

**073206T4CHE**

**CHEMICAL ENGINEERING LEVEL 6**

**ENG/OS/CE/CR/07/6/A**

**Audit Production Process**

**Nov/Dec 2024**



**TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION  
COUNCIL (TVET CDACC)**

**PRACTICE  
TITLES**

**INSTRUCTIONS TO CANDIDATES**

*This assessment consists of two tasks*

*Do not write on the question paper.*

*A separate plain paper will be provided.*

*Return this paper to assessor at the end of assessment*

**This paper consists of SIX (6) printed pages**

**Candidates should check the question paper to ascertain that all  
pages are printed as indicated and that no questions are missing**

1. You are required to perform the following tasks

**Task 1:** Auditing bottoms of distillation columns

**Task 2:** Determine the capacity of a small centrifugal pump

2. You have been provided with the following resources for the practical tasks:

**a) Task 1: Apparatus and Reagents**

- 3 liquid samples
  - Sample A (100 ml)
  - Sample B (100 ml)
  - Sample C (100 ml)
- Specific gravity bottle 25 ml
- Analytical balance
- pH meter
- Thermometer
- Plain papers
- Tissue paper/cotton waste

**b) Task 2: Apparatus and**

- 0.5 HP pump with suction and discharge valves
- Two tanks (for the suction and for the discharge side)
- PPR pipes
- Clips for fastening PPR pipes onto the suction and discharge
- Stop watch
- Calibrated jug
- Screw driver

**c) PPE's**

- Latex single use gloves

**PROCEDURE****Task 1: Auditing bottoms of distillation columns**

The given samples are typical of those obtained from the bottoms of 3 distillery columns of plant ABC during normal operation. The conformance standard is: the bottoms should:

- Contain *less than 5% alcohol concentration*;
- Have *pH value of between 6.5 and 7.5*

- a) Take the pH readings of the three samples and record the values in TABLE 1
- b) Take the temperature readings of the three samples and record in TABLE 1
- c) Weigh the specific gravity bottle accurately. Fill the bottle with 25 ml of the first sample solution, insert the stopper, remove the spill-over solution with a tissue paper and weigh. Transfer the solution back to the volumetric flask, clean and fill the bottle with distilled water and weigh as done for the sample.

Calculate the specific gravity of the sample distillate and read the alcohol percentage from table of specific gravity vs. alcohol % by volume.

**Weight of empty specific g** =  $W_1$  = ..... g

**Weight of bottle with sam**  $W_2$  = ..... g

**Weight of bottle with distil**  $W_3$  = ..... g

**Calculate specific gravity using**

$$\text{specific gravity} = \frac{\text{weight of sample}}{\text{weight of distilled water}}$$

- d) Repeat the procedure in (a) for samples B and C
- e) Read the alcohol concentrations from the table given in the appendix using the temperature and specific gravity values calculated
- f) Record the values obtained in TABLE 1

**Table 1**

| Sample | weight | pH | Specific gravity | Alcohol concentration |
|--------|--------|----|------------------|-----------------------|
| A      |        |    |                  |                       |
| B      |        |    |                  |                       |
| C      |        |    |                  |                       |

