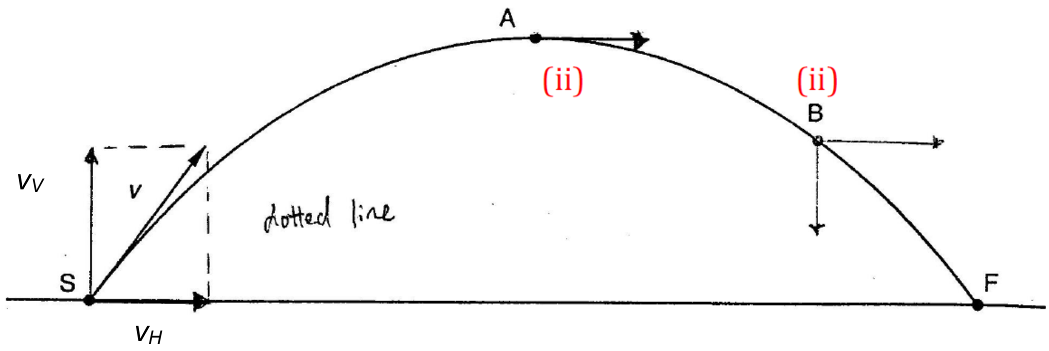
| DHS | Mark Scheme | Syllabus |
|---|---|---|
| | **Year 6 Preliminary Examinations H1 Physics 2016** | **8866** |

**Paper 1**

| *Question Number* | *Key* | *Question Number* | *Key* |
|---|---|---|---|
| 1 | **A** | 16 | **C** |
| 2 | **B** | 17 | **D** |
| 3 | **C** | 18 | **C** |
| 4 | **A** | 19 | **D** |
| 5 | **C** | 20 | **A** |
| 6 | **D** | 21 | **B** |
| 7 | **D** | 22 | **A** |
| 8 | **D** | 23 | **A** |
| 9 | **A** | 24 | **B** |
| 10 | **B** | 25 | **D** |
| 11 | **A** | 26 | **B** |
| 12 | **A** | 27 | **C** |
| 13 | **A** | 28 | **D** |
| 14 | **C** | 29 | **B** |
| 15 | **C** | 30 | **D** |

**Paper 2**

**1** **(a)**




**(i)** Correct lengths of vector components. B1

**(ii)** All horizontal components must be of the same length B1
vertical component of A should be zero B1
vertical component of B is downwards and less than that at S B1

**(b)** **(i)** correct shape of the graph (parabola), max at mid point B1

**(ii)** correct shape B1
at maximum height, min value of KE is not zero B1 [7]

**2** **(a)** apply conservation of momentum
$0 = (0.500 \times 3.8) - (0.310 \times v)$ C1
$v = 6.1\ \text{m s}^{-1}$ A1

**(b)** $F = \Delta p/\Delta t$ C1
$= (0.500 \times 3.8)/0.25$ C1
$= 7.6$ N A1 [5]

**3** **(a)** mass is the property of a body resisting changes in motion /
quantity of matter in a body/ measure of inertia to change in motion B1
weight is the force due to gravitational field/ force due to gravity /
force due to gravitational force B1

**(b)** **(i)** Constant horizontal speed,
net force in the horizontal direction is zero M1
Resistive force = $F \cos\theta = 300 \cos(30°) = 260$ N A1

**(ii)** vertical direction ➔ $300\sin(30°)$ + contact force = mg M1
Contact force = $(50 \times 9.81) - 300\sin(30°) = 340$ N A1 [6]

**4** **(a)** **(i)** constant phase difference B1

**(ii)** wavelength estimate: 550 to 700 nm C1
Separation = $\lambda D/a$
$= (650 \times 10^{-9} \times 2.4) / (0.86 \times 10^{-3})$
$= 1.8$ mm A1

**(iii)** dark fringes are brighter as amplitude no longer completely cancel A1 bright fringes are less bright as resultant amplitude is smaller A1

**(iv)** shorter wavelength for blue, so separation is less A1

**(b) (i)** 160 cm A1

**(ii)** $v = f\lambda$,

$= 20 \times 1.6$

$= 32$ m s$^{-1}$ A1

**(iii)** progressive wave reflected at the fixed ends B1

incident and reflected (two) waves travelling in opposite directions interfere B1

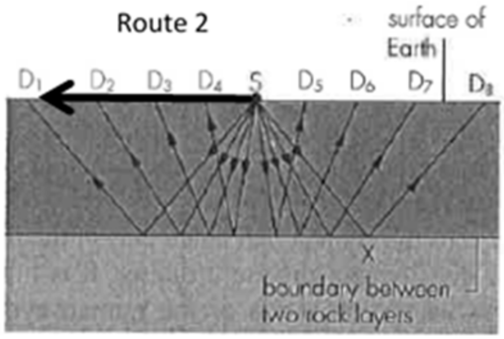
speed is the speed of one of these waves A1 [11]

