1990 Credit Paper

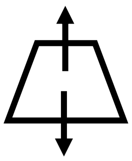
1. a. $f = \frac{1}{P} = \frac{1}{1.5} = 0.667$ m [½,½,1]

   b. Long sighted [1]

   c. Use an image from far away, e.g. a window at the other side of the room, use the lens to form an in focus image on a piece of paper on the opposite side of the lens from the window. Measure the distance between the lens and the paper in metres, this will be the focal length of the lens. [3]

2. a. w = mg = 25 000 x 4 = 100 000 N
   = 1 x10^5 N = 100 kN (½,½,1)

   b. i.



   (1)

   ii. $a = \frac{F_u}{m} = \frac{160000 - 100000}{25000}$

   $= \frac{60000}{25000} = 2.4$ m/s^2 [½,½,1]

   [1 for F_u]

   c. The weight on Earth would be much greater, so the thrust would not be greater than it, so not able to take off. (1)

3. a. P – reflector, Q – condenser, R – slide, S – objective lens [4x½]

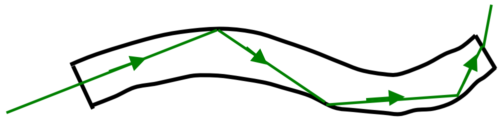
   b. P – reflector – to reflect any light heading away form the slide back towards it
   Q – condenser – to provide an even level of illumination on the slide
   S – objective lens – to focus the image on a screen [3x1]

4. a. i. laser [1]
   ii. photodiode [1]
   iii. electrical [1]

   b. much better sound quality (digital not analogue), longer recording time [2]

5. While the circuit is complete a current flows activating the electromagnet. This means that the bell circuit has a break in it between the metal contacts so the bell does not ring. If either the door or window contacts are broken the electromagnet switches off, the spring pulls the metal contacts closed and the bell will begin to ring. (3)

6. a.



   [1 – st. lines, 1 – incidence = reflection]

   b. i. Y shines light down onto the tumour. X carries the light reflected off the tumour back up to the doctor’s eye. The light bounces off the sides of the fibre by total internal reflection. [3]

   ii. The surgeon would use the endoscope to line up the end of the fibre with the tumour. He would then replace the light source with a laser and fire it at the tumour. The bigger the tumour the longer the laser would be used (2)

7. a. Switches W, X, Y, Z (3)

   b. i. $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{96} + \frac{1}{96} = \frac{2}{96}$

   $R_P = \frac{96}{2} = 48\ \Omega$ (½,½,1)

   ii. $P = \frac{V^2}{R} = \frac{240^2}{48} = 1\,200$ W (½,½,1)

8. a. i. To cut out background radiation (1)

   ii. 90 hours, because the count rates 90 hours apart are all about half of the earlier one (1)

   b. i. Ionisation is the addition or removal of electrons from the outer parts on an atom. [2]

   ii. alpha radiation [1]

   iii. alpha is the most ionising of all the radiations, it cannot penetrate the skin so is mostly harmless, but if an alpha emitting gas is breathed into the body it can cause damage to the soft tissue of the lungs. (2)

   c. Radon - 222 (1)

9. a. i. $\lambda = \dfrac{v}{f} = \dfrac{3x10^8}{480x10^6}$ = 0.625 m [½,½,1]

ii. $t = \dfrac{dist}{speed} = \dfrac{88x10^3}{3x10^8}$ = 0.000 293 s

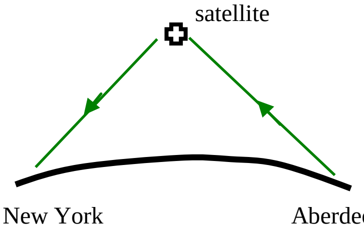
= $2.93x10^{-4}$ s [½,½,1]

iii. It is high frequency, so has a short wavelength, this means it would not diffract well round the curvature of the Earth AND the power of the transmitter in Aberdeen would not be powerful enough to reach New York. (1,1)

b. i. 3 hours (1)

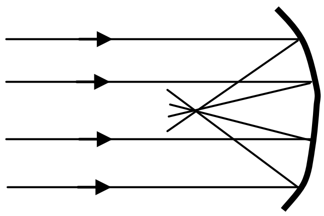
ii. 65 600 km (1)

iii.



