



NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2010

PHYSICAL SCIENCES: PAPER I

MARKING GUIDELINES

Time: 3 hours

200 marks

These marking guidelines were used as the basis for the official IEB marking session. They were prepared for use by examiners and sub-examiners, all of whom were required to attend a rigorous standardisation meeting to ensure that the guidelines were consistently and fairly interpreted and applied in the marking of candidates' scripts.

At standardisation meetings, decisions are taken regarding the allocation of marks in the interests of fairness to all candidates in the context of an entirely summative assessment.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines, and different interpretations of the application thereof. Hence, the specific mark allocations have been omitted.

QUESTION 1 APPLYING PHYSICS TO SOCCER

- 1.1 1.1.1 the (launch) **angle** (OR angle to the horizontal at which the ball is kicked). (2)
- 1.1.2 The horizontal displacement increases as the launch angle increases up to ($40^\circ - 50^\circ$) and thereafter it decreases. establish maximum displacement where H occurs (2)
- 1.1.3 **Siya's** results were more precise since they showed the **least variation** between readings for the same angle. (Lowest standard deviation)
Give all candidates 3 due to afrikaans translation. (3)
- 1.1.4 Ruan may have been kicking the ball with a **greater force**. /velocity/ impulse (2)
- 1.1.5 Not a fair test and/or results are not reliable
Or Yes it was fair
Any ONE of the following reasons is worth two marks each (3)
- It is not a fair test (unreliable results) because Ruan and Siya could have kicked the ball with **different amounts of force (launched it at different velocity)**. Even if the same person kicked the ball every time he had no accurate way of keeping the force constant – uncontrolled variable.
 - Tried to control variables.
 - Took repeat readings.
 - Consistent with known values.
 - It is not a fair test (unreliable results) because the **angle was only measured to the nearest $\pm 5^\circ$** . The board only shows 10° , 20° , 30° , 40° , etc. as the angles, e.g. they could not measure 45° .
 - It is not a fair test (unreliable results) as they **may not have kicked the ball through the centre of gravity therefore putting spin on the ball** – uncontrolled variable.
 - It is not a fair test (unreliable results) since the **range would have been affected by how well they followed through their kicks** – uncontrolled variable. (Foot in contact with ball for varying times.)
 - The results are unreliable since they **lack precision** as shown by the **big difference between readings** for the same angle.
(Contradiction = zero)
- If the candidate just says that variables were not controlled without being specific give 1 mark for reason.
- 1.1.6 Design some type of launch apparatus that ensures a constant force is exerted on the ball, e.g. a spring loaded plunger or a 'catapult' that is always pulled back to the same place. Or use a device that measure angle more accurately. (2)
- 1.2 1.2.1 The net (resultant) force can be defined as the **rate of change of momentum**. (2)

1.2.2 $F_{\text{net}} = \frac{\Delta p}{\Delta t}$ or $F_{\text{net}} \Delta t = m \Delta v$ or $v_f = v_i + a \Delta t$ (v = u + at)
 $\Delta t = \frac{(v - u)}{a} = \frac{0,43(-22 - 26)}{0,05}$ (conversion) $a = -960 \text{ m} \cdot \text{s}^{-2}$ Both formulae ✓
 $F_{\text{net}} = -412,8 \text{ N}$
 $F_{\text{net}} = 412,8 \text{ N}$
 $F_{\text{net}} = ma$
 $= 0,43 \times -960$
 $F_{\text{net}} = -412,8 \text{ N}$ (5)

NB *(u – v) gets $\frac{4}{5}$

An answer of 34,4n gets $\frac{3}{5}$

1.3 1.3.1 Time to Ruan

Horizontal component of velocity,

$$v_x = 12 \cos 40 = 9,19 \text{ m} \cdot \text{s}^{-1}$$

$$\Delta x = v_i \Delta t + \frac{1}{2} a \cdot \Delta t^2 \quad (a = 0)$$

$$8,4 = 12 \cos 40 \cdot \Delta t$$

$$\Delta t = 0,914 \text{ s}$$

Vertical component of velocity, $v_y = 12 \sin 40 = 7,71 \text{ m} \cdot \text{s}^{-1}$

$$\Delta y = v_i \Delta t + \frac{1}{2} a \cdot \Delta t^2 \quad (\text{Old formula: } s = ut + \frac{1}{2} at^2)$$

$$\Delta y = 12 \sin 40 (0,914) + \frac{1}{2} (-10)(0,914)^2$$

$$\Delta y = 2,87 \text{ m} \quad (\Delta y = 2,96 \text{ m if use } g = 9,8 \text{ m} \cdot \text{s}^{-2})$$

