NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2020

TECHNICAL SCIENCES: PAPER I

MARKING GUIDELINES

Time: 3 hours 150 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

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. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

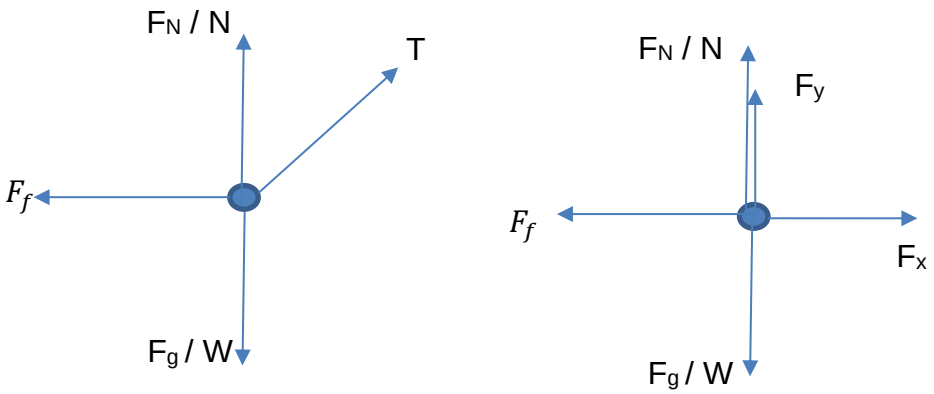
QUESTION 1 MULTIPLE-CHOICE QUESTIONS

1.1 B
1.2 C
1.3 D
1.4 B
1.5 D
1.6 C
1.7 C
1.8 C
1.9 D
1.10 D

QUESTION 2

2.1 An object continues in a state of rest or uniform (moving with constant) velocity unless it is acted upon by a net (resultant) force.

2.2



FORCE	DESCRIPTION	MARKS
F_N / N	Normal force	X
F_f	Friction	X
F_g / W	Weight	X
T	Tension in the rope/ Fx and Fy components	X

2.3 $F_X = T\cos\theta$
$F_X = 5\cos 25°$
$F_X = 4{,}532\ N$ to the right

2.4 That single force that has the same effect as all the other forces combined.

OR

The vector sum of all the forces acting on an object

2.5 **Positive marking from Question 2.3**

$F_{net} = ma$ (to the right is positive)

$F_{p_x} + (-f_k) + (F_{Qx}) + (-f_k) + F_{app} = 0$

any one of the equations

$4.532 - 2,5 - 4.532 - 1 + F_{app} = 0$

$F_{app} = 3,5N$ (to the right)

2.6 Acceleration is to the **right**.
Mass of system decreases while applied force remains constant.
Thus block Q will accelerate in the direction of the applied force (F).

2.7 Increase

QUESTION 3

3.1 $\frac{80}{3.6} = 22,22\ m{\cdot}s^{-1}$ (if only the answer is given award 2 marks)

3.2 The total linear momentum of an isolated system remains constant in magnitude and direction.

3.3 **Positive marking from Question 3.1**

$\Sigma_{p_i} = \Sigma_{p_f}$ (to the right is +)

$m_{Taxi}v_i + m_{car}v_i = m_{taxi}v_f + m_{car}v_f$

$5800v + (1500)(-22,22) = (5800)(10) + (1500)(6)$

$v_f = 17,298\ m{\cdot}s^{-1}$ (to the right)

3.4 **Positive marking from Question 3.3**

$F_{net}{\cdot}\Delta t = m_y v_f - m_y v_i$

$F_{net}{\cdot}0,2 = (5800)(10) - (5800)(17,298)$

$F_{net} = -211642\ N$

$\therefore F_{net} = 211642\ N$ to the left

3.5 **Positive marking from Question 3.4**

211642 N to the right. Newtons third law.

3.6 Airbags
Safety belts
Crumple zones } any two

QUESTION 4

4.1 Energy is the ability to do work.

4.2 $E_p = mgh$

$E_p = (1,2)(9,8)(10)$

$E_p = 117,6$ J

4.3 The total mechanical energy (sum of gravitational potential energy and kinetic energy) in an isolated system remains constant.

4.4 **Positive marking from Question 4.2**

$(E_p + E_k)_{top} = (E_p + E_k)_{bottom}$
$117,6 + 0 = 0 + \frac{1}{2}mv^2$
$117,6 + 0 = 0 + (0,5)(1,2)v^2$
$v = 14$ m·s^{-1}

4.5 $W_{f_{mud}} = f_{mud} \cdot \Delta X \cdot cos\theta$
$W_{f_{mud}} = 650 \cdot 0,2 \cdot \cos 180°$

$W_{f_{mud}} = -130$ J

4.6 $P = \frac{w}{\Delta t}$

$P = \frac{4,8 \times 10^5}{(2 \times 60)}$

$P = 4000\ w$

4.7 **Positive marking from Question 4.6**

1hp = 746 w

x hp = 4000 w

$x = \frac{4000 \times 1}{746}$

$x = 5.36$ hp (if only the answer is given award 2 marks)

4.8 **Positive marking from Question 4.6**

$P_{ave} = Fv$
$4000 = F \cdot 10$
$F = 400\ N$

QUESTION 5

5.1 Within the limit of elasticity, stress is directly proportional to the strain.

5.2 $\sigma = \frac{F}{A}$

$\sigma = \frac{20 \times 9,8}{3,14 \times 10^{-4}}$

$\sigma = 624203,82$ Pa

$A = \pi r^2$
$A = \pi(\frac{0,02}{2})^2$
$A = 3,14 \times 10^{-4} m^2$

5.3 $\Delta l = 0,75 \times 50\% = 0,375$ m (if only the answer is given award 2 marks)