[2]

iv.



Collects more signal, focuses it onto the aerial to make it stronger [2]

10. $V_{LDR} = \dfrac{R_{LDR}}{R_{total}} x V_S = \dfrac{1000}{50000} x5$

= 0.1 V [½,½,1]

b. When lights are on light level is high, so resistance is low, so voltage across LDR is low. The input to the NOT gate will be LOW (1)

c i. The resistance increases [1]

ii. It will be HIGH (1)

iii. It will be LOW (1)

d. $V_R = V_S - V_{LED}$

= 5 – 1.7 = 3.3 V (1)

$I = \dfrac{V_R}{R} = \dfrac{3.3}{330}$ = 0.01 A

= 10 mA (½,½,1)

11. a. The sand gets lighter so the acceleration will increase as the mass decreases [1,1]

b. i. It is an inverse relationship, and the results show that as v gats bigger so does R. (1)

ii. C – refrigerator = kv^2 because

$\dfrac{200}{5^2} = \dfrac{800}{10^2} = \dfrac{1800}{15^2} = \dfrac{3200}{20^2} = \dfrac{5000}{25^2} = 8$ (3)

c. $F_U = F_{engine} - F_{resistance}$

= 4 640 – 4 400 = 240 N (1,1)

$a = \dfrac{F_U}{m} = \dfrac{240}{1240}$ = 0.194 ms^{-2} (½,½,1)

12. a. E_{out} = 65% of E_{in}

= 0.65 x 1 500 = 975 therms [½,½,1]

b. $E_{in} = \dfrac{E_{out}}{Eff.} = \dfrac{975}{80/100}$

= 1 218.75 therms [½,½,1]

c. Difference = 1 500 – 1 218.75

= 281.25 therms (1)

Saving = 281.25 x 0.4 = £112.50 (1)

d. $time = \dfrac{\cos t}{saving.per.year} = \dfrac{£270.00}{£112.50}$

= 2.4 years

= 2 years 146 days (½,½,1)

e. The water passes through the steam twice so has a greater chance to heat up. (2)

13. a.i. A – It charges up so voltage increases [1]

B - It switches on when the input to the transistor is greater than 0.7 V [2]

C – The relay switch will open (1)

ii. The capacitor discharges, which reduces the voltage across it so the transistor switches off and the relay switch will close switching the light on (3)

b. They should change only one variable at a time and note it's effect on the time (2)

Total marks KU [47]
PS (51)

	KU	PS
Grade 1 - ≥	33	36
Grade 2 - ≥	24	26
Grade 7 - ≤	23	25

(N.B. half marks are rounded up)

1991 Credit Paper

1. a. Weight per unit kilogram OR rate at which a body accelerates downwards [1]

b.

Situation	*Gravitational Field Strength*	*Mass*	*Weight*
On the Earth	10 N/kg	80 kg	800 N
At a point in the journey	Negligible	80 kg	0 N
On the Moon	1.6 N/kg	80 kg	128 N

(3)

2. 4.3 years = 4 years + 109.5½ days
15th May 1991 + 4 years = 15th May 1995
15th May 1995 + 31 days = 15th June 1995
15th June 1995 + 30 days = 15th July 1995
15th July 1995 + 31 days = 15th August 1995
15th Aug. 1995 + 18½ days
= Early September 1995 (2)

3. a. i. Live (brown), Neutral (blue) [2]

ii. Live wire is where electricity enters the appliance, putting switch in there ensures that the appliance is not electrically live when the switch is off. [2]

b. i. Earth [1]

ii. If a fault develops the earth wire provides a path for the large current to pass to Earth, blowing the fuse and cutting off the supply. [2]

iii. $I = \frac{V}{R} = \frac{240}{48} = 5\text{ A}$ [½,½,1]

