1.1 $E_K = \frac{1}{2}mv^2$ ✓

$= \frac{1}{2}(0.5)(2)^2$ ✓

$= 1\ J$

1.2 $(E_K + E_P)_{top} = (E_K + E_P)_{bottom}$ ✓

$1 + mgh = \frac{1}{2}mv^2 + 0$

$1 + 0,5(10)(0,6) = \frac{1}{2}(0,5)v^2$ ✓

$1 + 3 = 0,25v^2$

$16 = v^2$ ✓

$4 = v \quad \therefore v_{bottom} = 4\ m.s^{-1}$ ✓

1.3 b = bob c = cube

$P_{before} = P_{after}$

$m_b u_b + 0 = m_b v_b + m_c v_c$ ✓ formula

$0,5(4) + 0 = 0,5\,v_b + 0,1\,(3.5)$ ✓ values

$v_b = 3,3\ m.s^{-1}$ to the right ✓ ✓

1.4 $E_{K\,before} = \frac{1}{2}m_b u_b^2 + 0$ for the cube

$= \frac{1}{2}(0,5)(4)^2$

$= 4\ J$ ✓

$E_{K\,after} = \frac{1}{2}m_b v_b^2 + \frac{1}{2}m_c v_c^2$

$= \frac{1}{2}(0,5)(3,3)^2 + \frac{1}{2}(0,1)(3,5)^2$

$= 2,7 + 0,6$ ✓

$= 3.3\ J$ ✓

$E_{K\,after} < E_{K\,before} \therefore$ collision was inelastic

1.5 $F\Delta t = m\Delta v$ $\quad F = \frac{m(v-u)}{t}$ ✓formula

$= \frac{0,1(3,5-0)}{0,006}$ ✓values $= 58,3\ N$ ✓

1.6.1 flooring material used ✓

1.6.2 frictional force exerted on the cube ✓

1.7 time taken for cube to come to rest ✓

1.8 $a = \frac{F_{res}}{m} = \frac{5}{0,1} = 50\ m\cdot s^{-2}$ ✓✓✓

1.9

s	?
u	3,5
v	0
a	-50
t	

✓data

$s = \frac{v^2-u^2}{2a}$ ✓formula

$= \frac{0-(3,5)^2}{2(-50)}$

$= 0,1225\ m$ ✓

2.1 $25 \times 3,6 = 90\ km\cdot h^{-1}$ ✓

2.2 $5\ m\cdot s^{-1}$ downwards $(-5\ m\cdot s^{-1})$ ✓✓ must indicate direction

2.3 $V_{TC} = V_{TH} + V_{HC} = -5 + 25 = 20\ m\cdot s^{-1}$ (upwards) ✓ ✓

2.4

s	?
u	20
v	
a	-10
t	8

✓data

$s = ut + \frac{1}{2}at^2$ ✓formula

$= 20(8) + \frac{1}{2}(-10)(64)$

$= 160 - 320$

$= -160$

Therefore the cliff height is 160m. ✓

2.5 ① Calculate time when $v = 0$ (to get x-intercept)

s	
u	20
v	0
a	-10
t	?

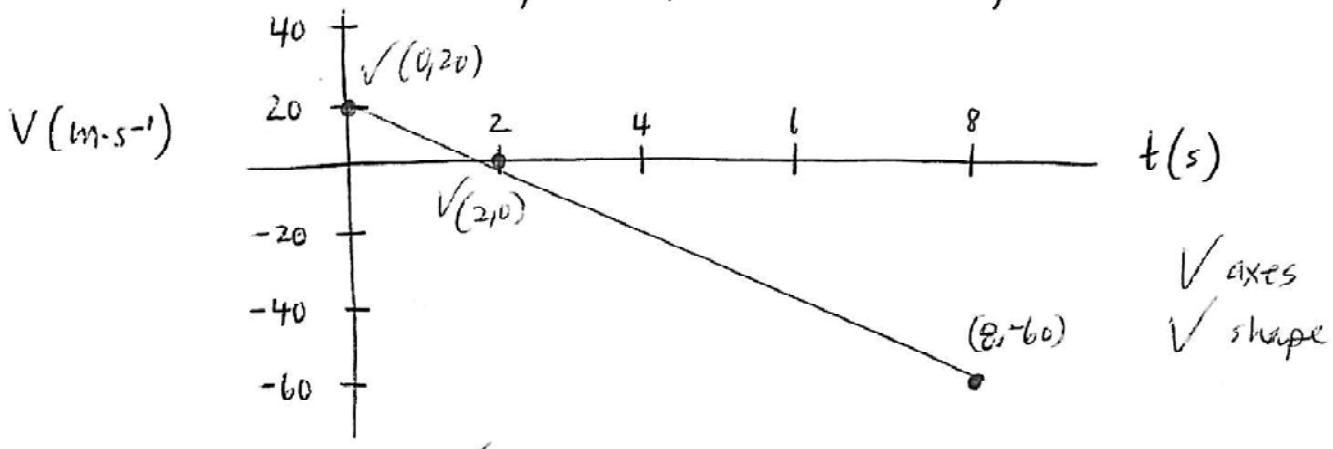
$$t = \frac{v-u}{a} = \frac{-20}{-10} = 2 \text{ seconds}$$

