higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

PHYSICAL SCIENCE
(First paper)
NQF LEVEL 3

(10021003)

2 December 2020 (Y-paper)
13:00–16:00

Nonprogrammable calculators may be used.

This question paper consists of 11 pages.

219Q1N2002

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TIME: 3 HOURS
MARKS: 150

INSTRUCTIONS AND INFORMATION

1. Answer all the questions.
2. Read all the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Show the formulae and substitutions in all calculations.
5. Approximate all final answers accurately to TWO decimal places.
6. Start each section on a new page.
7. Use only a black or blue pen.
8. Write neatly and legibly.

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SECTION A

QUESTION 1

Give ONE term for each of the following descriptions by writing only the term next to the question number (1.1–1.5) in the ANSWER BOOK.

1.1 Type of force resisting the movement of solid surfaces in contact.

1.2 An arrangement of resistors used to measure the unknown resistance of a resistor.

1.3 Type of lens that is used to correct short-sightedness.

1.4 A wave that can be propagated through a vacuum.

1.5 The physical quantity represented by the gradient of a displacement-time graph.

(5 × 1) **[5]**

QUESTION 2

Choose a term from COLUMN B that matches a description in COLUMN A. Write only the letter (A–J) next to the question number (2.1–2.5) in the ANSWER BOOK.

COLUMN A		COLUMN B	
2.1	Maximum displacement from the mean position.	A	real
2.2	Property of matter that causes it to resist a change in its state of rest or uniform motion.	B	weight
2.3	Force equal in magnitude but opposite in direction to resultant.	C	virtual
2.4	Image that is always upright.	D	step-down transformer
2.5	A cell phone charger.	E	amplitude
		F	equilibrant
		G	Newton's second Law
		H	inertia
		I	wavelength
		J	step-up transformer

(5 × 1) **[5]**

QUESTION 3

Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (3.1–3.5) in the ANSWER BOOK.

3.1 When two forces act simultaneously on an object, the resultant is a minimum if the angle between the forces is 90^0.

3.2 The ratio of the distance moved by the effort to the distance moved by the load is called the velocity ratio.

3.3 Radio waves are longitudinal waves.

3.4 Coulomb's Law states that the direction of the induced current is such that it will oppose the change that is causing it.

3.5 The direction and the shape of a magnetic field around a current-carrying conductor can also be determined by the right-hand thumb rule.

(5 × 2) **[10]**

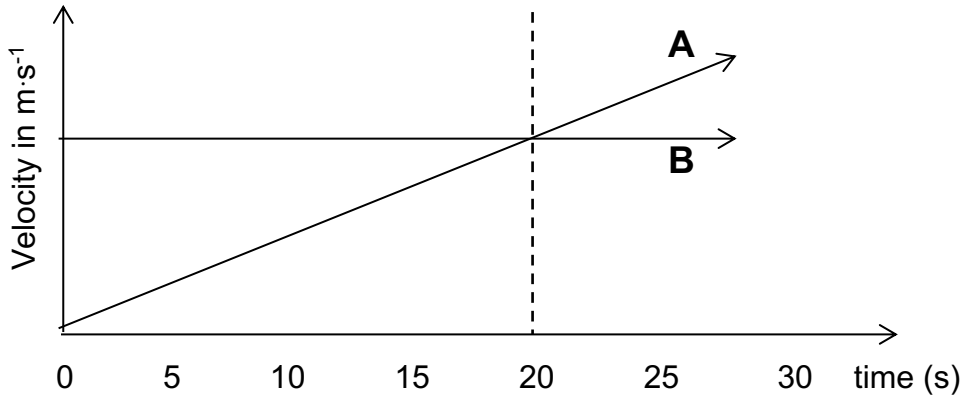
QUESTION 4

Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question number (4.1–4.5) in the ANSWER BOOK.

4.1 We can see a bell ringing in an evacuated jar, but we cannot hear it. This shows that …

A light waves can travel through a vacuum, but not sound waves.
B sound waves can travel through a vacuum, but not light waves.
C both sound and light waves can travel through a vacuum.
D neither sound nor light waves can travel through a vacuum.

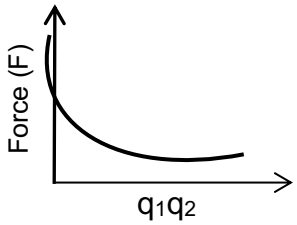
4.2 The graph below shows the velocity of two cars, A and B, varying with time. At a time of 20 seconds the distance travelled by car A is…



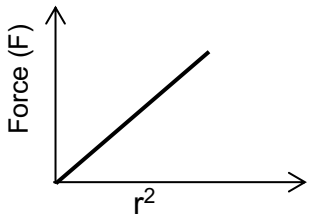
A half that of car B.
B a quarter that of car B.
C the same as that of car B.
D greater than that of car B.