4. a. i. Sound with a frequency above the limit of human hearing OR sound with a frequency greater than 20 000 Hz [1]

ii. $\lambda = \frac{v}{f} = \frac{1600}{8x10^6} = 0.000\ 2\text{ m}$

[½,½,1][1 for 1 600 from Data sheet]

iii. The higher the frequency the shorter the wavelength, so the better the resolution [1]

b. Scanning unborn babies OR treatment of joint injuries [1]

c. X-rays can cause damage to babies, ultrasound does not. [1]

5. a. speed of sound is much less than the speed of light (1)

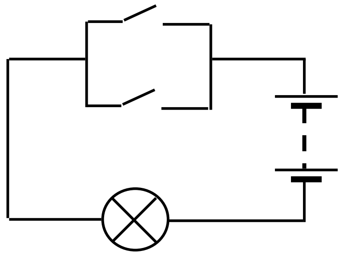
b. $t = \frac{dist}{speed} = \frac{150}{340} = 0.44\text{ s}$ (½,½,1)

$d = vt = 3x10^8 \text{ x } 0.44 = 1.32x10^8\text{ m}$
$= 132\ 000\text{ km}$ (½,½,1)

c. i. MW has the longer wavelength (1)

ii. MW diffracts over/round hills much better so it would get into valleys that FM would not [2]

6. a.i.



[1]

ii. Either or both of the switches would complete the circuit, so the light comes on if either of both doors are open. (2)

b. i. A – S_1 only – sidelights only (1)
B – S_1 & S_2 – sidelights & headlights (1)

ii. I = 2 x 0.5 = 1 A [1]

iii. $I = \frac{P}{V} = \frac{48}{12} = 4\text{ A}$ [½,½,1]

7. a. NOT gate (invertor) [1]

b. i. thermistor or thermocouple [1]

ii. relay [1]

c.

	P	Q	R	S	*Motor*	*Heater*
Case 1	0	0	0	1	OFF	OFF
Case 2	1	0	1	1	OFF	ON
Case 3	1	1	1	0	ON	OFF

(4)

8. a. avge speed = $\dfrac{dist.from.X.to.Y}{time.on.stopclock}$ [2]

b. i. instantaneous speed – (1)

ii. first light gate starts timer, second light gate stops timer, then use avge speed $= \dfrac{dist.between.gates}{time.on.timer}$ (3)

c. i. $E_P = mgh = 0.07 \times 10 \times 0.6$
$= 0.42$ J [½,½,1]

ii. $E_P = E_K$ (1)

$E_K = ½mv^2$ so $v = \sqrt{2E_K/m}$

$v = \sqrt{2 \times 0.42/0.07} = \sqrt{0.84/0.07}$

$= \sqrt{12} = 3.46$ m/s (1)

iii. No energy is lost to friction (1)

9. a. $E_H = cm\Delta T = 4\,200 \times 300\,000 \times 4$
$= 5.04 \times 10^9$ J = 5.04 GJ
[½,½,1][1 for 4 200 from data sheet]

b. $t = \dfrac{E}{P} = \dfrac{5.04 x 10^9}{50 x 10^3}$
= 100 800 s = 28 hours
[½,½,1][1 for answer in hours]

c. Heat energy is lost to the surroundings during the heating period (1)

d. i. $kWh = P_{kW} x t_{hours} = 50 \times 32$
= 1 600 kWh (1,1)

ii. Cost = units x unit cost
= 1 600 x 0.06 = £96.00 (1,1)

e. It reduces the heat loss to the surroundings, so lowers the running costs (1)

10. a.i. P – treble
Q – bass
R – mid range (3)

Not in course any more

ii. It would be very bassey, very thumpy, much more lower frequencies [1]

b. input power = $\dfrac{P_{out}}{power.gain} = \dfrac{18}{45000} =$

4×10^{-4} W = 0.4 mW [½,½,1]

c. i. 2 000 Hz, 45 dB (1,1)

ii. Misses out the fundamentals at 100 Hz, 5 000 Hz, 5 500 Hz, and 6 000 Hz (2)