5.4 **Positive marking from Question 5.3**

$\varepsilon = \frac{\Delta L}{L}$

$\varepsilon = \frac{0,375}{0,75}$

$\varepsilon = 0,5$

5.5 **Positive marking from Question 5.2 and question 5.4**

$K = \frac{\sigma}{\varepsilon}$

$K = \frac{624203,82}{0,5}$

$K = 1248407,64$ Pa

5.6 A body that does not show a tendency to regain its original shape and size when the deforming force is removed

QUESTION 6

6.1 Viscosity is the property of the fluid to oppose relative motion between the two adjacent layers.

6.2 6.2.1 Mass of marble.
Time (10s)
Volume of the oil.
} Any one

6.2.2 Different SAE grades oils.

6.2.3 Displacement of the marble in the oil.

6.3 The marble will have sunk further down into the oil in the same amount of time (10s).

6.4 If the temperature increases, the intermolecular forces are weaken and the viscosity decreases, thus the marble sinks further down in to the oil in the same amount of time (10s).

QUESTION 7

7.1 In a continuous liquid at equilibrium, the pressure applied at a point is transmitted equally to the other parts of the liquid.

7.2 10000 $cm^2 = 1\ m^2$
325 $\text{cm}^2 = ?\ m^2$

$\frac{325}{10000} = 3{,}25 \times 10^{-2}\ m^2$ (if only the answer is given award 2 marks)

7.3 **Positive marking from Question 7.2**

$A = \pi r^2$
$A = \pi(0{,}0175)^2$
$A = 9{,}62 \times 10^{-5} m^2$

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

$$\frac{550}{9{,}62 \times 10^{-4}} = \frac{F_2}{3{,}25 \times 10^{-2}}$$

$F_2 = 18581{,}081N$

$F_2 = F_g$

$\therefore F_g = m \cdot g$
$18581{,}081 = m \cdot 9{,}8$
$m = 1896{,}029$ kg

QUESTION 8

8.1 The insulating material between the two plates of a capacitor.

8.2
- Increase the applied voltage across the plates.
- Increases the total area of the opposing surfaces of the plates.
- Decreases the distance between the plates.

(Any 2 of the factors)

8.3 Capacitance of a capacitor Is the amount of charge it can store per volt.

8.4 Forward bias.

QUESTION 9

9.1 $\frac{1}{R_{\|}} = \frac{1}{R_1} + \frac{1}{R_2}$

$\frac{1}{R_{\|}} = \frac{1}{2} + \frac{1}{2}$

$R_{\|} = 1\Omega$

9.2 The potential difference across a conductor is directly proportional to the current in the conductor at constant temperature.

9.3 9.3.1 4 cells × $1,5V = 6V$ (if only the answer is given award 1 mark)

9.3.2 **Positive marking from Question 9.3.1**

$\frac{3}{4} \times \frac{6}{1} = 4,5V$ (if only the answer is given award 2 marks)

9.4 **Positive marking from Question 9.3.2**

$w = V \cdot I \cdot \Delta t$

$w = (4,5)(1,5)\,(3 \times 60)$

$w =$ 1215J

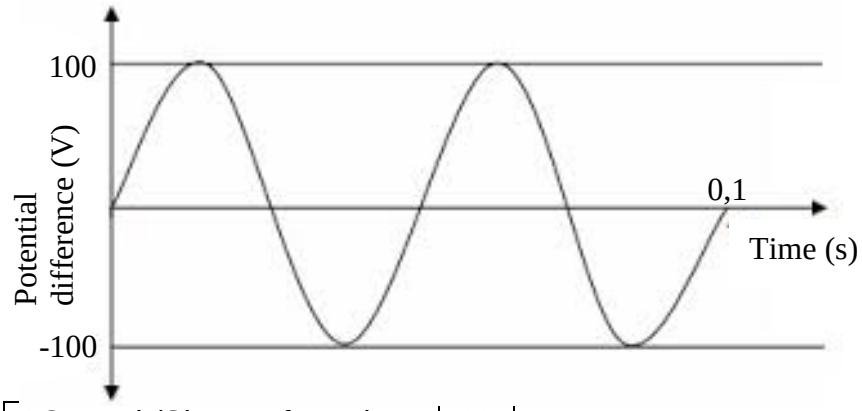
10.5 The rate at which electrical energy is converted in an electric circuit.

10.6 Increase.

QUESTION 10

10.1 10.1.1 Clockwise

10.1.2



AC graph/Shape of graph	X
2 Cycles	X
100V & 0,1s indicated	X

10.1.3 (a) Slip rings

(b) (Carbon) brushes

10.1.4 AC generator

10.1.5 Faraday's law states that when the magnetic flux linked with the coil changes, an emf is induced in the coil. The magnitude of the induced emf is directly proportional to the rate of change of magnetic flux.

10.2 10.2.1 $\varepsilon = -\frac{N \cdot \Delta \emptyset}{\Delta t}$

$\varepsilon = -\frac{480 \cdot 1{,}6 \times 10^{-3}}{1}$

$\epsilon = 0{,}768\ V$

10.2.2 **Positive marking from Question 10.2.1**

$V = I \cdot R$

$0{,}768 = I \cdot 1{,}5$

$I = 0{,}512\ A$

Total: 150 marks