GAUTENG PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

PREPARATORY EXAMINATION

2025

MARKING GUIDELINES

TECHNICAL SCIENCE (PAPER 1) (11101)

10 pages

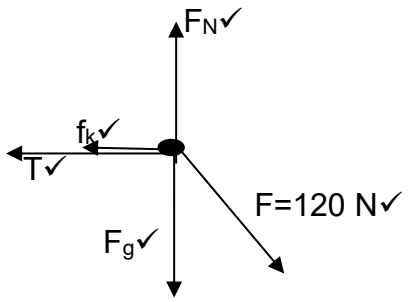
QUESTION 1: MULTIPLE-CHOICE QUESTIONS

1.1	C ✓✓	(2)
1.2	A ✓✓	(2)
1.3	D ✓✓	(2)
1.4	D ✓✓	(2)
1.5	A ✓✓	(2)
1.6	B ✓✓	(2)
1.7	B ✓✓	(2)
1.8	D ✓✓	(2)
1.9	C ✓✓	(2)
1.10	A ✓✓	(2)
		[20]

QUESTION 2

2.1 Newton Second Law of Motion
When a net/resultant force is applied to an object of mass, m, it accelerates the object in the direction of the net force. The acceleration is directly proportional to the net/resultant force and inversely proportional to the mass of the object. ✓✓ (2 or 0) (2)

2.2



ACCEPTABLE LABELS:
N/F_N: Normal
F_g/w: Force due to gravity/Weight
F_f/f_k/f: friction force
F_A: Applied force/120 N
T: Tension force in the rope

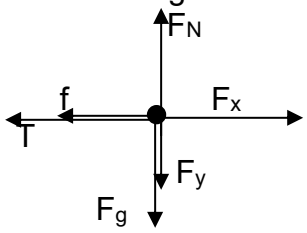
NOTE:
One mark for each force represented by an arrow with a correct label.
Penalise (once) for each of the following:
- No arrows
- There is no dot
- Gap between the line and the dot
- Dotted lines are used
- Additional force is included
- A force diagram is given.
- If components were drawn (5)

2.3 $f_k = \mu_k N$ ✓
= (0,15)(16 x 9,8) ✓
= 23,52 N ✓ (3)

2.4 $F_N = F_y + F_g$ } any one✓
$F_N = F\sin\theta + mg$ }
F_N = (120 sin 30°) + (24 x 9,8) ✓
F_N = 295,2 N ✓ (3)

2.5 Positive marking from 2.3 and 2.4

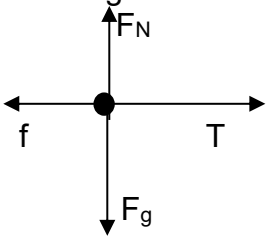
For the 24 kg block



$f_k = \mu_k N$
= (0,15)(295,2)
= 44,28 N

F_{net} = ma ✓
F_x – T – f = ma
Fcos θ – T – f = ma
(120 cos 30°) ✓ – T – 44,28 = 24 a
103,92 – T – 44,28 = 24a✓
59,64 – T = 24a
T = -24a + 59,64 ….①✓

For the 16 kg block



F_{net} = ma
T – f = ma
T – 23,52 = 16a
T = 16a + 23,52 ….②✓

① = ②✓
16a + 23,52 = –24a + 59,64
16a + 24a = –23,52 + 59,64
40a = 36,12
a= 0,90 m.s^{-2} move to right ✓ (7)

2.6 Positive marking from 2.5

Option 1
T = 16a + 23,52
T = 16(0,90) + 23,52✓
T = 37,92 N ✓

OR

Option 2
T = –24a +59,64
T = –24(0,90) + 59,64
T = 38,04 N (2)

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QUESTION 3

3.1 *Direction right is positive*

$\sum p_{\text{before collision}} = \sum p_{\text{after collision}}$ ✓ any one

$m_x v_i + m_y v_i = (m_{x+y})v_f$

$\underline{(1\,500)(20) + (1\,000)(v_f)}$ ✓ = $\underline{(1\,500 + 1\,000)(6)}$ ✓