Ruan is NOT able to save the ball as he can only jump to a maximum height of 2,7 m (8)

If calculations wrong but the horizontal and vertical components have been correctly worked out give 1 mark each (max = 2 marks)

Alternative

To find when ball is at a height of 2,7 m

$$\Delta y = v_i \Delta t + \frac{1}{2} a \cdot \Delta t^2$$

$$(\text{Old formula: } s = ut + \frac{1}{2} at^2)$$

$$2,7 = 12 \sin 40 \Delta t + \frac{1}{2} (-10) \cdot \Delta t^2$$

$$\Delta t = 0,538 \text{ s or } 1 \text{ s}$$

$$(\Delta t = 0,525 \text{ s or } 1,049 \text{ s if use } g = 9,8 \text{ m} \cdot \text{s}^{-2})$$

Range

$$\Delta x = v_i \Delta t \quad (\text{Old formula: } s = ut)$$

$$\Delta x = 12 \cos 40 \times 0,538 \quad \text{OR} \quad \Delta x = 9,19 \times 1$$

$$= 4,94 \text{ m}$$

$$= 9,19 \text{ m} \quad (\Delta x = 4,83 \text{ m or } 9,64 \text{ m if use } g = 9,8 \text{ m} \cdot \text{s}^{-2})$$

Ball rises above 2,7 m when at a distance of 4,94 m to 9,19 m from Siya, therefore when the ball is 8,4 m from Siya it will be at a height of greater than 2,7 m and Ruan will not be able to catch it. (8)

NOTE If they work out the max height reached by the ball (when $v_y = 0 \text{ m} \cdot \text{s}^{-1}$) they will get 2,97 m. They can NOT draw valid conclusions from this as the ball is not at its max height where Ruan is standing.

1.3.2 **Time to Ground**

$$v_f = v_i + a\Delta t \quad (v = u + at)$$

$$0 = 12\sin 40^\circ + (-10)\Delta t$$

$$\Delta t = 0,771 \text{ s to highest point}$$

$$\text{Total time to ground} = 2 \times 0,771 = 1,54 \text{ s}$$

OR

$$\Delta y = v_i\Delta t + \frac{1}{2}a(\Delta t)^2$$

$$(s = ut + \frac{1}{2}at^2)$$

$$0 = 12\sin 40^\circ \Delta t + \frac{1}{2}(-10)\Delta t^2$$

$$\Delta t = 1,54 \text{ s}$$

$$(\Delta t = 1,57 \text{ s if use } g = 9,8 \text{ m}\cdot\text{s}^{-2})$$

Range (horizontal)

$$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2 \quad (a = 0)$$

$$\Delta x = 12\cos 40^\circ \times 1,54$$

$$\Delta x = 14,18 \text{ m}$$

Therefore ball crosses goal line

$$(\Delta x = 14,47 \text{ m if use } g = 9,8 \text{ m}\cdot\text{s}^{-2})$$

(8)

$$\begin{aligned} \text{Or } t &= \frac{v - u}{a} \\ &= \frac{-7,7 - 7,7}{-10} \\ &= 1,545 \end{aligned}$$

1.3.2 **Alternative Time to Goal**

$$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2 \quad (a = 0)$$

$$13,2 = 12\cos 40^\circ \Delta t$$

$$\Delta t = 1,436 \text{ s}$$

$$\text{OR } v_y \text{ at } 1,4636 \text{ s}$$

$$v_f = v_i + a\Delta t$$

$$= 7,7 + (-10) 1,44$$

$$= -6,7 \text{ m}\cdot\text{s}^{-1}$$

 $\therefore$ still accelerating down**Vertical position of ball at 1,436 s?**

$$\Delta y = v_i\Delta t + \frac{1}{2}a(\Delta t)^2 \quad (s = ut + \frac{1}{2}at^2)$$

$$\Delta y = 12\sin 40^\circ (1,436) + \frac{1}{2}(-10)(1,436)^2$$

 $\Delta y = 0,766 \text{ m}$ (i.e. ball is still 0,766 m **above** the ground when it reaches the goal line)**Therefore ball crosses goal line**

