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- 1.1 D
1.2 C
1.3 A
1.4 C
1.5 B
1.6 D
1.7 D
1.8 B
1.9 B
1.10 B (20)

Question Two

2.1.1 $v = \frac{\Delta x}{\Delta t}$ ✓

$1,5 = \frac{\Delta x}{2}$ ✓

$\Delta x = 3 \text{ m}$ ✓ (3)

2.1.2

$x = v_i t + \frac{1}{2} a t^2$ ✓

$= 1,5 (1,2 \text{ ✓}) + \frac{1}{2} 1,75 (1,2)^2 \text{ ✓✓ (subs)}$

$x = 3,06 \text{ m}$ He has to cover 6,5 m (distance used) ✓, therefore he won't make it. ✓ (6)

OR

$v_f^2 = v_i^2 + 2ax$ ✓ (equations)

$= 1,5^2 + 2 (1,75)(6,5) \text{ ✓(distance calc) ✓ (subs)}$

$v_f = 5 \text{ m} \cdot \text{s}^{-1}$

$v_f = v_i + at$

$5 = 1,5 + 1,75 t \text{ ✓ (subs)}$

$t = 2 \text{ s}$ He has to make it in 1,2 s ✓, so no ✓. (6)

2.2.1 distance is *the length of path travelled* ✓✓ (2)

2.2.2 Area = x ✓ = $\frac{1}{2} \times 3,5 \times 20 \text{ ✓} = 35 \text{ m ✓}$ (3)

(can use equations of motion)

2.2.3 $a = \frac{\Delta y}{\Delta x}$ ✓

$= \frac{0 - 20}{4 - 0,5} \text{ ✓ (max 2/3 if reversed)}$

$= -5,7 \text{ m} \cdot \text{s}^{-2} \text{ ✓}$ (3)

2.2.4 Use $v_f^2 = v_i^2 + 2ax$ ✓ (equation application) Downloaded from eduresourceza.com

$$0 = (2v_i)^2 + 2ax$$

$$x = \frac{4v_i^2}{2a} \checkmark \text{ (shown manipulation)}$$

x increases by 4 times ✓ (answer) (3)

2.3.1 gradients represent accel due to gravity of ball in free fall/ same acceleration value. (1)

2.3.2 period of time that the ball is on the ground. (1)

2.3.3 The gradient would be less steep (lower gradient) ✓ as a flatter ball would not bounce as quickly/ stay in contact with the floor for longer ✓. (2)

2.3.4 0,5 s (1)

2.3.5 Just about to leave the floor (for the first time). (1)

2.3.6 $v_f^2 = v_i^2 + 2ax$ ✓ (equations)
 $0 = 2,4^2 + 2(-9,8)x$ ✓✓ (subs)
 $x = 0,294 \text{ m (above ground)}$ ✓ (4)

Question 3

3.1 $T = W = 850 \times 9,8$ ✓
 $= 8330 \text{ N}$ ✓ (2)

3.2 Cage 1 $F_g - T = ma$ $925 \times 9,8 - T = 925a$ ✓ Solving simultaneous eq: $a = 0,41 \text{ m} \cdot \text{s}^{-2}$ ✓	Cage 2 $T - F_g = ma$ ✓ (eqs) $T - (850)(9,8) = 850a$ ✓
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(4)

3.3 $v_f^2 = v_i^2 + 2ax$
 $= 0 + 2(0,79)(50)$ ✓✓
 $v_f = 8,89 \text{ m} \cdot \text{s}^{-1}$ ✓ (3)

3.4 $v_f^2 = v_i^2 + 2ax$ $0 = 8,89^2 + 2a(20)$ ✓✓ $a = -2 \text{ m} \cdot \text{s}^{-2}$ ✓ $F_R = ma$ $= -2(925)$ ✓ $= 1827,6 \text{ N up}$ ✓	OR $\Delta x = \left[\frac{v_f + v_i}{2} \right] \Delta t$ $20 = (8,89/2)t$ ✓✓ $t = 4,5 \text{ s}$ $F_{net} \Delta t = m \Delta v$ $(4,5) = (925)(0 - 8,89)$ ✓✓ $= 1827,6 \text{ N up}$ ✓
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(5)