4.3 Which ONE of the following graphs represents Coulomb's Law?

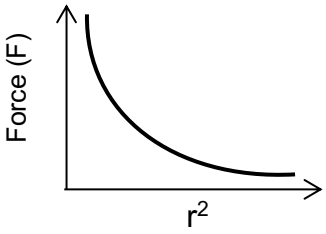
A



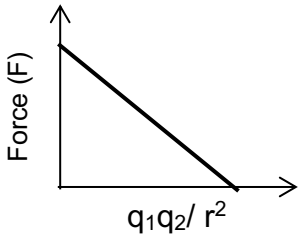
B



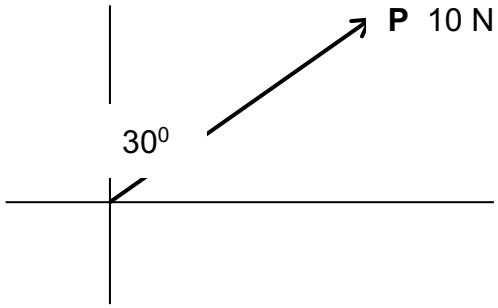
C



D



4.4 Vector **P** has a magnitude of 10 N on a bearing of 30°.

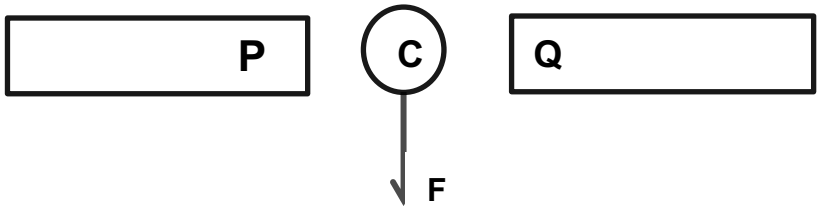


Which ONE of the following pairs CORRECTLY represents the X and Y components of **P** respectively?

A 10 cos 60°; 10 sin 30°
B 10 cos 30°; 10 sin 30°
C 10 sin 60°; 10 cos 60°
D 10 sin 30°; 10 cos 30°

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4.5 In the diagram below, a straight current-carrying wire, **C**, experiences a downward force when placed between two magnets P and Q.



Which ONE of the following combinations CORRECTLY represents the polarities of the magnets and the direction of the conventional current?

	Polarity P	Polarity Q	Current direction of C
A	South	North	Out of the page
B	North	South	Into the page
C	North	South	Out of the page
D	South	North	Into the page

(5 × 3) **[15]**

TOTAL SECTION A: 35

SECTION B

QUESTION 5

5.1 Write the symbol of the unit of the following using a prefix where necessary (e.g. 1×10^3 m = 1 km):

5.1.1 3×10^{-3} g

5.1.2 200×10^{-6} C

5.1.3 6×10^{-12} m

(3 × 1) (3)

5.2 Convert the following to the unit indicated:

5.2.1 8 560 mm to m (1)

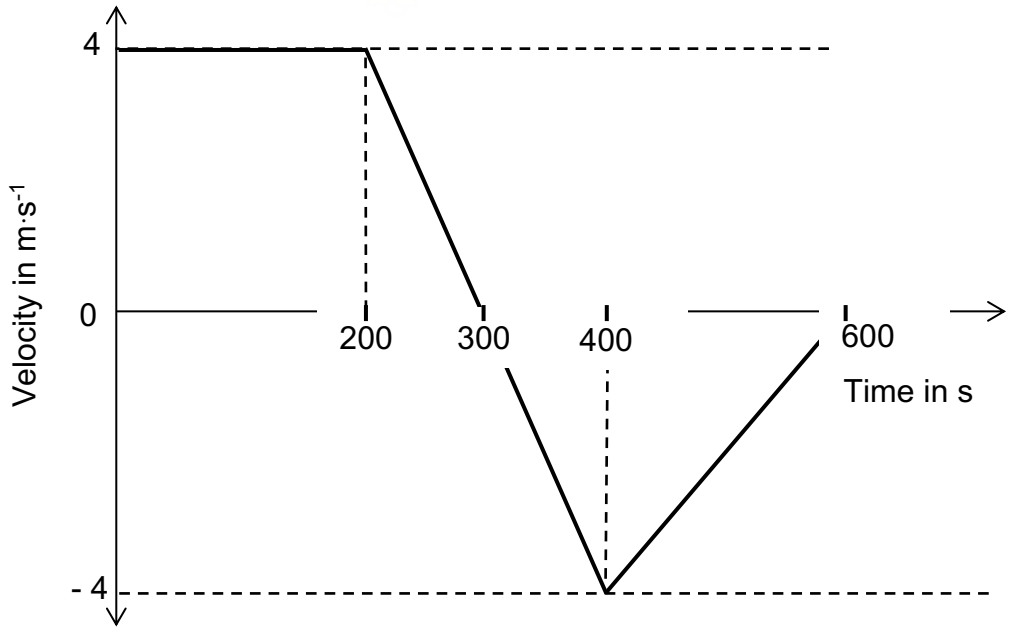
5.2.2 0.25 kW to W (1)