**5 (a)** <u>Oscillation of the molecules</u> of the wave is <u>along the direction of transfer of energy</u> of the wave. B1

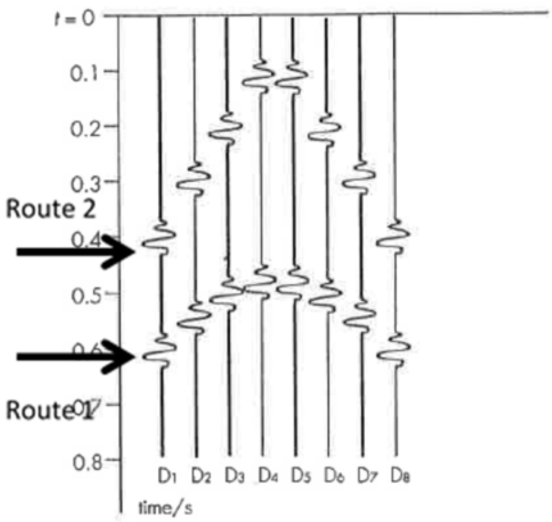
**(b)** $A = \rho v^2 = (2700)(3100)^2 = 2.59 \times 10^{10}$ A1

Units of $A$ = (kg m$^{-3}$)(m s$^{-1}$)$^2$ = kg m$^{-1}$ s$^{-2}$ = Pa A1

**(c)**



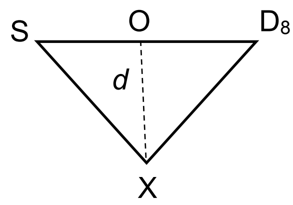

**(d)**



**(e)** The waves should be weaker after traveling longer distances, B1
hence direct waves should show larger amplitude than reflected waves. B1

**(f)** 1. $SD_8$, $t$ = 0.4 s, so $SD_8$ = (3.1)(0.4) = 1.24 km A1
2. $SXD_8$, $t$ = 0.6 s, so $SXD_8$ = (3.1)(0.6) = 1.86 km A1

**(g)** Assume SX = $XD_8$
Using Pythagoras Theorem,




$$\text{depth d} = \sqrt{(XD_8)^2 - (OD_8)^2}$$

$$= \sqrt{\left(\frac{SXD_8}{2}\right)^2 - \left(\frac{SD_8}{2}\right)^2}$$

$$= \sqrt{\left(\frac{1.86}{2}\right)^2 - \left(\frac{1.24}{2}\right)^2}$$ C1

= 0.69 km A1 [11]

**6** **(a)** Electromotive force of a source is the work done per unit charge when non-electrical energy is transferred into electrical energy when the charge is moved round a complete circuit. B1
Potential difference between two points in a circuit is the work done per unit charge when electrical energy is transferred into non-electrical energy when the charge passes from one point to the other. B1 [2]

**(b)** **(i)**

| $R$ / Ω | ($R$ + $r$) / Ω | $I$ / A | $P$ / W |
|---|---|---|---|
| 2.0 | 4.0 | 1.5 | **4.5** |
| 3.0 | 5.0 | **1.2** | **4.3** |
| 4.0 | 6.0 | **1.0** | **4.0** |

Both currents correct [B1] and all three powers correct [B1]

**(ii)** suitable smooth curve B1

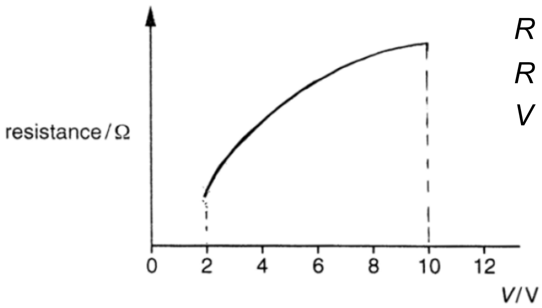
**(iii)** Maximum at $R$ = 2 ± 0.2 Ω B1

**(iv)** All the power is wasted as heat in the internal resistance B1
No power/energy to external resistor B1

**(v)** 1. Total power supplied = 6 x 1.5 = 9.0 W — C1
Efficiency = 4.5/9.0 = 0.5 — A1
2. *R* for maximum fraction = 10 Ω — A1 — [9]

**(c) (i)** Read the values of potential difference (*V*) and current ($I$) from graph, resistance *R* is the ratio of *V* to $I$, $R = V / I$. — B1

**(ii)**




*R* ↑ as V ↑ [B1]
*R* is never zero and graph starts from *V* = 2 V to 10 V [B1]

