National Anveshika Experimental Skills Test (NAEST 2017): Screening Test Questions, Answers, and Solutions

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The NAEST 2017 screening test was conducted by National Anveshika Network of India at various centres throughout the country. Screening test is a video quiz consisting of multiple video clips, each of 1-2 min duration. The video clip demonstrates a short experiment/concept and question(s) are based on these experiments. The student need to answer the questions given in the answer sheets provided to them. The screening test in Telangana and AP consists of 16 video clips and related questions.

Each question may have one or more correct options. Tick the correct option(s). Each correct tick will fetch 1 mark and each wrong tick will get penalty of -0.5 *marks.*

1 Click to view Video 01 on YouTube

Choose correct Option(s)

(a). The least count of the vernier calipers is 1 cm

(b). The least count of the vernier calipers is 0.1 cm

(c). The least count of the vernier calipers is 0.01 cm

(d). Length of the chalk is within 8.0 cm - 8.2 cm

(e). Length of the chalk is within 7.8 cm - 8.0 cm

(f). Length of the chalk is more than 8.0 cm

(g). Length of the Box is within 4.8 cm - 5.0 cm

(h). Length of the Box is within 4.6 cm - 4.8 cm

(i). Length of the Box is more than 5.0 cm

2 Click to view Video 02

Force by water on the ball is within

(a). 11-12 gm-wt

(b). 4-5 gm-wt

(c). 15-16 gm-wt

Force by the ball on water is

(d). 11-12 gm-wt

(e). 4-5 gm-wt

(f). 15-16 gm-wt

Tension in the thread is

(g). 11-12 gm-wt

(h). 4-5 gm-wt

(i). 15-16 gm-wt

3 Click to view Video 03

The refractive indices of air, oil and glass are $\mu_a = 1$, $\mu_o = 1.42$ and $\mu_g = 1.50$ respectively.

Empty test tube placed in oil is clearly visible because

(a). μ_o and μ_g are close to each other.

(b). μ_o and μ_g are very different from each other.

(c). μ_o and μ_a are very different from each other.

(d). μ_g and μ_a are very different from each other.

(e). μ_g and μ_a are close to each other.

The test tube filled with oil becomes nearly invisible because

(f). μ_o and μ_g are close to each other.

(g). μ_o and μ_g are very different from each other.

(h). μ_o and μ_a are very different from each other.

(i). μ_g and μ_a are very different from each other.

(j). μ_g and μ_a are close to each other.

4 Click to view Video 04

The video shows making of GHEE from home made butter. After Ghee is separated, the water part goes out as vapour and one gets pure GHEE. Bubbles continue to come even after switching off the burner. The reason is

(a). The surface is getting cooled.

(b). Air was dissolved in Ghee that comes out as bubbles.

(c). The bubbles were formed at the bottom of the vessel when the burner was on and these bubbles are coming up.

(d). The temperature of the material in the vessel is non uniform.

(e). When the burner was put off, the temperature of the Ghee was more than the boiling point of water in it.

5 Click to view Video 05

Assume small oscillations of the toy so that displacement of a small portion can be treated as on a straight line. Call a portion of head just above the neck as A, the portion of the body just below the neck as B, the end of the right arm as C and the end of the left arm as D.

The phase difference between oscillation of A and B is

(a). 0

(b). $\pi/2$

(c). π

(d). $3\pi/2$

The phase difference between oscillation of C and D is

(e). 0

(f). $\pi/2$

(g). π

(h). $3\pi/2$

6 Click to view Video 06

The cap floats in water.

In the first part, the cap comes to the edge

(a). Because of the attraction from the rim

(b). Because of the force of buoyancy

(c). Because of the surface tension

(d). Because of its weight

In the second part, the cap comes at the middle of the water

(e). Because of the repulsion from the rim

(f). Because of the force of buoyancy

(g). Because of the surface tension

(h). Because of its weight

7 Click to view Video 07

In the first part (bottle with one hole and cap open), the pressure P_A at A (in the liquid) and the atmospheric pressure P_0 have relation

(a). $P_A < P_0$

(b). $P_A = P_0$

(c). $P_A > P_0$

In the second part (bottle with two holes and cap closed), the pressure P_A, P_B, P_0 (A, B in the liquid) have relation

(d). $P_A < P_0$

(e). $P_A = P_0$

(f). $P_A > P_0$

(g). $P_B < P_0$

(h). $P_B = P_0$

(i). $P_B > P_0$

8 Click to view Video 08

Choose the correct Option(s)

(a). The lens is convex

(b). The lens is concave

The focal length of the lens is within

(c). 24cm - 25cm

(d). 5cm - 6cm

(e). 18cm - 19cm

9 Click to view Video 09

When the pen is rotated, the image is rotated by an angle

(a). 0 degree

(b). 20 degree

(c). 40 degree

(d). 90 degree

When the mirror is rotated, the image is rotated by an angle

(e). 0 degree

(f). 20 degree

(g). 40 degree

(h). 90 degree

10 Click to view Video 10

Two bulbs are identical.