Not in course any more

11. a. $E_K = ½mv^2 = ½ \times 68\,500 \times 93^2$
$= 2.96 \times 10^8$ J = 296 MJ [½,½,1]

b. Work done by friction is equal to the kinetic energy of the shuttle

$F = \dfrac{W}{d} = \dfrac{2.96 x 10^8}{2000}$

148 000 N (½,½,1)

c. I is dissipated as heat energy due to the air friction [2]

d. Very low thermal conductivity so that even if the outside of the shuttle is very hot the middle does not heat up. (1)
Very high specific heat capacity so that large amounts of heat energy are required to heat up the times by a small amount (1)

Total marks	KU	[42]
	PS	(46)

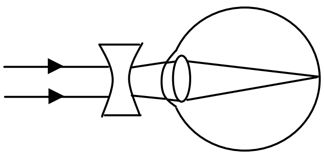
	KU	PS
Grade 1 - ≥	29	32
Grade 2 - ≥	21	23
Grade 7 - ≤	20	22

(N.B. half marks are rounded up)

1992 Credit Paper

1. a. $\lambda = \frac{v}{f} = \frac{1500}{5x10^6} = 0.000\ 25$ m
   = 0.25 mm [½,½,1]
   b. Less likely to cause harm to the unborn baby (1)

2.



(1 – concave lens, 1 – refraction, 1 – focus at retina)

3. a. i. Y is Ultra Violet [1]
   ii. Z is microwave OR radar [1]
   b. γ - radiation : film OR GM tube OR scintillation counter [1]
   X- rays : film [1]
   Ultra Violet : film OR skin [1]
   Visible : film OR eye [1]
   Infra Red : film OR skin OR suitable photodiode [1]
   Microwaves : suitable microwave diode [1]
   Radio/TV : Radio/TV receiver[1]
   c. Same as speed of light [1]

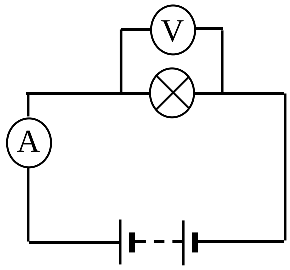
4. a. Jones will record the shorter time, because the runners will have started before the sound has reached him. (2)
   b. $t_{sound} = \frac{dist}{speed} = \frac{100}{340}$
   = 0.294 s (½,½,1)
   Smith’s time will be 11.3 + 0.294
   = 11.6 s (1)

5. a. $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{7} + \frac{1}{28}$
   $= = \frac{4}{28} + \frac{1}{28} = \frac{5}{28}$
   $R_P = \frac{28}{5} = 5.6\ \Omega$ [½,½,1]
   b. 7 Ω filament is brake light, $\frac{V^2}{R}$ means it would be more powerful
   (1,1)

6. a. E = Pt = 50x(5x60) = 50 x 300
   = 15 000 J (1)
   $L = \frac{E}{m} = \frac{15000}{0.05}$
   = 3 x 10^5 J/kg (½,½,1)
   b. some ice will have melted due to the temperature of the room (1)
   c. insulate the beaker to stop heat energy from the room melting ice OR run a control experiment with heater switched off (1)

7. a. 1089 kHz has the longer wavelength [1]
   b. TV has a shorter wavelength than radio, shorter wavelengths do not diffract round/over hills as well, so reception is poorer [1,1]
   c. The signal for the video is already there it does not rely on transmission by waves over the hills (1)

8. a.



[1]

   b. i. P = VI = 2.5 x 320 x 10^{-3} = 0.8 W
   (½ each for values from graph) (½,½,1)
   ii. 2.1 V at 6 hours (1)
   iii. $R = \frac{V}{I} = \frac{2.1}{0.2} = 10.5\ \Omega$ (½,½,1)
   c. i. C – move at steady speedy – 4 hours at 200 mA, Z – 6 hours, so 2 extra hours (1)
   ii. Calculate minutes per penny
   for Y = $\frac{240}{80}$ = 3 mins per penny for Z = $\frac{360}{96}$ = 3.75 mins per penny
   Z is better value for money (2)