$$(\Delta y = 0,972 \text{ m if use } g = 9,8 \text{ m}\cdot\text{s}^{-2})$$

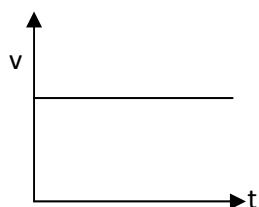
$$\text{OR } t = 1,436 \text{ s}$$

But time to

$$= 1,54 \text{ s } \therefore \text{ still in air}$$

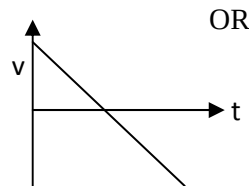
(8)

1.3.3 (a)

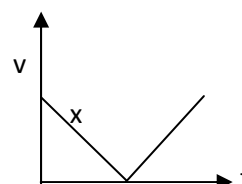
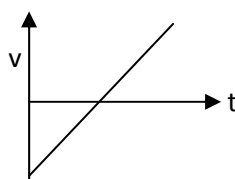


(2)

(b)



OR



(2)

41 marks

QUESTION 2 CONSTRUCTION OF MOSES MABHIDA SOCCER STADIUM

2.1 Power is the rate of doing work or the rate at which energy is expended. (2)

2.2 $E_p = mgh$ or $U_G = mgh$
 $= (6 \times 10^4 \times 10) \times 106$
 $= 6,36 \times 10^7 \text{ J}$

2.3 $P = \frac{W}{t}$
 $= \frac{6,36 \times 10^7}{300} \text{ (conversion)}$
 $= 2,12 \times 10^5 \text{ W}$

Alternative (If use $g = 9,8 \text{ m} \cdot \text{s}^{-2}$)

$E_p = mgh$ (4)

$= (6 \times 10^4 \times 9,8) \times 106$
 $= 6,23 \times 10^7 \text{ J}$

2.3

$P = 2,08 \times 10^5 \text{ W}$ (4)

2.4 2.4.1 $v_f^2 = v_i^2 + 2a\Delta y$ ($v^2 = u^2 + 2as$)
 $v_f^2 = 0^2 + 2(10)106$
 $v_f = 46,04 \text{ m} \cdot \text{s}^{-1}$ (Accept round off to $46 \text{ m} \cdot \text{s}^{-1}$)

NOTE: If $g = 9,8 \text{ m} \cdot \text{s}^{-2}$ then $v_f = 45,58 \text{ m} \cdot \text{s}^{-1}$

OR $E_k \text{ at bottom} = E_p \text{ at top}$
 $\therefore v = \sqrt{2gh}$ (method)
 $= \sqrt{2 \times 10 \times 106}$
 $= 46,04 \text{ m} \cdot \text{s}^{-1}$ (Accept round off to $46 \text{ m} \cdot \text{s}^{-1}$)

Alternative

$E_p = mgh$
 $= 2,5 \times 10 \times 106$
 $= 2650 \text{ J}$
 $E_k = \frac{1}{2}mv^2$
 $2650 = \frac{1}{2} \times 2,5 \times v^2$
 $v = 46,04 \text{ m} \cdot \text{s}^{-1}$

$v = 46,04 \times 3,6 = 165,76 \text{ km} \cdot \text{h}^{-1}$

(Give conversion mark even if final answer is wrong)

(If round off to $46 \text{ m} \cdot \text{s}^{-1}$ then $v = 165,6 \text{ km} \cdot \text{h}^{-1}$)

(5)

2.4.2 The work done by a net (resultant) force on an object is equal to the change in its kinetic energy. (Give all candidates 2 marks as not in SAGS) (2)

2.4.3 $E_k = \frac{1}{2}mv^2$ (at ground level)
 $= \frac{1}{2} \times 2,5 \times 46,04^2 \text{ c.o.e. from 2.4.1}$
 $= 2650 \text{ J}$ (2 645 J if $v = 46 \text{ m} \cdot \text{s}^{-1}$)

OR

$v^2 = u^2 + 2as$
 $0^2 = 46^2 + 2a(0,4)$
 $a = -2645 \text{ m} \cdot \text{s}^{-2}$
 $F_{\text{net}} = ma$
 $= 2,5 \times -2645$
 $= -6,61 \times 10^3 \text{ N}$