In the first case

(a). The bulbs are connected in series

(b). The bulbs are connected in parallel

(c). The voltage across each bulb is approximately 5 Volts

(d). The voltage across each bulb is approximately 10 Volts

(e). The current through two bulbs are equal

(f). The current through two bulbs are not equal

In the second case

(g). The bulbs are connected in series

(h). The bulbs are connected in parallel

(i). The voltage across each bulb is approximately 5 Volts

(j). The voltage across each bulb is approximately 10 Volts

(k). The current through two bulbs are equal

(l). The current through two bulbs are not equal

11 Click to view Video 11

Select the correct options

(a). The cross-section area of the pipe does not change when its opening is pressed

(b). The cross-section area of the pipe decreases when its opening is pressed

(c). The cross-section area of the pipe increases when its opening is pressed

(d). The speed of water coming out of the pipe decreases when pipe is pressed

(e). The speed of water coming out of the pipe increases when pipe is pressed

(f). The range of projectile path increases when speed of water is decreased

(g). The range of projectile path decreases when speed of water is decreased

12 Click to view Video 12

The situation in first case can be caused when

(a). Like poles of two magnets are facing each other

(b). Unlike poles of two magnets are facing each other

The situation in second case can be caused when

(c). Like poles of two magnets are facing each other

(d). Unlike poles of two magnets are facing each other

13 Click to view Video 13

Select the correct options

(a). The temperature of boiling water is less than 100 degree Celsius

(b). The temperature of boiling water is equal to 100 degree Celsius

(c). The temperature of boiling water is more than 100 degree Celsius

(d). The temperature of water inside the small bowl is 100 degree Celsius

(e). The water in small bowl does not boil because its temperature is less than 100 degree Celsius

(f). The water in small bowl does not boil because it is not getting heat required for vaporization

14 Click to view Video 14

Select the correct options

When water is stationary, the force on the leaf due to water is

(a). vertically upward

(b). vertically downward

(c). towards centre of the tub

When water is rotating, the force on the leaf due to water is

(d). vertically upward

(e). vertically downward

(f). towards centre of the tub (axis of rotation)

(g). normal to the water surface (in contact with the leaf)

15 Click to view Video 15

Select the correct option(s)

(a). On heating with candles, the length of the aluminium rod increases

(b). On heating with candles, the length of the aluminium rod decreases

(c). The bulb glows because aluminium rod become conducting on heating

(d). The bulb glows because circuit gets completed due to thermal expansion of aluminium rod

16 Click to view Video 16

Select the correct options

(a). The galvanometer deflection is due to induced electricity in the coil when magnet passes through it

(b). If the magnet is stationary then electricity is not induced

(c). If the magnet moves with constant speed then electricity is not induced

(d). If magnet accelerates then the galvanometer deflection is less when magnet enters the coil and deflection is more when magnet leaves the coil

(e). The acceleration of the magnet can be increased by increasing hanging mass on the right side

(f). The acceleration of the magnet can be increased by reducing hanging mass on the left side

Solution of Question 01

The correct answers are (b), (d), (f) and (g).

The least count of the Vernier calipers is defined as

$$\text{LC} = 1\,\text{MSD} - 1\,\text{VSD}$$

where MSD is main scale division and VSD is Vernier scale division. In given Vernier scale $1\,\text{MSD} = 1$ cm. Also, $10\,\text{VSD} = 9\,\text{MSD}$, which gives $1\,\text{VSD} = (9/10)\text{MSD} = 0.9$ cm. Thus,

$$\text{LC} = 1\text{ cm} - 0.9\text{ cm} = 0.1\text{ cm}$$

In case of chalk, main scale reading (MSR) is 8 and Vernier scale reading (VSR) is 1. Thus, length of the chalk is

$$l = \text{MSR} + \text{LC} \times \text{VSR} = 8 + 0.1 \times 1 = 8.1\text{ cm}$$

In case of box, main scale reading (MSR) is 4 and Vernier scale reading (VSR) is 9. Thus, length of the box is

$$l = \text{MSR} + \text{LC} \times \text{VSR} = 4 + 0.1 \times 9 = 4.9\text{ cm}$$

Many students liked my explanations on IIT JEE problems related to Vernier Calipers. Based on their appreciation and encouragement, I extended it further to make it more useful. The result of this effort is a brand new article on Vernier calipers. This comprehensive articles covers theoretical principles, worked out examples, IIT JEE solved problems, exercises (more than 25), links to related articles/videos and an interesting activity. You can view this article here or download pdf from here. We are sure you will like this article even more. You may share it with other Physics students, teachers and enthusiasts.