9. a. 1 hour = 3 half lives [1]
2 000 $\rightarrow$ 1 000 $\rightarrow$ 500 $\rightarrow$ 250 Bq [1]

i. 

ii. measure the count rate at different times, plot a graph of count rate against time and see how long it takes for the count rate to half [4]

c. 3 mm Aluminium & 1 mm Lead (2)

10. a.i. NOT gate (1)

INPUT (A)	OUTPUT (B)
0	1
1	0

(1)

ii. AND gate (1)

INPUT (A)	INPUT (B)	OUTPUT (Z)
0	0	1
0	1	0
1	0	0
1	1	1

(1)

b. i. L is HIGH, M is HIGH (1,1)
ii. N is HIGH (1)
iii. Solenoid (1)
c. Remove the NOT gate going from detector 5 (1,1)

11. a. 0.7 s (from graph) (1)
b. i. steady deceleration [1]
ii. constant speed [1]
c. distance AB = vt
= 30 x 0.7 = 21 m (1)
distance BC = area under graph
= lb + ½bh
= 2x20 + ½x2x10
= 40 + 10 = 50 m (1)
Yes he was slowed down after 71 m (1)

d. a = $\frac{v-u}{t} = \frac{20-30}{2}$
$= \frac{-10}{2}$ = - 5 m/s^2 [½,½,1]

e. F = ma = 1 000 x 5
= 5 000 N = 5 kN [½,½,1]

12. a. E_P = mgh = 17.5 x 10 x 100
= 17 500 J every second [½,½,1]

b. Eff. = $\frac{P_{out}}{P_{in}} x100 = \frac{7x10^3}{1.75x10^4} x100$
= 40 % [½,½,1]

c. They take up a lot of land OR are expensive to build OR not attractive to look at OR less effective in Summer [1]

d. Does not pollute the atmosphere OR does not use up fossil fuels [1]

13. a.i. There is a constant gravitational attraction between the satellite and the Earth [1]
ii. The combination of constant horizontal speed and the constant falling results in a circular path [1]
b. Once its position is known it can be destroyed, so it only has a short life time in orbit. Navigation satellites have a much longer life as being in a known position is part of their purpose (3)
c. i. P_{in} = ½mv^2 = ½x80x4 000^2
= 6.4 x 10^8 J = 640 MJ [½,½,1]

ii. $\Delta T = \frac{E_H}{cm} = \frac{6.4x10^8}{320x80} = \frac{6.4x10^8}{25600}$
= 25 000 °C [½,½,1]

iii. Some of the satellite would melt, energy would be used up in the form of specific latent heat of vaporisation (1)

14. a. As magnet moves inside coil a voltage is induced. The quicker the movement, the greater the induced voltage. One side of the grove produces a voltage in one coil and vice versa (3)
b. The frequency will be greater (1)
c. voltage gain = $\frac{V_{out}}{V_{in}} = \frac{12}{0.2x10^{-3}}$
= 60 000 (½,½,1)

d. i. $P_{in} = \frac{P_{out}}{gain} = \frac{100}{400}$ = 0.25 W [½,½,1]

ii. $R = \frac{V^2}{P} = \frac{12^2}{0.25}$ = 576 Ω (½,½,1)

Total marks KU [42]
PS (46)

	KU	PS
Grade 1 - ≥	29	32
Grade 2 - ≥	21	23
Grade 7 - ≤	20	22

(N.B. half marks are rounded up)

1993 Credit Paper

1. a. They have a short wavelength and do not diffract well (1)
   b. Transmitter in New York sends signal to satellite, satellite receives it amplifies it retransmits it down to receiver in London [1,1]
   c. $\lambda = \frac{v}{f} = \frac{3x10^8}{625x10^6} = 0.48$ m [½,½,1]

2. $f = \frac{1}{P} = \frac{1}{0.4} = 2.5$ D (½,½,1)

3. a. 400 N (balanced at const speed) [1]
   b. F_U = 2 000 – 400 = 1 600 N [1]
   $a = \frac{F_U}{m} = \frac{1600}{1200} = 1.33$ m/s^2 [½,½,1]