**(iii)** The battery may have internal resistance,
so terminal p.d. smaller than 12 V — B1
Resistance of lamp is comparable to the maximum resistance of variable resistor,
By potential divider, it is not possible to get p.d. of 0V across lamp. — B1 — [5]

**(d) (i)** One correct route from P to Q — B1
Second correct route from P to Q — B1

**(ii)** any two from: — B2 — [4]
Independent switching/ if one fails the others work
Many sockets can be attached to the ring
Extra sockets can be put in with little difficulty
Fault at one side will still leave circuit working
Large currents can be supplied by two cables

**7 (a) (i)** region of space / area where — B1
a force is experienced by — M1
current-carrying conductor/ moving charge/ permanent magnet — A1
**(ii)** particle must be moving — M1
With component of velocity normal to magnetic field — A1 — [5]

**(b) (i)** electrons in rod moves to right, apply FLH rule, current to left, field is out of paper, magnetic force on electrons is upwards. — M1
B is at a higher potential. — A1
**(ii)** It is a complete circuit. Current flows from B through lamp to A — M1
Lamp lights up. — A1 — [4]

**(c) (i)** force = $0.40 \times 10^{-3} \times 9.81$
$= 3.9 \times 10^{-3}$ N — A1
**(ii)** Force on magnet (balance) is upwards — B1
By Newton's 3rd law, force on rod is downwards — M1
By FLH, pole P is a south pole. — A1
**(iii)** F = BIL
$3.9 \times 10^{-3} = (30.0 \times 10^{-3})\, I\, (0.10)$ — C1
$I = 1.3$ A — A1 — [6]

| | | | | | |
|---|---|---|---|---|---|
| | **(d)** | **(i)** | at least 4 straight horizontal lines of equal spacing | B1 | |
| | | | with arrows pointing to the left. | B1 | |
| | | **(ii)** | anticlockwise moments = clockwise moments about XY | | |
| | | | (0.40)( $I$)(0.06) x (0.6SR) = (0.3 x 9.81) x (0.4SR) | C1 | |
| | | | $I$ = 81.75 A | C1 | |
| | | | r = e.m.f. / $I$ = 2.0 / 81.75 = 0.024 Ω | A1 | [5] |
| **8** | **(a)** | **(i)** | The arrow is below the axis and pointing to the right. | B1 | |
| | | **(ii)1.** | $p = \frac{h}{\lambda} = \frac{6.63\times10^{-34}}{6.50\times10^{-12}}$ | C1 | |
| | | | = 1.02 × $10^{-22}$ N s | A1 | |
| | | **2.** | Energy = $\frac{hc}{\lambda} = \frac{\left(6.63\times10^{-34}\right)\left(3.00\times10^{8}\right)}{\left(6.50\times10^{-12}\right)}$ | C1 | |
| | | | = 3.06 ×$10^{-14}$ J | A1 | |
| | | **(iii)1.** | $0.34\times10^{-12} = \left(6.63\times10^{-34}\right)/\left(9.11\times10^{-31}\times3.0\times10^{8}\right)\times\left(1-\cos\theta\right)$ | C1 | |
| | | | $\theta = 30.7°$ | A1 | |
| | | **2.** | deflected electron has energy | M1 | |
| | | | this energy is derived from the incident photon | A1 | |
| | | | deflected photon has less energy so longer wavelength | B1 | |
| | | **(iv)** | $\Delta E = \frac{1}{2}mv^2$ | | |
| | | | $\frac{\left(6.63\times10^{-34}\right)\left(3\times10^{8}\right)}{\left(6.50\times10^{-12}\right)} - \frac{\left(6.63\times10^{-34}\right)\left(3\times10^{8}\right)}{\left(6.84\times10^{-12}\right)} = \frac{1}{2}\left(9.11\times10^{-31}\right)v^2$ | C1 | |
| | | | $v = 5.78\times10^{7}$ m $s^{-1}$ | A1 | |
| | | **(v)** | Momentum is a vector quantity | B1 | |
| | | | Either must consider momentum in two directions | | |
| | | | Or direction changes so cannot just consider magnitude | B1 | [14] |
| | **(b)** | | Photon with specific energy (frequency) emitted when electron falls from higher to lower energy level, | B1 | |
| | | | an electron in atom can only have specific energy levels | | |
| | | | so certain frequencies only therefore line spectra | B1 | |
| | | | atoms must be in gaseous form to be sufficiently far apart | B1 | |
| | | | electrons must be in high energy states – | | |
| | | | either gas must be at a high temperature or a high voltage across it | B1 | [4] |
| | **(c)** | | Spectrum appears as continuous spectrum crossed by dark lines | B1 | |
| | | | Electrons in gas absorb photons with energies equal to excitation energies, and photons re-emitted in all directions | B1 | [2] |

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