higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

PHYSICAL SCIENCE
NQF LEVEL 4
(First paper)

28 November 2024

This marking guideline consists of 10 pages.

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SECTION A

QUESTION 1

1.1 Reverse bias✓
1.2 Monochromatic light✓
1.3 Sonic boom✓
1.4 Torque✓
1.5 Mechanical advantage✓

(5 × 1) **[5]**

QUESTION 2

2.1 I✓
2.2 A✓
2.3 J✓
2.4 E✓
2.5 F✓

(5 × 1) **[5]**

QUESTION 3

Marking guidelines: 2 marks for True.
NO MARKS for False.
NO MARKS if the statement is written in the NEGATIVE.
2 marks for CORRECTED statement.

3.1 True✓✓

3.2 True✓✓

3.3 True✓✓

3.4 False✓ SI unit for power✓

3.5 False✓ The horizontal component of acceleration is zero.✓

(5 × 2) **[10]**

QUESTION 4

4.1 C✓✓✓
4.2 D✓✓✓
4.3 B✓✓✓
4.4 A✓✓✓
4.5 C✓✓✓

(5 × 3) **[15]**

TOTAL SECTION A: 35

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SECTION B

QUESTION 5

5.1 5.1.1 340×10^{-9} m✓

5.1.2 $\frac{480}{1 \times 10^{3}}$ **OR** $\frac{480}{1\,000}$

$= 0{,}48$ kg✓

5.1.3 $\frac{240}{1 \text{ min} \times 60 \text{ s}} = 4$ W✓

OR

3J/min = 0.05W
240J/min = X
X=4W ✓

(3 × 1) (3)

5.2 5.2.1 m^3✓
5.2.2 A✓
5.2.3 J✓

(3 × 1) (3)

5.3 5.3.1 High voltage/Risk of electrical shock/Overhead cables✓

5.3.2 Corrosive chemical substances✓

5.3.3 Toxic substances✓

5.3.4 Explosive material/Explosion risk✓

(4 × 1) (4)
[10]

QUESTION 6

6.1 6.1.1 A free fall is the unimpeded motion of an object in the absence of air friction/resistance where only gravitational force influences the object.✓✓

6.1.2 Gravitational acceleration is the constant acceleration of a free-falling object due to gravity.✓✓

(2 × 2) (4)

6.2 6.2.1 $V_r^2 = V_i^2 + 2a\Delta y$✓

$= \sqrt{0^2 + 2 \times 9{,}8 \times 105}$✓✓

$V_f = 45{,}37 \text{ m} \cdot s^{-1}$✓

6.2.2 $t = \frac{V_f - V_i}{g}$✓

$= \frac{45{,}37 - 0}{9{,}8}$✓✓

$= 4{,}63 \text{ s}$✓

(2 × 4) (8)
[12]

QUESTION 7

7.1 The principle of conservation of momentum states that the total linear momentum of an isolated system remains constant in magnitude and direction.✓✓ (2)

7.2 7.2.1 In an elastic collision, both the total linear momentum and total kinetic energy are conserved.✓✓

7.2.2 In an inelastic collision, total linear momentum is conserved but total kinetic energy is not conserved.✓✓

7.2.3 Impulse is the product of the resultant/net force acting on an object and the time the resultant/net force acts on the object.✓✓

7.2.4 Newton's second law states that the rate of change of the momentum of an object is proportional to and in the direction of the applied force.✓✓

(4 × 2) (8)

7.3 Momentum before collision = Momentum after collision

$M_1U_1 + M_2U_2 = M_1V_1 + M_2V_2$

$(1{,}2 \times 2) + (2{,}4 \times 1{,}5) = (1{,}2 \times V_1) + (2{,}4 \times 1{,}75)$✓

$2{,}4 + 3{,}6 = 1{,}2V_1 + 4{,}2$✓

$V_1 = 1{,}5 \text{ m} \cdot s^{-1}$ (towards the right or east)✓✓ (4)
[14]

QUESTION 8

8.1 The law of conservation of energy states that energy cannot be created or destroyed,✓ but one form of energy can be transformed into an equivalent amount of another form of energy.✓ (2)

8.2 Work is done on an object when a force exerted on the object✓ moves it in the direction of the force.✓ (2)

8.3 8.3.1 $W = F_s$
$= 350 \times 850$
$= 297\ 500$ J✓

$P = \frac{W}{t}$

But:

$t = \frac{w}{P}$

$= \frac{297\ 500}{10\ 000}$✓✓

$= 29{,}75$ s✓ (4)