3.5 $T - W = ma$ ✓
 $T - 9065 = 1827,6$ ✓✓
 $T = 10892,6 \text{ N up}$ ✓ (4)

3.6 $\Delta E_k = F_R \cdot \Delta x = \frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$ ✓ OR
 $= -1827,6(20)$ ✓ (coe Q3.4) OR $= -\frac{1}{2}(925)(8,89)^2$
 $= 36552 \text{ J}$ ✓ $= 36552,34 \text{ J}$ (3)

3.7 $P = \frac{W}{t}$ ✓
 $= \frac{36552}{4,5}$ ✓
 $= 8122,67 \text{ W}$ ✓ (to receive all 3 marks there must be some acknowledgment of Power or Watts) (3)

Question 4

4.1 In the absence of air resistance or any external forces✓, the mechanical energy of an object (or system) is constant✓. (2)

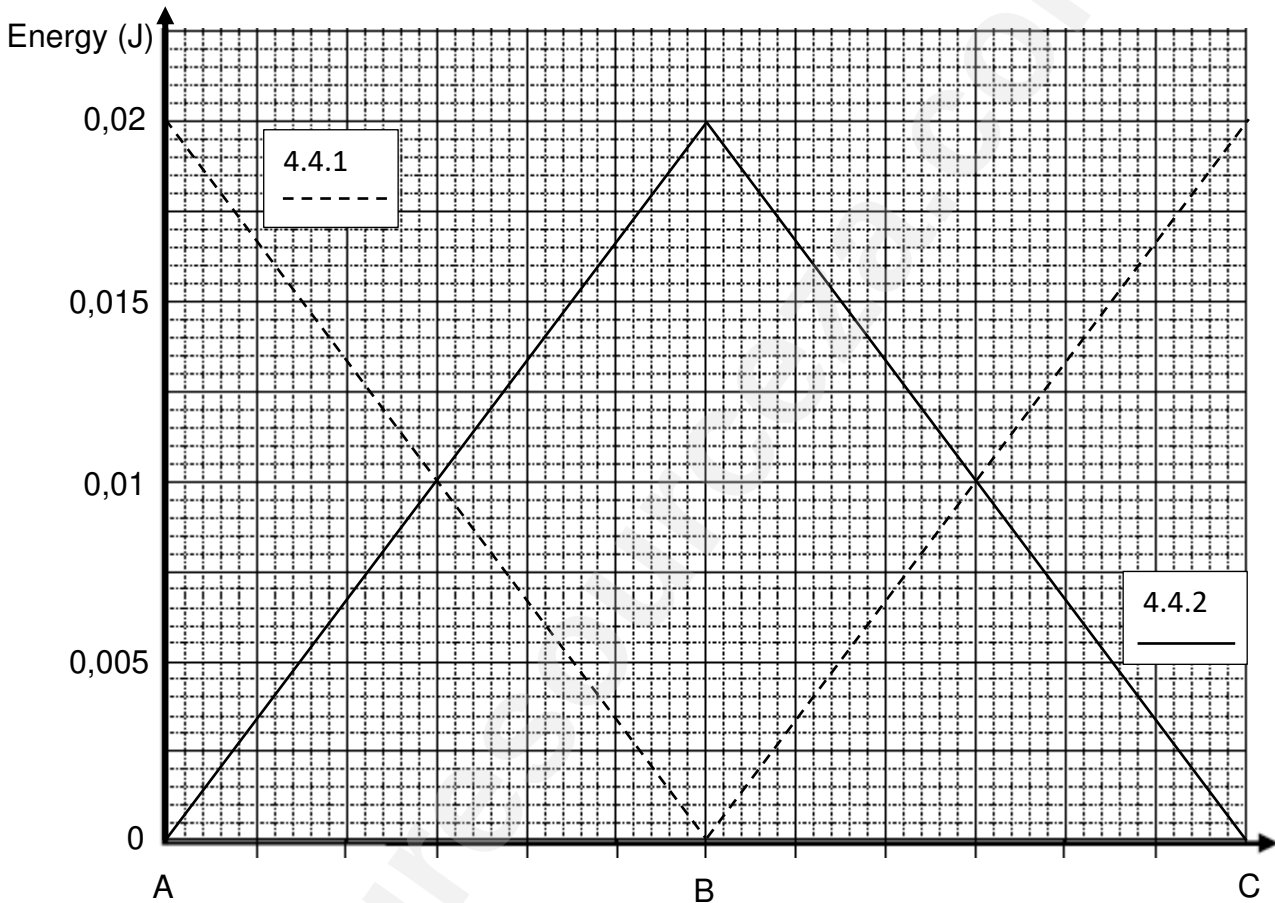
4.2 $mgh = \frac{1}{2} mv^2$ ✓

$9,8 \times 0,03 = \frac{1}{2} v^2$ ✓✓ subs conv

$v = 0,767 \text{ m.s}^{-1}$ ✓ (4)

