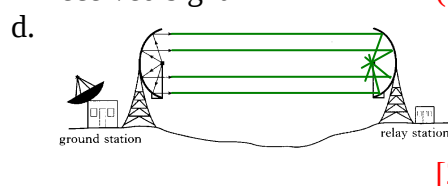


2000 Credit Paper

1. a. Stays above the same point on the Earth's surface OR Height of 36 000 km above Earth's surface round equator OR Period of 24 hours Any 2 x [1]

b. $\lambda = \frac{v}{f} = \frac{3 \times 10^8}{6 \times 10^9} = 0.05 \text{ m}$ (½,½,1)
(1 for correct speed)

- c. 4 GHz (not 6 because it is used for the received signal) (1)



2. a. $t = \frac{d}{v} = \frac{2}{340} = 0.00588 \text{ s}$ (½,½,1)
 $t = \frac{d}{v} = \frac{19}{340} = 0.0558 \text{ s}$ (1)

Time difference in hearing is 0.0499 s

- b. i. Time difference in result is 0.03 s, so lane 8 actually took less time to swim so should be given the race (1,1)
 ii. Loudspeakers should be put behind each swimmer so they all hear the horn at the same time (1)

3. a. i. 175 Ω (from graph) (1)
 ii. $I = \frac{V}{R} = \frac{230}{175} = 1.31 \text{ A}$ (½,½,1)
 iii. $P = I^2 R = 1.31^2 \times 175 = 302 \text{ W}$ (½,½,1)
 So the 300 W is fitted (1)
 b. The resistance is lowest in the first 0.5 seconds, so the current will be largest causing the the greatest chance of blowing the filament. (1,1)

4. a.i. It is double insulated, so does not require an earth wire [1]
 ii. Blue and brown (1,1)
 iii. 6.52 A needed so fit a 13 A [1]
 b. i. $I = \frac{V}{R} = \frac{230}{5000} = 0.046 \text{ A}$ [½,½,1]
 ii. The current is too small to blow the fuse so the supply would not be cut off and the person would be electrocuted (1,1)
 iii. To cut off the supply if the current becomes too large [1]
 iv. The current would now be larger because the resistance of the dummy would be less. (1,1)

- 5 a.i. Beta particles are less penetrating than gamma rays [1]
 ii. Radiation kills living cells (can cause genetic damage) [1]
 b. i. A – The radiation causes fogging on the photographic film [1]
 B – The more radiation that is received the darker the film will [1]
 ii. The additional film badge will give a more accurate measure of the radiation received by the hands, as not all of the radiation will reach the badge on the clothing (1,1)
 iii. Do not eat in the lab, point away from the body, use tongs where possible, store in lead lined boxes, etc. [1]

6. a. i. P supplies light to send down into the patients body [1]
 Q takes light back up to the doctor's eye [1]
 ii. Cold light means that there is no Infra Red component that could cause damage to the patients internal organs [1]
 iii. Discharge lamp, less heat will be produced than by filament lamp (1,1)
 b. Heat energy $\rightarrow$ electrical energy [1]
 c. i. 0.03 mV (from graph) (1)
 ii. Any value greater than 0.03 mV (1)

7. a. Solar cell → amplifier → voltmeter [1]

b. i. voltage gain = $\frac{V_{out}}{V_{in}}$
 $= \frac{120}{0.3} = 400$ [½,½,1]

ii. $V_1 = \frac{R_1}{R_{total}} \times V_S = \frac{180}{400} \times 0.0004$
 (1 convert 0.4 mV into V)
 $= 0.00018 \text{ V} = 0.18 \text{ mV}$ (½,½,1)

8.a.i. NOT gate [1]

ii.

	No can in light beam	Can in light beam
Light level at LDR	high	low
Resistance of LDR	low	high
V_{in}	high	low
V_{out}	low	high

(8 x ½)

b. i. binary [1]

decimal [1]

ii. A – AND gate [1]

B

Input 1	Input 2	Output
0	0	0
0	1	0
1	0	0
1	1	1

[4 x ½]

iii. Capacitor (1)

9. a. $v = \frac{d}{t} = \frac{90000}{3600} = 25 \text{ m/s}$ [½,½,1]

b. $v = \frac{d}{t} = \frac{14}{0.4} = 35 \text{ m/s}$ (½,½,1)