Solution of Question 02

The correct answers are (a), (d) and (h).

Weight of the ball is $W_b = 15.65\text{ gm} - \text{wt}$ and weight of the container with water is $W_c = 451.25\text{ gm} - \text{wt}$. Weight of the container when ball is immersed in it is $W = 462.72\text{ gm} - \text{wt}$.

The forces acting on the ball are its weight W_b (downwards), tension in the string T (upwards) and buoyancy force B (upwards). The net force on the ball is zero (Newton's second law), which gives,

$$W_b = T + B$$

The forces on the container and water when ball is immersed in it are (a) weight of the container with water inside it W_c (downwards), (b) force due to ball on water B (downwards) and (c) reaction force on the container from balance W (upwards). Note that force due to ball on water is equal to force on ball due to water (Newton's third law). Net force on the container and water is zero (Newton's second law) i.e.,

$$W = W_c + B$$

which gives $B = W - W_c = 462.72 - 451.25 = 11.47\text{ gm} - \text{wt}$. Substitute in earlier equation to get $T = W_b - B = 15.65 - 11.47 = 4.18\text{ gm} - \text{wt}$.

Solution of Question 03

The correct answers are (e) and (f).

For light going from oil to test tube: refractive index changes only slightly so most of the light is refracted into glass and falls on glass air surface. Here the refractive index changes significantly and hence most of the light reflected back. This reflected light finally helps us to see the tube.

When oil is filled in the test tube at the second surface to the test tube again refractive index changes only slightly and most of the light gets transmitted hence we are not able to see clearly.

Solution of Question 04

The correct answers are (d) and (e).

Solution of Question 05

The correct answers are (c) and (g).

Let us have a careful look at the construction of the toy. It has three parts (i) head where point A is located (b) trunk with point C on left, point B in middle and point D on right and (iii) base (white color). The trunk is connected with a rod. This rod makes small oscillations about an axis passing through some point in the base and normal to the plane formed by A, B and C. The displacement of C and D are out of phase i.e., phase difference between these points is π (try to write equation for displacement of C and D).

The head and trunk are joined together by a joint. The head is free to rotate about an axis passing through this joint and perpendicular to plane formed by B, C, and D. The points A and B are on two different bodies. These points oscillates about an axis perpendicular to the line joining A and B and passing through the joint. The displacement of A and B are out of phase i.e., phase difference between these points is π (try to write equation for displacement of A and B).

Solution of Question 06

The correct answers are (c) and (g).

Solution of Video 07

The correct answers are (c), (f), and (g).

In the bottle with single hole, the water flows out of the hole when cap is open. The pressure at the water surface is equal to the atmospheric pressure P_0 (because cap is open). The pressure at point A is equal to the P_0 plus hydrostatic pressure due to water column between A and water surface i.e., $P_A = P_0 + \rho g h$, where ρ is density of water, g is acceleration due to gravity and h is the depth of A below water surface. Thus, $P_A > P_0$. What will be the pressure when cap is closed?

In the bottle with two holes, the water flows out from the bottom hole A and air flow in from the upper hole B when cap is closed (see the video carefully). The pressure at B (into water) is less then atmospheric pressure as air flows in (from high pressure to low pressure) i.e. $P_B < P_0$. The water flows out of hole A which is possible when $P_A > P_0$.

Solution of Question 08

The correct answers are (a) and (e).

The beams of incident light are almost parallel. The lens converges these parallel lines. Thus, lens is convex.

The position of the lens is 6 cm and the position of point of convergence is 25 cm. Thus, distance between the lens and the point of convergence is equal to the focal length $f = 25 - 6 = 19$ cm. Note that position of the spot of high intensity is at 28 cm, and this is not the point of convergence.

Solution of Question 09

The correct answers are (b) and (g).

When object is rotated by an angle θ, the image is also rotated by the same angle θ. When the mirror is rotated by an angle θ, the image is rotated by an angle 2θ. It can be proved by using laws of reflection.

Solution of Question 10

The correct answers are (a), (c), (e), (h), (j) and (k).