4.3 Measure how high ball 5 moves above its original resting point✓. If it is 3 cm then energy has been conserved✓. (2)

4.4



4.4.1 & 4.4.2 2 marks for Ek and Ep correct relative to each other - mirrored.

1 mark for start at 0 J and peak at 0,02 J

1 mark for other line start at 0,02 and peak at zero

1 mark for lines intercepting at 0,01 J

1 mark for shape of both lines.

(6)

Question 5

$$5.1 \quad F_{g//} = F_{fs}^{\max}$$

$$= 500 \times 9,8 \sin 40^\circ \checkmark \checkmark$$

$$= 3149,66 \text{ N } \checkmark$$

(3)

$$5.2 \quad F_{fs}^{\max} = \mu_s F_N \checkmark \quad F_N = F_{g\perp} = 500 \times 9,8 \cos 40^\circ \checkmark \text{ (calc)}$$

$$3149,66 = \mu_s \cdot 3753,62 \checkmark \text{ (subs)}$$

$$\mu_s = 0,84 \checkmark$$

(4)

5.3.1 The same

(1)

5.3.2 The same surface. Not at the max static friction.

(2)

5.4.1 Inertia is the property of an object $\checkmark$ that causes it to resist a change in its state of rest or uniform motion $\checkmark$.

(2)

5.4.2 There is friction between the horse box floor and the bucket $\checkmark$ hence, the force of static friction of the box floor on the bucket is a resultant force $\checkmark$ on the bucket and hence overcomes the bucket's inertia (or place mark here $\checkmark$) so it moves with the floor of the horse box.

(2)

If car moved quicker, motion of floor under box ('fwd' force) would be greater than static friction force and bucket would move backwards.

Impulse reasoning: F_{fs} is exerted over a long period of time.

$$5.4.3 \quad F_{fs} = \mu_s F_N \checkmark$$

$$= 0,3 \checkmark \times (3 \times 9,8) \checkmark$$

$$= 8,82 \text{ N } \checkmark$$

(4)

$$5.4.4 \quad F_A = m a \checkmark$$

$$8,82 = 3 \times a \checkmark$$

$$a = 2,94 \text{ m} \cdot \text{s}^{-2} \checkmark$$

(3)

Question 6

6.1.1 An elastic collision is a collision in which both momentum and kinetic energy are conserved.

(2)

6.1.2 Inelastic.

(1)

$$6.1.3 \quad E_k = \frac{1}{2} m v^2 \checkmark$$

$$= \frac{1}{2} \times 0,2 \times (0,21)^2 \checkmark \text{ subs, } \checkmark \text{ conv}$$

$$= 4,41 \times 10^{-3} \text{ J } \times 0,7$$

$$= 3,09 \times 10^{-3} \text{ J } \checkmark$$

$$E_k = \frac{1}{2} m v^2$$

$$3,09 \times 10^{-3} = \frac{1}{2} (0,2) v^2 \checkmark \text{ subs}$$

$$v = 0,18 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(6)

$$6.2 \quad \Sigma p_b = \Sigma p_a \checkmark$$

$$81\,000 v_1 = 6\,000 \times (-1000) + 75\,000 \times 4\,500 \checkmark \checkmark \checkmark \text{ (subs)}$$

$$V_1 = 4092,6 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(5)

Question 7

7.1 $F = G \frac{m_1 m_2}{r^2}$

$$F = \frac{6,7 \times 10^{-11} \times 6,4 \times 10^{23} \times 6,0 \times 10^{24}}{(5,6 \times 10^{10})^2} \quad \checkmark \text{ (subs)} \\ \checkmark \checkmark \text{ (conv, subs)}$$

$$F = 8,2 \times 10^{16} \text{ N} \quad \checkmark \text{ attraction} \quad \checkmark \quad (5)$$