② Calculate v at 8 seconds (to get final point of graph)

s	
u	20
v	
a	-10
t	8

$$v = u + at$$
$$= 20 + (-10)(8)$$
$$= -60$$

NB. y-intercept is initial velocity



3.1 electrical energy ✓ to mechanical energy ✓

3.2 $F = mg = 4000N$ ✓

$P = Fv$ ✓
$= 4000(5)$
$= 20000W$ ✓

} or any other pair of values

3.3 $20kW \times 120hrs = 2400kWh$ ✓

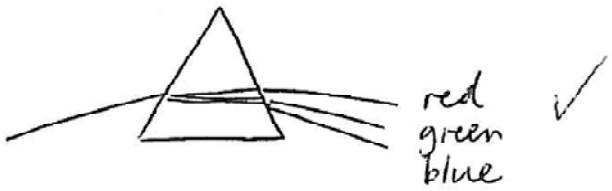
$cost = 0,6(2400) = R1440$ ✓

4.1 Red. ✓ Yellow absorbs blue ✓ and magenta absorbs green. ✓

4.2 The green t-shirt was cyan ✓ and yellow dyes. ✓
The cyan dye has come out leaving only yellow. ✓
The company must reformulate the cyan dye. ✓

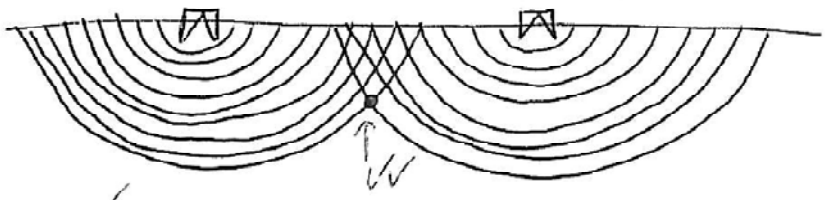
4.3 $f = \frac{c}{\lambda} = \frac{3 \times 10^8}{540 \times 10^{-9}} = 5{,}6 \times 10^{14}\ Hz$ ✓ ✓ ✓

4.4 The 3 colours of light will emerge separately.
Blue has the shortest wavelength ∴ will travel slowest through glass ∴ will refract the most.



✓

4.5 Red. ✓✓

5.1  ✓✓ ✓ ✓

5.2 destructive interference ✓

5.3 higher frequency sound (or shorter λ) ✓
sources further apart ✓

5.4 diffraction ✓

5.5 The music will involve many ✓ frequencies and so no clear interference pattern will result. ✓

6.1 Doppler effect ✓✓

6.2 $\lambda = \frac{v}{f}$ ✓ $= \frac{340}{30000}$ ✓ $= 0,011\ m$ ✓

6.3 increase ✓

6.4 $f_o = \left(\frac{v}{v - v_s}\right) f_s = \left(\frac{340}{340-3}\right) 30000 = 30267\ Hz$ ✓✓✓

6.5 $v_s = \left(\frac{f_s - f_o}{f_o}\right) v = \left(\frac{30000 - 29500}{29500}\right) 340 = 5.8\ m.s^{-1}$ away from detector ✓✓✓✓