In first case, the bulbs are connected in series. The current through each bulb is equal, say i_s. Since bulbs are similar, their filament resistance is same, say R. Thus, voltage drop across each bulb is $V_s = i_s R$ (by Ohm's law). Since battery voltage is approximately 10 V, we get $2V_s = 2i_s R = 10$ (this is Kirchhoff's law). Solve to get voltage across each bulb as $V_s = i_s R = 5$ V.

In second case, the bulbs are connected in parallel. The voltage across each bulb is equal to the battery voltage i.e., $V_p = 10$ V. Since bulbs are similar, their filament resistance is same, say R. Thus, current through each bulb is $i_p = V_p/R = 10/R$ (by Ohm's law) is equal.

The glow of the bulb is related to its power which is given by $P = i^2 R$. The power of each bulb in first case is $P_s = i_s^2 R = 25/R$ and in second case is $P_p = i_p^2 R = 100/R$. Thus, glow of the bulb in second case (when connected in parallel) is almost four times its glow in first case (when connected in series).

Solution of Question 11

The correct answers are (b), (e) and (g).

For a given parameter, the circular shape has maximum cross-section area (it is an interesting result from mathematics). Thus, when opening is pressed, the shape no longer remains circular and hence area reduces.

The continuity equation of fluid mechanics states that product of cross-section area and speed remains constant i.e., $Av = const$, where A is cross section area and v is speed of water. Thus, when A is reduced (by pressing opening), v is increased i.e., speed of water increases.

The water attains a parabolic path (projectile motion). The angle of projection (θ) is zero as pipe is almost horizontal. The time taken by the water to travel a vertical distance H is $T = 2H/g$. Thus, horizontal distance travelled is $R = vT = 2vH/g$. Thus, range increase when opening is pressed.

Solution of Question 12

The correct answers are (b), (c) and (d).

The compass needle is placed in the magnetic field produced by the two bar magnets. In first case, the compass needle is parallel to the magnetic field (i.e., magnetic field is along the direction of compass needle). This field is produced when unlike poles of the magnet faces each other.

In second case, the compass needle gets deflected when one of the bar magnet is brought close to it. This can happen when (1) magnetic field at the compass location is perpendicular to the line joining two magnets or (2) magnetic field at the compass location is along the line joining two bar magnets but north pole of the compass needle faces the north pole of bar magnet and the

south pole of the needle faces the south of bar magnet. Thus, this situation can occur when like poles of bar magnets are facing each other or unlike poles of bar magnets are facing each other.

Solution of Question 13

The correct answers are (b), (d) and (f).

The water changes phase from liquid to gas through vaporization. It absorbs 'latent heat of vaporization' in this process. The water boils at 100 °C under atmospheric pressure.

The boiling water is at 100 °C. The water in small bowl is also at 100 °C. The water in small bowl is not boiling because it is not getting necessary heat for evaporation. The temperature outside and inside the small boil is same (100 °C). In the absence of temperature gradient (difference), heat can not be conducted through the material of the bowl.

Solution to Question 14

The correct answers are (a) and (g).

The leaf is floating on the surface of water. It is the property of liquids to apply force normal to the surface. When water is stationary, water surface is horizontal plane and hence force on the leaf is vertically upwards.

When water is rotating, water surface takes shape of a paraboloid. The force on the leaf is normal to this surface. Note that there are two forces acting on the leaf (1) its weight (downwards) and (2) force due to water (normal to surface). The resultant of these two forces is towards centre of the tub (axis of rotation). The resultant force provides centripetal acceleration to the leaf.

Solution of Question 15

The correct answers are (a) and (d).

The solids expands when their temperature is increased. Thus, the length of the aluminium rod increases when it is heated with candles. There is a small gap (not visible in video) between aluminium rod and vertical stand. When rod expands, it touches the vertical stand and circuit get completed.

Solution of Question 16

The correct answers are (a), (b), (d), (e) and (f).

The electricity gets induced when magnet passes through the coil (Faraday's law of electromagnetic induction). The electricity is induced only when there is relative motion between the magnet and coil (i.e., when magnetic flux through the coil changes with time). Thus, electricity is not induced when magnet is stationary.

The magnetic flux through the coil changes with time even-if magnet moves with constant speed (note that magnetic field of the magnet is non-uniform in space).

When magnet accelerates, its speed is less when it enters the coil and it is more when it leaves the coil. Thus, if magnet accelerates then the galvanometer deflection is less when magnet enters the coil and deflection is more when magnet leaves the coil (it is visible in the video).

The given scenario was similar to Atwood's machine. The acceleration of the coil increases if hanging mass on the right is increased or hanging mass on the left is reduced.