OR $\Delta E_k = \Delta E_p = mgh$
 $= 2,5 \times 10 \times 106$
 $= 2650 \text{ J}$ (2 597 J if $g = 9,8 \text{ m} \cdot \text{s}^{-2}$)

$\Delta E_k = W$

$E_{kf} - E_{ki} = F_{\text{net}} \cdot \Delta x$

$0 - 2650 = F_{\text{net}}(0,4) \text{ conversion } (\Delta E_k = E_{kf} - E_{ki} = -2650 \text{ J})$

$F_{\text{net}} = -6625 \text{ N}$ ($-6612,5 \text{ N}$ if $v = 46 \text{ m} \cdot \text{s}^{-1}$) ($-6492,5 \text{ N}$ if $g = 9,8 \text{ m} \cdot \text{s}^{-2}$)

(Ignore sign since question only required **magnitude**)

(6)

OR $5 = \frac{(u + v)t}{2}$ $F_{\text{net}} = \frac{m(v - u)}{\Delta t}$

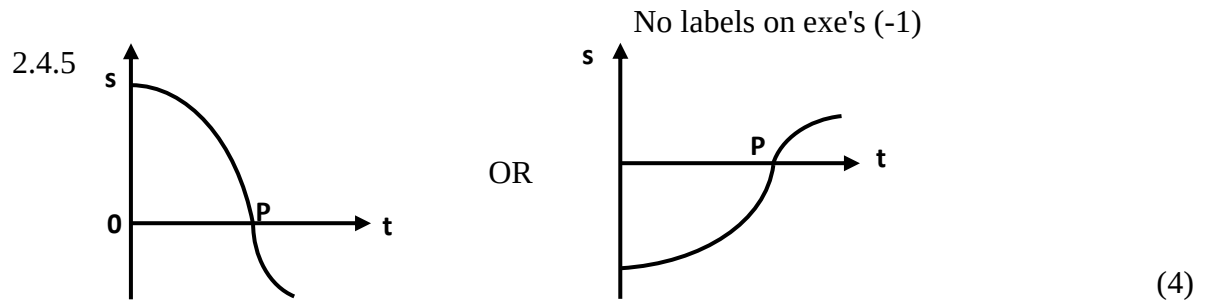
$0,4 = \frac{(46,04)t}{2}$

$= \frac{2,5(0 - 46,4)}{0,0174}$

$t = 0,00174 \text{ s}$

$= -6624 \text{ N}$

2.4.4 $F_{\text{applied}} = F_{\text{net}} + F_{\text{gravity}}$
 $= 6\,625 + 25 \text{ c.o.e. from 2.4.3}$
 $= \mathbf{6\,650\,N}$ (6 637,5N or 6 517,5 N if $g = 9,8\, \text{m}\cdot\text{s}^{-2}$) (2)



2.4.6 Construction sites can be **dangerous** as shown by the fast speed ($165,76\, \text{km}\cdot\text{h}^{-1}$) of the falling bolt which could do serious harm if it hit someone on the head. Or the force needed to bring the bolt to rest is very large (6 650 N). (Justification) High energy (3)

32 marks

QUESTION 3 SOUND PROBLEMS AT SOCCER CITY

3.1 $f_o = \frac{v}{v - v_s} f_s$ (correct formula)

$$820 = \frac{340}{(340 - 16)} \times f_s$$

$$f_s = 781 \text{ Hz} \quad (5)$$

3.2 $v_{js} = 4 + 16 = 20 \text{ m} \cdot \text{s}^{-1}$ **towards Sashen/bus** (2)

3.3 3.3.1 Interference occurs when two waves pass through the (same region of space at the same time) resulting in the superposition of waves. (3)

- Waves meet
- In-phase (consistent) out of phase (dest)
- Change amplitudes/ soft/ loud

3.3.2 $v = f \cdot \lambda$

$$340 = f \times 0,8$$

$$f = 425 \text{ Hz} \quad (3)$$

3.3.3 **Jenny will hear a louder note than Sashen.** If no calculations but well explained $\max = \frac{3}{8}$

Jenny: The path difference for the notes arriving from the 2 speakers is $(24 - 16) = 8 \text{ m}$ which is equal to a whole number of wavelengths ($8 \div 0,8 = 10$ waves) therefore **constructive interference** of waves results in a louder note. (Compression meets compression and rarefaction meets rarefaction – notes arrive at Jenny in phase.)