This is 10 m/s over the speed limit (1)

c. i. 5 seconds (from graph) (1)

ii. $a = \frac{v-u}{t} = \frac{50-0}{10} = 5 \text{ m/s}^2$ [½,½,1]

iii. dist = area under speed/time graph
 $= lb = 40 \times 50 = 2000 \text{ m}$ [½,½,1]

iv. dist = area under speed/time graph
 $= \frac{1}{2}bh = \frac{1}{2} \times 20 \times 50 = 500$ (1)

dist = area under speed/time graph
 $= \frac{1}{2}bh = \frac{1}{2} \times 24 \times 40 = 480$ (1)

dist between them = 500 - 480
 $= 20 \text{ m}$ (1)

10. a.i. $P = \frac{E}{t} = \frac{8.64 \times 10^7}{6 \times 3600} = \frac{8.64 \times 10^7}{21600}$
 $= 4000 \text{ W} = 4 \text{ kW}$ [½,½,1]

ii. $\Delta T = \frac{E_H}{cm} = \frac{8.64 \times 10^7}{2625 \times 144} = \frac{8.64 \times 10^7}{378000}$
 $= 228.6 \text{ }^\circ\text{C}$ (1½,½,1)

iii. Actual temperature will be less because heat energy will be lost to the surroundings during the night (1)

b. So that the heat can be released slowly or so that people do not come into direct contact with the blocks (1)

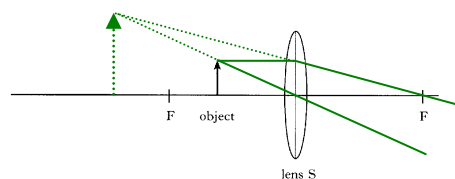
c. Convection or radiation (1)

11. a. To collect as much light as possible so that very distant objects may be observed [1]

b. i. $P = \frac{1}{f} = \frac{1}{0.02} = 50 \text{ D}$ [½,½,1]

ii. Q (it has the shortest focal length) (1)

c.



[3, 1 for each line, 1 for image]

12. a. Inertia [1]

b. i. 8.8 N/kg (from graph) (1)

ii. $w = mg = 20000 \times 8.8$
 $= 176000 \text{ N}$ [½,½,1]

iii. weight decreases [1]
 mass stays the same [1]

c. It falls towards the Earth but because of its forward speed it follows the curve of the Earth's surface following a circular path. [1,1]

Total marks KU [50]
 PS (50)

	KU	PS
Grade 1 - ≥ 35	≥ 35	
Grade 2 - ≥ 25	≥ 25	
Grade 7 - ≤ 24	≥ 24	

(N.B. half marks are rounded up)

2001 Credit Paper

1. a. 1 500 m/s (1)
 ii. Answer to include a halving (of either distance or time after/before calculation) [1]
 $d = vt = 1\,500 \times 0.1 = 150\text{ m}$ [½,½,1]
 iii. $\lambda = \frac{v}{f} = \frac{1500}{30 \times 10^3} = 0.05\text{ m}$ [½,½,1]
 b. Diagram should have same frequency/wavelength, smaller amplitude, inversion not required (1, 1)
 c. The time interval will be the same, the speed of the wave does not depend on its frequency. (1, 1)

2. a. $I = \frac{P}{V} = \frac{75 \times 10^{-3}}{3} = 25\text{ mA}$ [½,½,1]
 b. 100 mA (1)

3. a. Ammeter is in series and reads 100 mA, voltmeter is in parallel and reads 2.5 V (1, 1)

- b. i. $V_R = V_S - V_L = 12 - 2.5 = 9.5\text{ V}$ (1)
 ii. $R = \frac{V}{I} = \frac{9.5}{0.1} = 95\ \Omega$ (½,½,1)

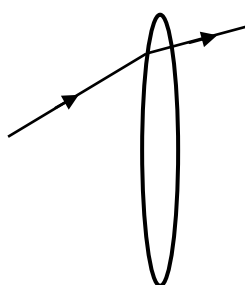
4. a. 1 – reverse magnetic field [1]
 2 – reverse direction of current [1]

- b. i. LHS – field coil
 RHS – commutator (1, 1)
 ii. A – gives smoother rotation, greater turning force
 B – lighter, stronger magnetic field, less fragile (1, 1)

- 5 a.i. Long sight means that you can see clearly distant objects but cannot see clearly close up objects. [1]

- ii. $f = \frac{1}{P} = \frac{1}{2.5} = 0.4\text{ m}$ [½,½,1]

b.