4. a. X – line, Y – neutral, Z – earth (1,1)
   b. It shows that the toaster is connected to the mains, and that the fuse is not blown (1)

5. a. neutron, uranium nucleus, fission fragments, neutrons [1]
   b. The three neutrons could all collide with other nuclei, causing them to become unstable, and fission would occur. If two of them could be absorbed in the reactor using control rods then the reaction will be a self sustaining chain reaction. [3]

6. a. V^2 = PR= 0.02 x 18 = 0.36
   $V = \sqrt{0.36} = 0.6$ V (½,½,1)
   b. $V_{in} = \frac{V_{out}}{gain} = \frac{0.6}{20} = 0.03$ V (½,½,1)

7. a. 1. Gives coverage over a greater range of wavelengths (1)
   2. Some are water soluble (1)
   b. R (1)
   c. Some are UVA screens and some are UVB (1)
   d. Helps the body rouduce vitamin D OR stops rickets OR reduces acne [1]

8. a.

X	Y	P	Q	R	S
0	0	1	1	1	0
0	1	1	0	0	1
1	0	0	1	0	1
1	1	0	0	0	1

(2)

   b. OR gate [1]
   c. Circuit A because when the switch is open all the voltage is across the switch so the output at Y will be HIGH (2)

9. a. i. 230 V [1]
   ii. Each bulb needs only 12 V, so connecting them is series supplies this (12 x 20 = 240 V) (1)
   iii. $I = \frac{P}{V} = \frac{6}{12} = 0.5$ A [½,½,1]
   iv. Q = It = 0.5 x 20 = 10 C [½,½,1]
   .v. $R = \frac{V}{I} = \frac{12}{0.5} = 24\ \Omega$ [½,½,1]
   b. i. $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{45} + \frac{1}{30}$
   $= \frac{2}{90} + \frac{3}{90} = \frac{5}{90}$
   $R_P = \frac{90}{5} = 18\ \Omega$ [½,½,1]
   ii. If the filament blows the lights will still work because there will not be a break in the circuit. (2)

10. a. Ionisation is the removal or addition of electrons from the outer parts of an atom [1,1]
   ii. Any two from α, β, γ [1,1]
   b. i. The darker the film the more radiation she has received because X-rays make photographic film which has not been exposed to the light become exposed. [1,1]
   ii. To keep within prescribed limits OR to protect her health [1]
   iii. Chemicals might be α emitters which have a very short range in air. A detector on the finger would give a much more accurate record of the radiation received (2)
   c. It gives a 3D computerised image rather than a 2D photographic one. [1]

11. a.i. AND gate [1]
ii. When light if on the sensor the output is 0, and 1 is needed to make counter register (1,1)
iii. 5 (1 x 4 + 1 x 1) [1]
b. i. 8 x 0.01 = 0.08 s [1]
ii. length of the car [1]
iii. speed = $\frac{length.of.car}{time}$ [1]
c. i. The frequency would be less [1]
ii. It would be less accurate as the on/off time would be longer (1)

12. a. E_E = VIt = 60x6.25x20
= 7 500 J (1,1,1)
b. E_P = mgh = 150x10x4.15
= 6 225 J (½,½,1)
c. Eff. = $\frac{E_{out}}{E_{in}} x100$
= $\frac{6225}{7500} x100$ = 83 % [½,½,1]
d. Energy will be wasted as heat or sound. (1)

13. a.i. E_H = cmΔT = 4 180x0.3x(24-15)
= 4 180x0.3x9 = 11 286 J
[1-temp change] [½,½,1]
ii. Any two from use metal tuning instead of plastic OR reduce the rate of water flow OR paint tubing black OR use thinner tubing OR use longer tubing OR use more powerful lamp (2x1)
b. i. 900 kWh (from graph) (1)
ii. area = $\frac{3000}{900}$ = 3.33 m^2 (½,½,1)
iii. No it would not, it would not be 100% efficient so a larger area would be required (1)