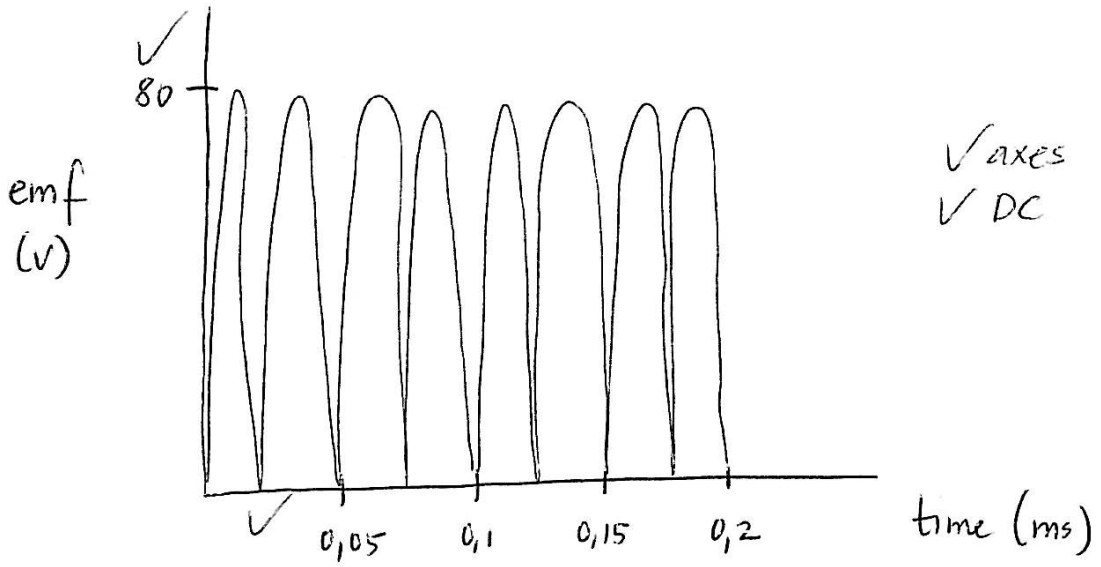
7.1 DC ✓ polarity ✓ does not change

7.2 replace the split-ring commutator ✓ with slip rings ✓

7.3 A ✓✓

7.4 friction between moving parts ✓
electrical resistance in wires ✓ (both → heat)

7.5



7.6 increase magnetic field strength ✓
increase number of turns on the coil ✓

7.7 Diodes only allow current to flow in one direction. ✓

7.8.1 light emitting diode ✓

7.8.2 any 2 eg. headlamps/torches, indicator lights, ✓✓ digital displays, car lights, traffic lights

7.9 downwards ✓

7.10 increase magnetic field strength ✓
increase current flow through wire ✓

7.11 anti-clockwise rotation ✓

8.1 A <u>changing/oscillating</u> ✓ electric field induces ✓ a changing magnetic field ✓ in the perpendicular plane, which induces a changing electric field, etc...

8.2 gamma, UV, visible, microwaves ✓✓✓✓

8.3 gamma rays ✓

8.4 X rays, infrared, radiowaves ✓✓✓

8.5.1 O_2 ✓ molecule - requires a shorter ✓ wavelength to be split (ie. less than 200nm vs 200–300nm)

8.5.2 The reactions <u>absorb</u> ✓ UV radiation which can cause sunburn, cancer, mutations, etc.
✓✓ any 2

9.1 light of sufficient energy / frequency shines on a metal surface and electrons are ejected from the surface (one e^- per photon)

9.2 it established the particle nature of light

9.3 $2.48\,eV \times 1.6\times10^{-19} = 3,968\times10^{-19}\ J$

$E_{photon} = W_f + E_{k_{electron}}$ but $E_k = 0$ if just sufficient

$\therefore E_{photon} = W_f \quad \therefore W_f = \frac{hc}{\lambda}$

$\lambda = \frac{hc}{W_f} = \frac{6.6\times10^{-34}(3\times10^8)}{3.968\times10^{-19}}$

$\lambda = 5\times10^{-7}\,m \quad (500nm)$

9.4 Electrons will be emitted with $E_k > 0$.

10.1 line emission spectrum

10.2 excited e^- drop down from higher to lower atomic energy levels, thereby causing photons (of the same energy as the difference between energy levels) to be emitted

10.3 each element has a unique arrangement of atomic energy levels $\therefore$ photons of different energies will be emitted

10.4 $E = hf = 6.6\times10^{-34}(5.2\times10^{14}) = 3.4\times10^{-19}\ J$