7.2

Moon

$$g_m = \frac{GM_m}{r_m^2}$$

Earth

$$6 g_e = \frac{81 GM_e}{r_e^2} \quad \checkmark \text{ Using correct formula} \\ \checkmark \checkmark \text{ (working correctly with 6 and 81)}$$

$$r_e^2 = \frac{81 GM_e}{6 g_e}$$

$$r_e = 3,67 r_m \quad \checkmark \text{ (radius ratio)} \quad (4)$$

7.3.1 Electric field at a point is the force $\checkmark$ per unit positive charge (2)

7.3.2 electric field due to Q_1

$$E = \frac{kQ}{r^2} \quad \checkmark$$

$$E = \frac{9 \times 10^9 \cdot 3 \times 10^{-6}}{(8,1 \times 10^{-2})^2}$$

$$E = 4,11 \times 10^6 \text{ N.C}^{-1}$$

electric field due to Q_2 $\checkmark \checkmark$ subs $\checkmark \checkmark$ conv

$$E = \frac{kQ}{r^2}$$

$$E = \frac{9 \times 10^9 \cdot 6,5 \times 10^{-6}}{(11,9 \times 10^{-2})^2}$$

$$E = 4,13 \times 10^6 \text{ N.C}^{-1}$$

$$E_{\text{net}} = 15837,85 \text{ N.C}^{-1} \text{ (without rounding)} \quad \checkmark \quad (6)$$

7.3.3 $E = \frac{F}{q} \quad \checkmark$

$$= 15837,85 \times 4,5 \times 10^{-6} \text{ (subs coe)} \quad \checkmark$$

$$= 0,07 \text{ N} \quad \checkmark \quad (3)$$

Question 8

8.1 $V = I R \checkmark$

$$45 = 0,03 R \checkmark$$

$$R_T = 1500 \Omega \checkmark$$

(3)

8.2 $V_{//} = I_{R2} R_{R2}$

$$= 0,02 \checkmark \text{ (calc)} \times 750 \checkmark$$

$$= 15 \text{ V}$$

$$15 = 0,01 R_3 \checkmark \text{ (subs)}$$

associated with R_3

$$R_3 = 1500 \Omega \checkmark$$

OR using ratios

(4)

8.3 $V_{//} = 15 \text{ V}$ thus $V_{R1} = 30 \text{ V} \checkmark$

$$V = IR$$

$$30 = 0,03 R_1 \checkmark$$

$$R_1 = 1000 \Omega \checkmark$$

OR $1/R_{//} = 1/750 + 1/1500 \checkmark$ (use of $R_{//}$)