14. a.i. 4.5 N/kg (1)
ii. w = mg =80 x 4.5 = 360 N [½,½,1]
iii. 80 kg [1]
b. i. distance = area under the graph
= ½bh + lb
= ½x80x3200 + 100x100
= 128 000 + 10 000
= 138 000 m
= 138 km [½,½,1]
ii. a = $\frac{v-u}{t} = \frac{3300-100}{80}$
= $\frac{3200}{80}$ = 40 m/s^2 [½,½,1]
c. He is experiencing the unbalanced force caused by Newton’s Second Law, i.e. F = ma, he is decelerating so he feels as though he is being pushed into his seat. (1,1)
d. If energy is used up melting the shield, less will be used to raise the temperature of the capsule. E_H = mL instead of E_H = cmΔT (1,1)

Total marks	KU	[50]
	PS	(41)

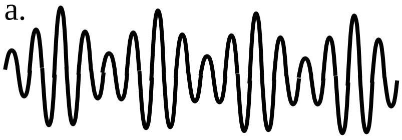
	KU	PS
Grade 1 - ≥	35	29
Grade 2 - ≥	25	21
Grade 7 - ≤	24	20

(N.B. half marks are rounded up)

1994 Credit Paper

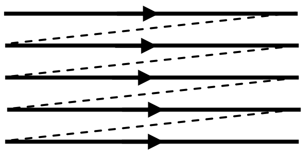
1. a. Nd-YAG (1)
   b. Warms muscles, which can speed up the repair of torn or pulled muscles [1]
   c. $f = \frac{v}{\lambda} = \frac{3x10^8}{6.3x10^{-7}} = 4.76x10^{14}$ Hz
   (1- speed of light, then ½,½,1)
   d. E = Pt = 2.0x0.2 = 0.4 J (½,½,1)
   15 pulses = 15x0.4 = 6 J (1)

2. a.



(2)

   b. $t = \frac{d}{v} = \frac{700x10^3}{2x10^8}$ = 3.5 ms = 0.0035 s
   (1- speed in fibre, then ½,½,1)
   c. build up of picture in series of horizontal lines, fly back in between.



[3]

3. a. $R_S = R_1+R_2+R_3$
   = 18+18+24 = 60 Ω [½,½,1]
   b. $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$
   $= \frac{1}{200} + \frac{1}{150} + \frac{1}{200}$
   $= \frac{3}{600} + \frac{4}{600} + \frac{3}{600} = \frac{10}{600}$
   $R_P = \frac{600}{10}$ = 60 Ω [½,½,1]
   c. $P = \frac{V^2}{R} = \frac{240^2}{60}$ = 960 W [½,½,1]
   d. i. resistance [1]
   ii. check that the measured result does not differ from 60 Ω (1)
   iii. A short circuit would indicate that the element has melted, an open circuit would indicate that the element has blown (1)

4. a. half life is time taken for activity to drop to half its original value, which from the graph is 6 min. (1,1)
   b. it passes through the body easily (1)
   c. Gives a computerised 3D image instead of a photographic 2D image [1]
   d. i. ionisation is when electrons are added or removed from the outer parts of an atom [1,1]
   ii. it is very ionising (1)
   e. sievert (Sv) [1]

5. a.

P	Q	R	S
0	1	1	1
1	1	1	0

(2)

   b. it alternates between 1 and 0, at the same rate as the pulse generator (1,1)
   c. i. LOW (1)
   ii. V_R = IR = 0.02x140 = 2.8 V (½,½,1)
   $V_{LED} = V_S - V_R$ = 5 – 2.8 = 2.2 V (1)

6. a. $L = \frac{E_H}{m} = \frac{3.15x10^5}{0.15}$
   $= 2.1x10^6$ J/kg [½,½,1]
   b. i. some of the mass lost will be due to water splashing out and not due to water boiled off as steam (1)
   ii. Use a container with higher sides (1)