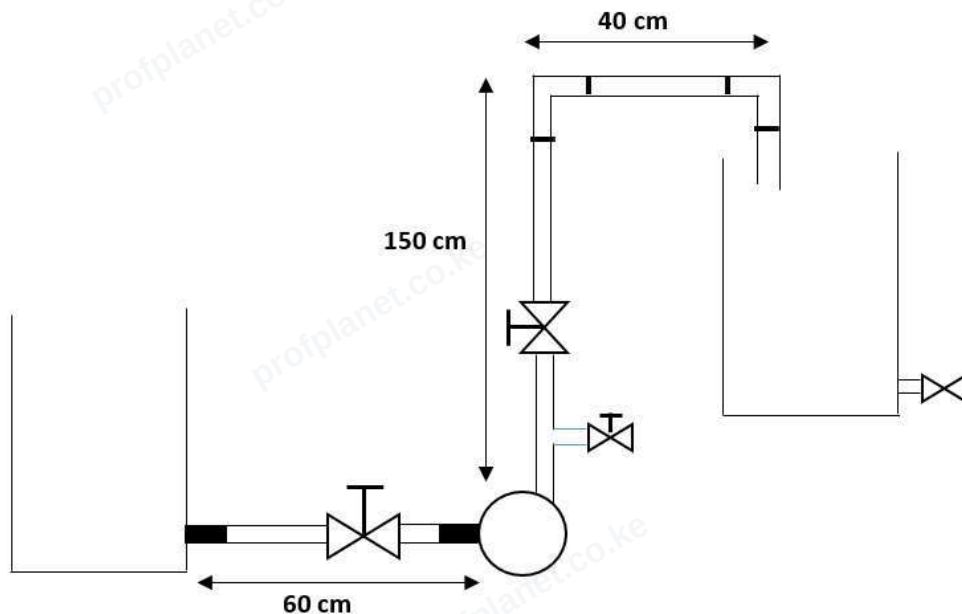
- g) State the sample that conforms to the standard given

.....

- h) Discard the used samples properly

### TASK 2: Determine the capacity of a small centrifugal pump

You are provided with the following pump and tank setup in Figure 1:



- Fill the suction side tank to  $\frac{3}{4}$  full capacity
- Carefully prime the pump following the correct procedure
- Switch on the pump
- Slowly open the discharge valve as the stop watch is started
- Run the pump for 10 seconds, collecting the water into the discharge tank
- Switch off the pump following the correct procedure
- Drain the tank, and measure the volume of water pumped into the discharge tank and record in the table.
- Refill the suction tank to  $\frac{3}{4}$  full capacity
- Repeat the procedure and run the pump for 20 seconds
- Measure the volume of water pumped into the discharge tank and record in the table
- Calculate the capacity of the pump in litres per minute

| <b>Discharge<br/>volume (litres)</b> | <b>Time (seconds)</b> | <b>Capacity<br/>(litres/min)</b> |
|--------------------------------------|-----------------------|----------------------------------|
| <b>1</b>                             |                       |                                  |
| <b>2</b>                             |                       |                                  |