$30\,000 + 1\,000v_f = 15\,000$

$1\,000v_f = -15\,000$

$V_f = -15\ m \cdot s^{-1}$

$v_f = \underline{15\ m \cdot s^{-1} \text{ to the left / east}}$ ✓ (4)

3.2 Positive marking from 3.1

$E_{k\ \text{before collision}} = ½\ mv^2 + ½\ mv^2$ Both formulae correct ✓

$= ½\ (1\,500)(20)^2 + ½\ (1\,000)(-15)^2$

$= 412\,500$ J ✓

$E_{k\ \text{after collision}} = ½\ m_{x+y}v^2$

$= ½\ (1\,500 + 1\,000)(6)^2$

$= 45\,000$ J ✓

Kinetic energy is not conserved (energy has been lost), therefor the collision is Inelastic. ✓ (4)

3.3 The product of the net force and the contact time. ✓✓ (2)

3.4 Neither ✓

Impulse $_x$ = Impulse $_y$ (1)

[11]

QUESTION 4

4.1 $P_{av} = Fv_{av}$ ✓

$P_{av} = (120)(5)$ ✓

$P_{av} = 600$ W ✓ (3)

4.2 4.2.1 At point A ✓ (1)

4.2.2 $E_{MA} = E_{MB}$

$E_p + E_k = E_p + E_k$ ✓ any one

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

$\underline{15(9{,}8)(12) + 0}$ ✓ $\underline{= 0 + \frac{1}{2}(15)v^2}$ ✓

$v = 15{,}34\ m \cdot s^{-1}$ ✓ (4)

4.2.3 Law of conservation of mechanical energy. ✓

The total mechanical energy of an isolated system remains constant. ✓✓ (2 or 0) (3)

[11]

QUESTION 5

5.1 An elastic limit is the maximum force that can be applied to body so that the body regains its original form completely on removal of the force. ✓✓ (2 or 0) (2)

5.2

Option 1

$\theta = \frac{F}{A}$ ✓ any one

$\theta = \frac{mg}{\pi r^2}$

$\theta = \frac{(6)(9{,}8)✓}{\pi(1\times 10^{-3})^2✓}$

= 18 716 621,31 Pa / $N \cdot m^{-2}$ **OR** ✓any one

= 1,88 x 10^7 Pa / $N \cdot m^{-2}$

Option 2

$A = \pi r^2$

$A = \pi(1 \times 10^{-3})^2$

$A = 3{,}142 \times 10^{-6}\ m^2$

$\theta = \frac{58{,}8}{3{,}142 \times 10^{-6}}$

= 18 714 194,78 Pa

Option 3

$A = \frac{\pi D^2}{4}$

$= \frac{\pi(\frac{2}{1000})^2}{4}$

$= 3{,}141592654 \times 10^{-6}\ m^2$

$\theta = \frac{F}{A}$

$= \frac{58{,}8}{3{,}141592654\times 10^{-6}}$

= 18 716 621,31 Pa / $N \cdot m^{-2}$

(range 18 714 194,78 – 18 716 621,31) (Note to teachers: teach the learners to only round off final answer – refer to option 2) (4)

5.3

$\varepsilon = \frac{\Delta l}{L}$✓ **OR** $\varepsilon = \frac{\Delta l}{L}$

$\varepsilon = \frac{1{,}5\ mm}{4\ 000\ mm}$✓ $\varepsilon = \frac{1{,}5\times 10^{-3}\ m}{4\ m}$

= 3,75 x 10^{-4}✓ = 3,75 x 10^{-4} (3)

5.4 Positive marking from 5.2 and 5.3

$K = \frac{\theta}{\varepsilon}$✓

$K = \frac{1{,}88 \times 10^7}{3{,}75 \times 10^{-4}}$ ✓

$K = 4{,}99 \times 10^{10}\ Pa$ / $N \cdot m^{-2}$ ✓ (3)