(1)

6. a. Time taken for the activity of a source to drop to half of its original value. [1, 1]
 b. i. becquerel [1]
 ii. Every time a radioactive particle hits the counter it causes a small current to be produced which is counted by a scalar timer. [1, 1]
 iii. killing germs, killing cancerous cells, fogging photographic film etc. [1]

7. a. i. $\frac{R_T}{R_R} = \frac{V_T}{V_R}$ so $\frac{R_T}{4300} = \frac{0.7}{4.3}$
 $R_T = \frac{0.7 \times 4300}{4.3} = 700\ \Omega$ (½,½,1)

- ii. A – 80 °C (1)
 B – The temperature will be less, because the resistance of the thermistor will have to be greater to get to the 0.7 V switch on voltage. (1, 1)

- b. i. transistor [1]
 ii. As the temperature falls the resistance of the thermistor increases. (½) This means the voltage across the thermistor increases. (½) If gets to more than 0.7 V (½) the transistor switches on. (½) Current will flow through the relay coil closing the relay switch. (½) This completes the circuit and switches on the heater. (½).

- 8.a.i. $\text{Gain} = \frac{P_{out}}{P_{in}} = \frac{64}{16 \times 10^{-3}} = 4\,000$ [½,½,1]

- ii. $V^2 = PR = 64 \times 9 = 576$
 $V = \sqrt{576} = 18\text{ V}$ (½,½,1)

- b. $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{9} + \frac{1}{9} = \frac{2}{9}$
 $R_p = \frac{9}{2} = 4.5\ \Omega$ [½,½,1]

- c. 256 Hz (same as input) [1]

9. a.i. $v = \frac{d}{t} = \frac{320}{21} = 15.2\text{ m/s}$ [½,½,1, 1 s.f.]

- ii. The cyclist will speed up and slow down during the journey, the inst speed shows only the speed at that time. (1, 1)

- b. i. $E_K = \frac{1}{2} mv^2 = \frac{1}{2} \times 80 \times 14.4^2 = 8\,410\text{ J}$ (½,½,1)

- ii. $F = \frac{W}{d} = \frac{8410}{50} = 168\text{ N}$ [½,½,1]

10. a.i. $a = \frac{v-u}{t} = \frac{15-0}{10} = 1.5 \text{ m/s}^2$ [$\frac{1}{2}, \frac{1}{2}, 1$]

ii. $F = ma = 268\,000 \times 1.5$
 $= 402\,000 \text{ N}$ [$\frac{1}{2}, \frac{1}{2}, 1$]

iii. Unbalanced force is greater during 10 – 40 s, the graph is steeper there. (1, 1)

iv. length of runway = distance travelled
 $= \text{area under graph}$ [$\frac{1}{2}$]
 $= \frac{1}{2}bh + lb + \frac{1}{2}bh$ [$\frac{1}{2}$]
 $= \frac{1}{2} \times 10 \times 15 + 30 \times 15 + \frac{1}{2} \times 30 \times 65$ [$\frac{1}{2}$]
 $= 75 + 450 + 975$ [$\frac{1}{2}$]
 $= 1\,500 \text{ m}$ [1]

b. i. The engine thrust is **greater than** the air friction force. (1)

ii. The lift is **equal to** the weight (1)

11. a.i. Fossil fuel - Non radioactive waste.
 (1)

Nuclear - Only 5 kg of waste OR more energy per kg. (1)

ii. Must be near a source of water, as both need 550 kg per second for cooling. (1, 1)

b. i. nuclear $\rightarrow$ heat [1]

ii. kinetic $\rightarrow$ electrical [1]

c. i. neutron, neutrons, heat [1, 1, 1]

ii. The two produced neutrons can hit other nuclei causing fission. This in turn produces other neutrons and so on.
 [1, 1, 1]

12. a. $E_H = mL = 12 \times 10^{-3} \times 3.34 \times 10^5$
 $= 4\,008 \text{ J}$ [$\frac{1}{2}, \frac{1}{2}, 1, 1$ for correct L]

b. From the water. (1)

c. i. $E_H = cm \Delta T = 4180 \times 0.2 (18-15)$
 $= 2\,508 \text{ J}$ [$\frac{1}{2}, \frac{1}{2}, 1, 1$ for correct c]

ii. 4.8 °C, if all energy comes from water not surroundings. [1, 1]

13. a. Our atmosphere absorbs X-rays (1)

b. gamma, X-ray, visible, radio (4 x 1)

c. There are many different signals coming from space so many different type of detector are needed. [1, 1]

d. Fire Q for a set length of time (causing an acceleration) ($\frac{1}{2}$) switch it off (travels at constant speed) ($\frac{1}{2}$) fire P for the same length of time as Q (causing a deceleration) ($\frac{1}{2}$) it will then be stopped ahead of the shuttle ($\frac{1}{2}$)

Total marks

KU [50]
 PS (50)

KU

PS

Grade 1 - ≥ 35 ≥ 35

Grade 2 - ≥ 25 ≥ 25

Grade 7 - ≤ 24 ≥ 24

(N.B. half marks are rounded up)