- l) Clean and rearrange your work area

## APPENDIX.

## 2-112 PHYSICAL AND CHEMICAL DATA

TABLE 2-110 Ethyl Alcohol (C<sub>2</sub>H<sub>5</sub>OH)\*

| %  | 10°C    | 15°C    | 20°C    | 25°C    | 30°C    | 35°C    | 40°C    | %   | 10°C    | 15°C    | 20°C    | 25°C    | 30°C    | 35°C    | 40°C    |
|----|---------|---------|---------|---------|---------|---------|---------|-----|---------|---------|---------|---------|---------|---------|---------|
| 0  | 0.99973 | 0.99913 | 0.99823 | 0.99708 | 0.99568 | 0.99406 | 0.99225 | 50  | 0.92126 | 0.91776 | 0.91384 | 0.90985 | 0.90580 | 0.90168 | 0.89750 |
| 1  | 785     | 725     | 636     | 520     | 379     | 217     | 034     | 51  | .91943  | 555     | 160     | 760     | 353     | .89940  | 519     |
| 2  | 602     | 542     | 453     | 336     | 194     | 031     | .98846  | 52  | 723     | 333     | .90936  | 534     | 125     | 710     | 288     |
| 3  | 426     | 365     | 275     | 157     | 014     | .98849  | 663     | 53  | 502     | 110     | 711     | 307     | .89896  | 479     | 056     |
| 4  | 258     | 195     | 103     | .98984  | .98839  | 672     | 485     | 54  | 279     | .90885  | 485     | 079     | 667     | 248     | .88823  |
| 5  | 098     | 032     | .98938  | 817     | 670     | 501     | 311     | 55  | 055     | 659     | 258     | .89850  | 437     | 016     | 589     |
| 6  | .98946  | .98877  | 780     | 656     | 507     | 335     | 142     | 56  | .90831  | 433     | 031     | 621     | 206     | .88784  | 356     |
| 7  | 801     | 729     | 627     | 500     | 347     | 172     | .97975  | 57  | 607     | 207     | .89803  | 392     | .88975  | 552     | 122     |
| 8  | 660     | 584     | 478     | 346     | 189     | 009     | 808     | 58  | 381     | .89980  | 574     | 162     | 744     | 319     | .87888  |
| 9  | 524     | 442     | 331     | 193     | 031     | .97846  | 641     | 59  | 154     | 752     | 344     | .88931  | 512     | 085     | 653     |
| 10 | 393     | 304     | 187     | 043     | .97875  | 685     | 475     | 60  | .89927  | 523     | 113     | 699     | 278     | .87851  | 417     |
| 11 | 267     | 171     | 047     | .97897  | 723     | 527     | 312     | 61  | 698     | 293     | .88882  | 446     | 044     | 615     | 180     |
| 12 | 145     | 041     | .97910  | 753     | 573     | 371     | 150     | 62  | 468     | 062     | 650     | 233     | .87809  | 379     | .86943  |
| 13 | 026     | .97914  | 775     | 611     | 424     | 216     | .96989  | 63  | 237     | .88830  | 417     | .87998  | 574     | 142     | 705     |
| 14 | .97911  | 790     | 643     | 472     | 278     | 063     | 829     | 64  | 006     | 597     | 183     | 763     | 337     | .86905  | 466     |
| 15 | 800     | 669     | 514     | 334     | 133     | .96911  | 670     | 65  | .88774  | 364     | .87948  | 527     | 100     | 667     | 227     |
| 16 | 692     | 552     | 387     | 199     | .96990  | 760     | 512     | 66  | 541     | 130     | 713     | 291     | .86863  | 429     | .85987  |
| 17 | 583     | 433     | 259     | 062     | 844     | 607     | 352     | 67  | 308     | .87895  | 477     | 054     | 625     | 190     | 747     |
| 18 | 473     | 313     | 129     | .96923  | 697     | 452     | 189     | 68  | 074     | 660     | 241     | .86817  | 387     | .85950  | 407     |
| 19 | 363     | 191     | .96997  | 782     | 547     | 294     | 023     | 69  | .87839  | 424     | 004     | 579     | 148     | 710     | 266     |
| 20 | 252     | 068     | 864     | 639     | 395     | 134     | .95856  | 70  | 602     | 187     | .86766  | 340     | .85908  | 470     | 025     |
| 21 | 139     | .96944  | 729     | 495     | 242     | .95973  | 687     | 71  | 365     | .86949  | 527     | 100     | 667     | 228     | .84783  |
| 22 | 024     | 818     | 592     | 348     | 087     | 809     | 516     | 72  | 127     | 710     | 287     | .85859  | 426     | .84986  | 540     |
| 23 | .96907  | 689     | 453     | 199     | .95929  | 643     | 343     | 73  | .86888  | 470     | 047     | 618     | 184     | 743     | 297     |
