these variables are inversely proportional to one another.
Also the candidates cannot state that 'As the maximum kinetic energy of the emitted electrons decreases, the wavelength of the incident radiation increases.' (2)

9.3 The longer the wavelength of the incident radiation the lower the frequency and **the lower the energy of the photons** therefore the emitted electrons will have less kinetic energy since $E_k = E_{light} - W_o$ (W_o = constant for a particular metal).
The **manipulated** formula must be shown to obtain full marks. (3)

9.4 **Alternative 1**
$\lambda = 4,9 \times 10^{-7}$ m (x-intercept)

$$f_o = \frac{c}{\lambda}$$

$$= \frac{3 \times 10^8}{4,9 \times 10^{-7}}$$

$$\mathbf{= 6,12 \times 10^{14}\ Hz}$$ (4)

9.5 $W_o = h.f_o$

$= 6,6 \times 10^{-34} \times 6,12 \times 10^{14}$ (c.o.e. from 9.4)

$\mathbf{W_o = 4,04 \times 10^{-19}\ J}$

(3)

[13]

Total: 200 marks