Sashen: The path difference for the notes arriving from the 2 speakers is $(20 - 18) = 2 \text{ m}$ which is equal to a number of half wavelengths ($2 \div 0,8 = 2,5$ waves) therefore **destructive interference** of waves results in a softer note. Sashen receives waves exactly out of phase – he will not hear anything if both notes are of equal intensity. (Compression meets rarefaction – notes arrive at Sashen out of phase.) (8)

3.4 They will be more likely to pick up the broadcast on **medium** wave (MW) radio. (Diffraction is the ability of a wave to spread out as it passes through a small aperture or around a sharp edge.) The longer the wavelength the greater the diffraction therefore the medium waves are more likely to (spread out) around the mountains as they have a longer wavelength than the short waves. (4)

Give mark for knowing what diffraction is if rest of explanation is wrong.

3.5 3.5.1 The research can be trusted since it was obtained by well qualified people () (professors and a doctor) at a University () who would have access to accurate, relevant, scientific equipment () enabling them to take accurate measurements. () Or cannot be trusted incomplete research not enough information given (3)
Any of the points () worth a mark each. (maximum of 2)

3.5.2 Opinion (e.g. *I think that there should be rules governing the use of vuvuzelas because ...*)

Justification (*Possible points given below ...*) (4)

- Whilst the use of vuvuzelas is all part of the 'fun and atmosphere' for some, it is unethical to cause harm to others around you. (*e.g. some people enjoy smoking but there are rules that ban smoking in public places because smoking can damage the health of others.*)
- Scientific research shows that exposure for more than a couple of minutes can lead to deafness (and tinnitus). A soccer game lasts for over an hour
- Whilst vuvuzela supporters may say it causes no damage, people often don't realise that their hearing has been damaged, e.g. they just keep turning up the TV/radio until it is too late.
- Germs/saliva etc.
- Lots of vuvuzelas increases amplitude (loudness) ∴ more damage.

32 marks

QUESTION 4 CAMERA FLASH

4.1 Capacitance is the charge stored per volt. **OR** Capacitance is the rate of charge stored per unit applied voltage. **OR** Capacitance is the ratio of the charge on one of the plates of a capacitor to the potential difference between the plates. (2)

4.2 $C = \frac{Q}{V}$ ∴ $Q = C.V$
 $\quad \quad \quad = 160 \times 10^{-6} \text{ (conversion)} \times 300$
 $\quad \quad \quad \mathbf{Q = 0,048 \text{ C} \quad (4,8 \times 10^{-2} \text{ C})}$ (4)

4.3 A capacitor **releases its charge (energy) rapidly** so that a **large current** passes through the flashlight for a **very short time** producing a 'flash' of **bright light** (for a very short time period).
Release of charge and/or energy in short time/rapid (2)

4.4 4.4.1 Accept most **metals** (not Group 1) although lead is the only metal that will give complete protection. Accept ivory or bone. *Chemical symbols for suitable metals are acceptable.* (1)

4.4.2 Low intensity means fewer photons per second therefore less possibility of cell damage to humans standing nearby (less exposure to radiation).
 Low intensity means that less x-ray energy is available to be absorbed by people or baggage nearby therefore less exposure to dangerous radiation.
 MUST imply in their answer that '**x-rays are dangerous to humans**', OR 'penetrate human tissues and damage cells' 'therefore exposure must be limited'. (2)

11 marks

QUESTION 5 MOTORS AND GENERATORS5.1 Any **TWO** of the following points

- They both make use of **renewable** fuel sources.
- Wind power produces **no pollutants**.
- Wind power **does not contribute to global warming** as it does not produce CO_2
- Biodiesel may be considered to be '**almost**' **carbon neutral** since the CO_2 produced in burning is absorbed in the growth of bio-crops during photosynthesis.

(2)

5.2 5.2.1 Negative.

