

Name of the Student: _____

Max. Marks : 26 Marks

Time : 26 Minutes

Mark Schemes

Q1.

- (a) (i) 60 (degrees) ✓

1

- (ii) angle required is
- 150°
- ✓

which is $5\pi/6$ [or 2.6(2)] (radians) ✓*Correct answer in radians scores both marks.*

2

- (b) (i) (magnitude of the induced) emf ✓

Accept "induced voltage" or "rate of change of flux linkage", but not "voltage" alone.

1

- (ii) frequency
- $\left(= \frac{1}{T} \right) = \frac{1}{40 \times 10^{-3}}$
- ✓ (= 25 Hz)

no of revolutions per minute = $25 \times 60 = 1500$ ✓*1500 scores both marks.**Award 1 mark for $40s \rightarrow 1.5 \text{ rev min}^{-1}$.*

2

- (iii) maximum flux linkage (
- $=BAN$
-) = 0.55 (Wb turns) ✓

$$\text{angular speed } \omega \left(= \frac{2\pi}{T} \right) = \frac{2\pi}{40 \times 10^{-3}} \quad \checkmark \quad (= 157 \text{ rad s}^{-1})$$

peak emf ($= BAN\omega$) = $0.55 \times 157 = 86(.4)$ (V) ✓

[or, less accurately, use of gradient method ✓

$$\{ \text{e.g. } \varepsilon \left(= \frac{\Delta(N\Phi)}{\Delta t} \right) = \frac{0.5 - (-0.5)}{(16 - 4) \times 10^{-3}} = \frac{1.0}{12 \times 10^{-3}} \} = 83 (\pm 10)$$

(V) ✓ ✓

(max 2 for (iii) for values between 63 and 72 V or 94 and 103V)

3

- (c) sinusoidal shape of constant period 40 ms ✓

Mark sequentially.*Graph must cover at least 80ms.*

correct phase (i.e. starts as a minus sin curve)
 For 2nd mark, accept + sin curve.
 Perfect sin curves are not expected.

2

(d) $BAN = 0.55 \therefore \text{flux density } B = \frac{0.55}{4.0 \times 10^{-3} \times 550} \checkmark$

= 0.25(0) (T) $\checkmark$

OR by use of ϵ from (b)(iii) and f from
 (b)(ii) substituted in $\epsilon = BAN (2\pi f)$.

2

(Total 13 marks)

Q2.

- (a) direction of induced emf (or current) $\checkmark$
 opposes change (of magnetic flux) that produces it $\checkmark$

2

- (b) (i) (volumes are equal and mass of Q is greater than that of P) density of steel > density of aluminium $\checkmark$

Allow density of Q greater (than density of P).

1

- (ii) use of $s = \frac{1}{2} g t^2$ gives $t^2 = \frac{2 \times 1.0}{9.81}$ (from which $t = 0.45$ s) $\checkmark$
 Backwards working is acceptable for 1st mark

(vertical) acceleration [**or** acceleration due to gravity] is independent of mass of falling object

[**or** correct reference to $F = mg = ma$ with m cancelling] $\checkmark$

2nd mark must refer to mass.

Do not allow "both in free fall" for 2nd mark.

2

- (c) (i) moving magnet [**or** magnetic field] passes through tube $\checkmark$ there is a change of flux (linkage)(in the tube)

[**or** flux lines are cut **or** appropriate reference to $\epsilon = N (\Delta\phi / \Delta t)$] $\checkmark$

In this part marks can be awarded for answers which mix and match these schemes.

[Alternative:

(conduction) electrons in copper (or tube) acted on by (moving) magnetic field of Q $\checkmark$

induced emf (or current) is produced by redistributed electrons $\checkmark$]

2

- (ii) emf produces current (in copper) $\checkmark$
 this current [allow emf] produces a magnetic field $\checkmark$
 this field opposes magnetic field (or motion) of Q
 [**or** acts to reduce relative motion **or** produces upward force] $\checkmark$
 no emf is induced by P because it is not magnetised (or not magnet)
 [**or** movement of P is not opposed by an induced emf or current] $\checkmark$

Alternative to 3rd mark:

current gives heating effect in copper and energy for this comes from

- (d) time for P is unaffected because there is still no (induced) emf
 [or because P is not magnetised
 or because there is no repulsive force on P] ✓
 time for Q is shorter (than in (c)) ✓
 current induced by Q would be smaller ✓
 because resistance of brass $\propto$ resistivity and is therefore higher
 [or resistance of brass is higher because resistivity is greater] ✓
 giving weaker (opposing) magnetic field
 [or less opposition to Q's movement] ✓

Condone "will pass through faster" for 2nd mark.

If emf is stated to be smaller for Q, mark (d) to max 2.