8.3.2 $t \propto \frac{1}{P}$

If P increases then t increases. (2)
[10]

QUESTION 9

9.1 9.1.1 $AMA = \frac{f_r}{f_e}$

$= \frac{400}{120}$✓

$= 3{,}3$✓

9.1.2 VR = number of pulleys in a system = 5✓

9.1.3 $\text{Efficiency} = \frac{AMA}{VR} \times 100$

$= \frac{3{,}3}{5} \times 100$✓

$s = 66\%$✓

9.1.4 $\text{Work output} = \text{F.S}$
$= 400 \times 1$✓
$= 400\ \text{J}$✓

(4 × 2) (8)

9.2 $\frac{\text{Input distance}}{\text{Output distance}}$✓

$= \frac{6}{2}$✓

$= 3$✓ (3)

9.3 $\eta = \frac{Q_{output}}{Q_{input}} \times\ 100\%$

$Q_{output} = \frac{\eta}{100} \times Q_{input}$✓

$= \frac{25}{100} \times 160$✓✓

$=\ 40\ \text{J}$✓ (4)
[15]

QUESTION 10

10.1 Resonance is the transfer of energy between two bodies of the same natural frequency.✓✓ (2)

10.2 Checking for defects in plastics✓✓ (2)

10.3 The Doppler effect is an apparent change in frequency of a wave due to relative motion between the source and the observer.✓✓ (2)

10.4 10.4.1 Diffraction is the spreading of a wave into the space beyond a barrier/obstacle/gap.✓✓

10.4.2 Interference occurs when waves from two sources meet to produce a wave of different amplitude.✓✓

(2 × 2) (4)

10.5
- Longitudinal waves: The direction of the vibrations is parallel to the direction of the propagation of the wave.✓
- Transverse waves: The direction of the vibrations is perpendicular to the direction of the wave.✓ (2)

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10.6
- Same colour (monochromatic)✓
- All the light waves are in phase both spatially and temporally (coherence).✓
- All rays are parallel to each other and do not diverge significantly even over long distances (collimation).✓ (3)

[15]

QUESTION 11

11.1 11.1.1 Threshold frequency is the minimum frequency of light that will eject an electron from the metal surface.✓✓

11.1.2 Work function is the minimum energy a photon must have to eject an electron from a metal surface.✓✓

11.1.3 The photoelectric effect refers to the ejection of electrons from a metal when light above a certain minimum frequency shines on it.✓✓

(3 × 2) (6)

11.2 11.2.1 $E = hf$
$= (6{,}63 \times 10^{-34})(5{,}75 \times 10^{14})$✓
$= 3{,}81 \times 10^{-19}$ J✓ (2)

11.2.2 $E = \frac{hc}{\lambda}$

$= \frac{(6{,}63 \times 10^{-34})(3 \times 10^{8})}{(568 \times 10^{-9})}$✓✓✓

$= 3{,}502 \times 10^{-19}$ J✓ (4)

[12]

QUESTION 12

12.1 $P = \frac{v^2}{R}$✓

$R = \frac{v^2}{P}$

$= \frac{220^2}{90}$✓

$= 537{,}778\ \Omega$✓ (3)

12.2 12.2.1 $P = \frac{v^2}{R}$

$R = \frac{v^2}{P}$

$= \frac{220^2}{20}$ ✓

$= 2\,420\ \Omega$✓

$R_T = 537{,}778 + 2\,420 = 2\,957{,}778\ \Omega$✓ (3)

12.2.2 $I = \frac{v}{R}$

$= \frac{220}{2\,957{,}778}$ ✓✓

$= 0{,}0744\ \text{A}$✓ (3)

12.2.3 Potential difference across the 20 W bulb:

$v = IR$

$= 0{,}0744 \times 2\,420$✓

$= 180\text{V}$✓

Potential difference across the 90 W bulb:

$220 - 180 = 40\ \text{V}$✓✓ (4)

12.3 The light bulbs are in series and carry the same current and $P = \text{I}^2R$✓ i.e. the bulb with the greater resistance produces the greater power.✓ (2)

12.4 They must be connected in parallel.✓✓ The specified potential difference /Voltage will then be across both bulbs.✓✓ (4)

[19]

QUESTION 13

13.1
- Area of the metal plates✓
- Distance separating the plates✓
- Insulator used between the plates✓
- Potential difference between the plates✓ (4)

13.2 13.2.1 NOR✓
13.2.2 AND✓
13.2.3 XOR✓
13.2.4 NOT✓

(4 × 1) (4)
[8]

TOTAL SECTION B: 115
GRAND TOTAL: 150

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