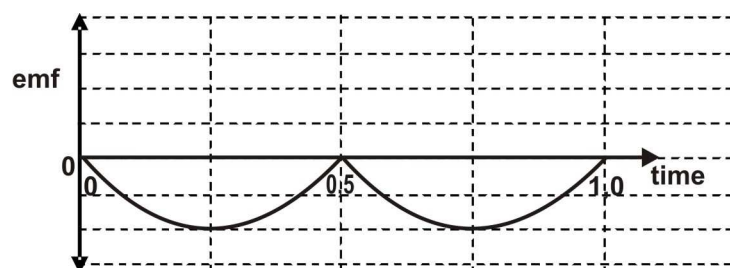
(1)

5.2.2 Any **TWO** of the following

- The surface area of the blades.
- Add gears.
- Change shape of blades.
- Adjust the angle of the blades.
- Increase the number of blades. / Put blades closer
- Use lighter blades (e.g. plastic vs metal)
- Reduce friction of shaft mechanism.
- Increase the force/pressure/speed at which the water flows over the blades. (This is NOT a modification to the turbine, but will be accepted)

(4)

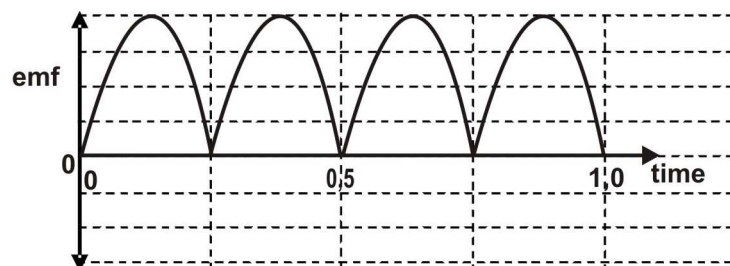
5.2.3 (a)



Opposite direction ✓
Same magnitude ✓

(2)

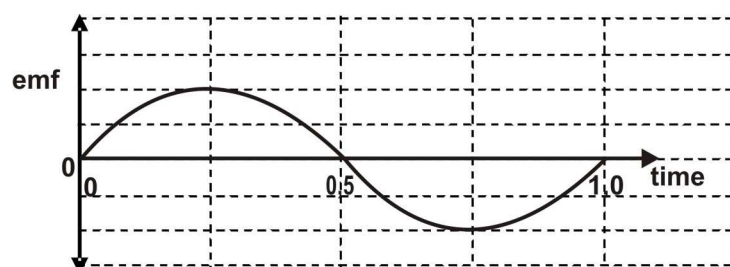
(b)



Double magnitude ✓
Double frequency ✓

(2)

(c)



Magnitude ✓
Direction ✓

(2)

13 marks

QUESTION 6 SOLAR POWERED LED SOCCER FLOODLIGHTS

6.1 **LEDs only require a very low voltage** to operate whereas the halogen floodlights require a high voltage. **OR** LEDs require a much lower voltage. **OR** LEDs require less energy per unit charge. (2)

- 6.2 6.2.1 **ONE environmental advantage** (any ONE of the following)
- Solar powered LED floodlights are not responsible for any CO₂ emissions therefore do not contribute to climate change (global warming) whereas the burning of paraffin lamps and candles produces CO₂ which contributes to climate change.
 - Solar powered LED floodlights are not responsible for any air pollutants whereas paraffin lamps and candles produce soot and other pollutants.
 - Solar power is a renewable energy source whereas paraffin and candles are derived from non-renewable sources.
 - Do not cause fire like paraffin lamp. (2)

6.2.2 **ONE health advantage** (any ONE of the following)
 LEDs do not produce pollutants unlike paraffin lamps and candles which produce fumes and soot which can cause respiratory problems.
 LEDs produce brighter light therefore they are less likely to be responsible for eye problems.
 LEDs cannot cause fires and burn people, unlike paraffin lamps and candles. (2)

6.3 **THREE ways of improving lives of communities**

Possible responses ...