| 24 | 787     | 558     | 312     | 048     | 769     | 476     | 168     | 74  | 648     | 229     | .85806  | 376     | .84941  | 500     | 053     |
| 25 | 665     | 424     | 168     | .95895  | 607     | 306     | .94991  | 75  | 408     | .85988  | 564     | 134     | 698     | 257     | .83809  |
| 26 | 539     | 287     | 020     | 738     | 442     | 133     | 810     | 76  | 168     | 747     | 322     | .84891  | 455     | 013     | 564     |
| 27 | 406     | 144     | .95867  | 576     | 272     | .94955  | 625     | 77  | .85927  | 505     | 079     | 647     | 211     | .83768  | 319     |
| 28 | 268     | .95996  | 710     | 410     | 098     | 774     | 438     | 78  | 685     | 262     | .84835  | 403     | .83966  | 523     | 074     |
| 29 | 125     | 844     | 548     | 241     | .94922  | 590     | 248     | 79  | 442     | 018     | 590     | 158     | 720     | 277     | .82827  |
| 30 | .95977  | 686     | 382     | 067     | 741     | 403     | 055     | 80  | 197     | .84772  | 344     | .83911  | 473     | 029     | 578     |
| 31 | 823     | 524     | 212     | .94890  | 557     | 214     | .93860  | 81  | .84950  | 525     | 096     | 664     | 224     | .82780  | 329     |
| 32 | 665     | 357     | 038     | 709     | 370     | 021     | 662     | 82  | 702     | 277     | .83848  | 415     | .82974  | 530     | 079     |
| 33 | 502     | 186     | .94860  | 525     | 180     | .93825  | 461     | 83  | 453     | 028     | 599     | 164     | 724     | 279     | .81828  |
| 34 | 334     | 011     | 679     | 337     | .93986  | 626     | 257     | 84  | 203     | .83777  | 348     | .82913  | 473     | 027     | 576     |
| 35 | 162     | .94832  | 494     | 146     | 790     | 425     | 051     | 85  | .83951  | 525     | 095     | 660     | 220     | .81774  | 322     |
| 36 | .94986  | 650     | 306     | .93952  | 591     | 221     | .92843  | 86  | 697     | 271     | .82840  | 405     | .81965  | 519     | 067     |
| 37 | 805     | 464     | 114     | 756     | 390     | 016     | 634     | 87  | 441     | 014     | 583     | 148     | 708     | 262     | .80811  |
| 38 | 620     | 273     | .93919  | 556     | 186     | .92808  | 422     | 88  | 181     | .82754  | 323     | .81888  | 448     | 003     | 552     |
| 39 | 431     | 079     | 720     | 353     | .92979  | 597     | 208     | 89  | .82919  | 492     | 062     | 626     | 186     | .80742  | 291     |
| 40 | 238     | .93882  | 518     | 148     | 770     | 385     | .91992  | 90  | 654     | 227     | .81797  | 362     | .80922  | 478     | 028     |
| 41 | 042     | 682     | 314     | .92940  | 558     | 170     | 774     | 91  | 386     | .81959  | 529     | 094     | 655     | 211     | .79761  |
| 42 | .93842  | 478     | 107     | 729     | 344     | .91952  | 554     | 92  | 114     | 688     | 257     | .80823  | 384     | .79941  | 491     |
| 43 | 639     | 271     | .92897  | 516     | 128     | 733     | 332     | 93  | .81839  | 413     | .80983  | 549     | 111     | 669     | 220     |
| 44 | 433     | 062     | 685     | 301     | .91910  | 513     | 108     | 94  | 561     | 134     | 705     | 272     | .79835  | 393     | .78947  |
| 45 | 226     | .92852  | 472     | 085     | 692     | 291     | .90884  | 95  | 278     | .80852  | 424     | .79991  | 555     | 114     | 670     |
| 46 | 017     | 640     | 257     | .91868  | 472     | 069     | 660     | 96  | .80991  | 566     | 138     | 706     | 271     | .78831  | 388     |
| 47 | .92806  | 426     | 041     | 649     | 250     | .90845  | 434     | 97  | 698     | 274     | .79846  | 415     | .78981  | 542     | 100     |
| 48 | 593     | 211     | .91823  | 429     | 028     | 621     | 207     | 98  | 399     | .79975  | 547     | 117     | 684     | 247     | .77806  |
| 49 | 379     | .91995  | 604     | 208     | .90805  | 396     | .89979  | 99  | 094     | 670     | 243     | .78814  | 382     | .77946  | 507     |
|    |         |         |         |         |         |         |         | 100 | .79784  | 360     | .78934  | 506     | 075     | 641     | 203     |

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