7. a. speed = $\frac{dist}{time}$
   $= \frac{4.5}{0.34}$ = 13.2 m/s (½,½,1)
   b. $a = \frac{v-u}{t} = \frac{20-10}{8}$
   = 1.25 m/s^2 (½,½,1)
   F = ma = 1 100 x 1.25
   = 1 375 N (½,½,1)
   c. 300 N (from graph) (1,1)
   d. It increases the air resistance of the car (1)

8 a. i. $V_R = V_S - V_{thermistor} = 12 - 2 = 10$ V [1]

ii. $I = \frac{V}{R} = \frac{10}{25000} = 4x10^{-4}$ A

$R = \frac{V}{I} = \frac{2}{4x10^{-4}} = 5\ 000\ \Omega$ [½,½,1]

b. 2.8 ^{o}C (1)

c. as temperature decreases, the resistance of the thermistor increases, so does the voltage across the thermistor, if it becomes greater than 0.7 V the transistor switches on and the lamp will light [4x½]

9. a. $E_P = mgh = 50x10x11.25$
$= 5\ 625$ J [½,½,1]

b. $E_K = ½mv^2$ so $v = \sqrt{\frac{2xE_K}{m}}$

$= \sqrt{\frac{2x5625}{50}}$

$= \sqrt{225} = 15$ m/s [½,½,1]

c. i. distance = area under graph
= ½bh + lb + ½bh
= ½x7x3 + 13x3 + ½x13x9
= 10.5 + 39 + 58.5
= 108 m [3]

ii. $F = \frac{W}{d} = \frac{2025}{108} = 18.75$ N [½,½,1]

10. a.i. $I = \frac{P}{V} = \frac{50}{12} = 4.17$ A [½,½,1]

ii. $I_{total} = 6xI_{bulb} = 6 \times 4.17 = 25$ A [1]

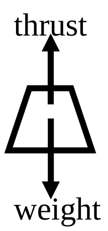
iii. $V_P I_P = V_S I_S$

$I_P = \frac{V_S I_S}{V_P} = \frac{12x25}{240} = 1.25$ A [½,½,1]

b. Energy is lost as heat, noise, vibration, etc. [1]

11. a.i. $w = mg = 2.1x10^6 \times 10$
$= 2.1x10^7$ N [½,½,1]

ii.



(2)

iii. there are no frictional forces to slow it down, so it obeys Newton’s 1st Law. [1]

b. i. it would have to be put in a higher orbit [1]

ii. Total power rec’d = 12 x 1.5 = 16 kW (1)

Eff. = $\frac{P_{OUT}}{P_{IN}} x100$ so

$P_{OUT} = \frac{P_{IN} xEff}{100} = \frac{18000x10}{100}$

= 1 800 W = 1.8 kW (½,½,1)

c. i. $E_H = cm\Delta T$ so

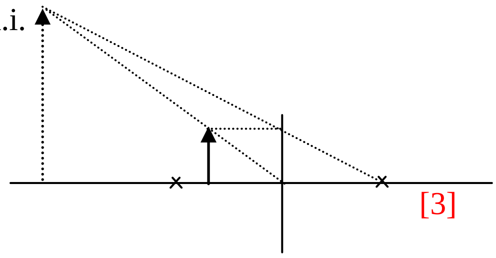
$c = \frac{E_H}{m\Delta T} = \frac{4.7x10^9}{3500x1300}$

$= \frac{4.7x10^9}{4.55x10^6}$

= 1 033 K/kg ^{o}C [½,½,1]

ii. It is made of silica (1)

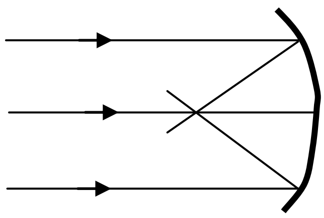
12. a.i.



[3]

ii. bigger objective lens [1]

b. i.



(2)

ii. skin, photographic film [1]

iii. Sodium & Hydrogen (1,1)

Total marks	KU	[48]
	PS	(48)

	KU	PS
Grade 1 - ≥	34	34
Grade 2 - ≥	24	24
Grade 7 - ≤	23	23

(N.B. half marks are rounded up)