- Upgrade education – provide lighting for evening classes
- Improve safety – less criminal activity in well lit areas
- Evening markets – opportunities for entrepreneurs, convenience of night shopping
- Emergency lighting for disaster situations
- Evening sports events – opportunities to exercise after dark and to interact socially (3 × 2 = 6)

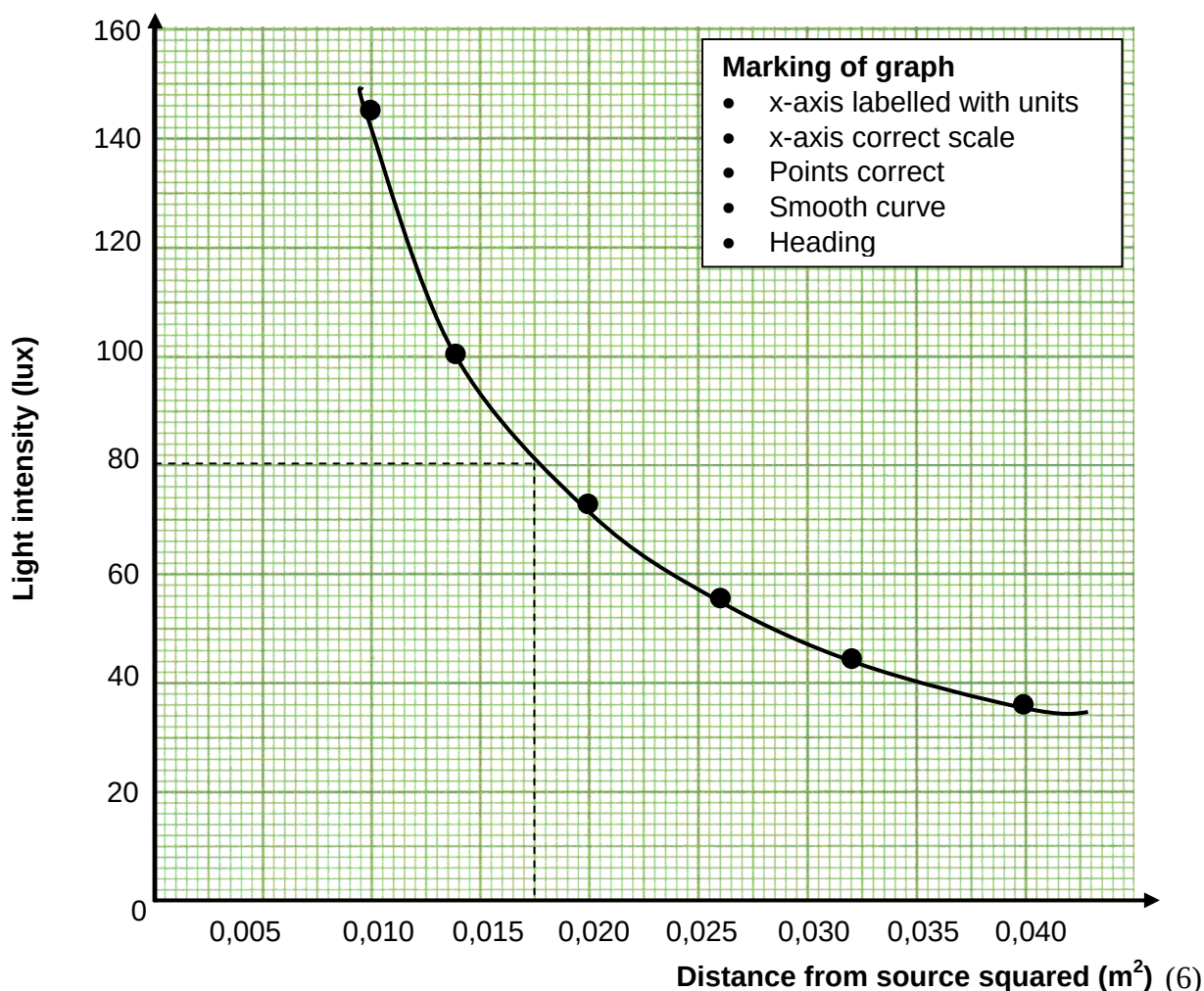
6.4 6.4.1 The greater the distance from the source the lower the light intensity. Or light intensity depends on distance from source. (2)

6.4.2 **Table of results to show the relationship between light intensity and distance from the source**

Distance from source (m)	Light Intensity (lux)	Distance from the source squared (m ²)
0,10	144	0,010
0,12	100	0,014
0,14	74	0,020
0,16	56	0,026
0,18	44	0,032
0,20	36	0,040

All to 3 decimal places (ignore 0,01, 0,02, & 0,045) (3)

6.4.3 **Graph to show how light intensity varies with distance from the light source squared**



6.4.4 distance squared = 0,0175 m² therefore, distance = $\sqrt{0,0175} = 0,132 \text{ m}$ (2)

6.4.5 the inverse of the distance squared **OR** $\frac{1}{\text{distance}^2}$ (2)

6.4.6 pd across resistor = (6 – 4) = 2 V
 Current in resistor = 2 × 0,025 (conversion) = 0,05 A
 $R = \frac{V}{I} = \frac{2}{0,05} = 40 \Omega$ (5)

6.4.7

- Only C will light up
- C is connected in forward bias (low resistance)
- B is connected in reverse bias (high resistance)
- Current takes path of least resistance through C therefore it will not pass through the branch with A and B.