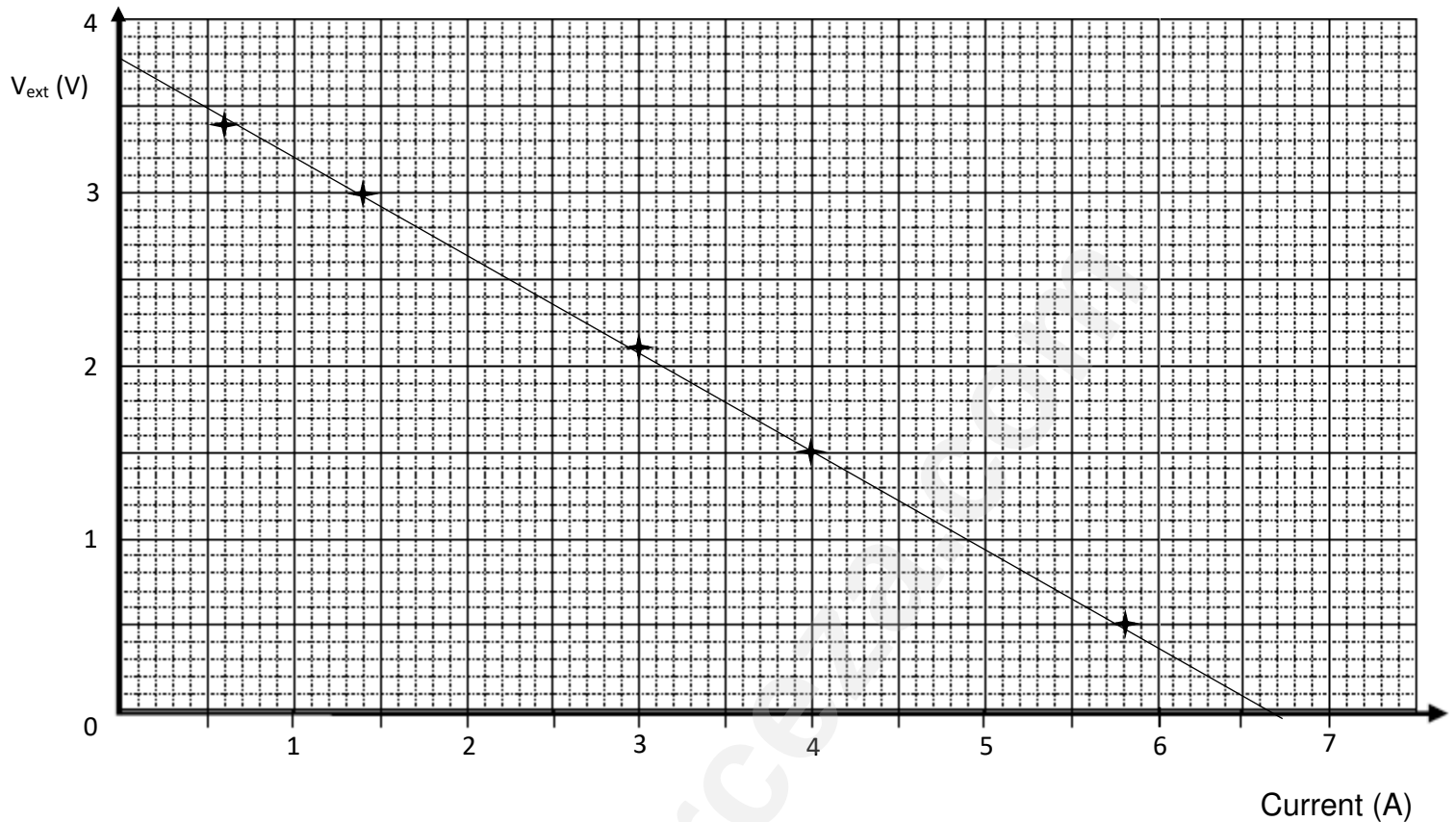
$$R_{//} = 500 \Omega$$

$$\text{But } R_T = 1500 \Omega \text{ thus } R_1 = 1000 \Omega \checkmark \checkmark \text{ (reasoning coe)}$$

(3)

Question 9

9.1



Scales ✓ Plots ✓✓ LOBF ✓ Axis labels ✓ (5)

9.2 As current increases V_{ext} decreases. ✓✓ (2)

9.3 Use $V_{\text{lost}} = Ir$ ✓
 V_{lost} increases with an increase in current ✓
 V_{ext} thus decreases ✓ (3)

9.4.1 $V_{\text{ext}} = -Ir + \text{emf}$ ✓✓ (2)

9.4.2 $\pm 3,8 \text{ V}$ (y-intercept) (1)

9.4.3 $r = \frac{\Delta y}{\Delta x}$ ✓ (must use points on LOBF ✓✓)
 $= r = \pm 0,56 \Omega$ ✓ (4)

9.5 Starts at same Y-intercept ✓, continues as a horizontal line ✓ (because $V_{\text{ext}} = \text{emf}$) (2)

[19]

QUESTION 10

10.1



10.1.1 arrows clockwise ✓ arrows anticlockwise ✓ (2)

10.1.2 see on diagram above ✓✓. (2)

10.2.1 split ring commutator (1)

10.2.2 half turn (1)