5.2.3 72 km·h^{-1} to m·s^{-1} (2)

[7]

QUESTION 6

6.1 The velocity-time graph below represents the motion of a car starting with an initial velocity of 4 m·s^{-1}, East.



6.1.1 Define *acceleration*. (2)

6.1.2 In which time periods was the acceleration of the car zero? (1)

6.1.3 Calculate the acceleration of the car between 200 and 300 seconds. (4)

6.1.4 Describe the motion of the car from 300 to 600 seconds. (4)

6.1.5 Calculate the displacement of the car at 600 s. (5)

6.2 An aircraft needs a runway of 1 200 m to take off. After travelling for 20 s from the beginning of the runway, the pilot notices a flock of birds 300 m ahead on the runway and immediately slams on the brakes. The aircraft decelerated uniformly at 2 m·s^{-2} for 10 s and the pilot abandons the trip.

6.2.1 Describe the motion of the passengers the moment that the pilot slams on the brakes. (1)

6.2.2 NAME and STATE the relevant law in physics that explains the motion of the passengers referred to in QUESTION 6.2.1. (3)

6.2.3 Calculate the magnitude of the aircraft's velocity 20 seconds after it accelerated uniformly at 1,5 m·s^{-2} along the runway. (3)

6.2.4 Did the aircraft strike the flock of birds? Use an appropriate calculation to justify your answer. (4)

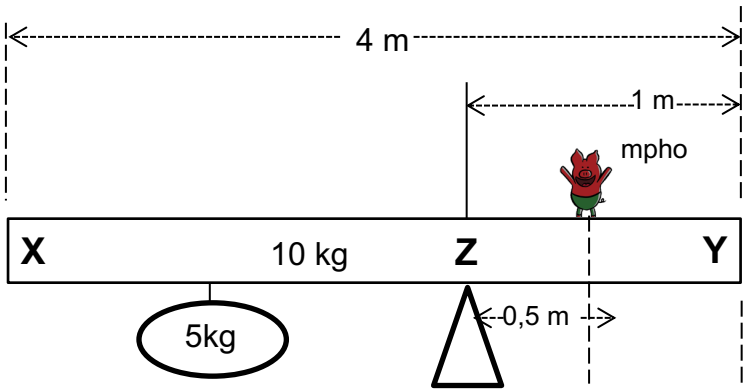
[27]

QUESTION 7

7.1 A small group of L3 learners planned to determine the mass of Mpho. They had a beam (**XY**) of 4 m long, with a mass of 10 kg.

They set up the beam with the pivot at **Z**, 1 m away from point **Y**. Mpho stands at a point, 0,5 m away from the pivot.

In order to balance the plank horizontally, a mass of 5 kg is hung 2 m away from the pivot.



7.1.1 Name the TWO conditions or laws which must be satisfied to keep the beam in horizontal equilibrium. (4)

7.1.2 Draw a labelled force diagram indicating ALL the downward forces acting on the beam, while the beam remains horizontal. (3)

7.1.3 Determine Mpho's mass. Show ALL calculations. (6)

7.2 A crate with a mass of 150 kg is moved up a ramp which is 4,5 m long on to a 1,5 m high platform.

Calculate the following:

7.2.1 Ideal mechanical advantage. (3)

7.2.2 Effort force that is required to move the crate up the slope. (4)

[20]

QUESTION 8

8.1 An object which is 3,5 cm high is placed 5 cm away from the optical centre of a concave lens with a focal length of 4 cm.

8.1.1 Draw a ray diagram by using accurate construction and measurement to show the formation of the image. (5)

8.1.2 Calculate the magnification of the image. (3)

8.1.3 State TWO properties of real images. (4)

8.1.4 Name ONE application of a concave lens. (2)

8.2 A guitar string produces sound waves of 1,2 m wavelengths in the air. When the sound enters another medium, X, its wavelength changes to 1,8 m.