(5)

If they say C and A^x light up then give max of $\frac{3}{5}$

37 marks

QUESTION 7 STREETLIGHTS

7.1 7.1.1 The red ink will appear **red** since it will **absorb the green frequencies** of yellow light and **reflect the red frequencies**. (3)
(If they refer to monochromatic yellow light then mark accordingly)

7.1.2 The cyan ink will appear **green** since it will **absorb the red frequencies** of yellow light and **reflect the green frequencies**. (3)

7.2 **magenta and cyan** (2)

7.3 7.3.1 **(atomic or line) emission** spectrum (2)

7.3.2 No Give all candidates 1 mark (1)

7.3.3 $E = \frac{h \cdot c}{\lambda}$
 $= \frac{6,6 \times 10^{-34} \times 3 \times 10^8}{5,89 \times 10^{-7}}$
 $E = 3,36 \times 10^{-19} \text{ J}$

Alternative

$f = \frac{c}{\lambda}$	$E = h \cdot f$	(both formulae)
$= \frac{3 \times 10^8}{5,89 \times 10^{-7}}$	$= 6,6 \times 10^{-34} \times 5,09 \times 10^{14}$	
$= 5,09 \times 10^{14} \text{ Hz}$	$E = 3,36 \times 10^{-19} \text{ J}$	

(5)

7.3.4 A yellow street lamp will only emit frequencies corresponding to yellow light (includes red to green frequencies) which is a narrow band of the visible spectrum. It will not emit bigger frequencies in the blue and violet end of the spectrum. Therefore any objects that are coloured with pigments in the blue to violet end of the spectrum will **appear black under a sodium lamp** since they will absorb the yellow light emitted by sodium lamps. The addition of mercury ensures that objects that are coloured with pigments in the blue to violet end of the spectrum will reflect these frequencies and will appear to be their true colours.

OR All three primary additive colours (red, blue, green) are now present in the light source which therefore produces (nearly) white light. All colours reflected true. (4)

7.4 7.4.1 The **minimum** amount of energy needed to emit an electron from the surface of a metal is called the **work function** of the metal. (2)

7.4.2 $E = 2,3 \times 1,6 \times 10^{-19} \text{ J}$
 $= 3,68 \times 10^{-19} \text{ J}$ (2)

7.4.3 $E = W_f + \frac{1}{2} m v^2$
 $(6,6 \times 10^{-34} \times 5,09 \times 10^{14}) = 3,68 \times 10^{-19} + (\frac{1}{2} \times 9,1 \times 10^{-31} \times v^2)$ (mass of electron)
 $4,21 \times 10^{-19} = 3,68 \times 10^{-19} + (\frac{1}{2} \times 10^{-31} \times v^2)$
 $v = 3,42 \times 10^5 \text{ m} \cdot \text{s}^{-1}$ (6)

Alternative

$$\begin{aligned}
 E_{\text{light}} &= h \cdot f \\
 &= 6,6 \times 10^{-34} \times 6,38 \times 10^{14} \\
 &= 4,21 \times 10^{-19} \text{ J} \rightarrow \\
 E_k &= E_{\text{light}} - W_f \\
 &= 4,21 \times 10^{-19} - 3,68 \times 10^{-19} \\
 &= 5,3 \times 10^{-20} \text{ J} \\
 E_k &= \frac{1}{2} m v^2 \\
 5,3 \times 10^{-20} &= \frac{1}{2} \times 9,1 \times 10^{-31} \times v^2 \\
 \underline{\underline{v = 3,42 \times 10^5 \text{ m} \cdot \text{s}^{-1} \rightarrow}}
 \end{aligned}$$

(6)

7.5 7.5.1 **B**

(2)

7.5.2 **A**

(2)

34 marks

Total: 200 marks