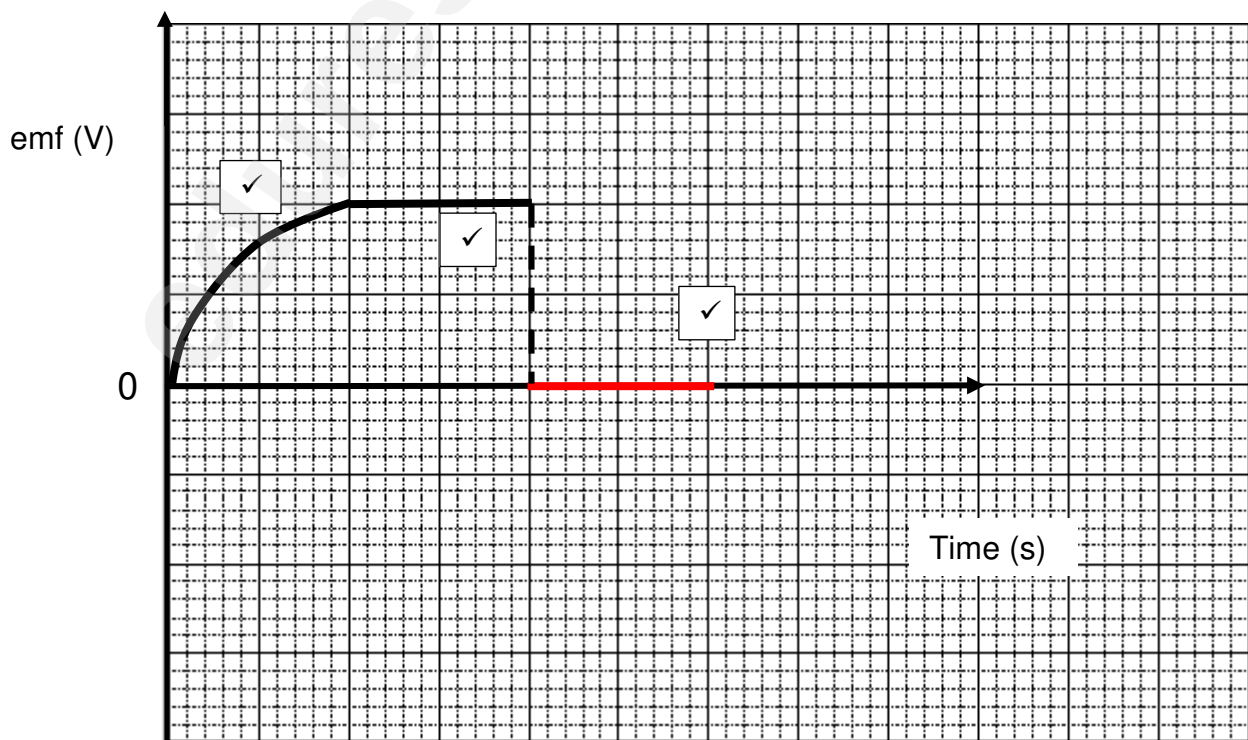
10.2.3 anticlockwise (1)

10.2.4 increase the number of turns in the coil OR use stronger magnets OR increase the current in the coil (1)

10.3.1 $90 - 20 = 70^\circ$ ✓ (many of them said 160° , so I allowed that) (1)

10.3.2 flux linkage is at a minimum when the coil is lying horizontal in the field ✓✓/ moving perpendicular to the field ✓✓/ angle between normal to field and field is 90° for min flux linkage ✓✓ as $\cos 90^\circ = 0$. (2)

10.4



(3)

10.5.1 Lenz's law: the induced current flows in a direction ✓ so as to set up a magnetic field to oppose the change in magnetic flux. ✓ (2)

10.5.2

- When the switch is turned on, the current increases the magnetic flux through Q ✓.
- Current in Q flows in the opposite direction ✓ – anticlockwise – to create an opposing flux.
- When the switch is closed again the magnetic flux through Q decreases ✓ so the current now travels clockwise to create a magnetic flux that will oppose the decrease ✓. (4)

10.6.1 Faraday's law of electromagnetic induction: the emf induced is directly proportional to the rate of change of magnetic flux (flux linkage) ✓✓. (2)

10.6.2 $V_p I_p = V_s I_s$ ✓
 $220 \times I_p = 5 \times 3$ ✓✓
 $I_p = 0,07 \text{ A}$ ✓ (4)

10.6.3 Increase (1)

10.6.4 $N_s/N_p = V_s/V_p$ ✓
 $N_s/N_p = 12/220$
 $= 0,054$
 $N_s = 0,054 N_p$ ✓ (an expression of the ratio (can be a fraction) (2)