[12]

QUESTION 6

6.1 Pressure at a particular point as the thrust acting on the unit area around that point. (2 or 0) (2)

6.2 $P = \frac{F}{A}$ ✓ any one
$P = \frac{mg}{A}$

$= \frac{(54)(9,8)}{0,85}$ ✓ ✓

$F_g = mg$
$= 54(9,8)$
$= 529,2$ N

= 622,59 Pa / $N \cdot m^{-2}$ **OR** ✓ any one
= $6,23 \times 10^2$ Pa / $N \cdot m^{-2}$ (4)

6.3 Positive marking from 6.2
The same as the output system, namely 622,59 Pa / $N \cdot m^{-2}$ ✓ (1)

6.4 Positive marking from 6.2 for option 1 only

Option 1

$\frac{F_{input}}{A_{input}} = \frac{F_{output}}{F_{output}}$✓

$\frac{F_{input}}{0,03}$✓ $= 622,59$✓

$F_{input} = 18,68\ N$✓

Option 2

$\frac{F_1}{A_1} = \frac{F_2}{A_2}$

$\frac{F_1}{0,03} = \frac{(54)(9,8)}{0,85}$

$F_1 = 18,68\ N$

Option 3

$P = \frac{F}{A}$

$622,59 = \frac{F}{0,03}$

F = 18,68 N

(range 18,68 – 18,69) (4)

6.5 It would double / increases ✓✓ (2)

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QUESTION 7

7.1 7.1.1 Society of Automotive Engineers ✓ (1)

7.1.2 It indicates the viscosity of oil measured at 100 °C ✓✓ (2)

7.1.3 **Negative marking if incorrect SAE was chosen**
SAE10 ✓
It has the smallest viscosity and will therefore flow fastest. ✓ (2)

7.2 7.2.1 It is oil that has grading for viscosity at both cold and hot conditions. ✓ (1)

7.2.2 The 30 is the viscosity of the oil at cold temperatures. ✓
The W indicates that the viscosity of value 30 is measured at cold temperatures. ✓
The 60 is the viscosity of the oil measured at 100 °C ✓ (3)

7.2.3 **Negative marking if incorrect SAE was chosen**
10W60 ✓
Since the viscosity of 10W will be applicable at cold temperatures ✓and it has a lower viscosity than the 30W of the other oil. ✓ (3)

[12]

QUESTION 8

8.1 8.1.1 Refraction ✓ (1)

8.1.2 Refraction occurs because light travels at different speeds in different mediums. ✓ When light moves from a less optically dense medium (like air) to a more optically dense medium (like water), its speed decreases, causing the light to bend towards the normal. ✓ (2)

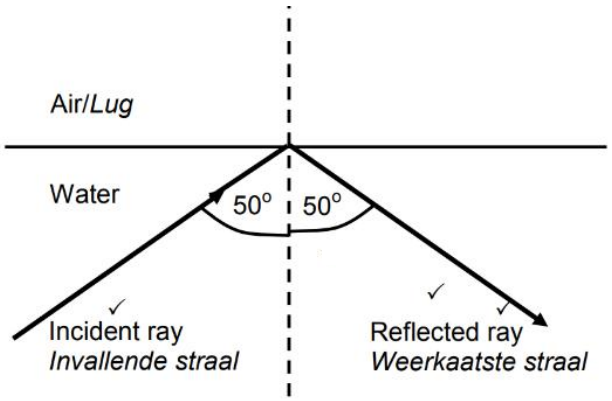
8.2 Critical angle: the angle of incidence in the denser medium such that the refracted ray just passes through the surface of separation of the two media ✓✓ (0 or 2)

OR

The angle of incidence in the optically dense medium for which the angle of refraction is 90° (2)