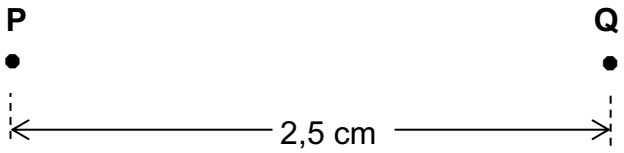
8.2.1 Define the *wavelength* of a wave. (2)

8.2.2 If the speed of sound in air is 342 $m \cdot s^{-1}$, calculate the speed of sound in medium X. (5)

[21]

QUESTION 9

9.1 Two positive point charges are placed at **P** and **Q**, 2,5 cm apart. The magnitude of the charge at **P** is half that of the charge at point **Q**.



The magnitude of the electrostatic force between the two-point charges is 270 N.

9.1.1 Calculate the charge at point **P**. (4)

9.1.2 Is the force between **P** and **Q** one of attraction or repulsion? (1)

9.1.3 Give a reason for the answer to QUESTION 9.1.2. (1)

9.1.4 Calculate the magnitude of the electric field strength at point **Q**. (4)

9.1.5 Draw the electric field pattern around a negatively charged sphere. (2)

9.2 A transformer is a device that uses the principle of induction to either step up or step down the voltage. Draw a diagram illustrating the main features of a step-up transformer.

The following must be clearly labelled in the diagram:

- The primary coil
- The secondary coil
- Magnetic flux
- Iron core

(4)

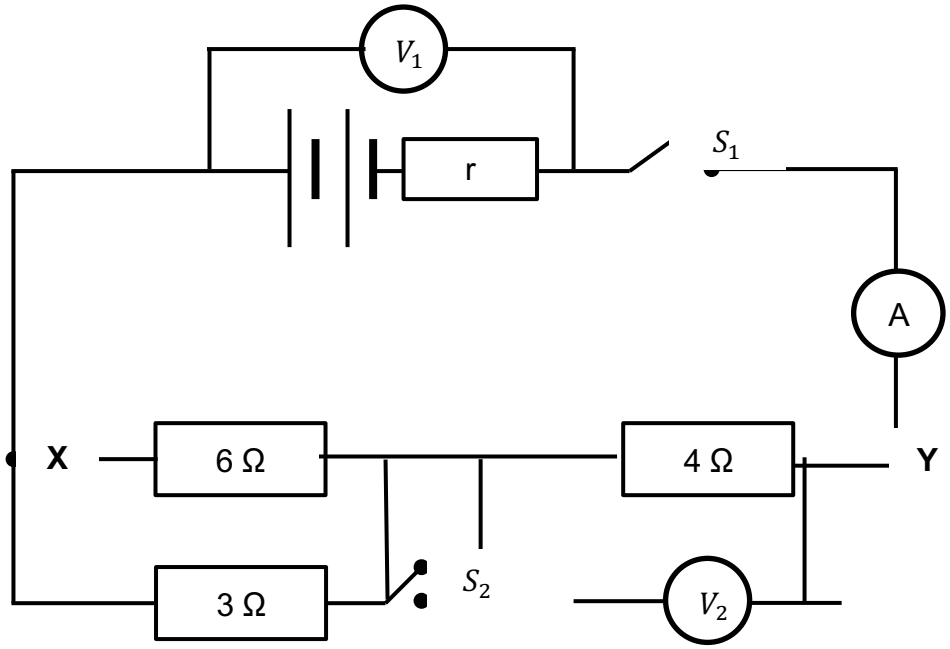
9.3 A parallel plate capacitor of 80 μF has a charge of 0,2 C on each plate.

Calculate the amount of charge that should be added to increase the potential difference by 200 V. (5)

[21]

QUESTION 10

In the circuit diagram below, the voltmeter (V_1) reads 24 V when switch S_1 is open and S_2 is closed.



10.1 What is the EMF of the battery? (1)

10.2 Calculate the equivalent resistance of the 3 Ω and 6 Ω resistors. (3)

10.3 Both switches are closed. The reading on V_1 is 18 V.

10.3.1 What is the potential difference across the combination of resistors between X and Y? (1)

10.3.2 Calculate the current through the ammeter. (4)

10.3.3 Calculate the internal resistance of the battery. (4)

10.3.4 Determine the reading on V_2. (3)

10.4 Switch S_1 is kept closed and switch S_2 is now opened.

10.4.1 Will the reading on V_2 INCREASE, DECREASE or REMAIN THE SAME? (1)

10.4.2 Explain the answer to QUESTION 10.4.1. (2)
[19]

TOTAL SECTION B: 115
GRAND TOTAL: 150

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