8.3 1 – Light must be traveling from a more optically dense medium to a less optically dense medium. ✓
2 – The angle of incidence must be greater than the critical angle. ✓ (2)

8.4



(3)

8.5 8.5.1 Dispersion ✓ (1)

8.5.2 Seven colours (7) ✓ (1)

8.5.3 Red ✓ (1)

8.5.4 Decrease ✓ (1)

8.5.5 The wavelength of light decreases ✓ when it enters the prism because the speed of light decreases ✓ due to the refractive index of the prism. Since the frequency of light remains constant✓ (3)

[17]

QUESTION 9

9.1 Capacitance, C, of a capacitor is the amount of charge it can store per volt.
✓✓ (2 or 0) (2)

9.2 $C = \frac{Q}{V}$✓

$1{,}5 \times 10^{-6}$✓ $= \frac{9{,}5 \times 10^{-3}}{V}$ ✓

$V = 6\,333{,}33\ V$ ✓ (4)
[6]

QUESTION 10

10.1 Electromotive force (EMF) is the maximum potential difference a source can provide when no current is flowing✓, while terminal potential difference (terminal voltage) is the actual voltage measured across the terminals when current is flowing ✓, which is typically lower than EMF due to the source's internal resistance. ✓ (3)

10.2 10.2.1

$R = \frac{V}{I}$ ✓

$6 = \frac{V}{1,5}$ ✓

$V_2 = 9V$ ✓

(3)

10.2.2 Positive marking from 10.2.1 only for option 1 and 3

Option 1

$R = \frac{V}{I}$

$12 = \frac{9}{I}$ ✓

I = 0,75 A ✓

I_T = 1,5 + 0,75 = 2,25 A ✓

OR

Option 2

R : 1 : 2

I : 1,5A : 0,75A

∴ I_T = 1,5 + 0,75

= 2,25 A

Option 3

$\frac{1}{R_p} = \frac{1}{r} + \frac{1}{r}$

$= \frac{1}{6} + \frac{1}{12}$

$R_p = 4\Omega$

$I = \frac{V}{R}$

$= \frac{9}{4}$

= 2,25 A

(3)

10.2.3 Positive marking from 10.2.2

Option 1

V = IR

= (2,25)(18) ✓

= 40,5 V ✓

OR

Option 2

$R = \frac{V}{I}$

$18 = \frac{V}{2,25}$

V_1 = 40,5 V (2)

10.2.4 Positive marking from 10.2.1 and 10.2.3

$V_3 = V_1 + V_2$

= 40,5 + 9 ✓

= 49,5 V ✓ (2)

10.2.5

Option 1		**Option 2**
$q = I\Delta t$ ✓	**OR**	$q = I\Delta t$
$= 1{,}5(3 \times 60)$ ✓		$= 1{,}5(180)$
= 270 C ✓		= 270 C

(3)

10.2.6 Positive marking from 10.2.5 for option 1 only

Option 1	**Option 2**
W = VQ ✓	$W = VI\Delta t$
= 9(270) ✓	= 9(1,5)(180)
= 2 430 J / $V \cdot C^{-1}$ ✓	= 2 430 J

Option 3	**Option 4**
$W = I^2Rt$	$W = \frac{V^2\Delta t}{R}$
$= (1{,}5)^2(6)(180)$	$= \frac{9^2(180)}{6}$
= 2 430 J	= 2 430 J

(3)

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QUESTION 11

11.1 Step-down transformer ✓ (1)

11.2 $\frac{V_S}{V_P} = \frac{N_S}{N_P}$

$\frac{20}{220}$ ✓ $= \frac{N_P}{55}$ ✓

$220\ N_P = 1100$

$N_P = 5$ Windings ✓ (3)

11.3 Cost = P x t x price 50 W = 0,05 kW

= (0,05 kW) ✓ (8 x 7h)(R1,10) ✓

= R3,08 ✓ (3)

[7]

TOTAL: 150